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Application of Analysis of Variance Method in Evaluating Construction Project Cost Performance: A Case Study of the Ministry of Finance Apartment Complex in Jayapura

Erwin
Jurusan Teknik Sipil Fakultas Teknik, Universitas Cenderawasih and tandekerwin@gmail.com

ABSTRACT

In a stage of project implementation, there are problems that can cause a project to experience cost overruns so that it can cause losses. Seeing from the problems found to get maximum results with good quality and quality of work, it is necessary to evaluate and control costs on project profits as a whole. During the construction of the Jayapura Ministry of Finance flat project, there were 5 addendums when the structural work was carried out starting from January to August. These changes have a major impact on the overall time and cost of a project and have a direct and indirect adverse impact. The method used in a control is the Variant Analysis method. Control aims to be able to find out the cost of the most dominant variant during the working period. This method will show the difference between the implementation cost and the budget. The application of this variant analysis method is only in the work of the structure of the flats of the Ministry of Finance of Jayapura from January to August. Based on the analysis using the Variance Analysis method, the most dominant cost variance occurs in the 2nd floor work item with a variance value - RP. 58,239,966.11 then in the lower structure work with a variance value - RP. 46,060,221.40 and in the 3rd floor work with a variance value - Rp. 36,434,137.98.

Keywords: *Project, Control, Variant Analysis, Finance Apartment Complex, Jayapura*

1. INTRODUCTION

Every project requires thorough and thorough planning to achieve its objectives. In construction projects, costs are one of the most important components of a project budget; without them, a project cannot be implemented [1].

During a project's implementation, problems can occur that can lead to cost overruns and, consequently, losses. To achieve maximum results with high quality work, evaluation and control of expenditures are necessary to ensure the project's overall profitability [2].

The main control lies in costs and schedules because projects often experience cost overruns or time delays, and do not comply with predetermined plans.

Formulation of the problem

The problems in this research are:

1. How to control material and time costs using the variance analysis method in the structural work of the Jayapura Ministry of Finance Flats Building.
2. How much of the most dominant cost variance occurs during the work period?
3. How big is the schedule performance index (SPI) and cost performance index (CPI).

Scope of problem

To ensure the proposal writing is focused and directed, the author has defined the problem. These limitations are as follows:

1. Controlling material costs in structural work with work items, namely pile cap work, tie beam work, column work, beam work, ring beam work and floor slab work.
2. Control of the Jayapura Papua Ministry of Finance flats project was carried out from the 20th to the 49th week.
3. The method used is the variance analysis method.
   This analysis focuses on comparing variance analysis in tabular form. Tabulation refers to the process of placing data in tabular form by creating a table containing data according to the analysis's requirements.
4. Focused on budget costs, implementation/actual costs and implementation time.
5. Quality is assumed to be constant
6. *Schedule*The RAP is made the same as the contract schedule / cost budget plan (RAB)

Research purposes

The objectives of this research are as follows:

1. To determine the control of material and time costs using the variance analysis method on the structural work of the Jayapura Ministry of Finance Flats Building.
2. To determine the dominant cost variance that occurs during the work period.

To find out the size of the schedule performance index (SPI) and cost performance index (CPI).

2. LITERATURE REVIEW

2.1 Project Definition

A project is a series of temporary activities that are limited by time, budget and certain resources and are intended to produce a product whose quality has been clearly defined [3].

2.2 Project Control

Project characteristics can be viewed in three dimensions: unique, involving a number of resources, and requiring organization. Control is necessary to ensure alignment between planning and implementation. Each project must be inspected and checked by the field supervisor to ensure it meets specifications.

2.3 Project Control Process

The control process continues throughout the project lifecycle to ensure good performance at every stage. Plans are created to serve as reference materials for project implementers. These reference materials then become standards for project implementation, including technical specifications, schedules, and budgets [4].

Control is a systematic effort to determine standards that are in accordance with planning targets, design an information system, compare implementation with standards, analyze possible deviations between implementation and standards, and then take the necessary corrective actions so that all resources are used effectively and efficiently in order to achieve targets [5].

