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ANALYSIS OF DELAYS IN THE CONSTRUCTION PROJECT OF THE PUMPING HOUSE IN THE SUMENEP DISTRICT USING THE CRITICAL PATH METHOD

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ABSTRACT

Delays in construction projects pose significant challenges, particularly in remote areas like the Sumenep District. This research analyzed the pump house construction project delays using the Critical Path Method (CPM) to identify the primary factors causing delays, including material supply issues and labor shortages. A qualitative descriptive approach was employed, involving in-depth interviews with project stakeholders and analysis of project documents, including weekly reports and schedules. The findings indicated that the project experienced an average delay of two weeks, primarily due to delays in material supply from Surabaya and concurrent labor shortages caused by multiple simultaneous projects. To address these challenges, the study proposed solutions such as strengthening logistics coordination with local suppliers, increasing the workforce on critical tasks, and utilizing additional heavy equipment. The implications of this research highlight the importance of effective time and resource management in construction projects, particularly in remote locations. Applying the CPM method, this study identifies the root causes of delays and provides practical strategies to enhance project efficiency and reduce costs. This research contributes to the existing literature on construction management in Indonesia, emphasizing the need for adaptive approaches tailored to local conditions.

Keywords: *Project Delay; CPM Method; Critical Path; Time Management; Cost Management*

INTRODUCTION

Delays in the implementation of construction projects are a global issue that is often a significant obstacle in the construction industry. According to research by Irawan et al. (2020), construction projects worldwide face substantial challenges in maintaining completion schedules due to various factors, such as labor shortages, limited material supply, and coordination problems between multiple stakeholders. In developing countries, including Indonesia, this issue is further exacerbated by inadequate logistics and higher project complexity. Therefore, an effective method to identify and address delays is necessary to ensure project success on schedule and within budget.

Time management in activity planning is a technique designed to organize and maximize the effective use of time. It involves a systematic process of controlling the allocation of time within certain constraints, so that each task can be completed efficiently and on time. Time management is not just about managing a schedule, but also includes the ability to plan and organize daily activities in a way that allows making the most of time (Mar'aini & Akbar, 2022).

The time management process includes various necessary interconnected steps to ensure that each activity can be completed in a timely and efficiently. These steps include prioritization, developing a realistic schedule, and monitoring and evaluating the use of time during activity execution (Venkatramani, 2023). Prioritization is a crucial early stage, where individuals or teams need to determine which tasks should be prioritized based on their importance and urgency (Daffa & Sukanta, 2022). By effectively prioritizing activities, resources, and energy can be focused on the work that has the most significant impact, thus avoiding the risk of delays and overlapping tasks (Wiratmani, 2015). Tools such as the Eisenhower Matrix or ABC method are often used to categorize tasks based on urgency and importance, aiding in quick and informed decision-making (Carpenter, 2022).

Effective time management is not just about increasing productivity; it also serves as the foundation for overall well-being (Setiawan & Firmanto, 2018). Amidst life's demands and distractions, the ability to manage time well can be the difference between individuals who feel overwhelmed and those who live a life of calm and control. More than just getting work done on time, time management

allows one to prioritize wisely, focus energy on the essential things, and avoid the pitfalls of multitasking that often degrade the quality of results (Sihombing, 2023).

Good time management provides benefits not only in professional aspects but also in personal life. Structured time allows room for rest, interaction with loved ones, and activities that support emotional fulfillment and personal growth. Without effective time management, the risk of getting stuck in a pattern of overwork increases, causing prolonged stress and damaging the balance between professional and personal life. Project time management encompasses a series of processes designed to ensure that each stage of project work can be completed according to a predetermined schedule. The primary focus is to effectively control the allocation of time so that each activity runs on time, avoiding delays and ensuring all resources are optimally utilized (Mantovani & Beatrix, 2023).

