Volume 4, No. 8 August 2025 - (1337-1345)
p-ISSN 2980-4868 | e-ISSN 2980-4841
https://ajesh.ph/index.php/gp

Cost Analysis of Additional Workers in a Pump House Construction Project in Sumenep Regency

Jenodius Aldino John[1], Esti Wulandari[2], Laksono Djoko Nugroho[3]
Universitas 17 Agustus 1945 Surabaya, Indonesia
Emails: johnjeno985@gmail.com , laksonodjoko@untag-sby.ac.id , wulandariesti@untag-sby.ac.id

ABSTRACT
Delays in construction projects are often significant challenges that can affect the overall success of a project. This study aims to analyze delays in the construction of pump houses in Sumenep Regency using the Critical Path Method (CPM). The objectives of this study are to identify the main factors causing delays, namely material supply delays and labor shortages. The analysis was conducted by measuring the impact of delays on project time and costs, as well as proposing alternative solutions to overcome potential delays in the future. The results of the study indicate that project delays caused an additional two weeks of time, resulting in an increase in the overall project cost of Rp127,571,400 for the SDSM 132 pump house and Rp110,743,800 for the SDSM 171 pump house. In response to these findings, the proposed alternative solutions include schedule optimization, increasing the number of workers on critical paths, and utilizing alternative material suppliers. This study emphasizes the importance of efficient time and resource management to prevent cost accumulation and ensure the project is completed on time.

Keywords: Project Delay, CPM Method, Critical Path, Time Management, Cost Management

INTRODUCTION

Delays in construction project implementation are a global issue and often pose a major challenge within this industry. Research by Irawan et al. (2020) indicates that construction projects worldwide struggle to meet completion schedules due to various obstacles, including labor shortages, material supply constraints, and coordination issues among stakeholders. In developing countries such as Indonesia, this problem is exacerbated by inadequate logistics and increasingly complex projects. Therefore, it is crucial to develop effective methods for identifying and addressing delays to ensure that projects are completed on schedule and within budget.

One of the main factors contributing to project delays is the lack of efficiency in time and resource management. For instance, the construction of a pump house in *Sumenep* Regency, which is the focus of this study, experienced significant delays due to two primary factors: delays in material supply from *Surabaya* and a shortage of labor (Dahlan et al., 2019). These two aspects interacted, creating obstacles in the project schedule that ultimately resulted in additional time and costs. This phenomenon not only reflects technical challenges but also underscores the importance of better project management.

The impact of these factors is particularly significant in the context of pump house construction in *Sumenep*. Delays in material delivery caused downtime for workers and heavy equipment, preventing the project from proceeding as originally planned. Additionally, labor shortages—due to the simultaneous implementation of similar projects in various locations—further compounded the allocation of human resources (Gunawan et al., 2014). The combination

of these issues contributed to an increase in project costs, with an additional Rp127,571,400 for the SDSM 132 pump house unit and Rp110,743,800 for the SDSM 171 pump house unit (Nazilah P. Abas et al., 2022). This cost increase places a financial burden on the contractor and may negatively impact project profitability.

This study applies the Critical Path Method (CPM) to analyze delays in the project. CPM is a specialized tool designed to identify the critical path in construction projects—a series of activities that determine the overall project duration (Liston Hari Aryono, 2014). By utilizing this method, project managers can identify activities that most influence the schedule, enabling more efficient resource management. For example, the CPM method has been applied in previous studies, including bridge projects (Irawan et al., 2020) and parking garage construction (Iluk et al., 2020), with the aim of optimizing schedules and reducing costs.

Further supporting the context of this research, a study by Agung Hardianto (2015) on hotel construction projects in *Palembang* demonstrated the effectiveness of CPM in controlling both time and cost, highlighting how critical path identification can mitigate delays. Similarly, research by Fu'at et al. (2022) on residential construction projects in *Kediri* emphasized the role of CPM and Gantt charts in synchronizing project schedules and budgets, providing a framework for minimizing deviations. These studies collectively underscore the versatility and applicability of CPM across diverse construction projects, reinforcing its relevance to the current study.

Cost monitoring and control are integral parts of cost planning. During the project, actual costs must be compared with the planned budget so that any differences or deviations can be identified and corrected immediately. Tools such as Earned Value Management (EVM) can be used to evaluate project performance in terms of cost and time simultaneously, enabling project managers to take corrective actions in a timely manner.

