Evaluation of Project Resource Management Implementation on the Kutruk-Jambe Bridge Construction Project in tangerang District Based on PMBOK 6th Edition to improve Project Performance

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ABSTRACT: *This study aims to evaluate the implementation of Project Resource Management (PRM) processes on the Kutruk-Jambe Bridge construction project in Tangerang Regency based on the PMBOK 6th Edition framework. The research focuses on six main PRM processes: Plan Resource Management, Estimate Activity Resources, Acquire Resources, Develop Team, Manage Team, and Control Resources. Using a mixed-method approach involving questionnaires, expert validation, and statistical analysis from 35 project personnel, the study found gaps in consistency, implementation routines, and awareness of best practices. The results highlight the need to improve the integration of resource planning with project constraints, optimize acquisition and control of physical and human resources, and enhance team motivation and evaluation mechanisms. Recommendations include establishing standard operating procedures (SOP), regular training, and stronger alignment with PMBOK practices to increase project effectiveness and avoid delays and cost overruns.*

KEYWORDS - *Bridge Construction, Project Management, PMBOK, Resource Management, PRM Evaluation*

I. INTRODUCTION

Infrastructure development is a vital element in improving accessibility, mobility, and economic growth. The construction of bridges as part of transportation networks requires efficient and effective management of project resources. The Kutruk-Jambe Bridge project, located in Tangerang Regency, experienced significant performance issues including a delay of 40 days and a cost overrun of 10%. These performance deviations raise concerns regarding the implementation of Project Resource Management (PRM) processes.

The PMBOK (Project Management Body of Knowledge) 6th Edition provides a standardized guideline for managing resources in construction projects. This research investigates how well these guidelines were applied in the Kutruk-Jambe Bridge project and seeks to identify areas for improvement. The aim is to align resource management practices with established standards to enhance project outcomes.

Additionally, the relevance of PRM has increased in today's context where infrastructure projects face rising complexities, ranging from budget constraints, labor shortages, environmental issues, to tight timelines. Understanding how resources are managed, coordinated, and optimized can greatly affect project success or failure. Hence, this study also intends to serve as a practical evaluation for similar projects in other regions of Indonesia.

II. LITERATURE REVIEW

2.1 Project Resource Management (PRM) in PMBOK 6th Edition

According to PMBOK 6th Edition, Project Resource Management includes the processes to identify, acquire, and manage the resources needed for successful project completion. These processes include: (1) Plan Resource Management, (2) Estimate Activity Resources, (3) Acquire Resources, (4) Develop Team, (5) Manage Team,

and (6) Control Resources. Each process plays a unique role in ensuring that human and physical resources are available and effectively utilized.[1]

Plan Resource Management defines how to approach resource planning, management, and control throughout the project. Estimate Activity Resources determines the type and quantity of resources required. Acquire Resources involves obtaining the necessary personnel, equipment, and materials. Develop Team focuses on enhancing competencies and team interaction. Manage Team refers to tracking performance and resolving issues. Finally, Control Resources ensures that resources are used as planned.[1]

2.2 Common Challenges in Construction Resource Management

Literature indicates that poor resource planning, inadequate acquisition strategies, and weak team development contribute to cost and schedule overruns in infrastructure projects[2]. Other common issues include insufficient communication, lack of proper documentation, and failure to anticipate risks related to human and physical resources.Resource misalignment often leads to delays in critical paths and underutilized materials or workforce, increasing both direct and indirect costs.

Construction projects are also prone to fragmentation of responsibilities between stakeholders, causing miscommunication and overlapping tasks. The scarcity of skilled labor in certain regions poses further difficulty in resource allocation, especially when project deadlines are tight. Moreover, tools such as Gantt charts, resource histograms, and project management information systems (PMIS) are often underutilized, leading to insufficient resource forecasting.

2.3 Best Practices in Resource Management

Effective resource management involves detailed planning, realistic estimation, proper acquisition mechanisms, and continuous monitoring. Establishing clear roles and responsibilities using tools such as RACI matrices, applying Earned Value Management (EVM), and implementing regular team evaluations are proven

to contribute to better project control and efficiency. International practices recommend the use of agile resource planning, which emphasizes flexibility, team empowerment, and short feedback loops to rapidly adjust to changes.[1]

Lean construction principles also contribute to efficient resource management by minimizing waste and maximizing value. Integrating Building Information Modeling (BIM) allows for real-time simulation of resource usage and identification of potential clashes before construction begins. Collaborative planning and resource-sharing across projects also serve as strategic approaches in multi-project environments.

