INTERNATIONAL JOURNAL ON ADVANCED TECHNOLOGY, ENGINEERING, AND INFORMATION SYSTEM (IJATEIS)

COST AND TIME ANALYSIS USING EARNED VALUE METHOD IN ADMINISTRATION BUILDING CONTRUCTION PROJECT AT POLIJE CAMPUS

Dodik Irniawan[1*], Wateno Oetomo[2], Risma Marleno[3]
[1-3]Master of Civil Engineering Study Program, Faculty of Engineering,
Universitas 17 Agustus 1945 Surabaya
E-mail: [1)] d.irniawan@gmail.com

Abstract

Implementation of construction projects often faces delays in work completion. Delays in project completion that exceed the time limit specified in the contract cause losses both from the contractor as the executor and the assignor. Project implementers pay more attention to the cost aspects incurred and often ignore the time control of project implementation so that project implementation often experiences delays in work. The purpose of this study is to analyze the time efficiency carried out by the provider from the beginning of the work, during monitoring, to the end of the project implementation. And estimate how much it costs from the start of work, when monitoring until the project is completed using the Earned Value Method. From the analysis, results and discussion of the Bondowoso Polije Campus Administration Building project, it can be concluded that the project work time exceeds 2,543 weeks for the total work and will experience a loss of Rp 393,323,318.10 from the reduction of the total contract minus the total financing. Therefore, the construction management proposes to shift the work schedule to work that does not require the achievement of the main construction. In addition, the contractor should communicate to the assignor of the Administration Building project to increase the duration of the administrative building construction project work. And participate in finding alternative suppliers of the main material without having to wait for the vendor to get the material needed.

Keywords: *Earned Value Method, Cost Efficiency, Time*

1. INTRODUCTION

A construction project is a series of activities carried out to build a building within a specified time frame. Cost, time and quality are three important aspects that must be considered in the implementation of a project. The resource cost planning aspect in project implementation is intended to control costs during project implementation(Pranowo, 2007). The time aspect in preparing the project schedule is carried out to monitor the progress of the project so that the project is completed on time. The quality aspect, a project is said to be good if it can satisfy the client. Realistic project costs, projects completed on time, and good project quality then the project can be said to be successful (Bhakti, 2018).

A construction project is always required to be completed on time without any delays in project implementation(Marleno et al., 2018). But in fact, in the implementation of construction projects, there is often a mismatch between the planned schedule and the reality in the field. This is caused by several obstacles, both calculated obstacles and obstacles outside the calculation. This obstacle is the cause of the delay in project implementation. If delays in project implementation occur, then this delay must be

anticipated by accelerating the duration of the project so as not to be subject to agreed sanctions. In this case, acceleration is carried out to obtain the optimum time with the minimum project cost (direct costs and indirect costs)(Hendriyani et al., 2020).

The implementation of construction projects often faces delays in work completion. Delays in project completion that exceed the time limit specified in the contract cause losses both from the contractor as the executor and the assignor. Project implementers pay more attention to the cost aspects incurred and often ignore the time control of project implementation so that project implementation often experiences delays in work(Asnuddin et al., 2018).

For the smooth running of a project, good management is needed to manage or handle the project from the beginning until the project ends, namely project management(Santoso, 2003). Project management is an effort to use limited resources efficiently, effectively and on time in completing a project that has been determined or planned(Soeharto, 1997). There are 3 activities from the basic functions of project management, namely planning, scheduling and controlling(Marpaung et al., n.d.).

Planning is one of the vital functions in project management activities(Dimyati & Kadar, 2014). Therefore, to achieve goals, management must make proactive steps in conducting comprehensive planning so that goals and objectives can be achieved. Planning is said to be good if the entire process of activities in it can be implemented in accordance with the predetermined goals and objectives with a minimum level of deviation and maximum final results (Husein & Perencanaan, 2011).

Then the result of planning is the project scheduler, with project scheduling information can be known about the planned schedule and project progress, in terms of resource performance in the form of costs, labor, equipment, and materials as well as project duration plans and time progress for project completion(Ifeanyi, 2019).

