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Monitoring and Controlling the Duration of Work for Rehabilitation of Uninhabitable Houses in Katingan Regency

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Abstract:- PKRTLH activities are carried out regularly every year by the Katingan Regency Government to overcome the high number of uninhabitable houses.The implementation of PKRTLH activities is planned for 20 weeks with a fixed cost per housing unit of IDR 20,000,000. Based on the experience of previous years, it is known that this activity often experiences delays from the set schedule. Delays in one stage of the activity will affect the next stage, so time control is needed with monitoring activities. To be able to monitor PKRTLH activities, time performance calculations can be made. The purpose of this research is to obtain Estimated Duration (ED) calculations using the Earned Value Management (EVM) method and advanced methods, namely Earned Schedule (ES) and Time Performance Index (TPI). The data used comes from the progress data of PKRTLH Activities2022, then the data is analyzed by the above methods. The results of the analysis, in the reference period in Week 11, show the SPI value = 0.635, while the TPI value = 0.636. Prediction results, the weight of the plan cumulative progress in Week 11 can only be achieved in Week 17. Seen from the calculation of ES and TPI, it is predicted that the Total Time Estimate (T') of PKRTLH activities will be delayed from the plan for 20 weeks to 31 weeks.

Keywords:- *Project duration prediction; EVM; TPI.*

I. INTRODUCTION

The house is a building that functions as a place to live or shelter and a means of family development, so in addition to functioning as a place used for protection from climate disturbances and other living things, the house is the initial place for life development[1]. Having a proper house is a human right that every citizen has based on the provisions of Article 28H paragraph (1) of the 1945 Constitution of the Republic of Indonesia[2]and supported by the Law Number 1 Year 2011[3]. The total number of houses in Indonesia recorded as many as 75,615,091 units[4]with the number of uninhabitable houses (RTLH) of 4.50%, from 3,408,567 units spread across 36,086 villages or sub-districts[5]. In general, RTLH is owned by Low-Income Communities (MBR) and Poor Communities who do not have access to proper housing[6].

Therefore, to alleviate this problem, it is necessary for the State to play a role both through the Central Government and Regional Governments. In the 2020-2024 National Medium-Term Development Plan (RPJMN) there is a Policy Direction for Housing and Settlement Development, namely gradually increasing people's access to proper, safe and affordable housing and settlements to create an inclusive and liveable city[7].In linewith that, the Regional Government of Katingan Regency, Central Kalimantan Province, launched the Uninhabitable House Quality Improvement Program (PKRTLH Activities). The PKRTLH Activities is a program to provide assistance for low-income people to encourage and increase self-help in improving the quality of houses and new construction of houses along with Infrastructure, Facilities and Public Utilities[8]. The output of this activity is liveable and habitable houses. In 2022, Katingan Regency implemented PKRTLH as many as 50 housing units[9].

As is well known, the implementation of construction work is certainly not free from risks both known and unknown[10][11][12]. The risks that may arise in the PKRTLH Activities are related to the location of housing units that are spread far apart. One of the risks that may arise as a result of the location of the houses that are far apart is the late completion of the work. In the 2021 implementation, there were obstacles in the form of difficulties in submitting Phase I Construction reports due to their location far from the capital, so that this late information would then hamper the direction of PPK policies and decisions for the next stages in this activity, such as the implementation of the stage 2 fund transfer stage. This resulted in the 2021 implementation being late behind schedule by 3 weeks. This is a challenge for the PKRTLH Commitment Making Officer (PPK) to minimize risks and carry out project management appropriately and efficiently.

There have been many research related to monitoring and evaluating the implementation of construction activities as decision-making materials [13] [14] [15] [16] [17] [18] [19] [20]. From these research it is known that the performance of contractors and consultants has a significant impact on the implementation of construction work in terms of cost and time. In addition, proper schedule planning, the use of Management Information Systems and consistent control and monitoring carried out by the owner also contribute to the successful implementation of a project.

