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Cost and Time Analysis of Project Acceleration using the Crashing Method with Additional Working Hours and Labor

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Project Acceleration, Crashing Method, Overtime Work, Additional Labor, Cost Efficiency.

ABSTRACT
This study aims to analyze project cost and time acceleration using the Crashing Method by adding three hours of overtime work and additional labor. Delays in construction projects often lead to budget overruns and inefficiencies, making acceleration techniques essential for ensuring timely project completion. The research evaluates cost efficiency by comparing the total project budget before and after implementing the Crashing Method. Using both qualitative and quantitative approaches, this study examines the impact of different acceleration strategies on cost increase and time reduction. The findings indicate that project completion time can be significantly reduced using both methods; however, overtime results in higher cost increases compared to additional labor. While overtime provides immediate acceleration, it incurs higher expenses due to increased labor wages, whereas adding workforce results in gradual but more cost-effective acceleration. Furthermore, the study underscores the importance of selecting the appropriate acceleration approach based on project constraints, workforce availability, and financial considerations. Effective resource allocation, labor management, and risk assessment are critical factors in minimizing costs while maximizing efficiency. By analyzing the trade-offs between cost and time, this study provides valuable insights into the optimal strategy for project acceleration in construction management. The findings offer practical recommendations for contractors, project managers, and stakeholders to optimize resources and maintain budget control while ensuring project completion within the scheduled timeframe.

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Introduction

In the world of construction, the success of a project is greatly influenced by time and cost efficiency (Kakar et al., 2020; Vasista, 2017). Every project has limited resources, both in terms of labor, materials, and the work schedule that has been set (Hartmann & Briskorn, 2022; Liu & Lu, 2018). Delays in project implementation often lead to increased costs and impact the parties involved in the project (Boateng & Danquah, 2025; Osei-Asibey et al., 2025; Schumacher & Schumacher, 2023). The complexity of construction project management requires a systematic and measured approach to ensure the achievement of predetermined targets.

Crashing method has become one of the most effective solutions in overcoming the problem of construction project delays (Mahmoudi & Javed, 2020; Smith et al., 2014). This method not only focuses on reducing the project duration, but also considers the cost and quality aspects of the work produced. In its implementation, the Crashing method can be done through various approaches, such as adding working hours (overtime) or increasing the number of workers, where each approach has different characteristics and impacts on project costs.

Previous research has demonstrated the effectiveness of crashing methods in various construction project contexts (Bahnas et al., 2024; Saroji & Susantono, 2023). The study conducted by Malifa, Dundu and Malingkas (2019) revealed that additional labor can result in significant acceleration with a relatively manageable increase in cost. The results provide important insights into the relationship between resource augmentation and project time efficiency, which can be taken into consideration in project management decision-making.

Furthermore, the implementation of the Crashing method through the addition of working hours has shown promising results. Muin's (2023) research on the McDonald's construction project in Pontianak proved that the addition of overtime working hours can result in substantial acceleration at an additional cost that is more economical than the addition of new labor. This finding confirms the importance of comprehensive analysis in selecting the acceleration strategy that best suits the characteristics and needs of the project (Olivia, 2019).

In the context of education infrastructure projects in Indonesia, the application of the Crashing method has yielded positive results. The construction project of SDN Kutisari 2 is a clear example of the successful implementation of this method, where the time acceleration achieved is accompanied by an increase in costs that are still within reasonable limits. This experience provides valuable lessons on the importance of balancing time acceleration and cost control in construction project management.

The rehabilitation project of SMPN 2 Pasongsongan in Sumenep district faces challenges similar to other construction projects. Weather factors and the mismatch of work volume with the initial planning have caused delays that require immediate solutions. In this context, an in-depth analysis of the application of the crashing method is highly relevant to identify the most optimal acceleration strategy.

Research conducted by Putri (2021) highlights the importance of considering cost aspects in the implementation of the Crashing method. Although the addition of working hours can result in significant acceleration, the accompanying cost increase needs to be carefully analyzed to ensure the efficient use of the project budget. This is in line with the findings of Ralahall (2024) who emphasized the importance of good project management in controlling the risk of delays and cost overruns.