Control is defined as a systematic effort to determine standards in accordance with planning goals and objectives, design information systems, compare implementation with standards, analyze possible deviations, then take the necessary corrective actions so that resources can be used effectively and efficiently in order to achieve goals and objectives (Monica, 2013).

From the above definition, it can be concluded that control requires standards or benchmarks as a comparison, performance measurement tools and corrective actions that will be taken if deviations occur(Ayudya et al., 2023). Activities carried out in the control process can be in the form of supervision, inspection and corrective action, which are carried out during the implementation process. (Ginting, 2020)Project control is a system that organizes all activities in the project with the aim that all are seen to function optimally, so that the implementation is on time in accordance with the project schedule (time schedule), and makes it well coordinated in order to produce work with the quality that is in accordance with the plan.

Once the project is broken down into component activities, the project scope is reorganized into a sequence of activities according to dependency logic. The output of this process is the Project Work Network. From the resulting work network, each activity is estimated for the period of time required to complete the activity concerned. The output of this process is a work network that already has the timeframe and estimated resources required to complete the activities(Mangkunegara & Prabu, 2005).

The work network, in which each component of the activity has been given a period of time, is then analyzed as a whole and the project completion period and milestones are calculated, which are important points from the project schedule point of view(Wijanarko & Oetomo, 2019). The output of this process is the master schedule, milestones and schedule for the implementation of work in the field.

The problem in the implementation of the Bondowoso Polije Campus Administration Building Project is the limited cost and time available. With a 5 (five) storey building design with a reinforced concrete structure, each floor of which has an area of 240 M2 with a total floor area of almost 1440 M2, this building is a fairly complex building, in terms of the function of the building itself. The contract value of physical work amounted to Rp. 5,599,873,601.60 and was carried out within 120 days or 18 weeks.

2. RESEARCH METHODS

The method used in this research is descriptive quantitative, research that describes the condition of a particular project by analyzing existing data. Data analysis uses analytical and descriptive methods. Analytical means that existing data is processed in such a way as to produce final results that can be concluded. While descriptive means describing the problems that already exist or appear. The Earned Value Analysis concept examines the tendency of schedule variance and cost variance at a period of time during the project(Barrientos-Orellana et al., 2023). However, in this study it will only discuss the time variant. The object used in this research is the Bondowoso Polije Campus Administration Building Construction Project(Soemardi et al., 2007).

The subject of this research is Cost and Time Performance Analysis with Earned Value Method on the Bodowoso Polije Campus Administration Building Project(Ariana & Lestari, 2023). This research focuses on cost and time control. There are two kinds of data in research, namely qualitative data and quantitative data. Qualitative data is data expressed in the form of words, sentences, and images. Quantitative data is data in the form of numbers or quantitative data that is summarized. The data needed to conduct this research are actual project costs, weekly project reports, project plan S-curves, and interviews.

3. ANALYSIS AND DISCUSSION

This analysis will focus on evaluating the cost and time control of the Bondowoso Polije Campus Administration Building Project. From this analysis, the results of job performance will be obtained every week. The performance is used to find solutions to errors that may arise in a job in order to control costs and time(Rahman, 2010). The analysis used data from the Bondowoso Polije Campus Administration Building Project with a cost budget plan of Rp 5,599,873,601.60 which was carried out for 120 days or equal to 18 weeks. Drawing and calculations were carried out using Microsoft Excel software.

ACWP is the actual cost incurred to work on the project. Then BCWS is the amount of costs incurred based on the planned work weight. While BCWP is the amount of costs incurred based on the amount of work that has been completed.

