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Optimization of construction project time for type 85 boarding house using a simple path method

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ABSTRACT

The growth of the construction sector in Indonesia has driven high demand for rental housing, such as boarding houses, especially in major cities like Samarinda. However, delays in construction projects remain a common issue that can affect cost efficiency and investment potential. The purpose of this study is to evaluate the effectiveness of the simple Critical Path Method (CPM) in optimizing the construction time of a Type 85 boarding house project in Samarinda City. CPM is applied through activity mapping, duration determination, and the creation of a work network diagram. Data were obtained through field observations, project documentation studies, and interviews with contractors. The analysis results show that the project's critical path consists of a series of activities: A – B – C – D – H – F – G – I – J – K – L. By using CPM method, The project timeline can be shortened from 333 days to 283 days, leading to a 15% reduction in duration.These findings indicate that even in its simplified form, the application of CPM can improve time efficiency and help small subcontractors manage projects in a more organized and timely manner.

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INTRODUCTION

The Construction sector in indonesia has experienced tremendous growth over the past decade. According to data Badan Pusat Statistik (2023), The construction sector's contribution to Indonesia's GDP reached 10.34%, with an annual growth rate of 5.01%. One of the fastest growing categories is commercial building construction, especially residential buildings. This is especially evident in large cities, where rapid urbanization has created a huge demand for affordable and easily accessible boarding houses or rentals.

The simple Critical Path Method approach can be an effective and efficient solution, both in theory and practice, especially for small-scale projects such as boarding house construction. Theoretically, CPM allows for optimal management of time and resources. While in practice, this method facilitates the decision-making process in the field by emphasizing critical activities that

have a major impact on the duration of the project. Thus, resource limitations can be managed well without reducing the quality of the results or extending the project completion time.

Home buyers often choose type 85 houses for three reasons. First, this type of building is very cost-effective, allowing for a quick return on investment (ROI). Second, type 85 houses are individually designed so they are easier to build. Third, household retirement is one of the most resilient to economic changes because its demand is unchangeable.

However, various management issues often arise when implementing pension infrastructure. A study by Asmi & Pratama (2016) found that 78% of construction projects in South Asia experienced delays of between 30% and 40% compared to the planned time. These delays have wide-ranging consequences, ranging from increased construction costs due to shortages of materials and wages to lost investor opportunities due to delays in business operations.

Based on a study by Asmi & Pratama (2016) this research was conducted to explore the reasons behind delays in 53 telecommunication projects across Nigeria, using a questionnaire-based survey. The findings revealed that there are seven primary contributors to these delays. These include the lack of experience among contractors, consistently high and unstable material prices, frequent modifications to project designs, and broader issues such as economic instability. Additionally, financial challenges like elevated loan interest rates for contractors, payment methods, and issues related to funding and disbursement also played significant roles in hindering project timelines.

Boarding houses or rented houses are facilities needed by students or office workers whose schools or workplaces are far from their homes. Having a boarding house or rented house close to the area can shorten the journey or travel time to the destination. Seeing this, many people build boarding houses for long-term investment. To build a boarding house, a mature budget plan is needed. (Kaya dkk., 2022).

Building a boarding house or rental house requires careful planning, especially in terms of time and budget. One of the main challenges is avoiding delays that can increase costs and disrupt rental plans. Therefore, the application of effective project management methods, such as the CPM, is very important. This method helps identify critical tasks in a project so that completion time can be optimized. With proper planning, building a boarding house is not only more efficient but also more profitable as a long-term investment.

In the construction of boarding houses or rental houses, CPM, which is very suitable as a project management tool, has proven effective in overcoming delay problems. This method, originally developed by DuPont in 1957, has shown significant improvements in practice. A recent study shows that the application of CPM combined with Building Information Modeling (BIM) technology can increase the accuracy of construction planning by up to 35% (J Pantiga & A Soekiman 2021).

In Indonesia, the use of financial cost management in small-scale projects, such as pension payments, is still not widely used. A study by Handayani (2020) found that only 22% of subcontractors used scientific methods in project planning. This is in line with the findings of Rakasyiwi et al. (2022) which states that CPM is more widely applied to large projects (e.g., konstruksi infrastruktur) by certified contractors, while small projects still rely on empirical experience. The lack of adoption of CPM in small subcontractors is due to resource constraints, lack of training, and the perception that this method is complicated for simple projects. (Siregar dkk., 2021). Another case study proves that the implementation of CPM in the distribution of social assistance is able to reduce delays in disbursement of funds by up to 30%. Therefore, this study will test the feasibility of adapting a simplified CPM for a pension payment project, taking into account existing resource constraints. (Oleh & Asmoro, 2024).