2.4 Analysis of Variance Method

The variance method involves calculating the number of units completed and then comparing it to the plan, or looking at resource usage records, and comparing it to the budget [6]. This method will show the difference between implementation costs and the budget.

2.5 Yield Value Method

In project management, there is a concept called the Earned Value Concept (EVC). This concept is a budget calculation based on the work completed (Budget Cost of Work Performed). In other words, this concept measures the number of units of work completed within a given time period, when assessed based on the available budget for that work. This allows for the relationship between the physical results achieved and the budgeted amount spent [7], [8].

3. METHODS

3.1 Research Object

The object used in this research is the Jayapura Ministry of Finance Flats development project with the following project data:

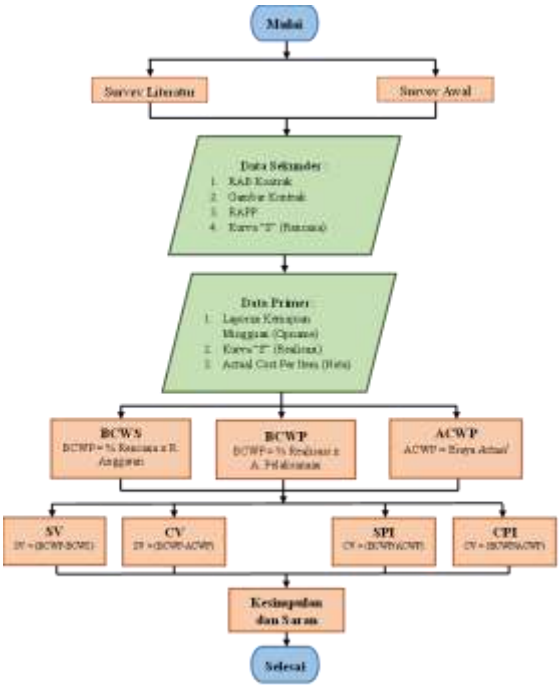
Picture1. Site Plan for the Jayapura Ministry of Finance Flats
(Source: Jayapura Financial Apartment Construction Management, 2023)

3.2 Research Location

The research location for the construction of the Ministry of Finance Flats of the Jayapura City KPPBC TMP C Work Unit is on Jalan Garuda, Wai Mhorock, Abepura District, Jayapura City, which can be seen in Figure 3.1. The location is at 2°35'54.5"S and 140°41'00.7"E or -2.598464° N and 140.683523° N. It is currently located next to the Jayapura City Land Office. The location for the construction of the Ministry of Finance Flats of Jayapura City has a length of 61.25 m and a width of 14.90 m.

Picture2. Location of the Ministry of Finance's Flats Development Project in Jayapura
(Source: Google Maps, 2023)

3.3 Flow Chart



Picture3. Research Stage Flowchart

4. RESULTS AND DISCUSSION

3.1 Recapitulation RAB

The recapitulation of the RAB calculation results based on AHSP 2022. The recapitulation results are as follows:

Tabel 4.12 Rekapitulasi Rencana Anggaran Biaya (RAB)

NO.	URAIAN PEKERJAAN	JUMLAH HARGA (Rp.)
II.A.	**PEKERJAAN STRUKTUR STANDART**	**5.371.429.088,30**
	PEKERJAAN STRUKTUR ATAS (UPPER STRUCTURE)	
	A.2. PEKERJAAN LANTAI 1	803.026.880,42
	A.3. PEKERJAAN LANTAI 2	1.982.410.367,00
	A.4. PEKERJAAN LANTAI 3	1.868.707.836,97
	A.5. PEKERJAAN LANTAI DAK	586.183.203,52
	A.6. LANTAI ATAP	331.100.800,39
II.B.	**PEKERJAAN STRUKTUR NON STANDART**	**1.091.584.798,15**
	PEKERJAAN STRUKTUR BAWAH (SUB STRUCTURE)	
	B.1. PEKERJAAN STRUKTUR BAWAH (SUB STRUCTURE)	1.091.584.798,15
	JUMLAH HARGA PEKERJAAN STRUKTUR	**6.463.013.886,45**

(Sumber : Manajemen Konstruksi Rusun Kemangan Jayapura, 2023)

Based on the 2022 unit price analysis, the cost of structural work is IDR 6,463,013,886.45.