With comprehensive and structured cost planning, projects can not only be completed within budget but also meet quality and time targets. Additionally, good planning enhances transparency and accountability, as all cost components are considered and documented from the outset. Ultimately, effective cost planning plays a crucial role in ensuring overall project success and maintaining good relationships with stakeholders through professional and accurate budget management.

With good cost planning, all these factors are analyzed in detail to ensure that the budget is realistic and covers all project needs. This helps identify potential expenses that may arise beyond the initial plan and allows for the implementation of cost control strategies to prevent budget overruns. Cost planning also facilitates monitoring and evaluation during project implementation so that any deviations from the budget can be addressed immediately. Thus, effective cost planning supports the completion of projects within the planned budget and helps ensure overall project efficiency and success (Liston Hari Aryono, 2014).

To estimate the budget and control costs, project managers and their teams must determine the physical resources (human, tools, and materials) and the quantities of these resources required to complete the project. It is very important to involve people who have experience and expertise in similar projects. The main output of this process is a list of resource requirements, including people, tools, and materials. In addition to providing a basis for cost estimates, budgets, and cost control, the list of required resources is vital for project resource management and project procurement management.

Cost monitoring and control are also integral parts of cost planning. During the project, actual costs must be compared with the planned budget so that any differences or deviations can be identified and corrected immediately. Tools such as Earned Value Management (EVM) can be

used to evaluate project performance in terms of cost and time simultaneously, enabling project managers to take corrective action in a timely manner.

The novelty of this research lies in its in-depth focus on simultaneous time and cost analysis in pump house projects in *Sumenep*. Although the CPM method has been widely applied in large-scale projects, detailed studies on its application in medium-scale projects in remote areas such as *Sumenep* are still rare. This research also offers alternative solutions specifically designed to address the unique geographical and logistical challenges in the region, such as improved logistics coordination and utilization of local material suppliers.

The urgency of this research stems from the pressing need to improve project management efficiency in Indonesia, particularly in the infrastructure construction sector. The pump house construction project in *Sumenep* not only plays a crucial role in supporting the irrigation and water management systems in the area but also has the potential to serve as a model for similar projects in the future. By understanding the root causes of the problems and implementing data-driven solutions, this study is expected to contribute significantly to improving the performance of construction projects in Indonesia.

The objectives of this study are to analyze the impact of delays on the construction of pump houses in *Sumenep* Regency using the CPM method. Specifically, this study aims to (1) analyze the duration of delays in the project and (2) calculate the impact of delays on costs.

This study offers various significant benefits. First, for students and researchers, it provides an in-depth understanding of the application of the CPM method in project delay analysis, which can be used as a reference for further research. Second, for contractors, the results can serve as guidelines to improve project management efficiency and reduce the risk of delays. Lastly, for institutions, this research presents empirical data useful for formulating guidelines for time and cost management in construction projects.

With this background, this research not only has academic relevance but also offers significant practical implications. Through the application of the CPM method, it is hoped that this study can provide practical solutions to address construction project delays, particularly in areas facing logistical challenges such as *Sumenep*.

METHOD

This research is a qualitative study with a descriptive approach, aiming to provide an in-depth understanding of the problems of delays in the construction of pump houses in *Sumenep* Regency. The research was conducted at the SDSM 132 and SDSM 171 pump house project sites, located in *Sumenep* Regency, during the period from January to December 2024. The selection of these locations was based on the unique challenges they face, particularly those related to logistics and resources, which affect the project implementation schedule.

This study covers several crucial aspects, including project schedule analysis, identification of factors causing delays, and evaluation of their impact on project costs and duration. The data collected consists of both primary and secondary data. Primary data were obtained through in-depth interviews with field supervisors, project managers, and workers involved in the project. Meanwhile, secondary data include various project documents, such as work schedules, weekly reports, and cost reports.

The population studied comprises all parties involved in the project implementation, such as contractors, consultants, and project owners. The research sample was taken purposively, by selecting individuals who have a direct role in managing project time and resources. From this

process, 10 people were selected based on their relevance and expertise in the project field in question.

The research instruments used in this study consist of interview guidelines, observation sheets, and data analysis checklists. The interview guidelines were designed to explore information about the experiences, views, and strategies applied by respondents in dealing with project delays. Meanwhile, the observation sheets were used to record conditions in the field, including obstacles in logistics and resource distribution. Data analysis checklists were employed to ensure consistency in the data collection and processing.