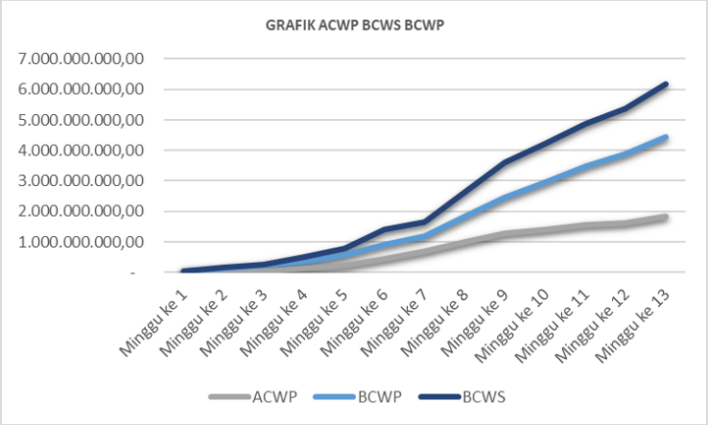

Figure 1. Comparison of ACWP, BCWS and BCWP

From the comparison of Figure 1, it shows that the BCWP value tends to experience a steady increase but is below the BCWS value from week 1 to week 13. While ACWP has always been below the BCWS and BCWP values since the start of the project.

This shows that a lot of work has not been completed since week 1 to week 13. Then in week 11 to week 13 the unfinished work experienced a peak delay. The actual cost is always below the project plan budget limit.

A cost variation value equal to zero is an indicator that the work carried out is in accordance with the planned cost.

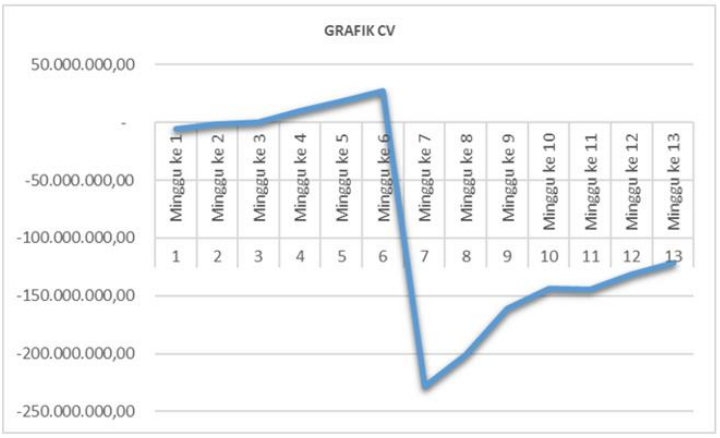

Figure 2. Cost Variation

From Figure 2, the results of the cost variation analysis show an increase and decrease in CV values over time. Until the last week the author conducted the research, namely week 13. The CV indicator shows a negative value. This shows that all periods of work from week 1 to week 13 are lower than the planned cost.

Schedule variation is the difference between the amount of planned work costs and realized costs. The calculation of the schedule variation value shows the project conditions for each week.

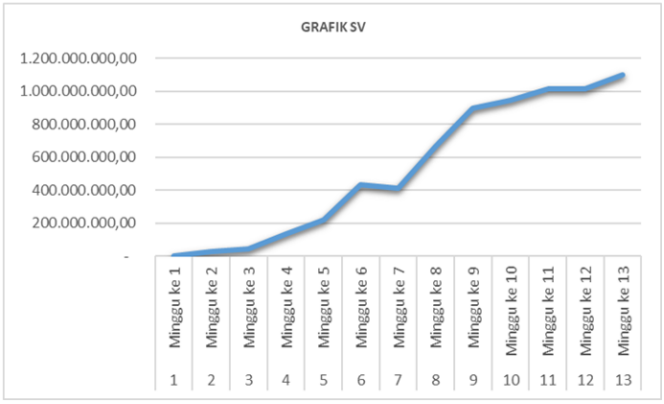

Figure 3. Schedule Variations

From Figure 3, the results of the schedule variation analysis show a slight increase in the SV value from week 1 to week 6 and continues in the following week until it reaches its peak in week 9. Then from week 11 the SV value decreases until it passes the value of 0 in week 11 and continues to decline sharply to touch the lowest value in week 12 then back up again until week 13. According to the interview results, the SV value was negative in the 11th-12th period due to the lack of material supply.

The cost performance index (CPI) is an indicator used to determine the cost productivity index on realized work whether it is in accordance with the budget plan or not. A CPI value of less than one indicates a schedule delay and a CPI value of more than one indicates the realized work is more economical than the project budget. While a CPI value equal to 1 indicates cost performance with the project budget.

