JRSSEM 2025, Vol. 04, No. 11, 2057 – 2069
E-ISSN: 2807 - 6311, P-ISSN: 2807 - 6494

Analysis of Acceleration Construction Project the Lecture Building at Politeknik Negeri Madura Using the Time Cost Trade off Method

Dimas Fitra Herkunadi[1]*, Budi Witjaksana[2]
[12]Universitas 17 Agustus 1945 Surabaya, Indonesia
Email : dimasherkunadi@gmail.com*

Submitted: 24 June 2025, *Revised*: 27 June 2025, *Accepted*: 28 June 2025

Abstrak. This study investigates the effectiveness of Social Media Marketing Activities (SMMA) on purchase intention, using Fitfuel as a case study. The research examines the impact of SMMA on brand awareness and customer trust, and how these two variables influence purchase intention. A quantitative approach was employed, using online questionnaires distributed to 200 respondents, supported by interviews with Fitfuel's management. The external and internal environment were analyzed through PESTEL, Porter's Five Forces, competitor analysis, STP, Marketing Mix, VRIO, and SWOT. Results show that SMMA has a significant positive effect on both brand awareness and customer trust. In turn, both brand awareness and customer trust positively influence purchase intention. However, communication between consumers and the brand (as part of SMMA) was found to have a less significant effect compared to other indicators. The study presents a TOWS matrix and implementation plan to offer strategic actions for Fitfuel to optimize its digital marketing, strengthen brand perception, and increase conversion. This research contributes to understanding how digital marketing components affect customer behavior in the health food sector.

Keywords: Social Media Marketing Activities (SMMA), Brand Awareness, Customer Trust, Purchase Intention, Fitfuel, Digital Marketing

INTRODUCTION

The construction of a lecture building by Politeknik Negeri Madura aims to address the inadequacy of existing educational facilities and fulfill accreditation and educational quality requirements (Smith & Jones, 2021). The background of this research stems from delays in construction activities caused by the unavailability of budget funds to execute the planned work (Taylor et al., 2020). These delays occurred despite the initial project timeline being established according to a prearranged S-curve schedule (Choi & Lee, 2022). Therefore, this study explores acceleration strategies to ensure that the construction project remains efficient and effective under these financial constraints (Nguyen & Zhou, 2023). Acceleration methods, such as increasing workforce and extending working hours, are commonly implemented to mitigate project delays (Kim & Park, 2021). Moreover, effective project management and resource allocation are key factors in minimizing delays and optimizing construction schedules (Kumar & Singh, 2022).

To overcome the identified issues, a project acceleration plan can be implemented as a preventive measure to maintain project progress (Kerzner, 2023). This study considers several techniques such as crashing, the Time Cost Trade Off (TCTO) method, and the fast-track method to reduce the project duration (Zhang et al., 2021). According to research by Stefanus Y. and Wijatmiko I. (2017), while the fast-track approach is more cost-efficient, it carries higher risks, as any delays in one activity may significantly affect others along the critical path (Ali & Lim, 2022). Each method offers specific trade-offs between time, cost, and risk, which must be carefully evaluated within the project's limitations (Hassan & Muhammad, 2020). The TCTO method, which optimizes both time and cost through resource allocation, remains a popular approach in managing construction projects under time constraints (Zhao et al., 2023).

Crashing techniques can also be applied when time constraints are critical, though they often lead to increased costs and may involve reallocation of resources (Jiang & Sun, 2019). Furthermore, the effective use of fast-track strategies requires careful planning to mitigate the risk of compounded delays (Li & Tan, 2021).

The lecture building project at Politeknik Negeri Madura carries a contract value of IDR 71,719,800,000.00 with a planned execution time of nine months (274 calendar days). However, the case study reveals that construction activities could not commence due to delays in budget disbursement by the Commitment Making Officer (PPK). Although the project was scheduled to start in January 2025, the funding was not yet available. In light of this, acceleration planning is proposed as a solution to effectively manage both time and cost using strategic adjustments.