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In terms of the implementation of government program construction work, several researchers have also conducted evaluations and studies, especially related to housing construction work and government-owned public facilities[6][21][22][23]. Some of these studies have conveyed the obstacles that occur in the implementation of construction on government-owned programs. One of them is the dissatisfaction of the community as a user, administrative problems in the implementation of work and delays in completion of work. Of the several obstacles or problems, delays in work completion are the main problems that occur in the implementation of government-owned program construction.

To prevent delays, of course, PPK needs to make predictions related to the completion time of PKRTLH work. This prediction can be done using the Earned Value Management (EVM) method as conducted by Maromi and Indryani (2015)[24]. Alternatively, prediction of completion time can also be done using the Time Performance Index (TPI) method [25].Both methods are reliable methods in predicting project duration. Therefore, this research will monitor and control the duration of the Rehabilitation of Non-Habitable Houses (PKRTLH) in Katingan Regency using the EVM and TPI methods. This research is expected to provide a comparison of the two methods in predicting the duration of project implementation. In addition, it can provide guidance for PPK in monitoring and controlling the duration of the project so that it can ensure the project is carried out on time.

II. RESEARCH METHODS

A. Data Collection

➢ *Primary Data*

Primary data collection was carried out by directly interviewing parties related to PKRTLH activities in Katingan Regency and other similar activities that have a function to rehabilitate or improve the quality of uninhabitable houses. These parties are the Commitment Making Official (PPK), Technical Team and Field Facilitators (TFL) who have handled PKRTLH activities in the previous year. These interviews and discussions aimed to obtain an overview of the obstacles that occurred, especially related to making project implementation schedules and monitoring and control.

➢ *Secondary Data*

Secondary data includes literature studies related to similar research and KatinganRegency PKRTLH Activities documents. The purpose of secondary data collection is to support the process flow of PKRTLH activities and report formats required later, including data to be included in the Time Schedule.

B. Metode

To predict the duration of work, this researchuse the EVM methods and TPI methods. In general, this research is carried out with the steps as shown in the flowchart in Figure 1.