Although the above studies have identified the low use of scientific methods in small-scale project planning, they have not examined in more depth the factors inhibiting the adoption of financial cost management, such as resource constraints, lack of training, or subcontractor

perceptions of its benefits. In addition, there have been no studies comparing the effectiveness of the method (CPM) to evaluate the time efficiency of boarding house construction.

This study aims to identify the critical path and activities that most affect the total duration using CPM. From the results of the analysis, strategic recommendations will be formulated to reduce the duration of project implementation without sacrificing construction quality. This study aims to analyze the efficiency of the implementation time of one of the Type 85 boarding house constructions through the application of the (CPM) method in Samarinda City. Specifically, the study will identify the critical path of the project and determine the activities that most affect the total duration of the work, so that vulnerable points that have the potential to cause delays can be identified. (Akbar & Mar'aini, 2022).

This study aims to determine the optimization of time obtained from the application of CPM. This topic is important because of the importance of development in human life and the importance of saving time.

According to the Technical and Economic Analysis of the Influence of Tonnage and Manpower Productivity on the Speed of Barge Repair Progress at PT Kukar Mandiri Shipyard with the (CPM) approach (Saputra dkk., 2021), The CPM method can speed up the processing time by around 10%-25%. According to the Technical and Economic Analysis of the Effect of Tonnage and Manpower Productivity on the Speed of Barge Repair Progress at PT Kukar Mandiri Shipyard with the (CPM) approach (Hasan & Basuki, 2024). CPM in this project accelerates work by about 10%-25%, increases manpower productivity by 15-30%, and saves costs by 5-20%. According to CPM Analysis of Rolai-Rinjlai Road Construction (Sunita & Snigdha, 2013a). In the Rolai-Rinjani Road Construction project, CPM resulted in 15-30% faster completion, 5-15% cost savings, and increased the accuracy of equipment and manpower scheduling.

According to the Technical and Economic Analysis of the Influence of Tonnage and Manpower Productivity on the Speed of Barge Repair Progress at PT Kukar Mandiri Shipyard using the CPM approach(Hasan & Basuki, 2024), CPM in this project speeds up work by around 10%-25%, increases manpower productivity by 15-30%, and saves costs by 5-20%.

According to CPM Analysis of Role-Rinjani Road Construction (2013). In the Rolai-Rinjani Road Construction project, CPM resulted in 15-30% faster completion, 5-15% cost savings, and increased the accuracy of equipment and manpower scheduling. Some of the studies above show a positive influence on development using the CPM method to carry out efficiency and optimization of work. So further research is needed in this project.

RESEARCH METHOD

The research method applied is CPM with a simple approach (Perdana & Rahman, 2019), Ras, t.t 2007.). The steps include mapping construction activities, determining duration and dependencies, and using Microsoft project-based software or manual calculations. The analysis is done using a simple CPM, which includes identifying key project milestones, using network diagrams as a guide, and determining start and finish times (Arifuddin dkk., 2024), (M. Yoka Fathoni dkk., 2024).

The selection of core activities in CPM is determined by factors such as the logic of the work sequence, resource availability, duration of work, and risk level. The accuracy of determining the critical path is achieved through collaboration with project actors, validation of field data, and continuous monitoring. In this way, CPM is not just a theoretical concept, but actually functions as a decision-making tool that is in accordance with the dynamics of the project in the field.

The focus of the analysis is to find the critical path as a basis for schedule optimization, taking into account float time and the possibility of schedule compression without adding significant costs (Fatkhurrohman, 2022), Fauzananda, 2025). Data were obtained through field observations, documentation studies (such as working drawings, RAB, and project schedules), and interviews with related parties such as contractors and field supervisors. The analysis was carried

out by identifying critical activities, calculating duration, and determining the longest path that affects project completion. The results of the CPM analysis are then used to evaluate time efficiency and provide recommendations for schedule improvements.

