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THE ROLE OF SUPERVISION CONSULTANTS IN TIME PERFORMANCE OF COASTAL PROTECTION CONSTRUCTION PROJECTS IN JAKARTA

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Abstract

Coastal protection construction projects in Jakarta have a high level of complexity due to the influence of hydrodynamic conditions, soft soil, logistical limitations, and social dynamics of coastal communities. These conditions require the role of an effective supervisory consultant to ensure the achievement of project time performance. This study aims to analyze the role of supervisory consultants on time performance in coastal protection construction projects in Jakarta and formulate priorities for delay mitigation actions. The research method uses a quantitative and qualitative descriptive approach with a case study on the Coastal Protection Construction Project in Jakarta Phase 4 Package 1. Primary data were obtained through field observations, interviews, and questionnaires with related parties, while secondary data came from contract documents, progress reports, and project implementation schedules. Data analysis was carried out using the Schedule Performance Variance (SPV) method to measure time performance and the Analytical Hierarchy Process (AHP) to determine the priority of mitigation actions. The results of the study indicate that project delays are influenced by technical, logistical, administrative, and socio-environmental factors. The supervisory consultant plays a significant role in time control through technical, managerial, and administrative supervision. The AHP results indicate that accelerating material delivery and improving piling methods on soft soil are the main priorities in improving project time performance. This study confirms that optimizing the role of supervisory consultants can increase the effectiveness of time control in coastal protection construction projects in coastal areas.

Keywords: Supervisory Consultant, Time Performance, Coastal Protection Project, AHP, SPV.

INTRODUCTION

Jakarta's coastal areas face serious problems such as coastal abrasion, tidal flooding, and land subsidence, which directly impact infrastructure and the socio-economic activities of coastal communities. A report by the Geospatial Information Agency (BIG) indicates that the rate of land subsidence in several areas of North Jakarta has reached more than 10 cm per year, exacerbated by global sea level rise due to climate change (BIG, 2022). This situation increases the vulnerability of coastal areas to environmental damage and infrastructure failure, making the development of coastal protection projects a strategic necessity in coastal risk mitigation efforts (Dean & Dalrymple, 2004; Komar, 1998). Coastal protection construction projects have complex technical characteristics due to the influence of ocean hydrodynamics, soft soil conditions, tides, and extreme weather. This complexity often leads to project delays if not managed effectively. Time performance is one of the main indicators of construction project success, alongside cost and quality, as explained in the triple constraint concept of project management (Kerzner, 2018). Various studies have shown that coastal infrastructure projects have a higher risk of delays than land-based construction projects due to uncertain environmental and logistical conditions (Ogunlana & Promkuntong, 1996; Boy, et al, 2021). In this context, the supervision consultant plays a crucial role in controlling project implementation to ensure compliance with contract documents, technical specifications, and the planned schedule. The supervision consultant is responsible for technical, managerial, and administrative oversight, including controlling project implementation time (Ervianto, 2020). Previous research has shown that the effectiveness of the supervision consultant's role significantly influences construction project time performance, particularly through the accuracy of decision-making, the quality of coordination, and the intensity of field supervision (Sutrisno, 2016; Tomigolung et al. 2013; Dwiretnani et al., 2024). However, most previous research has focused on building, road, and irrigation projects, while empirical studies specifically examining the role of the supervision consultant in coastal protection construction projects in Jakarta are still limited. However, coastal protection projects carry more complex technical and social risks, such as conflicts with fishing activities, limited site access, and the need for design adjustments due to field conditions (Pilarczyk, 2000; Fahlepi, 2024). Therefore, this study is important to analyze the role of supervisory consultants in the time performance of coastal protection construction projects in Jakarta and to formulate effective and adaptive supervision strategies to coastal conditions.

LITERATURE REVIEW

Construction Projects

A construction project is defined as a series of activities carried out once and for a specific or relatively limited period. A construction project is a process that transforms various project resources, including manpower, materials, equipment (machines), methods, and money, into a physical structure. The characteristics of construction projects can be viewed from three main dimensions: unique nature, the need for various resources, and a structured organization (Ervianto, 2005). Project management is defined as all planning, implementation, control, and coordination of a project from its inception (idea) to its completion, ensuring timely, cost-effective, and quality project implementation. A supervisory consultant is a party appointed by the project owner to carry out supervision work. Supervisory consultants can be either a business entity or an individual. Human resources are needed who are experts in their respective fields, such as civil engineering, architecture, mechanical, electrical, and others, so that a building can be constructed properly, quickly, and efficiently. Performance is a condition that must be known and confirmed to certain parties to determine the level of achievement of an agency's results in relation to the vision of an organization or company and to understand the positive and negative impacts of an operational policy (Soeharto, 2001).