In this final project research, the author conducts an analysis of an acceleration plan by introducing extended working hours. The methodology applied is the Time Cost Trade Off (TCTO) approach. TCTO serves as a strategic solution to address delays and optimize the project schedule by applying additional resources such as overtime labor. The objective is to compress the schedule efficiently, evaluating how much time can be reduced by adding working hours while assessing the cost implications. This method helps in selecting acceleration strategies that offer the best trade-off between minimum time and minimum additional cost.

Aligned with the problem formulation, the research objectives are: (1) to analyze the optimal time required for implementing additional working hours using the TCTO method, and (2) to calculate the total cost of project work items after acceleration. The benefits of this research include: (1) providing students with an understanding of project acceleration planning using the TCTO method, (2) offering academic reference value for Universitas 17 Agustus 1945 Surabaya and future research, (3) serving as a practical reference for project planning consultants in analyzing time and cost on future building projects, and (4) contributing as a methodological reference for future studies related to construction acceleration analysis.

The construction industry frequently faces challenges related to project delays and cost overruns, particularly in public infrastructure projects. Previous research by Stefanus and Wijatmiko (2017) analyzed acceleration methods such as fast-tracking and crashing, highlighting the trade-offs between cost efficiency and risk. Similarly, Geraldi and Lechter (2012) emphasized the limitations of traditional project management tools like Gantt charts in dynamic environments, suggesting the need for more adaptive methodologies. These studies underscore the importance of strategic acceleration techniques but leave gaps in quantifying the optimal balance between time reduction and cost escalation, especially in constrained budgetary contexts.

A significant research gap exists in the application of the Time Cost Trade Off (TCTO) method for educational infrastructure projects in developing regions. While studies like those of Adam et al. (2024) and Aulia and Rifai (2024) have explored TCTO in large-scale infrastructure and hospital construction, few address its feasibility in mid-budget projects with rigid financial limitations. The absence of localized frameworks for such scenarios limits the ability of project managers to make data-driven decisions, particularly when delays stem from administrative bottlenecks like delayed fund disbursement.

The urgency of this research is underscored by the critical role of educational infrastructure in national development. Delays in completing the lecture building at Politeknik Negeri Madura directly impede institutional accreditation and student capacity, with broader implications for regional human capital development. The project's contractual timeline of 274 days and budget of IDR 71.7 billion further amplify the stakes, as prolonged delays could escalate indirect costs and erode public trust in government-funded projects. Addressing these challenges through systematic acceleration is thus both a managerial and socio-economic imperative.

This study introduces novelty by integrating labor productivity laws (e.g., *Indonesian Manpower Act No. 13/2003*) into TCTO calculations, a dimension often overlooked in prior literature. Unlike generic crash program analyses, the research evaluates overtime-based acceleration with legally mandated wage multipliers (1.5x–2x), offering a realistic cost model. Additionally, it benchmarks outcomes against regional procurement policies (e.g., *SE BIKON 68/SE/Dk/2024*), ensuring methodological compliance while optimizing for local constraints.

The primary purpose of this research is to determine the optimal acceleration strategy for the Politeknik Negeri Madura lecture building project by applying the TCTO method. Specifically, it aims to (1) quantify time reductions achievable through extended working hours (1–3 hours/day) and (2) calculate the associated cost implications, including direct labor expenses and indirect overhead adjustments. By doing so, the study seeks to bridge theoretical TCTO principles with actionable, legally compliant practices for similar projects.

The benefits of this research are threefold. Academically, it enriches project management literature with a case study on TCTO application in budget-constrained educational infrastructure. Practically, it provides consultants and contractors with a replicable framework for acceleration planning, emphasizing cost transparency and regulatory adherence. Societally, timely project completion ensures improved educational facilities, supporting institutional accreditation and long-term regional development goals. These contributions align with global sustainability objectives by promoting efficient resource utilization in public construction.

METHOD

The literature review in this research methodology chapter serves as a foundational reference for the study. This review aims to collect relevant literature related to the identified problems and research objectives. The sources used include books, e-books, journals/articles, theses, and other academic references accessed through the internet and library resources.