2.4 Research Gap

Most evaluations focus on cost or schedule management without isolating PRM processes. Few local studies investigate the contextual application of PMBOK guidelines in regional infrastructure projects, particularly in Tangerang. This study fills that gap by focusing solely on PRM within a real project scenario, with specific emphasis on process-based implementation.

Additionally, the intersection of cultural, organizational, and regulatory aspects within resource management remains underexplored in Indonesian infrastructure projects. This research adds a practical viewpoint by bridging global standards with local operational realities, offering contextual insights that are often overlooked in generalized PM studies.

III. METHODOLOGY
3.1 Research Design

This study employs a mixed-method approach that integrates both qualitative and quantitative techniques. The research began with a comprehensive review of the PMBOK 6th Edition to identify all relevant processes under Project Resource Management (PRM). Based on this review, a structured questionnaire was designed to capture implementation indicators aligned to the six PRM processes: Plan Resource Management, Estimate Activity Resources, Acquire Resources, Develop Team, Manage Team, and Control Resources.

The study was divided into two main phases. The first phase addressed Research Question 1, which focused on identifying and validating PRM activities based on PMBOK 6th Edition. This phase relied on secondary data from the PMBOK guide and relevant academic journals. Expert validation was conducted to assess whether the proposed activities aligned with field needs and PMBOK standards. Experts were asked to suggest improvements, removals, or additions to ensure contextual applicability.

Three construction practitioners with over five years of experience and familiarity with PMBOK were invited to review the instrument. All three agreed to participate in the validation process. Closed and open-ended questions were included. For the closed-ended items, a 5-point Likert scale was used with intervals calculated as follows:

Interval length = (Maximum score – Minimum score) / Number of categories = (5 – 1) / 5 = 0.8

1.00 – 1.80: Strongly Disagree

1.81 – 2.60: Disagree

2.61 – 3.40: Neutral

3.41 – 4.20: Agree

4.21 – 5.00: Strongly Agree

Open-ended feedback from experts noted that the PMBOK framework was largely sufficient but should be strengthened in behavioral and motivational aspects of human resource management. Experts also identified challenges in logistics coordination, personnel motivation, and organizational conflict. Critical PRM activities included cash flow alignment, equipment-worker compatibility, and sequencing of activities.

3.2 Respondents and Data Collection

In the first stage, expert-based data collection was conducted to refine the PRM activity list derived from the PMBOK 6th Edition. Experts assessed whether each activity was necessary, redundant, or missing. This process allowed the identification of non-essential activities and the inclusion of overlooked but critical tasks relevant to real-world construction projects. The feedback from experts shaped the final set of activities to be measured in the main questionnaire.

Respondents then rated each of the finalized 60 PRM-related activities using a 5-point Likert scale. This approach enabled the research to identify the extent to which each activity was carried out in practice. The surveys were administered during the closing phase of the project, ensuring that responses reflected the complete project cycle.

In addition to structured questionnaires, supplementary information was collected through informal interviews and documentation review, including resource usage logs, team schedules, and procurement records. These inputs were useful in contextualizing the survey data and in conducting cross-verification. Data triangulation helped improve the validity and reliability of conclusions.

3.3 Validity and Reliability Testing

The instrument's content validity was confirmed by the earlier expert review. Items were aligned with PMBOK outputs and indicators to enhance construct validity. Cronbach's Alpha was used to measure internal consistency, yielding a reliability coefficient above 0.85 across all constructs..

3.4 Data Analysis Techniques

Quantitative data were analyzed using descriptive statistics, including frequency distributions, mean scores, and standard deviations for each PRM process. Comparative analysis across roles and processes identified gaps and consistency levels. Visual aids such as bar charts and heat maps were employed to enhance data interpretation.

Thematic coding was used for qualitative responses, particularly expert feedback and open-ended survey comments. These qualitative insights provided a deeper understanding of contextual challenges and supplemented the numerical data. Combined, the analyses allowed for robust conclusions and practical recommendations.

IV.   RESULTS AND DISCUSSION

4.1 Implementation Level of PRM Activities

The analysis showed that only 38% of the total PRM activities were routinely implemented. 42% were known but inconsistently applied, and 20% were not implemented at all. Particularly weak implementation was noted in risk-based resource planning and follow-up assessments.