Construction Methods in Coastal Protection Implementation

The coastal protection construction method is a series of systematic stages designed to realize coastal protection structures in accordance with the principles of coastal engineering and construction project management. This method encompasses technical planning, site preparation, physical work implementation, quality control, and initial post-construction maintenance. The selection of construction methods must take into account site conditions (geotechnical and hydrodynamic), the type of coastal protection structure being constructed, material availability, and weather and tidal factors.

1. Preparatory Work
2. Excavation and Foundation Preparation
3. Structural Work
4. Supplementary Work
5. Quality Control Work
6. Initial Maintenance Work

The success of coastal protection project implementation is greatly influenced by various interacting factors, including technical, managerial, and environmental aspects. Each factor has a different impact on project performance, particularly on implementation timeliness, work quality, and cost efficiency. In the context of coastal protection construction projects in Jakarta, the factors influencing project performance can be categorized into five main groups: (1) technical factors, (2) managerial factors, (3) environmental factors, (4) resource factors, and (5) external policy factors.

METHOD

Case Study

Figure 1. Study Case

The location of the Coastal Protection Construction Supervision Work in Jakarta, Phase 4, Package 1, is at the Kalibaru Exit, Cilincing District, North Jakarta. Cilincing District is the district with the largest number of urban villages in North Jakarta.

Data Collection Methods

Data collection was conducted through three main methods. First, a documentation study was used to collect various project documents, such as planned and actual S-Curves, work progress reports (MC-0 to MC-100), deviation reports, and a list of instructions and warnings issued during the supervision period. These documents provide a factual overview of time deviations and the control measures implemented by the consultant in accordance with their mandate to control project quality and time. Second, in-depth interviews were conducted to gain an understanding of time control strategies, obstacles encountered in the field, and the effectiveness of communication between the consultant, contractor, and the PPK. Third, field observations were used to directly assess the work implementation conditions and the suitability of the contractor's work methods to the established schedule. These observations strengthened empirical evidence of the consultant's role in ensuring the smooth running of construction activities.

Data Processing Methods

The data obtained was then processed through several systematic stages. The first stage was data reduction, which is the process of filtering information so that the research focuses on aspects related to time control, the role of supervision, and the causes of work delays. Next, the data was classified into specific categories, such as schedule progress, technical factors affecting time, consultant corrective actions, and contractor compliance with the implementation plan. This grouping made it easier for researchers to identify delay patterns and relate them to the supervisory actions taken. The next stage was the process of coding themes for qualitative data from interviews, as well as tabulating quantitative data such as weekly progress figures and deviations from the planned S-Curve.

Analysis Method

This research's analysis method uses both quantitative and qualitative approaches. Quantitative analysis was conducted using the Earned Value Management (EVM) method using Schedule Variance (SV) and Schedule Performance Index (SPI) indicators to assess project time performance based on a comparison between the planned and actual schedules. Furthermore, the Analytical Hierarchy Process (AHP) method was used to prioritize the supervisory consultant's role and determine delay mitigation actions based on technical, managerial, and administrative oversight criteria. Assessments were obtained from paired comparison questionnaires and tested for consistency using the Consistency Ratio (CR).

Qualitative analysis was conducted through a review of interviews, field observations, and supervisory documents to strengthen the interpretation of the quantitative results. The integration of EVM and AHP results was used to comprehensively assess the supervisory consultant's contribution to project time performance.

RESULTS AND DISCUSSION

During the project implementation period from November 12, 2020, to December 6, 2021, various issues were identified that impacted the completion of the Coastal Protection Construction Project in Jakarta. These issues were classified into three main groups: technical field issues, logistical and material issues, and social and coordination issues. This indicates that project delays were influenced not only by technical construction aspects, but also by logistical, administrative, social conditions, and land preparation factors. Technical issues included inconsistencies in equipment and material specifications, soft soil conditions at several STAs that affected spun pile driving, spun pile deformation exceeding tolerance limits, and inconsistencies in concrete quality and structural connections. Logistical issues were the dominant cause of delays, primarily due to late delivery of spun piles and other supporting materials, which hampered piling and structural work. Furthermore, social issues such as land disputes, the presence of residential houses along the piling route, and fishing activities that disrupted the mobilization of equipment and materials also contributed to the delays.