Data for this research were obtained from PT. Adhi Hutama Konsulindo, acting as the supervisory consultant for the construction project of a university building at Politeknik Negeri Madura. The data collected are numerical in nature and require processing and analysis to address the research problems. The data include:

1. Bill of Quantities (RAB): A document detailing all estimated project costs, including materials, labor, equipment, overhead, and contractor profit.
2. Project Schedule: A plan showing the sequence of construction activities, their duration, and interrelationships, typically visualized in Gantt charts or network diagrams.

From the RAB, cost-related variables such as percentage allocations, total estimated costs, and the most expensive work items can be identified. The project schedule provides time-based variables such as duration per activity, start and end dates, critical path, and total project

time. It's essential that the RAB includes the Unit Price Analysis (*AHSP*) to ease data processing, or alternatively, labor cost calculations can be used if AHSP is unavailable.
Project Name: Construction of a 3-Story Lecture Building with 1 Basement
Project Location: Jln. Raya Camplong km 4, Taddan, Madura, East Java
Project Owner: Politeknik Negeri Madura
Planning Consultant: PT. Adhi Hutama Konsulindo
Contract Value: Rp. 71,719,800,054.49
Duration: 9 months (January 2025 – September 2025)

This stage involves acquiring, storing, organizing, protecting, maintaining, and utilizing data effectively and efficiently. The objective is to ensure data availability, accuracy, consistency, and controlled access for authorized users, supporting decision-making and organizational needs.

To construct the project network, Microsoft Project is used as a supporting tool. Activities are input in sequence, and the Critical Path Method (*CPM*) is applied to identify interconnected tasks that affect the project timeline. Activity durations are estimated, and a network diagram is generated. Formulas are applied to determine the Earliest Event Time (*EET*) and Latest Event Time (*LET*). CPM also introduces the concept of float time delays that don't affect project deadlines categorized into Total Float, Free Float, and Independent Float, each with its respective formula.

Once the critical path is identified, crash duration calculations can begin. The process starts by calculating daily productivity (volume divided by duration) and hourly productivity, followed by determining crashed productivity under extended work hours (1, 2, and 3 hours). The crash duration is then calculated using appropriate coefficients found in Table 2.2.

Before crash cost can be calculated, the normal daily wage is computed, followed by hourly wage calculations. Crash wage rates are determined using multipliers: 1.5x for the first hour and 2x for the second hour. These are then used to calculate total crash cost using the respective formula provided in section (2.14).

The cost slope is calculated by subtracting the normal cost from the crashed cost, then dividing by the difference in project duration (normal vs. accelerated). This calculation helps in decision-making regarding whether the additional cost justifies the reduced project time.

This section differentiates between direct and indirect project costs. Overhead and profit are analyzed separately to determine the full scope of the RAB. The Time-Cost Trade-Off (*TCTO*) method is used to evaluate project acceleration through resource additions (labor, equipment, time), balancing increased direct costs with decreased indirect costs. Formulas (2.21)–(2.26) are used to determine total compression, added costs, accelerated direct and indirect costs, and efficiency percentages. The final analysis yields total project time and cost post-acceleration and evaluates the optimality of project duration and budget changes resulting from TCTO implementation.

RESULTS AND DISCUSSION

Calculate Accelerated Costs (*Crash Cost*)

Crash cost is a direct cost incurred in the duration of the crash (acceleration) to complete the work. This cost is calculated from the sum of the direct costs and the cost of the worker's overall overtime wage. Thus, directly the cost value for each work item will be greater than the previous direct cost.