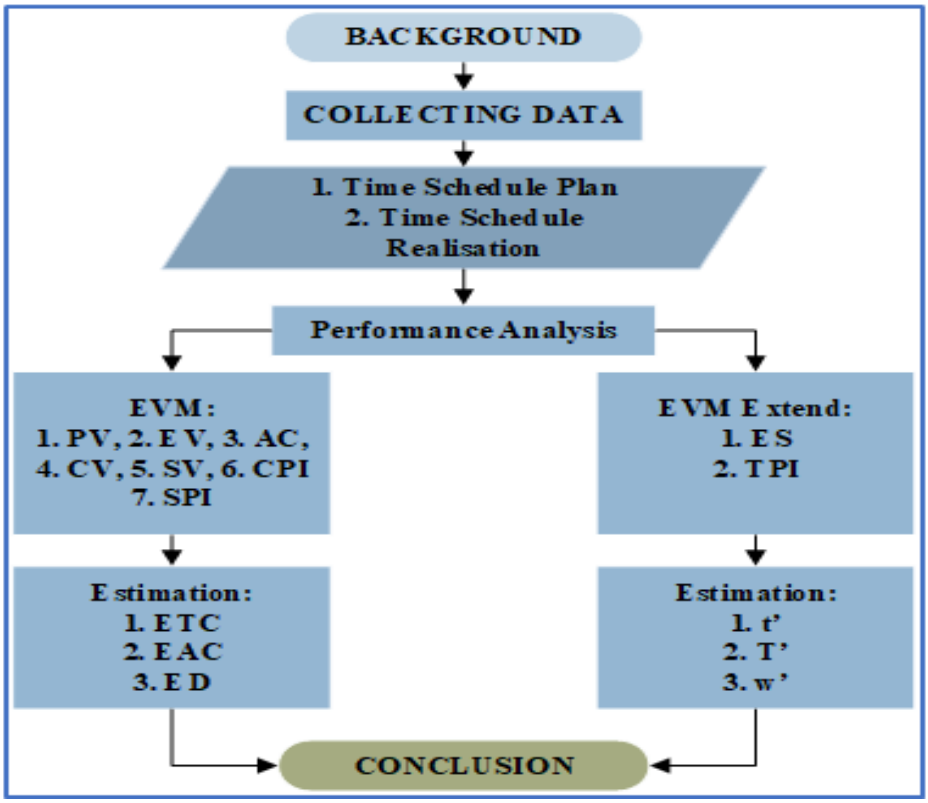

Fig. 1: Research Flowchart

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Table 1: Calculation Results of PV, EV & AC Week 1 to 11.

Week	% Cum. Plan	% Cum. Real	PV (IDR)	EV (IDR)	AC (IDR)
1	10	0	100,000,000	0	0
2	21	20	210,000,000	200,000,000	200,000,000
3	23	20	230,000,000	200,000,000	200,000,000
4	25	22	250,000,000	220,000,000	220,000,000
5	26	24	260,000,000	240,000,000	240,000,000
6	30	24	300,000,000	240,000,000	240,000,000
7	40	26	400,000,000	260,000,000	260,000,000
8	50	26	500,000,000	260,000,000	260,000,000
9	55	35	550,000,000	350,000,000	350,000,000
10	61	40	610,000,000	400,000,000	400,000,000
11	63	40	630,000,000	400,000,000	400,000,000

III. RESULT AND DISCUSSION

A. Activity General Data

In making predictions of the length of duration carried out, it refers to data on the implementation of PKRTLH activities in Katingan Regency in 2022, as follows:

Activity Name	:	PKRTLH Katingan District2022
Location	:	Tumbang Kaman Village, Tumbang Kajamei Village and Karuei Village
Total Value	:	IDR 1,000,000,000
Start, Finish	:	June 3, 2022 to October 20, 2022 (20 weeks)
Reference Period	:	Week 11

As mentioned above, in 2022 the planned duration time is 20 weeks. As for the review, it is determined that at least PPK conducts a review in Week 11. This is because in that week there is an LPD I stage with a cumulative plan weight of 63%, where this stage is a critical point in the implementation of PKRTLH activities.

B. Controlling and Monitoring Project Duration with EVM

- *Planned Value (PV), Earned Value (EV)&Actual Cost (AC)*

The calculation of PV in Week 11 is as follows:

PV(M11) = % cumulative plan M11 x BAC
= 63% x IDR1,000,000,000
= IDR 630,000,000

The calculation of EV in Week 11 is as follows:

EV(M11) = % cumulative realisation M11 x BAC
= 40% x IDR 1,000,000,000
= IDR 400,000,000

The AC value is equal to the PV value, because PKRTLH activities are social assistance activities without profit where the costs incurred are the same as planned. For other weeks it is calculated in the same way and the results can be seen in Table 1.

- *Schedule Variance (SV) dan Cost Variance (CV)*

SV is obtained through the calculation below:

SV(M11) = EV(M11) – PV(M11)
= IDR 400,000,000 - IDR 630,000,000
= - IDR 230,000,000

CV calculation as follows:

CV(M11) = EV(M11) – AC(M11)
= IDRv400,000,000 –IDR 400,000,000
= IDR 0

The calculations for the other weeks are shown in Table 2.

Table 2: SV & CV Calculation Results Week 1 to Week 11

Week	SV (IDR)	CV (IDR)
1	-100,000,000	0
2	-10,000,000	0
3	-30,000,000	0
4	-30,000,000	0
5	-20,000,000	0
6	-60,000,000	0
7	-140,000,000	0
8	-240,000,000	0
9	-200,000,000	0
10	-210,000,000	0
11	-230,000,000	0

- *Schedule Performance Index (SPI)&Cost PerformanceIndex (CPI)*

SPI is obtained through the calculation below:

SPI(M11) = EV(M11) / PV(M11)
= IDR 400,000,000 / IDR 630,000,000
= 0.635

The CPI value is based on the following calculation:

CPI(M11) = EV(M11) / AC(M11)
= IDR 400,000,000 / IDR 400,000,000
= 1

The calculations for the other weeks are shown in Table 3.