Role of the supervisory consultant in technical aspects, managerial aspects and administrative aspects

Discussion of the technical aspects shows that the role of the supervising consultant is crucial because it directly relates to the accuracy of work execution and construction quality. Based on field data, the consultant consistently inspected the work for compliance with technical specifications, particularly for piling, casting, and utilities. However, several non-conformities were still identified, such as excess concrete volume, CT-joint imperfections, spun pile deformation, and materials that did not meet specifications. The consultant responded to these conditions by providing corrective technical instructions, rejecting substandard materials, and adjusting implementation methods to accommodate soft soil conditions and excessive lateral forces. Furthermore, frequent field inspections facilitated early detection of technical deviations, although field conditions such as soft soil, tidal fluctuations, and fishing activity still significantly impacted project time performance.

From a managerial perspective, the supervising consultant played a role in schedule development and evaluation, progress monitoring, and inter-stakeholder coordination. The consultant regularly evaluated the baseline schedule and actual progress through weekly coordination meetings. Any deviations were identified and discussed to determine expedited action. However, delays in material logistics, design changes, and field conditions inevitably led to some schedule deviations. The consultant also identified potential delays and implemented corrective actions, although their effectiveness depended heavily on the contractor's response and the support of relevant stakeholders, particularly in resolving social and land issues. The administrative aspect served as a legal and orderly underpinning for project implementation. The supervising consultant verified and approved daily, weekly, and monthly reports, as well as reviewed contract documents, shop drawings, and the DED. Several design revisions were required due to discrepancies between the planning documents and field conditions, particularly for retention ponds and sand bases. The consultant played a role in facilitating the approval process for design changes and ensuring that project documentation reflected actual field conditions. However, the multi-tiered administrative process resulted in some decisions taking longer to complete, impacting project timelines.

Identification of Technical Problems

Technical problems were the primary cause of time deviations in the Coastal Protection Project in Jakarta from November 12, 2020, to December 6, 2021. These problems primarily occurred during spun pile driving, casting, and backfilling. Key findings included non-conformance of materials and structural elements to technical specifications, such as excess concrete volume, concrete age less than 14 days, and imperfect CT-joint connections. Furthermore, spun pile deformation due to soft soil and excessive lateral forces from large-capacity dump trucks led to repair and replacement work, which directly impacted delays. Inappropriate implementation methods for field conditions, particularly in soft soil areas, also required adjustments, which extended the project duration.

Identification of Material and Logistics Problems

Material and logistics problems were the dominant factors hampering the achievement of the project's timeframe. Delays in the delivery of spun piles from the factory to the piling site caused major work interruptions. Furthermore, delays and inconsistencies in the delivery of gravel, iron, and U-ditch materials, damage to heavy equipment such as sling cranes and inner boreholes, and inadequate site access readiness also disrupted the smooth progress of the project and increased schedule deviations.

Identification of Administrative Issues

Administrative issues relate to inconsistencies in planning documents and formal coordination processes. Differences in benchmark coordinates between the 2016 and 2020 DEDs led to uncertainty in project elevations, necessitating re-verification. Furthermore, inconsistencies in the sand base and retention pond designs with field conditions required design revisions, which required formal administrative processes and a relatively lengthy timeframe. Delays in the submission of technical documents by the contractor also affected the speed of decision-making.

Identification of Social and Environmental Issues

Social and environmental issues significantly contributed to project delays, particularly related to land disputes and fishing activities. The presence of residential houses along the piling route and land conflicts in RW 06 required time-consuming mediation and land acquisition processes. Fishermen's activities, such as boats moored in the piling area and the use of the project site for economic activities, hamper the mobilization of equipment and materials. Furthermore, various community requests regarding fishing access and supporting facilities require cross-agency coordination, impacting the project's implementation schedule. Based on the identification of the problems above, an FGD was conducted with experts regarding the preparation of solutions and mitigation, which was then used for decision making using AHP.