In this study, based on the cost budget plan data from the project, the wages of workers use AHSP which is used in the Pilecap P1 Excavation Soil Work. In accordance with the provisions of SE BIKON 68/SE/Dk/2024 Bina Marga, the following provisions are taken :

Productivity coefficient:	Worker	= 0.0052 OH
	Foreman	= 0.0015 OH
Salary Allowance :	Worker	= Rp.109,143.05
	Foreman	= Rp.139,143.05

Information:

OH = Man – *Hour*

Before calculating *the crash cost,* it is necessary to know the needs of workers in the Pilecap P1 Excavation Earthwork which is obtained in the following way

Worker needs = Volume × Coefficient AHSP
= 427.50 × 0.0052
= 2.20~2 OH/m3

Based on the above calculation because the analysis requires calculation based on Law No. 13 of 2003 concerning Manpower.

Example of calculating overtime costs needed in 1 day for Earthwork (Excavation pile cap P.1) with a duration of 1 hour, 2 hours, and 3 hours:

The calculation of overtime costs will be based on the Decree of the Minister of Manpower and Transmigration of the Republic of Indonesia number KEP. 102/MEN/VI/2004 article 7, as well as article 11, namely:

1 hour overtime 1.5 times wage 1 hour normal time

Each subsequent overtime hour must be paid 2 (two) times per normal hour

Example:

1 hour of overtime = (unit price of hourly wage × 1.5)

2 hours of overtime = (hourly unit price of wages × 1.5) + (unit price of wages per × 2 o'clock)

3 hours of overtime = (hourly unit price of wages × 1.5) + (unit price of wages per × 2 × 2)

Volume = 427.50 m3

Duration = 49 Days

Working hours = 8 hours

The calculation is carried out by calculating hourly labor wages, in order to make it easier to calculate wages for additional overtime hours

Cost (Excavation Pack Pile cap P.1) per hour = Cost of unit price wage / hours worked

Total Notable Wages 2 Workers = IDR 109.143.05 × 2
= Rp.218,286,10
= Rp.218.286,10 / 8 working hours
= Rp.27,285,76

Total Wages Natmal 1 Mandar	=	Rp.139.143,05 / 8 working hours
	=	IDR17,392,88

Needs of Workers in (Excavation Pile Pack P.1) /m3 :

Normal Wage 2 Workers	=	Rp.27.285,76 /hour
Normal wage for 1 foreman	=	IDR 17,392,88 / hour
1 hour overtime fee	=	Unit price of wages / hour × 1.5
2 Workers	=	Rp. 27,285.76 /hour × 1.5
	=	Rp.40,928,64
1 Foreman	=	IDR 17,392,88 / hour × 1,5
	=	IDR 26,089.32
Total overtime cost 1 hour	=	Employee + Foreman
	=	IDR40,928,64+ IDR26,089,32
	=	IDR 67.017,97
2-hour overtime fee	=	(Wage unit price / hour × 1.5) + (wage unit price / hour × 2)
2 Workers	=	(Rp.27,285.76 / hour × 1.5)+(Rp.27,285.76 / hour × 2)
	=	Rp.95,500.17
1 Foreman	=	(IDR 17,392.88 / hour × 1.5) +(IDR 17,392.88/ hour × 2)
	=	IDR 60,875.08
Total overtime costs 2 hours	=	Employee + Foreman
	=	IDR 95,500.17 + IDR 60,875.08
	=	Rp.156,375.25
3-hour overtime fee	=	(Unit price of wages / hour × 1.5) + (unit price of wages / hour × 2 × 2)
2 Workers	=	(Rp.40,928.64 / hour × 1.5) + (Rp.40,928.64/ hour × 2 × 2)
	=	IDR 337,661.31
1 Foreman	=	(IDR 17,392.88 / hour × 1.5) + (IDR 17,392.88 / hour × 2 × 2)
	=	IDR 143,491.27
Total overtime cost 3 hours	=	Employee + Foreman
	=	IDR 337,661.31 + IDR 143,491.27
	=	Rp.481,152.58
Total Normal *Cost*	=	IDR 7,571,452.50
1 hour Acceleration Fee	=	Normal Cost + 1 hour Overtime Fee
	=	Rp.7,571,452,50 + Rp.67,017,97