4.3 RAP Recapitulation

The following is a recapitulation of the RAPP calculation results:

Tabel 4. 13 Rekapitulasi Rencana Anggaran Pelaksanaan Proyek (RAPP)

NO.	URAIAN PEKERJAAN	JUMLAH HARGA (Rp.)
II.A.	**PEKERJAAN STRUKTUR STANDART**	**4.405.317.797,57**
	PEKERJAAN STRUKTUR ATAS (UPPER STRUCTURE)	
	A.2. PEKERJAAN LANTAI 1	524.226.366,23
	A.3. PEKERJAAN LANTAI 2	1.674.603.033,89
	A.4. PEKERJAAN LANTAI 3	1.578.715.882,02
	A.5. PEKERJAAN LANTAI DAK	436.804.415,53
	A.6. LANTAI ATAP	190.968.119,90
II.B.	**PEKERJAAN STRUKTUR NON STANDART**	**952.826.778,60**
	PEKERJAAN STRUKTUR BAWAH (SUB STRUCTURE)	
	B.1. PEKERJAAN STRUKTUR BAWAH (SUB STRUCTURE)	952.826.778,60
	JUMLAH HARGA PEKERJAAN STRUKTUR	**5.358.144.576,16**

(Sumber : Kontraktor, 2023)

4.4 Actual Cost Recapitulation

The following is a summary of the actual cost calculations incurred by the service provider. The summary results are as follows:

Tabel 4.14 Rekapitulasi *Actual Cost*

NO.	URAIAN PEKERJAAN	JUMLAH HARGA (Rp.)
II.A.	**PEKERJAAN STRUKTUR STANDART**	**4.531.775.400,00**
	PEKERJAAN STRUKTUR ATAS (UPPER STRUCTURE)	
	A.2. PEKERJAAN LANTAI 1	539.244.000,00
	A.3. PEKERJAAN LANTAI 2	1.732.843.000,00
	A.4. PEKERJAAN LANTAI 3	1.815.150.000,00
	A.5. PEKERJAAN LANTAI DAK	447.126.000,00
	A.6. LANTAI ATAP	197.412.400,00
II.B.	**PEKERJAAN STRUKTUR NON STANDART**	**998.887.000,00**
	PEKERJAAN STRUKTUR BAWAH (SUB STRUCTURE)	
	B.1. PEKERJAAN STRUKTUR BAWAH (SUB STRUCTURE)	998.887.000,00
	JUMLAH HARGA PEKERJAAN STRUKTUR	**5.530.662.400,00**

(Sumber : Hasil Analisis Data)

4.5 Project Cost Variance

Next, the table below will describe the cost variance between the implementation budget plan and the actual cost to determine the most dominant cost variance for each work item, namely as follows:

Tabel 4.16 Varians Biaya Proyek

NO.	URAIAN PEKERJAAN	SELISIH HARGA
		RAP-*ACTUAL COST*
II.A.	**PEKERJAAN STRUKTUR STANDART**	**-126.457.602,43**
	PEKERJAAN STRUKTUR ATAS (UPPER STRUCTURE)	
	A.2. PEKERJAAN LANTAI 1	-15.017.633,78
	A.3. PEKERJAAN LANTAI 2	-58.239.966,11
	A.4. PEKERJAAN LANTAI 3	-36.434.117,98
	A.5. PEKERJAAN LANTAI DAK	-10.321.584,47
	A.6. LANTAI ATAP	-6.444.299,10
II.B.	**PEKERJAAN STRUKTUR NON STANDART**	**-46.060.221,40**
	PEKERJAAN STRUKTUR BAWAH (SUB STRUCTURE)	
	B.1. PEKERJAAN STRUKTUR BAWAH (SUB STRUCTURE)	-46.060.221,40
	JUMLAH SELISIH HARGA	**-172.517.823,84**

