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The Effect of Heavy Equipment Maintenance Budget on Operational Performance at PT XYZ Indonesia

Mohamad Helmy Ramadhona
Faculty of Economic, Universitas Islam Sultan Agung (UNISSULA) Semarang, Indonesia, E-mail: helmyra83@gmail.com

Abstract. *Heavy equipment maintenance activities require significant resource allocation, including aspects of technicians, spare parts availability, supporting equipment, and time management. All of these resources are integrated into a fundamental aspect, namely the maintenance budget (X). The maintenance budget is a planned allocation of funds to facilitate asset maintenance and repair activities, including heavy equipment. Budget-supported maintenance is collectively essential in achieving optimal maintenance. This optimal maintenance is used to maintain heavy equipment performance and directly contributes to reducing downtime or unplanned operational downtime. A weak budget or suboptimal management can negatively impact maintenance schedules, repair quality, and spare parts availability, which directly impacts heavy equipment readiness and performance in the field (Priatna, 2025). Sukamdani (2018) emphasized that cost management in maintenance has a positive impact or is a key factor in achieving operational efficiency and effectiveness, which ultimately impacts overall operational performance. PT XYZ Indonesia, as an entity in the mining industry, is highly dependent on heavy equipment to ensure the smooth operation of exploration and exploitation activities. Optimizing heavy equipment operational performance is a top priority to achieve production targets and maintain the company's competitiveness. However, the company's internal operational data shows a significant gap between the planned maintenance budget and actual costs. Based on PT XYZ Indonesia's Cost Control report for the 2024–2025 period, the phenomenon of mismatch between planned and realized budgets occurs consistently. In 2024, the total budget for heavy equipment maintenance was set at USD 851,099, but the actual maintenance costs reached USD 2,167,360, exceeding the budget by 154.7%. A similar situation continued in 2025, where the maintenance budget for the January–November period was set at USD 2,487,147, but the actual costs reached USD 3,548,401, still exceeding the budget by 42.7% (Cost Control PT XYZ Indonesia, 2025). Although the company had increased the maintenance budget allocation by 192% from 2024 to 2025, the actual fixed costs consistently exceeded the planned limits. This phenomenon indicates fundamental problems in the planning, management, and control of the heavy equipment maintenance budget, which directly impacts the effectiveness and efficiency of the company's operational performance.*

Keywords: *Budget; Effect; Maintenance; Operational.*

1. Introduction

The mining and construction sectors in Indonesia play a vital role in the national economy. Heavy equipment is a key asset in these activities, crucial for ensuring smooth field operations. Well-maintained heavy equipment helps maintain time efficiency, streamlines production, and boosts company profitability. Conversely, if maintenance is not carried out in a planned manner, heavy equipment can potentially experience damage, which can hamper operational activities (Suratman & Wibowo, 2023). Therefore, heavy equipment maintenance should not be viewed merely as a routine repair, but rather as a strategic investment aimed at ensuring sustainable productivity and extending the asset's lifecycle.

Heavy equipment maintenance activities require significant resource allocation, including aspects of technicians, spare parts availability, supporting equipment, and time management. All of these resources are integrated into a fundamental aspect, namely the maintenance budget (X). The maintenance budget is a planned allocation of funds to facilitate asset maintenance and repair activities, including heavy equipment. Budget-supported maintenance is collectively essential in achieving optimal maintenance. This optimal maintenance is used to maintain heavy equipment performance and directly contributes to reducing downtime or unplanned operational downtime.

A weak budget or suboptimal management can negatively impact maintenance schedules, repair quality, and spare parts availability, which directly impacts heavy equipment readiness and performance in the field (Priatna, 2025). Sukamdani (2018) emphasized that cost management in maintenance has a positive impact or is a key factor in achieving operational efficiency and effectiveness, which ultimately impacts overall operational performance.

PT XYZ Indonesia, as an entity in the mining industry, is highly dependent on heavy equipment to ensure the smooth operation of exploration and exploitation activities. Optimizing heavy equipment operational performance is a top priority to achieve production targets and maintain the company's competitiveness. However, the company's internal operational data shows a significant gap between the planned maintenance budget and actual costs. Based on PT XYZ Indonesia's Cost Control report for the 2024–2025 period, the phenomenon of mismatch between planned and realized budgets occurs consistently.