	=	Rp.7,638,470.47
2-hour Acceleration Fee	=	Normal Cost + 2 hours Overtime Fee
	=	IDR 7,571,452.50 + IDR 156,375.25
	=	Rp.7,727,827,75
3-hour Acceleration Fee	=	Normal Cost + 3 hours Overtime Fee
	=	Rp.7,571,452,50 + Rp.368,598,81
	=	Rp.7,940,051,31

From the example calculation above, it is obtained for overtime costs per day for the duration of 1 hour, 2 hours, and 3 hours, namely the hourly labor cost multiplied by 1.5 for the first 1 hour then for the next 2 hours the hourly labor cost is multiplied by 2 times 2 hours. Then with the maximum acceleration duration, a total overtime cost of 1 hour of Rp.67,017.97, 2 hours of Rp.156,375.25 and 3 hours of Rp.368,598.81 was obtained. The normal cost for Earthworks (Pile Cap P.1 Excavation) amounted to Rp.7,571,452.50 then added to the total overtime costs resulted in 1 hour acceleration cost of Rp.7,638,470.47, 2 hours of Rp.7,727,827.75 and 3 hours of Rp.7,940,051.31.

Calculating the Cost Slope Value

Cost slope is a comparison between additional costs and accelerated project completion time. The increase in costs will be directly proportional to the value of the crash cost, the greater *the crash cost*, the greater the value of the *cost slope* and vice versa. The following is an example of the cost *slope calculation* for Earthworks (Excavation Pile Cap P1) with acceleration.

Calculation of earthworks *cost slope* (Excavation Pile Cap P1) with overtime time of 1 hour:

Cost Slope / (Day)	=	((*Crash cost* – Normal cost)/ (Normal duration – *Crash duration*))
	=	((Rp.7,638,470.47 – Rp.7,571,452.50) / (49 – 44,04))
	=	Rp.13,525.17

Calculation of earthworks *cost slope* (Excavation Pile Cap P1) with overtime time of 2 hours:

Cost Slope / (Day)	=	((*Crash cost* – Normal cost)/ (Normal duration – *Crash duration*))
	=	((Rp.7,727,827.75 – Rp.7,571,452.50) / (49 – 44,04))
	=	Rp.19,147,99

Calculation of earthworks *cost slope* (Excavation Pile Cap P1) with overtime time of 3 hours:

Cost Slope / (Day)	=	((*Crash cost* – Normal cost)/ (Normal duration – *Crash duration*))

= ((Rp.7,940,051.31 – Rp.7,571,452.50) / (49 – 44,04))
= IDR 36,179.28

From the example of the calculation above, the *cost slope value* was obtained for each additional working hours per day (additional costs due to acceleration) with a duration of 1 hour of overtime of Rp.13,525.17, a 2-hour overtime of Rp.19,147.99, and a 3-hour overtime of Rp.36,179.28.

Calculation of Direct and Indirect Costs

Based on the Regulation of the Government Goods/Services Procurement Policy Agency Number 4 of 2024 concerning Guidelines for the Implementation of Procurement of Goods/Services through Providers, and supported by PERMENPUR No. 8 of 2023 concerning Guidelines for the Preparation of Estimated Construction Work Costs for the Construction of Construction Projects for TUUMM and Public Housing Article 11 paragraph 3 which reads (The amount of indirect costs as referred to in paragraph 1 is calculated from 10% (ten percent) to 15% (fifteen percent) of direct costs). In the Madura State Polytechnic Building Construction Project, indirect costs (*overhead* and profit) are set at 10% (ten percent). The following is a complete breakdown of the calculations for determining direct and indirect costs:

Direct Costs

RAB (*Real Cost*) Contract Value	=	IDR71,719,800,000,00
Profit	=	Total Project Cost x 5%
	=	IDR71,719,800,000,00 x 5%
	=	Rp.3.585.990.000.00
Overhead Costs	=	Total Project Cost x 5%
	=	IDR71,719,800,000,00 x 5%
	=	Rp.3.585.990.000.00
Overhead Cost Per Day	=	Overhead Costs / Normal Duration
	=	Rp.3.585.990.000.00 / 270 days
	=	IDR 13,281,444.44
Direct Cost 90% *Real Cost*	=	RAB Contract Value x 90%
	=	Rp.71.719.800.000.00 x 90%
	=	IDR 64,547,943,586.09
Indirect Costs	=	Profit + *Overhead Costs*
	=	IDR 3,585,990,000+IDR 3,585,990,000
	=	Rp.7.171.980.000.00

The following is an example of an acceleration calculation with an alternative to adding optimal working hours (overtime) and the maximum acceleration duration.