This research strategy was developed to produce practical solutions to existing problems. The first step is to identify the main factors causing project delays through document analysis and interviews with stakeholders. The data obtained are then analyzed using triangulation methods to ensure the validity and reliability of the research results. The results of this analysis are subsequently used to formulate strategic recommendations that can be applied to reduce the risk of delays in the future.

With this approach, the research aims not only to identify problems but also to offer data-driven solutions tailored to local conditions. It is hoped that the methodology used will make a significant contribution to construction project management, particularly in remote areas such as *Sumenep* Regency.

RESULTS AND DISCUSSION

The pump house construction project in Sumenep Regency consists of two main units, namely SDSM 132 and SDSM 171. This is part of the government's initiative to improve the irrigation system in areas that often experience drought. In interviews with the project manager, it was revealed that the implementation of this project involved various parties, including contractors, consultants, and material suppliers. The remote location of the project added challenges in terms of logistics and resource distribution.

This study focuses on the main variable, cost. Project delays are measured based on a pre-established schedule using the CPM method. The identified delay factors include (1) material supply delays and (2) labor shortages. This analysis is supported by data from weekly project reports, which show deviations between the planned schedule and actual implementation.

The analysis results reveal that material supply delays contributed to an average idle time of 14 days in both project units. In addition, labor shortages also had a negative impact on project duration, causing work on the critical path to be delayed by up to 10 days.

The cost analysis of delays in pump house work using *the Critical Path Method* (CPM) aims to identify the financial impact of each delay in the project. With CPM, it is possible to determine the critical path, which is the sequence of activities that determines the overall duration of the project. If there is a delay in one of the activities on the critical path, the overall duration of the project will also be affected. The additional costs resulting from these delays can include direct costs such as worker wages or indirect costs such as contract penalties or lost economic opportunities.

Table 1. Progress of SDSM 132 Pump House Work in Week 6

No	Description	Cumulative Weight	Cost (IDR)
1	Initial Plan	20.15	Rp 63,531,338
2	Actual	18.34	Rp 57,824,552
3	Deviation	1.81	Rp 5,706,785

Source: Researcher's Analysis, 2024

Table 2. Progress of SDSM 171 Pump House Work in Week 6

No	Description	Cumulative Weight	Cost (IDR)
1	Initial Plan	42	Rp 93,763,539
2	Implementation	36	Rp 78,626,824
3	Deviation	6.84	Rp 15,136,715

Source: Researcher's Analysis, 2024

The longest work duration is on the critical path. The addition of workers at the SDSM 132 pump house is calculated as follows:

Number of Workers on Pipe Procurement and Installation Work – Dia 8"

Workers = 15 people
Duration of work = 36 days
Desired duration of work = 24 days
Therefore, the additional workers are:
36 days × 15 people = 24 days × n

$n = \frac{36 \times 15}{24}$ = 22.5 people, rounded to 23 people

Additional Workers = 23 – 15 = 8 people

The additional cost is incurred to expedite the completion of the work, resulting in an increase in costs compared to the initial plan. The following table shows *the total cost slope* and the initial planned cost, indicating the increase in costs due to the addition of workers on the SDSM 132 pump house project.

Table 3. Summary of Total Costs at SDSM 13

NO	Work Description	Additional Labor Costs	*Cost slope* of work
II	**Deep Well Pump House**		
3	Coupling work	**(IDR)**	**(IDR)**
3.1	River Stone Pair 1 Piece: 4 Sets	Rp11,256,300	Rp1,250,700
3.2	Brick Stone Pair 1 Piece: 4 Pieces	IDR 7,504,200	Rp1,250,700
3.3	Construction Concrete	IDR 7,163,100	Rp1,023,300
III	**Channels and Supporting Structures**		
9	Masonry Work		
9.1	River Stone Pair 1 Pc: 4 Ps	Rp13,644,000	IDR 1,137,000
9.2	Brick Pair 1 Piece: 4 Sets	IDR 13,644,000	Rp1,137,000
9.3	Plaster 1 piece: 3 pieces	IDR 7,959,000	Rp 795,900

9.4	Acian	IDR 6,367,200	Rp 795,900
10	Drainage Work		
10.1	Procurement and Installation of Pipes – Dia 6"	Rp20,466,000	Rp1,705,500
10.2	Supply and Installation of Pipes – Dia 8"	Rp20,466,000	Rp1,705,500
10.5	Supply & Installation of Alfal Val. Ø8"	Rp19,101,600	Rp1,591,800
Total Slope Cost		**Rp127,571,400**	**Rp12,393,300**