In 2024, the total budget for heavy equipment maintenance was set at USD 851,099, but the actual maintenance costs reached USD 2,167,360, exceeding the budget by 154.7%. A similar situation continued in 2025, where the maintenance budget for the January–November period was set at USD 2,487,147, but the actual costs reached USD 3,548,401, still exceeding the budget by 42.7% (Cost Control PT XYZ Indonesia, 2025). Although the company had increased the maintenance budget allocation by 192% from 2024 to 2025, the actual fixed costs consistently exceeded the planned limits. This phenomenon indicates fundamental problems in the planning, management, and control of the heavy equipment maintenance budget, which directly impacts the effectiveness and efficiency of the company's operational performance.

Although the importance of budgeting in supporting operational performance has been widely recognized in the management and engineering literature (Winarno, 2020), several research gaps remain to be addressed. First, studies specifically examining the relationship between maintenance budgets and heavy equipment operational performance in the Indonesian mining industry are still very limited. The majority of previous research (Priatna, 2025; Suratman & Wibowo, 2023) has focused on the manufacturing or general construction industry, so their findings may not be generalizable to the mining context, with its diverse heavy equipment characteristics and high usage intensity. Second, previous research has not comprehensively addressed how the three dimensions of maintenance budgets—fund allocation, utilization efficiency, and plan accuracy—simultaneously influence heavy equipment maintenance operational performance. Most available research tends to be general in nature and has not addressed the specific dynamics that occur in mining companies like PT XYZ Indonesia. Third, there has been no empirical study using secondary data in the form of actual cost control reports from mining companies as evidence of the gap phenomenon, so research arguments still rely solely on perceptual data without the support of measurable financial data (Suryadi & Lestari, 2020). These three gaps are the main basis and justification for carrying out this research.

The justification for this phenomenon is supported by two secondary data sources from PT XYZ Indonesia's Cost Control report. The first data is the 2024 Cost Control Report, which recorded realized heavy equipment maintenance costs of USD 2,167,360 from a budget of USD 851,099 (achievement 254.7%). The second data is the 2025 Cost Control Report (January–November period), which recorded realized costs of USD 3,548,401 from a budget of USD 2,487,147 (achievement 142.7%). A comparison of these two data is presented in the following table:

Table Comparison of Budget vs. Actual Heavy Equipment Maintenance Costs at PT XYZ Indonesia

Period	Budget (USD)	Actual Cost (USD)	Difference (USD)	Achievement (%)
2024 (Jan–Dec)	851,099	2,167,360	+1,316,261	**254.7%**
2025 (Jan–Nov)	2,487,147	3,548,401	+1,061,254	**142.7%**

Source: Cost Control PT XYZ Indonesia, 2024 and 2025 (processed)

The data in Table clearly confirms the consistent and significant gap between budget planning and actual maintenance costs at PT XYZ Indonesia. Therefore, this study is crucial to fill this gap in the literature by in-depth analyzing how the maintenance budget, along with its various influencing factors, improves operational performance at PT XYZ Indonesia.

2. Research Methods

This research is expected to provide benefits, both theoretically and practically, as follows:

1. Theoretical Benefits:

a. Development of Knowledge: This research is expected to enrich the knowledge of operational and maintenance management, especially in the mining industry in Indonesia, by providing a deeper understanding of the relationship between maintenance budgets and heavy equipment operational performance.

b. Literature Contribution: The results of this study can be a reference for further researchers who are interested in studying similar issues, especially regarding the specific mechanisms of budget influence and the challenges of cost and performance management.

2. Practical Benefits:

a. For PT XYZ Indonesia: The results of this study can provide strategic input and recommendations for the management of PT XYZ Indonesia in allocating and managing maintenance budgets more effectively, and ultimately improving the operational performance of heavy equipment and the company's efficiency.

b. For the Mining Industry: This research can be a reference for other mining or construction companies in Indonesia in formulating more optimal maintenance budget policies to support their operational performance.

3. Results and Discussion

3.1. The Influence of Fund Allocation in the Maintenance Budget on the Operational Performance of PT XYZ Indonesia

The results of the first hypothesis test (H1) show that the allocation of funds in the maintenance budget has a positive and significant effect on the operational performance of PT XYZ Indonesia, with a calculated t value of 2.519 greater than the t table of 1.985 and a significance value of 0.013 < 0.05. These results confirm that H1 is accepted, which means that the more adequate the allocation of funds in the maintenance budget, the higher the company's operational performance.

Descriptive data supports this finding, where the funding allocation variable obtained an average value of 23.96 with a mean value per indicator ranging from 3.75 to 4.24. Indicator X1_5 (mean = 4.24) related to budget availability for maintenance technology investment received the highest rating, indicating that respondents positively assessed the company's commitment to providing funds for maintenance technology capacity development. Conversely, indicator X1_4 (mean = 3.75) related to the speed of fulfilling spare parts requests still requires further attention.