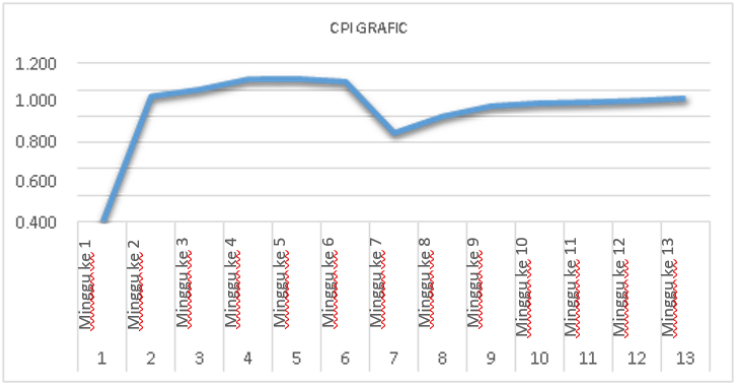

Figure 4. Cost Productivity Index

The cost productivity index for week 3 to week 6 shows a CPI value above one, which means that the cost productivity index is saving work costs from the project budget. And the highest index is in week 6.

Schedule productivity index (SPI) is an indicator used to determine the schedule productivity index on realized work whether it is in accordance with the plan schedule or not. An SPI value of less than one indicates a schedule delay and an SPI value of

more than one indicates the work is realized ahead of the plan schedule. While the SPI value equal to 1 indicates the performance of the realized work is the same as the plan schedule.

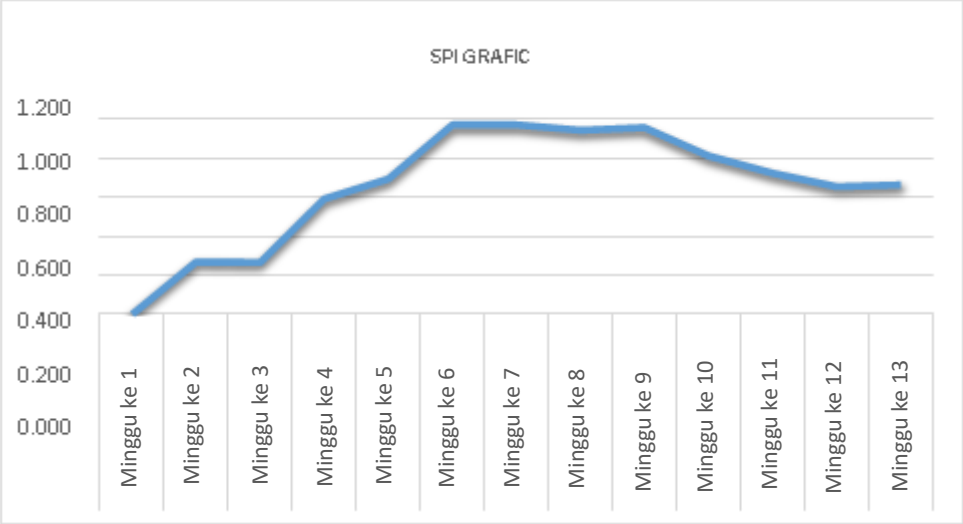

Figure 5. Time Productivity Index

In Figure 5, the Time Productivity Index for week 1 to week 13 shows that the SPI value is below 1, which means that the work productivity index is carried out later than the planned schedule.

This indicates that the work schedule is over 13 periods, namely week 1 to week 13.

According to the interview results (Appendix-3), SPI values of less than 1 in all periods were caused by the lack of material supply and the non-implementation of additional working hours. This led to the disruption of the sale and prioritization of the work order.

From the results of the analysis of the ETC value of the cost of work shows variations in the estimated remaining cost of work in each week. The effective ETC value must be at a number where the work realized is in accordance with the remaining work budget plan. Beyond that the work realized is said to be ineffective.