Table 3: SPI & CPI Calculation Results Week 1 to Week 11

Week	SPI	CPI
1	0.000	∞
2	0.952	1.000
3	0.870	1.000
4	0.880	1.000
5	0.923	1.000
6	0.800	1.000
7	0.650	1.000
8	0.520	1.000
9	0.636	1.000
10	0.656	1.000
11	0.635	1.000

- *Estimate to Complete (ETC), Estimate at Completion (EAC) &Estimated Duration (ED)*

ETC(M11) = (BAC-EV(M11) / CPI(M11)
= (IDR 1,000.000.000 – IDR 400,000.000) / 1
= IDR600,000,000

The EAC value is based on the following calculation:
EAC(M11) = ETC(M11) + AC(M11)
= IDR 600,000,000 + IDR 400,000,000
= IDR 1,000,000,000

ED based on the following calculation:
ED(M11) = PD / SPI(M11)
= 20/0.635
= 31.496≈31Weeks

The calculations for the other weeks are shown in Table 4.

Table 4: Calculation Results of ETC, EAC &ED Week 1 to Week 11

Week-	ETC (IDR)	EAC (IDR)	ED (Week)
1	∞	∞	∞
2	800,000,000	1,000.000,000	21
3	800,000,000	1,000.000,000	23
4	780,000,000	1,000.000,000	23
5	760,000,000	1,000.000,000	22
6	760,000,000	1,000.000,000	25
7	740,000,000	1,000.000,000	31
8	740,000,000	1,000.000,000	38
9	650,000,000	1,000.000,000	31
10	600,000,000	1,000.000,000	31
11	600,000,000	1,000.000,000	31

C. Project Duration Control and Monitoring with TPI

- *Earned Schedule (ES) & Time Performance Index (TPI)*

Earned Value (EV) is the real cumulative weight in the reference period, based on the EV data in Week 11 = 0.40 (see Table 1). Based on EV, the ES value can be calculated as follows:

ES(M11) = i – 1 + (EV – w(i – 1))/(w(i) – w(i – 1))
= 7

The calculation of the TPI value is as follows:
TPI(M11) = ES(M11) / ta(M11)
= 7 / 11
= 0.636

The calculations for the other weeks are shown in Table 5.

Table 5: ES and TPI Calculation Results Week 1 to Week

Week	ES	TPI
1	0.000	0.000
2	1.909	0,955
3	1.909	0.636
4	2.500	0.625
5	3.500	0.700
6	3.500	0.583
Table 5 Continue		
Week	ES	TPI
7	5.000	0.714
8	5.000	0.636
9	6.500	0.722
10	7,000	0.700
11	7.000	0.636

- *t', T' dan w'*

t' is the predicted completion time for each week. t' is obtained by the following calculation:
t'(11) = 11 + (11 – 7.000) / 0.636
= 17.29

T' is the predicted completion time for 100% of the work and is equivalent to ED in EVM, based on the following calculation:
T'(11) = t'(20) with reference period Week 11
= 31.43 ≈ 31Weeks

w' is the % cumulative weight of the next week of the review period which can be predicted by the following calculation:
w'(12) = 0.40 + (0.50 – 0.40) x (12 – 11) / (12.57 – 11)
= 0.46

The prediction results for the other weeks can be seen in Table 6 in red and blue.

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Table 6: Calculation results of t' and w' at Week 11 reference period

Week	w (cum. plan)	w' (cum. real)	t' (Week)
1	0.10	0.00	1.57
2	0.21	0.20	3.14
3	0.23	0.20	4.71

- *Predicted Time Schedule S Curve with TPI Calculation at Week 11 Reference Period*

The results of the prediction of completion time and prediction of cumulative weight can be made Time Schedule in the form of a Prediction S Curve as shown in Figure 2.