The Analytical Hierarchy Process (AHP) was used in this study to determine the most effective mitigation actions to address project delays. The AHP in this study is structured into three levels:

1. Level 1 (Goal): Determining the priority of mitigation actions to improve project time performance.
2. Level 2 (Criteria):
   a. K1 = Technical Supervision
   b. K2 = Managerial Supervision
   c. K3 = Administrative Supervision
3. Level 3 (Alternative Solutions):
   a. A1 = Accelerated Material Delivery
   b. A2 = Improved Piling Methods/Soft Soil Handling
   c. A3 = Handling Spun Pile Deformation
   d. A4 = Coordination Between Residents and Fishermen
   e. A5 = Alignment of the Destination Design (DED) and Building Construction Plan (BM)

Table 1. Ranking Criteria

Alternative	Description	Weight	Rank
A3	Mitigation of Spun Pile Deformation	0.331	1
A1	Acceleration of Material Delivery	0.260	2
A2	Treatment of Soft Soil / Method Adjustment	0.176	3
A5	Alignment of DED and Benchmark (BM)	0.129	4
A4	Coordination with Local Communities and Fishermen	0.103	5

The AHP analysis results indicate that technical factors play the most dominant role in influencing project time performance, as reflected in the highest weighting of the Technical Supervision criterion (0.633). This is consistent with field conditions that face recurring technical issues, such as spun pile deformation, dimensional mismatches, and soft soil conditions at several STAs. Theoretically, this aligns with Ervianto's (2020) statement that technical aspects are the most critical source of risk in projects characterized by deep foundation work and marine construction. In terms of alternative solutions, Handling Spun Pile Deformation (A3) ranks first in mitigation priorities. Its high weighting (0.331) indicates that structural deformation not only impacts quality and safety but also triggers a series of rework, additional inspections, method evaluations, and equipment adjustments, thus hindering subsequent work. Accelerating material delivery (A1) also received a significant weighting (0.260), illustrating that logistics is a major constraint on coastal construction projects in Jakarta, primarily due to the reliance on sea access, barges, and accurate manufacturing schedules. Furthermore, soft soil management (A2) emerged as the third priority (0.176). This can be explained by the geotechnical conditions of the piling route, which require special methods to ensure piles reach the required depth and bearing capacity. In this project, soft soil causes high resistance to standard driving methods, necessitating inner boring and other technical adaptations. Meanwhile, DED and benchmark alignment (A5) and community-fisherman coordination (A4) received lower weights than other alternatives. While still important, administrative and socio-environmental aspects are considered to have an indirect impact on the main construction activities. Nevertheless, A4 and A5 remain a priority because they can cause significant obstacles if not addressed, such as delays in equipment mobilization or design revisions requiring formal approval. Overall, the AHP confirms that mitigation efforts need to focus on the technical and logistical domains. Deformation management strategies, accelerated logistics, and adaptation of piling methods will have the greatest impact on improving project time performance. These results will be reinforced by the SPV analysis in the next subsection to see how these mitigations contribute to the numerical improvement of project progress.

Schedule Performance Variance

Schedule Performance Variance (SPV) analysis is used to quantitatively assess project time performance by comparing Planned Value (PV) and Earned Value (EV). This method provides a numerical indication of whether the project is on schedule or experiencing delays. SPV data is compiled based on the implementation period from November 12, 2020, to December 6, 2021, representing 20 observation weeks. In the early weeks, delays were caused by mobilization; in the middle weeks, delays increased due to material issues and deformation; while in the final weeks, time performance showed improvement after the implementation of mitigation measures.

Tabel 2. PV-EV Mingguan

Minggu Ke-	PV (%)	EV (%)	SV = EV–PV	SPI = EV/PV
1	3	2	-1	0.67
2	6	4	-2	0.67
3	10	7	-3	0.70
4	15	11	-4	0.73
5	21	15	-6	0.71
6	27	19	-8	0.70
7	33	23	-10	0.70
8	39	27	-12	0.69
9	45	31	-14	0.69
10	51	36	-15	0.71
11	57	42	-15	0.74
12	63	48	-15	0.76
13	69	55	-14	0.80
14	74	61	-13	0.82
15	79	67	-12	0.85
16	84	73	-11	0.87
17	88	78	-10	0.89
18	92	84	-8	0.91
19	96	90	-6	0.94
20	100	96	-4	0.96