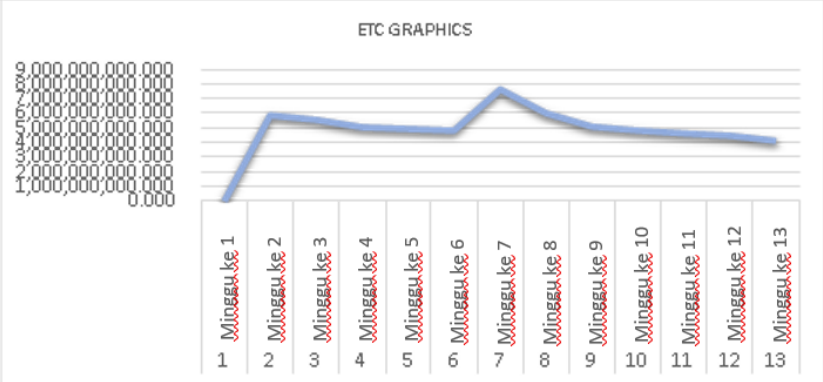

Figure 6. Projected cost of remaining work

From the results of the ETC analysis described in Figure 4.6 from week 7 to week 13, it shows that the ETC value tends to decrease until the end of week 13 reporting at Rp 4,145,586,504.49.

From the results of the analysis of the EAC value on the remaining cost of work shows the variation in the total cost required to complete a project. The EAC value is more economical if the value is below the planned budget.

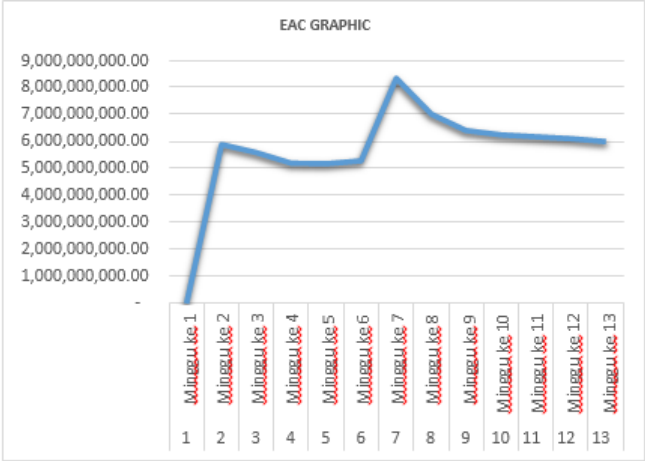

Figure 7. Projected Total Cost of Work

The results of the ETC analysis depicted in Figure 7 show a very high value in the 7th week reporting period, which is IDR 8,333,682,347.69 the cost required to complete a project. While in the 13th period obtained a value of Rp 5,993,156,919.70 which means that the estimated project will be completed with a total cost of work of Rp 5,993,156,919.70.

From the results of the analysis of the ETS value on the work schedule, it shows variations in the estimated remaining work schedule in each week. The effective ETS value must be at the number where the work is realized in accordance with the remaining work budget plan. Beyond that the work realized is said to be ineffective.

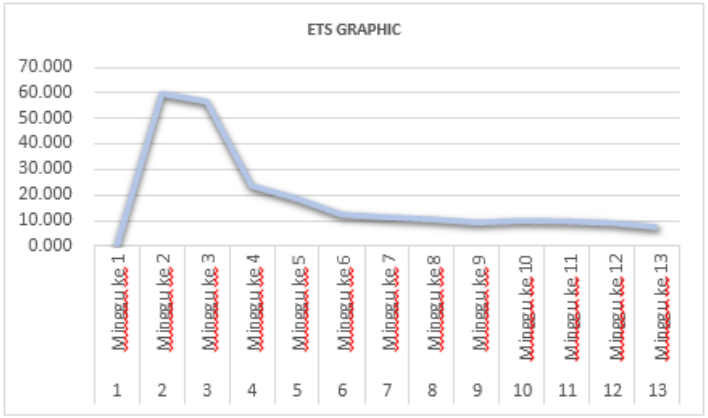

Figure 8. Projected Remaining Work Schedule

From the results of the ETS analysis described in Figure 4.8 from week 2 to week 13, the ETS value tends to decrease until the end of reporting week 13 at 7.543 weeks.