(Sumber : Hasil Analisis Data)

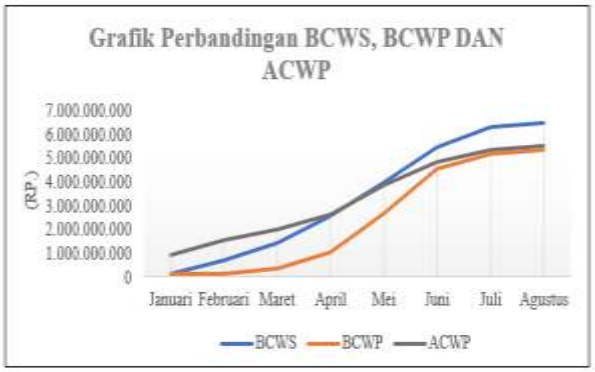
4.6 Calculation of Yield Value

In this sub-chapter, we will discuss the calculation using the concept of yield value for controlling project implementation in the construction of the Jayapura Ministry of Finance flats.

Tabel 4.21 Perbandingan Nilai BCWS, BCWP, dan ACWP

NO	BULAN	RENC. (%)	REAL. (%)	BCWS (Rp)	BCWP (Rp)	ACWP (Rp)
1	Januari	2,14	2,16	138.320.299,68	115.702.956,66	923.850.000,00
2	Februari	10,70	2,16	691.601.498,40	115.702.956,66	1.523.700.000,00
3	Maret	21,85	6,93	1.412.212.893,70	371.395.771,57	2.024.345.000,00
4	April	39,91	19,28	2.579.125.227,71	1.033.006.138,25	2.621.315.000,00
5	Mei	61,86	50,37	3.998.095.532,73	2.699.114.614,74	3.888.165.000,00
6	Juni	84,47	84,69	5.459.449.947,96	4.537.865.132,61	4.838.880.000,00
7	Juli	97,40	96,18	6.295.191.974,63	5.153.632.471,38	5.358.915.000,00
8	Agustus	100,00	100,00	6.463.013.886,45	5.358.144.576,16	5.530.662.399,75

(Sumber : Hasil Analisis Data)



Gambar 4.6 Grafik Dari Perbandingan Antara BCWS, BCWP, dan ACWP
(Sumber : Hasil Analisis Data)

4.7 Analysis of Variance

Schedule variance (SV) is used to determine whether a project is on schedule. The schedule variance is the difference between the BCWP and the BCWS. Meanwhile, the cost variance is used to determine whether a project is on budget or over budget. The cost variance is the difference between the BCWP and the ACWP.

Tabel 4.22 Nilai SV dan CV

NO	BULAN	SV (BCWP-BCWS)	CV (BCWP-ACWP)
1	Januari	(22.617.343,02)	(808.147.043,34)
2	Februari	(575.898.541,74)	(1.407.997.043,34)
3	Maret	(1.040.817.122,12)	(1.652.949.228,43)
4	April	(1.546.119.089,46)	(1.588.308.861,75)
5	Mei	(1.298.980.917,99)	(1.189.050.385,26)
6	Juni	(921.584.815,35)	(301.014.867,39)
7	Juli	(1.141.559.503,25)	(205.282.528,62)
8	Agustus	(1.104.869.310,29)	(172.517.823,58)

(Sumber : Hasil Analisis Data)

Gambar 4.7 Grafik Perbandingan Nilai SV dan CV
(Sumber : Hasil Analisis Data)

4.8 Cost work performance index (CPI) and Schedule Performance Index (SPI).

If the CPI value is 1, it means costs are in line with the planned budget. If the CPI is <1, it means the project is experiencing a loss. If the SPI is <1, it means the project is behind schedule, and vice versa.