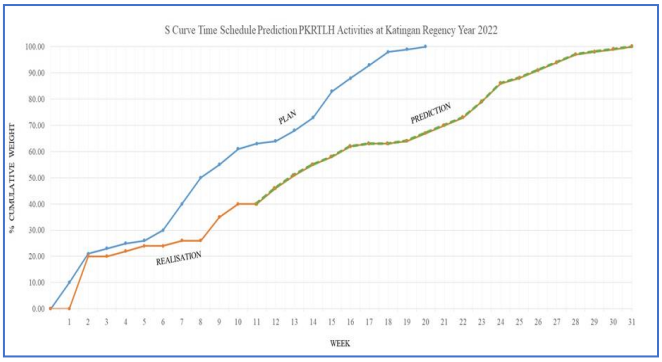

Fig. 2: Prediction Time Schedule S Curve

Table 6: Continue

Week	w (cum. plan)	w' (cum. real)	t' (Week)
4	0.25	0.22	6.29
5	0.26	0.24	7.86
6	0.30	0.24	9.43
7	0.40	0.26	11.00
8	0.50	0.26	12.57
9	0.55	0.35	14.14
10	0.61	0.40	15.71
11	0.63	0.40	17.29
12	0.64	0.46	18.86
13	0.68	0.51	20.43
14	0.73	0.55	22.00
15	0.83	0.58	23.57
16	0.88	0.62	25.14
17	0.93	0.63	26.71
18	0.98	0.63	28.29
19	0.99	0.64	29.86
20	1.00	0.67	31.43
21	1.00	0.70	
22	1.00	0.73	
23	1.00	0.79	
24	1.00	0.86	
25	1.00	0.88	
26	1.00	0.91	
27	1.00	0.94	
28	1.00	0.97	
29	1.00	0.98	
30	1.00	0.99	
31	1.00	1.00	

D. Comparison of Project Duration Prediction Results

Calculations using the EVM method resulted in a predicted completion time of 31 weeks. This method uses cost factors to obtain predictions. Predictions can be easily calculated if complete cost data is available, such as the need for direct cost and indirect cost data to obtain Actual Cost (AC) values. These direct costs can be in the form of wages, tool and material costs. Indirect costs are obtained from project financial management data. In the EVM method, SPI is obtained as a prediction of whether the project is late or not. The resulting SPI value is less than 1 (see Table 3), so it can be estimated that PKRTLH activities in 2022 will be late from schedule.

Using the TPI method, predictions are obtained by calculating the trendline of the % cumulative realized weight of the project, so there is no need to calculate the cost value. Or it can be said that TPI is similar to SPI in EVM but specific at the time side instead of cost. The advantage with the TPI method is that it can also predict the % cumulative realization weight of the next week until the work is 100% complete. The calculation results show that TPI is less than 1 (see Table 5), so it can also be predicted that activities will be late from schedule too.

IV. CONCLUSION

The results of the analysis obtained the following conclusions:

- In the Week 11 reference period with the EVM method, the Schedule Performance Index (SPI) value is 0.635. While the Time Performance Index (TPI) value of the advanced EVMcalculation results was obtained at 0.636. The SPI and TPI values are less than 1 and indicate activities are behind schedule.
- Both the EVM and TPI methods produce the same predicted completion time of 31 weeks. This prediction result shows that the PKRTLH Activity in 2022 is delayed for 11 weeks from the planned 20 weeks.
- For the case of predicting the duration of PKRTLH activities in Katingan Regency, it is more suitable to use the TPI method, because it is non-profit so it cannot be calculated in detail the value of costs, where then the AC value is used equal to the PV value. The TPI method is easier to apply because it only requires data on the weight of the cumulative realization of the project.

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