From the results of the analysis of the EAS value on the remaining cost of work shows the variation in the total schedule required to complete a project. The SAC value is faster if the value is below the total duration of the work that has been planned.

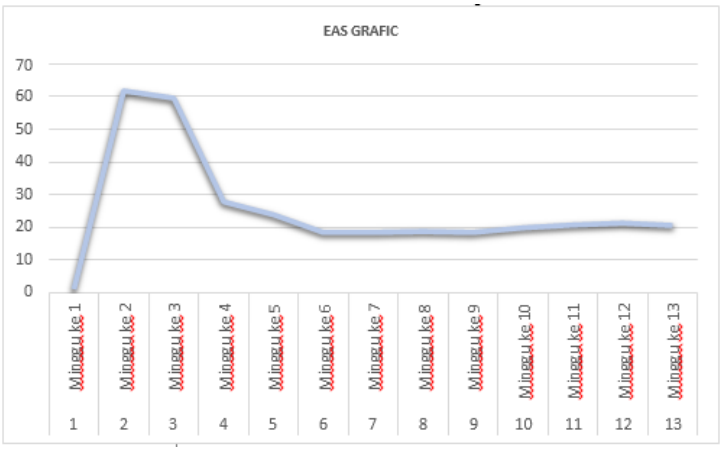

Figure 9. Projected Total Work Schedule

The results of the ETS analysis depicted in Figure 9 show a very high value in the week 2 reporting period, namely 61.745 weeks of the schedule required to complete a project. While in the 13th period obtained a value of 20.543 weeks which means the estimated project will be completed with a delay.

4. CONCLUSION

Building project, it can be concluded that:

1. a. Cost (CV) and Time Variation (SV) values, as follows:

   The CV value found variations in positive and negative values in each period. With the lowest value (-)IDR 228,191,016.04 in the 7th week period.
   SV values were not found to be negative in all periods.

   b. The Cost (CPI) and Time Productivity Index (SPI), are as follows:
   CPI values were found to vary positively and negatively across reporting periods. The lowest figure was 0.672 in the 7th period.
   The SPI value has an SPI value that is < 1, namely in all periods with a final SPI value of 0.663.

2. a. Estimated Cost (EAC) and Time (EAS) of Administration Building project as follows If the cost productivity index of the remaining period is considered the same as the end of the reporting period, the estimated cost to complete the project (EAC) of the administration building project is Rp 5,993,156,919.70.

   b. If the time productivity index of the remaining period is considered equal to the end of the reporting period, the estimated total work time (EAS) of the Administration Building project is 20.543 weeks.

So the estimated performance of the Administration Building construction project of the Bondowoso Polije Campus Building from a time review will experience a delay of 2.543 weeks and will experience a cost loss of Rp 393,323,318.10 from the reduction in the total contract minus the total financing.

5. ADVICE

Based on the results of this study, the researcher provides suggestions for several things that can be developed as follows:

a. In further research, in order to analyze project performance on the Bondowoso Polije Campus Administration Building construction project to get maximum results, further analysis is needed in week 13 until the end of project completion.
b. It is necessary to analyze project performance based on the quality of work so that the project is not only right in terms of cost and time but also right in terms of quality.
c. In analyzing project performance using the Earned Value Method so that work can be controlled properly, it is carried out using the help of the Microsoft Project program because some work that is in critical activities can be seen(Salsabila et al., 2022).

REFERENCES

Ariana, I. K. A., & Lestari, D. A. (2023). Analisis Kinerja Proyek Optimalisasi SPAM Gatak Kabupaten Sukoharjo dengan Metode Earned Value. *Journal of Integrated System*, *6*(1), 87–102.

Asnuddin, S., Tjakra, J., & Sibi, M. (2018). Penerapan Manajemen Konstruksi Pada Tahap Controlling Proyek.(Studi Kasus: Bangunan Laboratorium Fakultas Teknik Universitas Sam Ratulangi Manado). *Jurnal Sipil Statik*, *6*(11).