In its application, time management includes planning, scheduling, monitoring, and adjusting time on an ongoing basis, so that the risk of delays can be minimized and the target time for project achievement can be met efficiently. This process involves identifying activities that must be completed, estimating the duration of each activity, determining the order and dependency between tasks, and creating a clear schedule. In addition, regular monitoring is essential to detect deviations from the original plan and take corrective action in case of obstacles or changes in the situation. Thus, project time management not only ensures the project is completed on time but also supports smooth coordination between teams, fulfillment of quality standards, and achievement of overall project goals (Gunawan et al., 2014).

One of the main factors affecting delays is the lack of efficiency in managing time and resources. For example, the pump house construction project in Sumenep District, which is the focus of this research, experienced significant delays due to two main factors: delays in material supply from Surabaya and labor shortages (Dahlan et al., 2019). These two factors influenced each other, creating bottlenecks in the project schedule that led to additional time and costs. This phenomenon not only reflects technical challenges but also highlights the need for better project management (Pringgodani, 2015).

The impact of these factors is significant. In the context of the pump house's construction in Sumenep, material supply delays led to idle time for labor and heavy equipment, so work could not proceed as planned. In addition, labor shortages that occurred because similar projects were carried out simultaneously in various locations also made it challenging to allocate human resources (Gunawan et al., 2014). The combination of these two factors resulted in an increase in project costs of Rp127,571,400 for the SDSM 132 pump house unit and Rp110,743,800 for the SDSM 171 pump house unit (Sompie, 2022). The increased cost adds to the financial burden on the contractor and can reduce project profitability.

This research adopts the Critical Path Method (CPM) to analyze the delay. CPM is a tool designed to identify the critical path in construction projects, which is the set of activities that determine the overall duration of the project (Muttaqin & Hardaningrum, 2020). Using this method, project managers can identify activities that have the most significant impact on the project schedule, thus enabling more efficient management of resources. For example, the CPM method has been used in various previous studies, such as in the bridge projects Irawan (2020) Moreover, the construction of parking buildings (Iluk et al., 2020) aims to optimize schedules and reduce costs.

Research on "Project Scheduling Using the CPM Method (Critical Path Method)" emphasizes the importance of reviewing previous studies as a reference (Putra & Gandhi, 2019). Time control or scheduling is a handy tool for completing a project. In small-scale projects with few activities, the stages and time of implementation may be estimated without the need for formal project scheduling. However, for large-scale projects, scheduling or time control becomes very important to detail the estimated duration of each activity stage. This allows project implementation to run effectively and efficiently, and can reduce the risk of delays (Nida, 2019).

Project time control often involves network planning. This method helps manage project time by displaying a logical sequence of activities and their relationships. With a network, project managers can identify activities that must be carried out sequentially, activities that can be carried out simultaneously or interrelated, and determine the project's total duration based on a predetermined schedule of activities. This allows for more structured project management and minimizes the risk of delays (Anfaal Al Ghifari & Djuanda, 2023).

The novelty of this research lies in its simultaneous analysis of time and cost for pump house projects in the Sumenep area, addressing a gap in the application of the CPM method in medium-scale

projects in remote regions. While the CPM method is commonly used for large projects, studies focusing on its implementation in contexts like Sumenep are scarce. This research proposes tailored solutions to tackle unique geographical and logistical challenges, such as enhancing logistics coordination and utilizing local material suppliers. The urgency of this study is underscored by the need to improve project management efficiency in Indonesia's infrastructure sector, as the pump house project is crucial for irrigation and serves as a model for future initiatives. The research aims to analyze delays using the CPM method, assess their cost implications, and propose preventive solutions. Its benefits extend to students, contractors, and institutions by providing insights into project delay analysis, enhancing management efficiency, and offering empirical data for developing time and cost management guidelines, making it relevant both academically and practically (Hardianto, 2015).