Schedule Performance Variance (SPV) analysis showed that throughout the 20 weeks of implementation, the project generally experienced delays, characterized by negative SV values throughout the entire period. From weeks 1 to 10, delays reached a critical phase (SV −1% to −15%) due to logistical constraints, material mismatches, spun pile deformation, and differences in the DED, which delayed the start of work. A low Schedule Performance Index (SPI) value (SPI < 0.70) indicates very low time efficiency and indicates that the delays are dependency-driven and cannot be addressed simply by adding additional manpower. Improvements began to emerge from weeks 11 to 14, characterized by stabilization of SV (−15% to −13%) and an increase in SPI (0.74–0.82) as mitigation efforts became effective. In weeks 15 to 20, time performance improved significantly, with SV reaching −4% and SPI approaching 1 (0.96), indicating the project was almost back on track. These results demonstrate that the mitigation prioritized through the AHP method is positively correlated with the improvement of project time performance, thus supporting the integration of the AHP–SPV approach in project performance evaluation.

Overall, the integration of AHP–SPV demonstrates that priority-based mitigation measures have been proven to accelerate project recovery progress. This finding provides a managerial basis that project monitoring needs to incorporate both approaches simultaneously to maximize the effectiveness of time control. Technical implications relate to how the results of this study can be applied to improve quality control and construction methods in similar projects, particularly in piling, soft soil handling, and coastal structures.

1. The high priority weight for spun pile deformation handling measures (A3) emphasizes the need for more intensive technical supervision during the deep foundation stage. This requires the supervising consultant to conduct a more in-depth inspection of the alignment, verticality, and bearing capacity of the pile before commencing further work. The implementation of monitoring technology such as an inclinometer or additional load tests can be recommended for future projects to prevent recurrent deformation.
2. The role of adaptive piling methods (A2) becomes important in coastal areas with soft soil characteristics. This implies that every coastal project must have an alternative method that has been approved in the initial documents such as the Implementation Method and Project Quality Plan. The consultant must ensure that the method not only meets technical specifications but is also compatible with actual soil conditions that may differ from the initial investigation results.
3. Material quality control must be carried out more strictly during the fabrication stage, especially for precast components such as spun piles, U-ditches, and other precast concrete. The consultant needs to conduct regular fabrication audits to ensure that the production process does not have deviations that could impact quality, such as lack of mold cleanliness or inaccurate concrete composition.

This is supported by SNI 03-2834-2000 which emphasizes the importance of consistent concrete quality from the batching process. Managerial implications emphasize the importance of cross-party coordination, accurate reporting, and schedule control.

1. The analysis results indicate that accelerated material delivery (A1) must be a priority in project supply chain management. This implies that the contractor needs to have a more structured procurement system, including buffer stock, multiple suppliers, and the use of a digital-based delivery tracking system. The supervising consultant needs to monitor this through material procurement reports and verify proof of delivery.
2. Coordination between contractors, consultants, PPK, and external parties such as residents and fishermen must be more intensive. This project's experience shows that non-technical issues such as land conflicts or fishermen's activities can have a direct impact on time delays. Therefore, stakeholder management should be a formal part of the Project Management Plan.
3. The integration of AHP–SPV shows that evidence-based decision-making produces more effective results in time management. This implies that every project must have a complete weekly progress database so that evaluations can be carried out quantitatively, rather than simply based on opinions.

CONCLUSION

The supervision consultant plays a crucial multidimensional role in the implementation of coastal protection construction projects in Jakarta, encompassing technical, managerial, and administrative aspects. Technically, the consultant ensures compliance with specifications, methods, and field conditions, and addresses issues such as spun pile deformation and material incompatibilities. Managerially, the consultant acts as a time controller and mediator between stakeholders through weekly progress monitoring. Administratively, the consultant ensures alignment of design documents, technical approvals, and benchmark validation. Research shows that the active involvement of the supervision consultant directly impacts project time performance recovery and maintains work continuity until progress approaches the planned schedule. Improved project time performance can be achieved by optimizing the role of the supervision consultant by strengthening technical oversight of critical tasks, enhancing adaptive logistics management, and strengthening stakeholder management. Furthermore, aligning design documents from the outset and implementing data-driven decision-making using SPV and SPI indicators, and weekly progress trend evaluations are crucial factors. The integration of AHP and SPV analysis demonstrates that systematically prioritized mitigation strategies can significantly improve project time performance, making optimizing the role of the supervision consultant a determining factor in the success of similar projects in the future.

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