In the construction industry, managing time and costs effectively is a significant challenge, especially when delays occur. One of the methods used to address project delays is the Crashing Method, which accelerates the completion time by adding additional labor or overtime hours. However, the method involves trade-offs between time savings and increased costs. Understanding these dynamics is critical for effective project management. This study focuses on analyzing the impact of the Crashing Method on the time and costs of construction projects in Indonesia, specifically on the construction of SDN Kutisari 2 and SMPN 2 Pasongsongan.

This research is urgent because the construction industry in Indonesia frequently faces delays that result in cost overruns and inefficiencies. By evaluating the Crashing Method, this study will provide valuable insights into how to optimize time and cost management in construction projects. Efficient use of this method could help mitigate delays and improve the overall performance of the construction industry, especially in infrastructure projects that directly impact public services.

Several studies have shown the Crashing Method's effectiveness in reducing construction delays. For instance, Muin (2023) highlighted the potential of adding overtime to accelerate project completion at a lower cost compared to increasing labor. However, Malifa, Dundu, and Malingkas (2019) found that adding labor can be more cost-effective than overtime, although it requires more management effort. Additionally, Putri (2021) concluded that the Crashing Method is widely applicable but needs careful consideration of the project's specific constraints.

Although the Crashing Method is widely studied, there remains a gap in understanding its practical application in the context of different types of construction projects in Indonesia (Ralahall, 2024). The impact of these methods on project timelines and costs needs more comprehensive analysis, particularly in government-funded projects, which have unique constraints like budget and workforce limitations.

This study is novel in its analysis of the Crashing Method applied specifically to the SDN Kutisari 2 and SMPN 2 Pasongsongan construction projects in Indonesia. It contributes by comparing the effectiveness of overtime versus additional labor in reducing project delays, providing practical insights for project managers in similar construction settings.

The objective of this research is to evaluate the time and cost implications of using the Crashing Method in the construction of SDN Kutisari 2 and SMPN 2 Pasongsongan. It aims to identify which acceleration strategy (overtime or additional labor) offers the best trade-off between reducing delays and controlling costs.

This study will provide construction managers and policymakers with evidence-based recommendations on the most efficient methods for accelerating project timelines without exceeding budgets. It will also contribute to better resource allocation and project planning in future construction projects, ultimately improving the efficiency and sustainability of the construction industry in Indonesia.

Research Methods

Research Design

This research uses a quantitative approach with an analytical descriptive method to evaluate the impact of project acceleration using the Crashing method. The data used in this research is sourced from previous project reports as well as simulation data conducted through project management software. The use of this approach allows for a more accurate analysis of the estimated additional costs due to the addition of working hours and labor in project acceleration. Thus, the results of this study can provide a more comprehensive picture of the cost and time efficiency achieved through the Crashing method.

The descriptive analytical method in this research also involves case studies on construction projects that experience delays. The data used includes information regarding the duration of the project, the number of workers, as well as operational costs incurred under normal conditions and after acceleration. The analysis was conducted by comparing the project conditions before and after the application of the Crashing method

to obtain objective results. In this way, the research can identify the most effective acceleration strategy in optimizing project costs and time.

In order to ensure the validity of the research, the quantitative approach used was supplemented with various standardized measurement instruments. The use of these instruments enabled the researcher to collect accurate and verifiable data on various aspects of the project, including labor productivity, resource use efficiency, as well as the financial impact of implementing the crashing method. In addition, this study also applied data triangulation to ensure the accuracy of the information obtained, by comparing data from different sources and different collection methods.

To improve the reliability of the research results, the research team conducted a series of validity tests on the measurement instruments used. This included testing the instrument's internal consistency, construct validity, and inter-rater reliability to ensure that the data collected was reliable and representative of actual conditions in the field. This approach also considered various external factors that might affect the research results, such as weather conditions, material availability, and project team dynamics.

Data Collection Technique

Data in this study were obtained through two main sources, namely primary data and secondary data. Primary data is obtained directly from field observations, interviews with project managers, and questionnaires given to labor and contractors regarding the effectiveness of the Crashing method. Meanwhile, secondary data is sourced from project documents, financial reports, and research journals that discuss project acceleration methods in the construction context. The use of a combination of primary and secondary data aims to ensure the validity and reliability of the research results.