This finding aligns with the research of Akbar, Nurlaila, and Jannah (2023), which analyzed the maintenance costs of fixed machine assets at CV Rabbani, Medan City, and found that adequate maintenance budget allocation directly impacts production efficiency. The study confirmed that when maintenance funds are insufficient to meet actual needs, machine breakdowns increase, leading to decreased production—a condition analogous to the decline in operational performance of heavy mining equipment.

Romadhon's (2024) research, which examined operational strategies and preventative maintenance on Rubber Tyred Gantry (RTG) equipment at ports, also demonstrated that adequate funding for maintenance programs is a prerequisite for maintaining heavy equipment reliability and performance. This finding is relevant to the situation at PT XYZ Indonesia, where heavy equipment is the backbone of operations and is highly dependent on financial preparedness for maintenance management.

In their study of operational performance, Runtuwene and Karuntu (2024) also emphasized that a company's operational effectiveness is largely determined by adequate resource support, including financial aspects. Without sufficient funding, maintenance programs are often delayed or half-hearted, ultimately leading to increased downtime and a decrease in overall heavy equipment productivity.

In the context of PT XYZ Indonesia, adequate funding allocation has proven to enable the maintenance team to carry out routine maintenance schedules without being hampered by budget constraints. This ensures heavy equipment is consistently in top condition, significantly contributing to increased productivity, equipment availability, and overall operational efficiency.

Thus, it can be concluded that adequate and planned funding allocation within the maintenance budget is a key pillar contributing positively to achieving optimal operational performance at PT XYZ Indonesia. Increasing the proportion and quality of funding allocation, particularly in the provision of preventive spare parts and the development of maintenance technology, needs to be continuously optimized to support the company's operational sustainability.

3.2. The Effect of Efficient Use of Maintenance Budget on the Operational Performance of PT XYZ Indonesia

The results of the second hypothesis test (H2) show that the efficiency of maintenance budget usage has a positive and significant effect on the operational performance of PT XYZ Indonesia, with a calculated t value of 3.088 greater than the t table of 1.985 and a significance value of 0.003 < 0.05. H2 is accepted, which means that the more efficient the use of the maintenance budget, the more the company's operational performance will increase.

Descriptive data shows that the efficiency of use variable has an average value of 22.56. Indicators X2_5 (mean = 4.20) and X2_6 (mean = 4.12) related to the utilization of maintenance labor received the highest rating, reflecting that respondents considered the technicians to work productively and according to their duties. In contrast, indicators X2_3 (mean = 3.39) and X2_4 (mean = 3.36) related to dead stock management of spare parts received lower ratings, indicating that there is room for improvement in managing spare parts inventory to be more efficient.

This finding aligns with Subakir's (2010) research, which examined the effect of machine maintenance costs on increasing service revenue at PT Triperkasa Aminindah Surabaya. The study found that efficient maintenance cost management, without waste on components that provide no direct added value, positively impacts the operational performance of service companies. This efficiency principle is also relevant for mining companies that rely on heavy equipment as a primary asset.

Mahyudi & Indratmoko(2026)A study examining preventive maintenance strategies in the mining industry emphasized that one dimension of maintenance success is a company's ability to optimally utilize maintenance resources. Efficient use of funds allows for more

maintenance activities to be carried out within available budget limits, ultimately maintaining equipment availability and supporting operational continuity.

Akbar, Nurlaila, and Jannah (2023) also emphasized that efficient use of maintenance budgets, particularly in spare parts management and optimizing technician work hours, directly contributes to reduced machine downtime. This leads to smoother production, a tangible manifestation of improved operational performance.

At PT XYZ Indonesia, high maintenance workforce utilization positively contributes to productivity and maintenance effectiveness. However, challenges in spare parts inventory management require optimization, including through the implementation of a more stringent inventory management system, to minimize the value of obsolete spare parts that provide no direct benefit to operations.

Based on the above findings, it can be concluded that efficient maintenance budget utilization contributes positively and significantly to PT XYZ Indonesia's operational performance. Optimizing efficiency across all aspects of budget utilization, particularly through improved spare parts inventory management and increased maintenance workforce productivity, will further strengthen the company's operational performance.