Ayudya, I. I. M., Pratami, D., & Saputra, M. (2023). Perancangan Scope Baseline, Schedule Baseline Dan Performance Measurement Mengunakan Earned Value Method Pada Proyek Pengembangan Sistem Informasi Pendidikan Terintegrasi Universitas ABC. *EProceedings of Engineering*, *10*(2).

Barrientos-Orellana, A., Ballesteros-Pérez, P., Mora-Melià, D., Cerezo-Narváez, A., & Gutiérrez-Bahamondes, J. H. (2023). Comparison of the Stability and Accuracy of Deterministic Project Cost Prediction Methods in Earned Value Management. *Buildings*, *13*(5), 1206.

Dimyati, H., & Kadar, N. (2014). *Manajemen Proyek: CV Pustaka Setia*.

Ginting, J. V. B. G. (2020). Metode Earned Value Pada Pengendalian Proyek Pembangunan Gedung Sekolah SD Methodist-an Pancur Batu. *ARBITRASE: Journal of Economics and Accounting*, *1*(1), 6–10.

Hendriyani, I., Pratiwi, R., & Qadri, N. (2020). Optimasi Waktu dan Biaya pada Pelaksanaan Proyek Peningkatan Jalan Bina Bakti Kelurahan Gunung Seteleng Kabupaten Penajam Paser Utara dengan Metode Time Cost Trade Off (TCTO): Time and Cost Optimization in The Implementation of the Improvement of the Bina Bakti Road of Gunung Seteleng Kabupaten Penajam Paser Utara with Time Cost Trade Off (TCTO) Method. *Jurnal Ilmiah Teknik Sipil TRANSUKMA*, *3*(1), 65–76.

Husein, A., & Perencanaan, M. P. (2011). Penjadwalan, dan Pengendalian Proyek (Edisi

Revisi). *Yogyakarta: Andi Offset*.
Ifeanyi, E. I. (2019). Quantitative Approach to Project Scope Change Management in Building Projects. *PM World Journal*, *3*(4), 1–24.
Mangkunegara, A. P., & Prabu, A. (2005). Evaluasi kinerja sumber daya manusia. *Bandung: Refika Aditama*, 61–68.
Marleno, R., Surjokusumo, S., Oetomo, W., Setiawan, M. I., & Abdullah, D. (2018). The influence of stakeholder factors affecting the success of construction projects in Indonesia. *Journal of Physics: Conference Series*, *1114*(1), 12135.
Marpaung, R., Daulay, I. N., & Tambunan, V. (n.d.). Optimalisasi penjadwalan proyek pembangunan pabrik kelapa sawit dengan menggunakan metode PERT dan CPM pada PT. Bintang Riski Abadi. *SOROT*, *17*(2), 117–127.
Pranowo, D. A. (2007). *Pengendalian Proyek dengan Metode Earned Value (Studi Kasus Proyek Rusunawa Universitas Diponegoro Semarang)*. Prodi Teknik Sipil UNIKA Soegijapranata.
Rahman, I. (2010). Earned value analysis terhadap biaya pada proyek pembangunan gedung. *Surakarta: Universitas Sebelas Maret*.
Salsabila, M. D. N., Puspita, I. A., & Widyasthana, S. (2022). The Project Performance Evaluation of PLBN Project Using Earned Value Management Method. *International Journal of Innovation in Enterprise System*, *6*(01), 61–73.
Santoso, B. (2003). *Manajemen Proyek*. Guna Widya Anonim.
Soeharto, I. (1997). *Manajemen proyek dari konseptual sampai operasional*.
Soemardi, B. W., Abduh, M., & Reini & Pujoartanto, N. (2007). Konsep Earned Value untuk Pengelolaan Proyek Konstruksi, Buku Referensi, Konstruksi: Industri, Pengelolaan dan Rekayasa. *Bandung: Penerbit ITB*.
Wijanarko, B., & Oetomo, W. (2019). Analisis Percepatan Waktu Penyelesaian Proyek Dengan Metode Crashing Dan Fast Tracking Pada Pelebaran Jalan Dan Jembatan'. *Jurnal Untag__*.

Copyrights

Copyright for this article is retained by the author(s), with first publication rights granted to the journal.

This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (http://creativecommons.org/licenses/by/4.0/).