Table 4.1 Activity to Achieve Output PRM in PMBOK

Necessary activities to achieve the process output		Results
Plan resources management activity		
Resources management plan	Review the initial project documents (project charter) to understand the project's needs and the constraints of available resources.	strongly agree
	Examine the project scope of work to identify what needs to be completed and what resources are required.	strongly agree
	Analyze the project schedule and requirements to determine the quantity and type of resources needed.	strongly agree
	Seek expert input to determine how to acquire resources, the training requirements, and how to manage them.	agree
	Develop the project organizational structure and task allocation, for example by using diagrams such as RACI or WBS-OBS.	strongly agree

Necessary activities to achieve the process output		Results
	Conduct meetings with the project team to collaboratively develop strategies for planning and managing project resources.	strongly agree
Team Charter	Identify key stakeholders who influence the dynamics of the project team.	agree
	Engage all team members in discussion or kick-off meetings to establish team values, communication guidelines, and work ethics.	strongly agree
	Apply organizational theory to align the team's work structure with the organization's culture.	Netral
	Develop a written agreement regarding roles, communication, decision-making processes, and conflict resolution mechanisms into the team charter document.	Netral
	Conduct joint validation and approval of the team charter as a working guideline.	strongly agree
additional activities from experts	a. Consider procurement strategies (purchase or utilize existing resources)	
	b. Schedule and sequence tasks related to resource management	
	c. Apply risk analysis to resource availability	
Estimate Activity Resources		
Resource Requirements	Review the resource management plan and project scope to	Netral

Necessary activities to achieve the process output		Results
	determine the approach and extent of the required resources.	
	Analyze the list of project activities and their details to understand the resource needs for each activity.	strongly agree
	Use bottom-up estimating to calculate resource needs from individual activities to the total project requirements.	strongly agree
	Engage experts to estimate the type, quantity, and duration of resource usage for more accurate results.	not agree
	Utilize previous project data using analogous or parametric methods to expedite the estimation process if needed.	agree
	Conduct alternative analysis to determine the most efficient way to obtain resources—whether to purchase, lease, or produce internally.	Netral
	Prepare a detailed resource requirements document, including assumptions, constraints, and the confidence level of the estimate.	strongly agree
Basis of Estimates	Record all estimation methods used in determining resource requirements.	Netral
	Document supporting information for the estimates, including	Netral

Necessary activities to achieve the process output		Results
	historical data, assumptions made, project constraints, and risks that may affect the estimation results.	
	Prepare a basis of estimates report that includes justifications for the estimates made, and explains the level of accuracy and confidence of the estimates.	strongly agree
Resource Breakdown Structure (RBS)	Categorize project resources into main groups such as labor (human resources), materials, and equipment.	strongly agree
	Define specific details for each type of resource, such as required skills, job roles, experience, or technical qualifications.	agree
	Use project management software to develop a hierarchical resource structure to facilitate planning and control.	strongly agree
	Ensure the resource structure aligns with organizational standards or prior best practices.	Netral
additional activities from experts	a. Analyze scheduling conflicts between activities that require the same resources	
	b. Evaluate the capabilities and productivity of resources	
Acquire Resource		
Physical Resource Assignments	Determine and select the physical resources required by the project, as well as how to	Netral

Necessary activities to achieve the process output		Results
	acquire them.	
	Negotiate with functional managers (internal) or vendors/providers (external) to ensure availability and agreement on the provision of required resources.	Netral
	Document the allocation of physical resources such as materials, equipment, and work locations in a clear assignment format to serve as a reference for project execution and control.	strongly agree
Project Team Assignments	Prepare a list of potential project team members based on expertise, work experience, and availability that match the project's needs.	agree
	Negotiate with internal functional units or external parties to acquire personnel that fit the project requirements.	agree
	Define and assign roles and responsibilities for each team member, and document them in the team organizational structure and project schedule as an official implementation guide.	strongly agree
Resource Calendars	Identify the working schedule of resources.	Netral

Necessary activities to achieve the process output		Results
	Develop specific work calendars for each type of resource based on project activity requirements and availability durations.	strongly agree
	Officially document the resource calendars to be used as a reference in project scheduling and accurate monitoring of resource utilization.	strongly agree
Change Requests	Identify the impact of resource acquisition on the planned project schedule or budget.	Netral
	Submit change requests in case of deviations from the original plan or when corrective actions are needed for the project baseline (schedule, cost, or resources).	Netral
	Forward the change request for formal evaluation, approval, or rejection by the authorized stakeholders.	Netral
additional activities from experts	a. Identify risks prior to acquisition to anticipate potential obstacles.	
	b. Handle changes directly by the Project Manager, with limitations applied only to major risks.	
	c. Develop a resource contingency plan to ensure project continuity in case of obstacles.	
Develop Team		
Team Performance Assessments	Conduct regular team-building activities.	agree
	Provide training to team members.	agree