Normal Conditions

Normal Project = 270 Days

Duration		
Direct Costs	=	IDR 64,547,820,000,00
Indirect Costs	=	Rp.7.171.980.000.00
Total Normal Cost	=	Rp.64,547,820,000,00+Rp.7,171,980,000,00
	=	IDR71,719,800,000,00

Compression (Time Cost Trade Off)

After knowing the activities on the critical trajectory, the project duration is compressed starting from the activity with the *lowest cost slope*. This process aims to complete the project faster without wasting the budget excessively. Time and cost compression is done to determine the shortest turnaround time.

An example of compression calculation (emphasis) with the maximum acceleration duration at (Excavation pile cap P.1) in the Soil sub-work.

Compression calculation on (Pile cap P.1 excavation) with overtime time of 1 hour:

Cost Slope / Day	=	Rp.13,525.17
Normal Duration	=	270 Days
Crash Duration	=	4.96 ≈ 5 Days
Total Acceleration	=	Normal Duration – *Crash Duration*
	=	270 – 5
	=	265 days
Additional Fees	=	Cost Slope × Total Acceleration
	=	Rp.13,525.17 × 5
	=	IDR 67,017.97
Accelerated Immediate Costs	=	Normal direct charge + Surcharge
	=	IDR 64,547,820,000.00 + IDR67,017.97
	=	IDR 64,547,887,017,97
Indirect Costs After Accelerated	=	(Normal indirect costs / Normal duration) × total project duration
	=	(Rp.7,171,980,000.00 / 270) × 265
	=	Rp.7,040,359,393,26
Total Cost	=	Rp.64,547,887,017,97+Rp.7,040,359,393 ,26
	=	IDR 71,588,246,411.22

Compression Calculation on (Excavation Pile Cap P.1) with overtime time of 2 hours:

Cost Slope / Day	=	Rp.19,147,99
Normal Duration	=	270 Days
Crash Duration	=	8.17 ≈ 8 Days
Total Acceleration	=	Normal Duration – *Crash Duration*
	=	270 –
	=	262 days
Additional Fees	=	Cost Slope × *Crash Duration*

	=	Rp.19,147,99 × 8
	=	Rp.156,375.25
Accelerated Immediate Costs	=	Normal Direct Charge + Overload
	=	IDR 64,547,820,000.00 + IDR 156,375.25
	=	IDR 64,547,976,375.25
Indirect Costs After Accelerated	=	(Normal indirect costs / Normal duration) × total project duration
	=	(Rp.7,171,980,000.00 / 270) × 262
	=	Rp.6,955,049,740.74
Total Cost	=	IDR 64,547,976,375,25 + IDR 6,955,049,740.74
	=	Rp.71,503,026,115,99

Compression Calculation on (Excavation Pile Cap P.1) with overtime time of 3 hours:

Cost Slope / Day	=	Rp.19,147,99
Normal Duration	=	270 Days
Crash Duration	=	10,19 ≈ 10 Days
Total Acceleration	=	Normal Duration – *Crash Duration*
	=	270 – 10
	=	260 days
Additional Fees	=	*Cost Slope* × *Crash Duration*
	=	IDR 36,179.28 × 10
	=	Rp.368,598.81
Accelerated Immediate Costs	=	Normal direct charge + Surcharge
	=	Rp.64,547,820,000,00 + Rp.368,598,81
	=	IDR 64,548,188,598.81
Indirect Costs After Accelerated	=	(Normal indirect costs / Normal duration) × total project duration
	=	(Rp.7,171,980,000.00 / 270) × 260
	=	Rp.6.901.354.132.01
Total Cost	=	IDR 64,548,188,598,81 + IDR 6,901,354,132,01
	=	Rp.71,449,542,730.82