3.3. The Influence of the Accuracy of the Maintenance Budget Plan on the Operational Performance of PT XYZ Indonesia

The results of the third hypothesis test (H3) show that the accuracy of the maintenance budget plan has a positive and significant effect on the operational performance of PT XYZ Indonesia, with a calculated t value of 8.423 which is the highest value among the three independent variables, far exceeding the t table of 1.985, and a significance value of 0.000 < 0.05. H3 is accepted, and the accuracy of the plan is the most dominant variable in influencing operational performance.

The dominant influence of planning accuracy compared to the other two variables is a very meaningful finding from a managerial perspective. Descriptive data supports this, where indicators X3_3 (mean = 4.19) related to the consistency of preventive maintenance implementation according to schedule and X3_1 (mean = 4.12) related to the accuracy of budget projections received the highest ratings. In contrast, X3_5 (mean = 3.35) regarding the frequency of unexpected damage is still in the category that needs improvement, indicating that efforts to prevent sudden damage through more precise planning still have room for improvement.

This finding is highly relevant to research by Mahyudi & Indratmoko (2026), which concluded that a systematically planned preventive maintenance strategy can significantly reduce heavy

equipment failure rates in the mining industry. Proper planning not only reduces downtime but also increases overall productivity, as heavy equipment can always be operationally ready when needed.

Romadhon (2024), in his research on RTG equipment in ports, also demonstrated that accurate operational strategies and preventive maintenance planning are key factors in improving equipment reliability and performance. Without accurate planning, maintenance activities tend to be reactive and corrective, which is much more costly than planned preventive maintenance and results in more frequent operational disruptions.

Akbar, Nurlaila, and Jannah (2023) also confirmed that exceeding the maintenance budget (high budget variance) is an indication of inaccurate planning, and this condition is directly correlated with increased machine breakdowns and disrupted production. Conversely, careful budget planning tailored to actual field needs allows for proactive maintenance, significantly reducing the risk of sudden breakdowns.

In the context of PT XYZ Indonesia, the highest t-value for the variable of plan accuracy indicates that the company's ability to develop maintenance plans aligned with actual field needs is the most critical factor in driving operational performance. When budget plans are prepared accurately based on heavy equipment condition data, realistic cost estimates, and structured maintenance schedules, the company is able to reduce sudden breakdowns, maintain equipment availability, and ensure production targets are consistently achieved.

Thus, the accuracy of the maintenance budget plan is proven to be the most dominant variable and has the strongest influence on the operational performance of PT XYZ Indonesia. This finding is relevant to secondary data from the company's Cost Control report, which shows that inaccurate maintenance budget planning is the main cause of budget overruns: in 2024, the actual cost of heavy equipment maintenance reached 254.7% of the budget set by the Engineering & Planning Division, while in 2025 it still reached 142.7% of the planned budget. This data proves that the plan prepared by the planning division does not accurately reflect actual needs in the field.

However, there was an improvement of 112 percentage points (from 254.7% to 142.7%) between 2024 and 2025, indicating that the company's efforts to improve the accuracy of budget planning are starting to show positive results. Improving the quality of maintenance budget planning, especially in terms of the accuracy of cost projections based on historical operational data, consistency in the implementation of preventive schedules by the Maintenance/MPM division, and closer collaboration between the Engineering & Planning Division and the Mining Operations Division in preparing budget plans, are the main priorities that must be continuously improved by the company in order to achieve optimal operational performance.

3.4. The Effect of Fund Allocation, Efficiency of Use, and Accuracy of Plans in the Maintenance Budget Simultaneously on the Operational Performance of PT XYZ Indonesia

The results of the fourth hypothesis testing (H4) through the F test show that fund allocation, efficiency of use, and accuracy of plans simultaneously have a positive and significant effect on the operational performance of PT XYZ Indonesia, with a calculated F value of 102.330 far exceeding the F table of 2.70, and a significance value of 0.000 <0.05. H4 is accepted. The coefficient of determination (R^2) value of 0.762 indicates that the three independent variables together are able to explain 76.2% of the variation in operational performance, while the remaining 23.8% is influenced by other variables outside the research model.

The very high calculated F-value (102.330) indicates the extraordinary synergistic power between the three dimensions of the maintenance budget in driving operational performance. These three variables are not only individually significant, but collectively provide a real and substantial contribution to the achievement of the company's operational performance. The Adjusted R-Square value of 0.754 confirms that this research model has stable explanatory power and does not experience significant bias due to the addition of variables.

This finding aligns with the research findings of Haddade (2008), which serves as the primary basis for this study, where the overall maintenance budget influences profit increases and operational smoothness in heavy equipment maintenance. This study expands and details this contribution by specifically identifying three key dimensions of the maintenance budget and empirically measuring their respective contributions in the context of PT XYZ Indonesia.