Source: Researcher's Analysis, 2024

Table 4. Summary of Total Costs in SDSM 171

NO	**Description of Work**	**Additional Labor Costs**	***Slope* work *cost***
II	**Deep Well Pump House**		
3	Coupling work	**(IDR)**	**(IDR)**
3.1	River Stone Couple 1 Piece: 4 Sets	Rp12,279,600	Rp1,364,400
3.2	Brick Stone Pair 1 Piece: 4 Pieces	IDR 8,186,400	Rp1,364,400
3.3	Construction Concrete	Rp6,367,200	Rp909,600
III	**Channels and Supporting Structures**		
9	Couples' Work		
9.1	River Stone Pair 1 Pc: 4 Ps	Rp15,008,400	IDR 1,250,700
9.2	Stone Brick Pair 1 Piece: 4 Sets	IDR 15,008,400	$1,250.70
9.3	Plaster 1 piece: 3 pieces	IDR 10,233,000	Rp1,023,300
9.4	Acian	Rp 8,186,400	Rp1,023,300
10	Drainage Work		
10.2	Procurement and Installation of 8" Pipes	Rp17,737,200	Rp1,478,100
10.5	Procurement & Installation of Alfal Val. Ø8"	Rp17,737,200	Rp1,478,100
Total Slope Cost		**Rp110,743,800**	**Rp11,142,600**

Source: Researcher's Analysis, 2024

Delays in construction projects are a pressing issue, especially for projects in remote areas such as Sumenep Regency. The pump house project in Sumenep demonstrates how local factors such as logistical constraints and human resource limitations can be major obstacles to project success. Without appropriate solutions, these delays not only affect the project schedule but also result in significant cost increases. This study emphasizes that data-driven approaches, such as the CPM method, are essential for identifying root causes and developing effective mitigation measures.

This study offers strategic solutions to address delays, such as strengthening coordination with local suppliers to reduce reliance on distant supply chains. Additionally, increasing the number of workers on critical paths can help catch up on delays without overburdening existing staff. The use of additional heavy equipment is also recommended to expedite the completion of delayed activities.

If the recommended mitigation measures are implemented, the impact will be significant, including reduced idle time, improved schedule efficiency, and project cost control. For example, using local suppliers can shorten material delivery times by up to 30%, while increasing the workforce on critical paths can reduce project duration by up to 10 days. This solution also creates long-term positive impacts by enhancing local capacity to support similar projects.

This study complements previous research, such as that conducted by Dahlan et al. (2019), by focusing specifically on projects in remote areas. Although the CPM method has been widely used for time and cost optimization, this study adds a novel element by considering geographical and local logistical aspects, which are rarely discussed in previous literature. This more adaptive approach provides a unique contribution to construction project management in Indonesia.

CONCLUSION

This study aims to analyze the delays in the construction of pump houses in *Sumenep* Regency using the Critical Path Method (CPM). The main focus of this study is to identify the impact of delays on time and costs, as well as to find solutions that can be applied to anticipate these problems. The main results indicate that the two-week project delay was caused by material supply issues and labor shortages, which resulted in additional costs of Rp127,571,400 for SDSM 132 and Rp110,743,800 for SDSM 171. This study makes an important contribution to the construction management literature by emphasizing the need for integrated resource management to prevent cost increases due to delays. However, a limitation of this study is that it covers only two pump house units using a single approach, so generalization of the results should be done with caution. For future research, it is recommended that the project scope be expanded and additional methods, such as risk management scenario simulations, be applied to design more effective mitigation strategies. Overall, this study emphasizes the importance of a comprehensive and flexible planning approach as the key to improving the efficiency of similar projects in the future.

REFERENCES

Agung Hardianto. (2015). Analisa Pengendalian Manajemen Waktu Dan Biaya Proyek Pembangunan Hotel Dengan Network CPM Studi Kasus Batiqa Hotel Palembang. Institutional Repository, Universitas Muhammadiyah Malang, 3–17.

Dahlan, A., Nainggolan, T. H., & Ratnawinanda, L. A. (2019). Evaluasi Pengendalian Waktu Dan Biaya Menggunakan Metode Critical Path Method (Cpm) Dan Fast Track. In Student Journal GELAGAR (Vol. 1, Issue 1).