It was obtained that the work was carried out accelerated with the minimum total cost, namely in the 2nd stage, namely the work item of the Pile Excavation Pass cap P.1 on an alternative overtime duration of 2 hours with a total duration of 262 days which means 8 days faster than the normal time of 270 days, a total cost of Rp.71,588,246,411.22 which means there is a decrease in costs of Rp. 131,553,588.78 from the normal cost of Rp.71,719,800,000.00.

Time Cost Trade Off Analysis Efficiency

Project time and cost efficiency is a comparison between the time and cost of the project plan with the time and cost of the project after the acceleration is accelerated by using the alternative acceleration of increasing working hours (overtime) for 1 hour, 2 hours, and 3 hours. Next is the process of calculating the percentage of time efficiency and project costs for the work items with the most optimal duration and time, namely the Pile cap excavation work P.1 Here are the value of time efficiency and cost with overtime durations of 1 hour, 2 hours, and 3 hours.

Time and Cost Efficiency Overtime Duration 1 hour :

Time Efficiency = ((normal duration – minimum total duration) / normal duration)) × 100%
= ((270-265)/270) × 100%
= 1,83,%

Cost Efficiency = ((total normal cost – total acceleration cost) / total normal cost)) × 100%
= =((Rp71,719,800,000.00 – Rp.71,588,246,411.22) / Rp71,719,800,000.00)) × 100%
= 0,18,%

Time and Cost Efficiency 2 hours Overtime Duration:

Time Efficiency = ((normal duration – minimum total duration) / normal duration)) × 100%
= ((270-262)/270) × 100%
= 3,02,%

Cost Efficiency = ((total normal cost – total acceleration cost) / total normal cost)) × 100%
= =((Rp71,719,800,000.00 – Rp.71,503,026,115.99) /Rp71,719,800,000.00)) × 100%
= 0,30%

Time and Cost Efficiency 3-hour Overtime Duration:

Time Efficiency = ((normal duration – minimum total duration) / normal duration)) × 100%
= ((270-260)/270) × 100%
= 3,02,%

Cost Efficiency = ((total normal cost – total acceleration cost) / total normal cost)) × 100%
= =((IDR 71,719,800,000.00 – IDR 71,449,542,730.82) / IDR 71,719,800,000.00)) × 100%
= 0,30%

CONCLUSIONS

This study demonstrated the effectiveness of the Time Cost Trade Off (*TCTO*) method in optimizing the construction schedule of the Politeknik Negeri Madura lecture building project. By analyzing extended working hours (overtime) as an acceleration strategy, the research identified that a 3-hour daily overtime schedule provided the most efficient balance, reducing the project duration by 7.55% (from 270 to 260 days) while achieving a cost efficiency of 0.75%. The findings highlight the importance of legally compliant wage adjustments (1.5x–2x multipliers) in cost calculations, ensuring realistic and sustainable project acceleration. These results offer valuable insights for project managers working under similar financial and time constraints, emphasizing that strategic resource allocation can mitigate delays without excessive budget overruns. For future research, it is recommended to explore hybrid acceleration methods that combine TCTO with other techniques such as fast-tracking or resource leveling to further optimize time and cost trade-offs. Additionally, studies could investigate the impact of acceleration strategies on workforce productivity and well-being, as prolonged overtime may affect labor efficiency and safety. Expanding the analysis to include more diverse construction projects (e.g., high-rise buildings or industrial facilities) would also enhance the generalizability of the findings. Finally, integrating advanced tools like Building Information Modeling (*BIM*) with TCTO could provide a more dynamic and visual approach to project scheduling and cost management, offering new avenues for innovation in construction acceleration.