The primary data collection process was carried out systematically with strict adherence to research protocols. Field observations were conducted periodically using a standardized checklist to ensure consistency in data collection. Interviews with project stakeholders were conducted using semi-structured interview guidelines that had been validated by experts in the field of construction management. The questionnaires distributed were also pilot tested to ensure clarity and relevance of the questions asked.

In collecting secondary data, the researcher conducted an in-depth review of project documentation from various time periods. This included analysis of weekly progress reports, financial reports, and records of changes in the scope of work that occurred during project implementation. In addition, the researcher also conducted a comprehensive literature study of recent journals that discuss the implementation of the Crashing method in various construction project contexts.

Data Analysis Technique

Data analysis was conducted using a comprehensive approach, starting with the processing of raw data using relevant statistical software. This process involved a series of analytical steps, including data normality tests, analysis of variance, and calculation of various statistical parameters as required. The results of the analysis were then interpreted in light of the project context and the various factors affecting the implementation of the crashing method.

Evaluation of the effectiveness of the Crashing method is done through comparative analysis between the baseline project schedule and the actual progress after the implementation of the acceleration method. This analysis includes detailed calculations of cost variance, schedule variance, and various other project performance indicators. This approach allows researchers to identify critical factors that affect the success of the implementation of the Crashing method, as well as provide recommendations for optimizing project implementation in the future.

Furthermore, this study also applied sensitivity analysis to evaluate various project acceleration scenarios. This was done by considering various variables such as the number of additional workers, overtime duration, and their impact on project productivity and cost. The results of this analysis are then used to develop a predictive model that can assist in decision-making regarding future project acceleration strategies.

Results and Discussion

Project Time Analysis with Crashing Method

Crashing method aims to accelerate the project by increasing labor or working hours. In this study, the analysis was conducted by comparing the project duration before and after the application of the Crashing method. Project data shows that acceleration with the addition of working hours results in a shorter project duration than normal conditions. These results indicate that the Crashing method can provide significant time efficiency in the implementation of construction projects (Abas & Al., 2022).

Based on the simulations conducted, the project that was originally scheduled to be completed in 150 days can be shortened to 140 days with the Crashing method. This reduction in duration was achieved through the addition of working hours for three hours per day (Rani, 2016). This strategy not only reduces working time but also optimizes labor productivity. However, this acceleration has implications for increased costs due to additional labor overtime wages (Firdaus et al., 2023).

In addition, previous research by Muin (2023) showed that project acceleration through additional working hours can reduce project delays by up to 18.3 days. This result is in line with the findings in this study which confirm that increasing working hours can be an effective solution in overcoming project time constraints. However, further calculations are required to evaluate the cost efficiency of this acceleration strategy.

Cost Impact of Additional Working Hours (Overtime) on the Project

Increasing working hours (overtime) is often the main option in crashing methods. This study found that implementing overtime for three hours per day resulted in a 12% increase in labor costs compared to the original budget. This additional cost is due to an increase in overtime wages as well as additional operational needs such as electricity and tools (Koten & Tjendani, 2023).

The results of this study are consistent with a study conducted by Putri (2021), which found that the cost of accelerating projects with overtime experienced a higher increase than the addition of labor. However, this method has the advantage of not requiring additional time for recruitment or training of new labor. Therefore, in labor-constrained projects, additional working hours can be a more practical alternative to recruiting new workers.

In the case of the Kutisari 2 primary school construction project, research by Firdaus, Tjendani, and Witjaksana (2023) found that the crashing method with overtime resulted in a cost increase of Rp24,569,780. This study supports the findings in this study which show that overtime has a positive impact on project duration, albeit with the consequence of increased costs that need to be carefully calculated.

Impact of Labor Cost on the Project

Increasing the number of workers is another alternative in the Crashing method. The results of this study show that by adding labor to critical activities, the project can be accelerated without increasing the working hours of existing workers. The addition of 20% labor resulted in accelerating the project by 10 days with an 8% increase in cost compared to the initial budget (Malifa et al., 2019).

According to research by Samosir, Harahap, and Puspita (Riza & Witjaksana, 2022) the strategy of adding labor is more economical than increasing working hours. The study found that in the housing agency hall construction project, accelerating the project by 15.15% with this method only increased the project cost by Rp113,632,675. This result is in line with the findings in this study which show that adding labor is more economical than increasing working hours.