METHOD

This research was a qualitative study with a descriptive approach, which aimed to provide an in-depth description of the problem of delays in pump house construction projects in the Sumenep District. The study was conducted at the construction sites of SDSM 132 and SDSM 171 pump houses, located in the Sumenep District, during the period from January to December 2024. These sites were selected because they faced unique challenges in terms of logistics and resources that affected the project schedule. The analysis included the project schedule, identifying factors causing delays, and evaluating their impact on project cost and duration. The data used in this study included primary and secondary data. Primary data was obtained through in-depth interviews with field supervisors, project managers, and laborers involved in the project. Secondary data included project documents, such as work schedules, weekly reports, and project cost reports. The population in this study included all parties involved in project implementation, such as contractors, consultants, and project owners. The research sample was purposively selected, consisting of those who had a direct role in the management of project time and resources, totaling 10 individuals selected based on their relevance and expertise in the project.

The research instruments included interview guidelines, observation sheets, and data analysis checklists. The interview guide was designed to elicit information about the respondents' experiences, views, and strategies for dealing with project delays. Observation sheets were used to record conditions in the field, including logistical barriers and resource distribution. The data analysis checklist was used to ensure data collection and processing consistency. This research strategy was designed to produce applicable solutions to the problem. The first step involved identifying the main factors causing project delays through document analysis and interviews with stakeholders. Next, the data obtained was analyzed using the triangulation method to ensure the validity and reliability of the research results. The results of this analysis were then used to develop strategic recommendations that could be implemented to reduce the risk of delays in the future. With this approach, the research focused on problem identification and provided data-driven solutions relevant to local conditions. The methodology used was expected to significantly contribute to construction project management, particularly in remote areas such as the Sumenep District.

RESULTS AND DISCUSSION

The pump house construction project in the Sumenep district consists of two central units, SDSM 132 and SDSM 171. It is part of a government initiative to improve irrigation systems in areas that often experience drought. Based on interviews with the project manager, the implementation of this project involved various parties, including contractors, consultants, and material suppliers. The project's remote location added logistics and resource distribution challenges.

Job time analysis using the Critical Path Method (CPM) is a practical approach in project management. It is beneficial for identifying critical activities that affect the project's total duration. With CPM, it is possible to identify activities that require extra attention or need to be prioritized, allocate resources more efficiently, and plan anticipatory actions in case of delays.

This research focuses on the primary variable, time. Project delays were measured based on a pre-compiled schedule using the CPM method. Delay factors identified include (1) material supply delays and (2) labor shortages. The analysis was supported by data from the project's weekly reports, which showed deviations between the planned and realized schedules.

The research data included 24 weekly reports from both project units, interviews with 10 key respondents, and supporting documents such as project schedules and cost reports. This data was

analyzed using Microsoft Project software to visualize the critical path and the impact of delays on project duration.

The analysis showed that delays in material supply caused an average idle time of 14 days in both project units. Labor shortages also impacted project duration, with work on the critical path experiencing delays of up to 10 days.

To overcome the delays, this study recommends several strategic measures, including (1) strengthening logistics coordination with local suppliers, (2) increasing the number of workers on the critical path, and (3) using additional heavy equipment to speed up the work. The following table shows the critical path results of the CPM analysis:

Table 1. Critical Path of SDSM 132 and SDSM 171 Projects

NO	JOB DESCRIPTION	Number of Workers	Duration of Work
II	**DEEP WELL PUMP HOUSE**		
3	PARTNER WORK		48
3.1	Stone masonry one pc: 4 Ps	11	24
3.2	1 Pc Brick Masonry: 4 Ps	11	21
3.3	Concrete Construction	9	25
III	**CHANNELS AND INFRASTRUCTURE**		
9	PARTNER WORK		32
9.1	Stone masonry one pc: 4 Ps	10	26
9.2	1 Pc Brick Masonry: 4 Ps	10	26
9.3	Plastering 1 Pc: 3 Ps	7	18
9.4	Acian	7	16
10	DUCT WORK		48
10.1	Procurement and Installation of 6" Pipe-Dia	15	36
10.2	Procurement and Installation of 8" Pipe-Dia	15	36
10.5	Procurement & Installation of Alfal Val. Ø8"	14	35

Source: Processed by Researcher, 2024

The following table 2 shows the number of workers on work items that are on the critical path in the SDSM 171 pump house.