F.N. Wowor B.F. Sompie. Walangitan, G. Y. M. (2013). Aplikasi Microsoft Project Dalam Pengendalian Waktu Pelaksanaan Pekerjaan Proyek. Jurnal Sipil Statik , Vol.1 No.8, 543–548.

Fu'at, M. C., Ayu Septi Fauji, D., & Purnomo, H. (2022). Evaluasi Penjadwalan Waktu Dan Biaya Dengan Metode Cpm Dan Gantt Chart Pada Proyek Pembangunan Rumah Tipe 60/72 Griya Keraton Sambirejo Kediri. Jurnal Simposium Manajemen Dan Bisnis I, 100–108.

Gunawan, V. A., Sahay, A. S., & Sahay, N. S. (2014). Estimasi Biaya Dan Waktu Dalam Project Plan Pembuatan Website Dengan Pendekatan Information Techonology (It) Project

Management (Studi Kasus Pada Kecamatan Sebangau Kota Palangka Raya). Jurnal Teknologi Informasi, 11–18.

Iluk, T., Ridwan, A., & Winarto, S. (2020). Penerapan Metode CPM Dan PERT Pada Gedung Parkir 3 Lantai Grand Pannglima Polim Kediri. Jurmateks, Vol.3 N0.2(ISSN 2621-7686).

Liston Hari Aryono. (2014). Evaluasi Pengendalian Biaya Dan Waktu Menggunakan Metode Cpm Pada Proyek Jembatan Limpas Pengkol Kecamatan Karanggede Kabupaten Boyolali (Study Kasus Proyek Jembatan Limpas Pengkol Kecamatan Karanggede Kabupaten Boyolali). Instituional Repository, Universitas Muhammadiyah Surakarta. https://eprints.ums.ac.id/32260/

Mantovani, M. R., & Beatrix, M. (2023). Evaluasi Pengendalian Biaya Dengan Metode Critical Path Method (Cpm) Menggunakan Microsoft Project (Studi Kasus: Pekerjaan Tahap Vii Proyek Perkuatan Struktur Dermaga Berlian Tanjung Perak Surabaya). Jurnal Ilmiah Teknik Dan Manajemen Industri, 3(1), 2023–2721. https://doi.org/10.46306/tgc.v3i1

Mar'aini, A. R. Y. (2022). Penentuan Jalur Kritis untuk Manajemen Proyek (Studi Kasus Pembangunan Jalan Selensen- Kota Baru- Bagan Jaya). Jurnal Pustaka Manajemen, Vol.2 No. 2.

Muzaki Lubis. (2015). Cara Membaca Kurva-S. Blogger.Com. https://kebijakan-lkpp.blogspot.com/2018/10/cara-membaca-kurva-s.html

Nazilah P. Abas, Tampanatu P. F. Sompie, Aris Sampe, & Sherley Runtunuwu. (2022). Analisa Waktu Pelaksanaan dan Biaya Menggunakan Metode CPM dan Metode Crashing Pada Proyek Pembangunan Laboratorium Forensik Polda Sulut. Prosiding Seminar Nasional Produk Terapan Unggulan Vokasi, Vol.1 No.1.

Pringgodani, S. (2015). Faktor-Faktor Lapangan Yang Mempengaruhi Produktivits Pekerja Di Yogyakarta. Universitas Atmajaya Yogyakarta.

Project Manager. (2024). Critical Path Method (CPM) in Project Management. Https://Www.Projectmanager.Com/Guides/Critical-Path-Method.

R. Muchlisin. (2019). Pengertian, Manfaat, Metode dan Penyusunan Network Planning. https://www.kajianpustaka.com/2019/02

Sa'adah, N., Iqrammah, E., & Rijanto, T. (2021). Evaluasi Proyek Pembangunan Gedung Stroke Center (Paviliun Flamboyan) Menggunakan Metode Critical Path Method (CPM) Dan Crashing. Publikasi Riset Orientasi Teknik Sipil (Proteksi), Vol.3 No.2.

Sihombing S. Yosdani. (2023). Analisi Penerapan Manajemen Waktu Pada Proyek Konstruksi Menggunakan Jalur Kritis/CPM (Critical Path Method). Universitas Medan Area, Medan.

Team Asana. (2024). Metode Jalur Kritis Cara Menggunakan CPM untuk Manajemen Proyek. Https://Asana.Com/Id/Resources/.