Tabel 4.23 Nilai SPI dan CPI

NO	BULAN	SPI (BCWP/BCWS)	CPI (BCWP/ACWP)
1	Januari	0,8	0,1
2	Februari	0,2	0,1
3	Maret	0,3	0,2
4	April	0,4	0,4
5	Mei	0,7	0,7
6	Juni	0,8	0,9
7	Juli	0,8	1,0
8	Agustus	0,8	1,0

(Sumber : Hasil Analisis Data)

Gambar 4.8 Grafik Perbandingan SPI dan CPI
(Sumber : Hasil Analisis Data)

Tabel 4.24 Penilaian Elemen Nilai Hasil

NO	BULAN	INDIKATOR	VARIAN	NILAI	KINERJA	NILAI	PENILAIAN
1	Januari	Biaya	CV	(808.167.043,34)	CPI	0,1	Rugi
		Jadwal	SV	(22.617.343,02)	SPI	0,8	Terlambat dari jadwal
2	Februari	Biaya	CV	(1.407.997.043,34)	CPI	0,1	Rugi
		Jadwal	SV	(375.898.541,74)	SPI	0,2	Terlambat dari jadwal
3	Maret	Biaya	CV	(1.652.940.228,43)	CPI	0,2	Rugi
		Jadwal	SV	(1.040.817.122,12)	SPI	0,3	Terlambat dari jadwal
4	April	Biaya	CV	(1.188.308.881,75)	CPI	0,4	Rugi
		Jadwal	SV	(1.548.319.089,48)	SPI	0,4	Terlambat dari jadwal
5	Mei	Biaya	CV	(1.189.050.385,26)	CPI	0,7	Rugi
		Jadwal	SV	(1.298.980.917,99)	SPI	0,7	Terlambat dari jadwal
6	Juni	Biaya	CV	(301.014.867,38)	CPI	0,9	Rugi
		Jadwal	SV	(921.584.813,35)	SPI	0,8	Terlambat dari jadwal
7	Juli	Biaya	CV	(205.282.528,62)	CPI	1,0	Untung
		Jadwal	SV	(1.141.550.583,25)	SPI	0,8	Terlambat dari jadwal
8	Agustus	Biaya	CV	(172.517.825,38)	CPI	1,0	Untung
		Jadwal	SV	(1.104.800.310,28)	SPI	0,8	Terlambat dari jadwal

(Sumber : Hasil Analisa Data)

CONCLUSION

Based on the results of the evaluation and control using the variance analysis method on the Jayapura Ministry of Finance flats development project, the following conclusions can be drawn:

1. The results of the cost budget plan (RAB) for structural work using the SNI 2022 work unit price analysis (AHSP) amounted to IDR 6,463,013,886.45 (table 4.12). While the project implementation budget plan (RAP) cost was IDR 5,358,144,576.16 (table 4.13) and the actual cost incurred was IDR 5,530,662,400.00 (table 4.14).
2. The most dominant cost variance occurred in the 2nd floor work item with a variance value of -58,239,966.11, then the lower structure was employed with a variance value of -46,060,221.40 and in the 3rd floor work with a variance value of -36,434,137.98 (see table 4.16).
3. From the assessment of the evaluation and control results on the Jayapura Ministry of Finance flats development project using the earned value method using the BCWS, BCWP, and ACWP indicators which are then continued with the calculation of the variance analysis method which can be concluded that losses were experienced in January to June with a CPI value <1. While in July and August there was a profit because it had a CPI value >1 (see table 4.24). Then in January to August there was a delay with an SPI value <1 (see table 4.24).

SUGGESTION

Based on the results of observations and research that have been analyzed above, here are some suggestions that we would like to convey for improvements in future projects:

1. Contractors should pay attention to cost and time factors in order to achieve maximum results. In using the yield value method for project control, there needs to be accurate data in weekly reports, cost budget plans, implementation budget plans and implementation times.
2. There is a need for good communication and coordination between the parties in the project so that work obstacles do not arise which could result in delays in work in the field.
3. Project evaluation and control are very necessary so that we can identify as early as possible the factors that cause progress in the field to decline in order to avoid greater deviations in the work process.

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