Table 2. Duration and Number of Workers at SDSM 171

NO	JOB DESCRIPTION	Number of Workers	Duration of Work
II	**DEEP WELL PUMP HOUSE**		
3	PARTNER WORK		48
3.1	Stone masonry one pc: 4 Ps	12	24
3.2	1 Pc Brick Masonry: 4 Ps	12	21
3.3	Concrete Construction	8	25
III	**CHANNELS AND INFRASTRUCTURE**		
9	PARTNER WORK		32
9.1	Stone masonry one pc: 4 Ps	11	26
9.2	1 Pc Brick Masonry: 4 Ps	11	26
9.3	Plastering 1 Pc: 3 Ps	9	18
9.4	Acian	9	16
10	DUCT WORK		48
10.1	Procurement and Installation of 6" Pipe-Dia	13	36
10.5	Procurement & Installation of Alfal Val. Ø8"	13	35

Source: Processed by Researcher, 2024

Due to the delay in this work, each task must be accelerated. Work items on the critical path are reviewed here.

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

Number of Workers in the Procurement and Installation of 8" Pipe-Dia Work

Workers = 15 people

Duration of work = 36 days
Duration of work to be achieved = 24 days
Therefore, the addition of workers is :
36 days x 15 people = 24 days x n
n = $\frac{36\ x\ 15}{24}$ = 22.5 people rounded up to 23 people
Additional Workers = 23 - 15 = 8 people

Based on the analysis with the CPM method in the SDSM 132 and SDSM 171 pump house project, the project work was delayed for 2 weeks due to material delays. The results of this study are in line with previous findings showing the importance of time and resource management in construction projects (Dahlan et al., 2019). However, this study adds a new perspective on the challenges in remote areas, such as Sumenep, which require a more adaptive approach. With an in-depth analysis using the CPM method, this study successfully identified the leading causes of delays and their impact on costs. The proposed alternative solutions are expected to be applied to similar projects to improve the efficiency and effectiveness of project management (Oktatiyana et al., 2024).

Delays in construction projects are a pressing issue, especially for projects in remote areas such as the Sumenep district. The pump house project in Sumenep demonstrates how local factors such as limited logistics and human resources can impede project success. These delays affect the project schedule without appropriate solutions and result in significant cost increases. This research confirms that a data-driven approach, such as the CPM method, is indispensable to identifying the root of the problem and devising effective mitigation measures.

The two leading causes of delay identified in this study were (1) delays in material supply from Surabaya and (2) labor shortages caused by simultaneous project execution at multiple sites. The logistics problem became particularly evident when the project relied on distant suppliers, while the labor shortage was exacerbated by the uneven distribution of human resources. The combined impact of these two factors resulted in an average idle time of 14 days, which had a direct impact on the project schedule and cost (Sholeh, 2024).

This research offers strategic solutions to address delays, such as strengthening coordination with local suppliers to reduce reliance on long-distance supply chains. In addition, increasing the number of workers on the critical path can help catch up with delays without increasing excessive work pressure on the existing workforce. Additional heavy equipment is also recommended to accelerate the completion of delayed activities.

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

This research complements previous studies, such as the one conducted by Dahlan et al. (2019), by focusing on projects in remote areas. Although the CPM method has been widely used for time and cost optimization, this study adds an element of novelty by considering local geographical and logistical aspects, which are rarely discussed in previous literature. This more adaptive approach makes a unique contribution to construction project management in Indonesia (Saksono et al., 2024).

CONCLUSION

This study aims to analyze the delay of the pump house construction project in Sumenep District using the Critical Path Method (CPM), focusing on its effect on time and solutions that can be applied to anticipate delays. The main results show that the project delay of two weeks was caused by material supply issues and labor shortages. This study contributes to the construction management literature by emphasizing the importance of integrated resource management to prevent cost escalation due to delays. However, the limitation of the study lies in the scope, which only includes two pump house units with a single method, so generalization of the results needs to be done with caution. For future research, expanding the project scope and using additional methods, such as simulating risk management scenarios, is recommended to develop more effective mitigation strategies. This study emphasizes that a comprehensive and flexible planning approach is key to improving the efficiency of similar projects in the future.

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