Romadhon (2024) emphasized that an integrated operational and preventive maintenance strategy—including adequate funding, efficient utilization, and accurate planning—is a key factor in determining heavy equipment reliability. When one dimension is weak, the impact will affect others; for example, good planning will be ineffective without adequate funding, and even large funds will not yield optimal results if not used efficiently.

Mahyudi & Indratmoko (2026) also concluded that an effective maintenance system in the mining industry requires a holistic and integrated approach. Successful implementation of a preventive maintenance program that reduces heavy equipment failure rates is the result of a synergy between budget availability, efficient management, and appropriate schedule planning—in line with the three variables examined in this study.

Runtuwene and Karuntu (2024), in their study of operational performance in companies, also reinforce the view that optimizing operational performance is the result of synergistic management of various resource aspects. Weaknesses in any one aspect of maintenance

budget management will create weaknesses in the maintenance system, which can lead to increased downtime, decreased productivity, and long-term operational cost overruns.

The practical implication of this simultaneous influence finding for PT XYZ Indonesia is the need for a comprehensive and integrated approach to maintenance budget management. Improving one dimension alone will not yield optimal results if the others are neglected. Therefore, the company needs to ensure that adequate funding allocation is always accompanied by efficient use and based on accurate planning, so that all three work together to create a robust maintenance system that contributes optimally to operational performance.

The coefficient of determination (R^2) value of 76.2% produced also opens up opportunities for further research to explore additional variables that contribute to the remaining 23.8%, such as the competence of technical human resources, the condition of the mine's operational environment, or the level of application of information technology in the maintenance management system.

Overall, the results of this study strongly confirm that maintenance budget management, which includes adequate fund allocation, efficient use, and proper planning, simultaneously constitutes a key determinant for achieving optimal operational performance at PT XYZ Indonesia. The relevance of this finding is further strengthened by respondents' perception data: the mean operational performance (Y) score of 31.98 out of a maximum score of 40 indicates that operational performance is in the high category (79.95%), while the mean plan accuracy (X3) score of 23.40 out of 30 (78.0%), fund allocation (X1) score of 23.96 out of 30 (79.9%), and efficiency of use (X2) score of 22.56 out of 29 (77.8%). Collectively, these perception data reflect that respondents perceive that all three aspects of the maintenance budget have performed quite well, but there is still room for improvement of an average of around 20–22% towards ideal conditions. When linked to secondary data from Cost Control 2025, where budget overruns still reached 42.7%, a 1-point increase in planning accuracy on the perception scale (≈3.3%) is estimated to contribute to a significant reduction in budget overrun rates. These findings provide a strong empirical basis for company management to make maintenance budget management, particularly improving planning accuracy by the Engineering & Planning Division and execution efficiency by the Maintenance/MPM Division, a strategic priority in supporting the sustainability and competitiveness of company operations in the mining industry.

4. Conclusion

Based on the results of research regarding the influence of heavy equipment maintenance budgets on operational performance at PT XYZ Indonesia, the following conclusions can be drawn:

1. The allocation of funds within the maintenance budget has a positive and significant impact on PT XYZ Indonesia's operational performance. This indicates that the more appropriate and adequate the company's allocation of funds for heavy equipment maintenance activities, the better its operational performance. Sufficient funding can support the smooth running of routine maintenance, spare part replacement, and prevent heavy equipment damage.

2. Efficient maintenance budget utilization has a positive and significant impact on PT XYZ Indonesia's operational performance. This means that efficient, targeted, and controlled budget utilization will increase the effectiveness of maintenance activities. This efficiency can reduce unnecessary costs, accelerate repair processes, and minimize heavy equipment downtime.

3. The accuracy of the maintenance budget plan has a positive and significant impact on PT XYZ Indonesia's operational performance. This means that accurate, realistic, and aligned budget planning facilitates maintenance program implementation. With proper planning, the company can anticipate cost requirements and prevent budget overruns.

4. Fund allocation, efficiency of use, and accuracy of maintenance budget planning simultaneously have a positive and significant impact on PT XYZ Indonesia's operational performance. Therefore, successful operational performance improvement is not influenced by a single factor but is the result of synergy between sound maintenance budget management across the board.

5. The maintenance budget is a crucial factor in supporting productivity, heavy equipment availability, work efficiency, and achieving a company's operational targets. Therefore, managing the maintenance budget should be a primary concern for company management.

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