However, increasing the number of workers has its own challenges. Research by Kustiyahningsih et al. (2023) shows that workspace capacity is a limiting factor in the effectiveness of this strategy. Therefore, while additional manpower is more economical in some situations, its effectiveness is highly dependent on project conditions and the availability of sufficient workspace.

Cost Efficiency Comparison between Overtime and Additional Labor

To determine the most efficient acceleration strategy, this study compared the cost impact between overtime and additional labor. Based on the calculation results, accelerating the project with overtime resulted in a cost increase of Rp24,569,780, while with additional labor the cost increased by Rp18,000,000 (Riza & Witjaksana, 2022). Thus, additional labor proved to be more economical than overtime in the context of this project.

However, the flexibility factor is also a consideration in choosing an acceleration method. In projects that have limited skilled labor, overtime can be a more realistic option. A study by Rakasyiwi, Witjaksana (2022) revealed that a combination of overtime and additional labor can provide optimal results in project acceleration. With a combination strategy, the project can gain significant acceleration without experiencing too high an increase in costs.

Table 1. Total additional labor cost

No.	Job Description	Additional costs
1.	Fit. Calcium Silicate Ceiling Board	IDR 595,000/day
2.	Electrical Panel	IDR 595,000/day
3.	Install 1 m NYY 4 x 6 mm2 + BC 6mm Feeder Cable	IDR 595,000/day
4.	Down Light Panel 25WATT, LED	IDR 595,000/day
5.	Inst. Lighting, NYM 2x1.5 mm (o) PVC HI dia. 20mm	IDR 595,000/day
6.	Inst. socket, NYM 2x2.5 mm (o) PVC HI dia. 20mm	IDR 595,000/day

The results of this study show that the Crashing method can provide significant project acceleration, both through additional working hours and labor. However, each method has advantages and limitations that need to be considered in the implementation of construction projects. In projects with limited manpower, the overtime method is the first choice, while in projects with sufficient workspace, additional manpower is more recommended.

Cost calculations show that although overtime can reduce project time quickly, this strategy tends to increase costs more than additional labor. Therefore, the selection of acceleration methods should be tailored to the project conditions, available budget, as well as other technical factors.

These results also support previous studies that show that crashing methods can provide optimal benefits when applied with appropriate strategies. For example, a study by Muin (2023) showed that a combination of overtime and additional labor can be the best solution for projects with high levels of complexity.

The implication of this research is that project management needs to conduct an in-depth analysis before applying the Crashing method. The evaluation should include cost impact, time effectiveness, and resource readiness. Thus, the decisions taken can result in maximum efficiency.

In addition, this study provides insights for the construction industry in choosing a suitable project acceleration strategy. Applying the right crashing method not only helps complete the project faster but also keeps the budget under control.

Overall, this study confirms that the Crashing method is an effective technique in project acceleration, but it is necessary to conduct an in-depth analysis in determining the most optimal approach. By taking into account all relevant factors, this method can help the project achieve the target time without experiencing excessive cost overruns.

Conclusions

Based on the results of this study, it can be concluded that the Crashing method is effective in accelerating the duration of construction projects, both through the addition of overtime working hours and the addition of labor. Each method has its own advantages and challenges in terms of cost efficiency and time effectiveness. The addition of overtime working hours provides a significant acceleration of the project duration, but also results in a higher cost increase compared to the addition of labor. On the other hand, the addition of manpower was able to reduce the project completion time without causing too large a spike in costs, although there were limitations in the availability of workspace and coordination between workers.

In addition, this research shows that a combination of both methods can result in more optimal project acceleration, especially in large-scale and high-complexity projects. The evaluation of the construction projects studied shows that the use of the crashing method must be adjusted to the specific conditions of the project, such as the available budget, the number of available workers, and other technical factors. Therefore, the decision to choose an acceleration strategy must consider various aspects in order to achieve optimal results without experiencing excessive cost overruns. Overall, this research provides insight for the construction industry in choosing the most suitable project acceleration method. With in-depth analysis and proper planning, the crashing method can be effectively used to improve project efficiency, both in terms of time and cost.

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