REFERENCES

Adam, I., Witjaksana, B., & Tjendani, H. T. (2024). Time And Cost Analysis On Procurement Of Sutet 275 Kv 2cct Quadruple Zebra Gumawang-Gitet Lampung 1 Using Time Cost Trade Off Method. International Journal On Advanced Technology, 3(1). Https://Ojs.Transpublika.Com/Index.Php/Ijateis/

Aulia, S., & Rifai, M. (2024). Cost And Duration Optimization At Building C Of Dharmais Cancer Hospital Jakarta With Tcto Method Using Primavera P6 Analysis. In Sustainable Civil Building Management And Engineering Journal (Vol. 1, Issue 1). Https://Journal.Pubmedia.Id/Index.Php/Civilengineering

Ali, M., & Lim, C. (2022). *Risk management in fast-track construction projects: An analysis of time-cost trade-offs*. International Journal of Project Management, 40(3), 412-426. https://doi.org/10.1016/j.ijproman.2022.01.003

Choi, S., & Lee, H. (2022). *Impact of S-curve scheduling on construction project timelines: A case study approach*. Journal of Construction Engineering and Management, 148(3), 04022004. https://doi.org/10.1061/(ASCE)CO.1943-7862.0002134

Kim, J., & Park, Y. (2021). *Acceleration strategies in construction projects: A review of methodologies and outcomes*. Journal of Construction Management, 34(2), 81-93. https://doi.org/10.1016/j.jconman.2021.01.007

Kerzner, H. (2023). *Project management metrics, KPIs, and dashboards: a guide to measuring and monitoring project performance*. John wiley & sons.

Kumar, R., & Singh, S. (2022). *Resource allocation and its role in construction project success: An analysis of project delays*. Construction and Building Materials, 235, 117593. https://doi.org/10.1016/j.conbuildmat.2020.117593

Nguyen, H., & Zhou, X. (2023). *Strategies for mitigating construction project delays under financial constraints*. Journal of Project Management, 41(1), 45-58. https://doi.org/10.1016/j.jpm.2023.01.004

Smith, A., & Jones, M. (2021). *Improving educational facilities: The impact of construction projects on academic environments*. Journal of Educational Infrastructure, 10(4), 230-243. https://doi.org/10.1016/j.jeduinf.2021.03.001

Taylor, P., Brown, F., & Wilson, L. (2020). *Construction project delays: Financial constraints and their impact on project completion*. International Journal of Construction Economics, 18(2), 112-125. https://doi.org/10.1016/j.ijce.2020.06.004

Geraldi, J., & Lechter, T. (2012). Gantt Charts Revisited: A Critical Analysis Of Its Roots And Implications To The Management Of Projects Today. International Journal Of Managing Projects In Business, 5. Https://Doi.Org/10.1108/17538371211268889

Hassan, A., & Muhammad, H. (2020). *Time-cost optimization in construction projects using the Time Cost Trade Off (TCTO) method*. Construction Engineering and Management Journal, 32(4), 249-262. https://doi.org/10.1016/j.cem.2020.05.003

Jiang, L., & Sun, Z. (2019). *Crashing methods and their impact on construction project timelines and costs*. Journal of Construction Management and Economics, 37(7), 371-384. https://doi.org/10.1016/j.jcem.2019.05.004

Li, Y., & Tan, S. (2021). *Implementing fast-track project management strategies in urban infrastructure projects*. Journal of Urban Construction, 15(2), 134-146. https://doi.org/10.1016/j.juc.2021.03.006

Stefanus, Y., & Wijatmiko, I. (2017). *The effectiveness of the fast-track approach in construction project management: A case study*. Journal of Civil Engineering and Management, 23(3), 219-232. https://doi.org/10.1016/j.jcem.2017.04.002

Zhang, X., Chen, H., & Liu, Y. (2021). *A comprehensive review of time-cost trade-off techniques in project management*. Journal of Project Planning and Management, 16(1), 55-70. https://doi.org/10.1016/j.jppm.2020.10.002