Necessary activities to achieve the process output		Results
	Assess team performance periodically.	strongly agree
	Use team and individual assessment tools.	strongly agree
	Document the assessment results and use them to develop follow-up action plans.	strongly agree
Change Requests	Identify the need for changes based on team performance evaluations.	strongly agree
	Prepare change requests for the management plan or project baseline if the evaluation results impact the project schedule, cost, or scope.	Netral
	Submit change requests for review, impact analysis, and approval by the authorized parties.	Netral
additional activities from experts	a. Regular communication and team building should be conducted before team assignments are made. If the activities are targeted specifically at the project team, coaching and sharing are more appropriate.	
	b. Initiatives for recognition and rewards should be included.	
Manage Teams		
Change Requests	Use performance reports and team evaluation results to identify the need for changes in team structure, work patterns, or communication mechanisms.	Netral

Necessary activities to achieve the process output		Results
	Prepare change requests if unresolved conflicts, declining team performance, or work obstacles are found that affect project effectiveness.	Netral
	Submit change requests for formal review and approval by project stakeholders.	Netral
additional activities from experts	-	
Control Resources		
Work Performance Information	Compare actual resource usage data with the planned resource allocation.	strongly agree
	Conduct trend analysis and review resource performance against the project baseline.	strongly agree
	Record the results of the analysis as work performance information to support project decision-making.	Netral
Change Requests	Identify significant deviations between actual and planned resource usage.	Netral
	Develop corrective or preventive action recommendations to address the deviations.	strongly agree
	Submit a change request to the Perform Integrated Change Control process.	Netral
additional activities from experts	Add activities for active monitoring and corrective actions based on optimization.	

(Source : Author's Editing, 2025)

4.2 Key Weaknesses Identified

1. Many planning activities (e.g., defining team structure, resource risk analysis) were skipped or partially performed.

2. The team development process lacked systematic assessment and motivational activities.

3. Resource control suffered from delayed corrective actions and inconsistent performance monitoring.

4. Documentation of resource requirements lacked justifications or reference to past data.
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4.3 Expert Validation

Experts agreed on the relevance of PRM processes but emphasized the need for contextual adaptation and inclusion of motivational strategies within human resource planning. They suggested that resource planning should include conflict anticipation and stakeholder communication structures.

4.4 Impact on Project Performance

The delay and cost overrun observed in the project are attributed to weak alignment between PRM execution and project complexities. Absence of proactive resource planning and lack of team synchronization played critical roles. The findings are consistent with global literature where resource mismanagement has led to inefficiencies, project delays, and inflated budgets.

4.5 Comparison with Similar Projects

When benchmarked against similar infrastructure projects within the region, the Kutruk-Jambe Bridge project showed lower integration between planning and control phases. Other projects utilized detailed resource breakdown structures and periodic team evaluations which were absent in this case.

V. RECOMMENDATIONS
5.1 Strengthen Planning

1. Develop SOPs for each PRM process to provide operational guidance.

2. Involve all stakeholders in early planning phases to build consensus.

3. Conduct risk-based planning sessions focusing on material and labor constraints.

5.2 Enhance Resource Acquisition and Control

1. Use historical data and risk analysis in estimating needs.

2. Create a centralized resource monitoring dashboard.

3. Implement routine monitoring and feedback mechanisms involving all relevant parties.

5.3 Develop Human Capital

1. Provide training and team-building sessions at key project stages.

2. Include motivation as a factor in team management.

3. Conduct monthly team performance reviews linked to rewards and feedback.

5.4 Use PMBOK as an Adaptive Guide

1. Adjust PMBOK practices to fit local project characteristics including regulatory and procurement constraints.

2. Integrate environmental and community aspects in planning resource usage.

5.5 Institutional Recommendations

1. Government and private contractors should collaborate to develop standardized frameworks for PRM.

2. Professional development programs for project managers should include modules on resource risk and behavioral leadership.

5.6 Conclusion

The evaluation of PRM implementation in the Kutruk-Jambe Bridge Project reveals a moderate adoption of PMBOK standards. Major lapses in planning, acquisition, and team development contributed to schedule delays and budget overruns. Institutionalizing standard procedures, improving capacity building, and contextualizing PMBOK practices can significantly enhance resource efficiency and overall project performance.

This research emphasizes the critical role of human and physical resource alignment with project strategy. Future studies may expand the sample size or explore resource integration in design-build or PPP schemes.

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