Data Processing

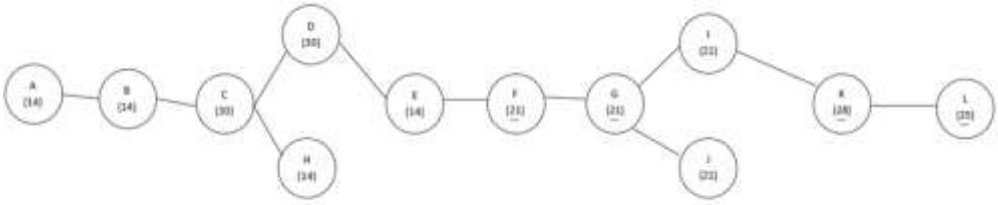
The processing of this research data is carried out through a series of systematic stages to support network planning and critical path identification. These stages include: (a) determining the code and duration of each job to facilitate the preparation of network planning; (b) creating a network diagram based on flow logic and dependencies between activities; (c) calculating the Earliest Event Time (EET) to determine the earliest time an event occurs; (d) calculating the Latest Event Time (LET) to determine the latest time the event occurs; and (e) determining the critical path, which is the path that passes through an event with an EET value equal to LET (Surahman dkk., 2024).

Activities According to Normal Time from Cost Budget Plan

Tabel 1. Data processed (2025)

No	Work	Work Code	Duration (Day)
1	Preparation	A	14
2	Excavation, Embankment and Piling	B	14
3	Concrete Work	C	30
4	Wall work and wall finishing	D	30
5	Roofing work	E	14
6	Ceiling Work	F	21
7	Electrical Work	G	21
8	Door and Window Frame Work	H	14
9	Sanitation and Water Works	I	21
10	Floor Work	J	21
11	Painting and Finishing	K	28
12	Other Jobs	L	25

Source: Data Processed (2025)



Picture 1. Analize Using Critical Path Method (CPM)

RESULTS AND DISCUSSIONS

Project Activity Process Overview

This research focused on observing the implementation process of a boarding house construction project that took 333 days to complete. The project was executed by a 4 person team, with overall management and supervision led by Mr. Totok. All construction materials were prepared in advance and supplied directly by the project owner prior to the start of the building phase. For data collection, the study employed an in-depth interview approach, where researchers engaged directly with the project owner to gather detailed insights. (Arman dkk., 2020). The variables analyzed include the main stages in the construction process, initial activities that

support the smooth running of subsequent activities, as well as estimates of the fastest duration and normal duration for each stage of work (Kusumah & Tomby, 2024).

Tabel 2. Rekapitulasi Aktivitas Proyek

No	Work	Code	Duration (Day) Normal	Duration (Day) *Quick Time*	Predecessor
1	Preparation	A	14	10	-
2	Excavation, Embankment and Piling	B	14	14	A
3	Concrete Work	C	30	30	B
4	Wall work and wall finishing	D	31	30	C
5	Roofing Work	E	21	14	D
6	Electrical Work	F	31	21	E
7	Ceiling Work	G	25	21	F
8	Door and Window Frame Work	H	21	14	C
9	Sanitation and Water Works	I	30	21	G
10	Floor Works	J	25	21	G
11	Painting and Finishing	K	60	28	I, J
12	Other Works	L	31	25	K

Source: data processed (2025)

Normal Duration Job Network

Based on the summary of project activities presented in Table 2, the researcher outlines the network scheme using the normal duration of each task. The construction project officially commenced on August 1, 2024, and is projected to conclude on June 30, 2025, resulting in a total normal duration of 333 working days. This timeline is established in reference to the activity details provided in Table 1, the normal duration work plan scheme can be prepared as follows:

Picture 2. Normal Time Plan Scheme

Picture 2. shows a series of activities that must be carried out in this project, starting from the preparatory work stage to finishing work and other work at the end of construction. The analysis of the scheme shows that activities A, B, C, D, E, F, G, H, I, J, K, and L form the main flow (critical path) that must be completed on time so that the project schedule is not disrupted.

By applying CPM to project network modeling, the critical path becomes a key instrument in estimating completion duration (Prabowo, 2019). The CPM network method is used to analyze a problem by estimating the most economical project schedule, based on the direct costs required to accelerate the completion of each project component (Leatemia dkk., 2013). In addition, this method also aims to determine the most optimal schedule by considering both direct and indirect costs. (Hermawan & Siswoyo, 2019). Based on the accumulated duration of each project activity, the total project implementation time is estimated to reach 333 days, which indicates the standard time required to complete all construction series activities.

Job Networking with Quick Time Using CPM

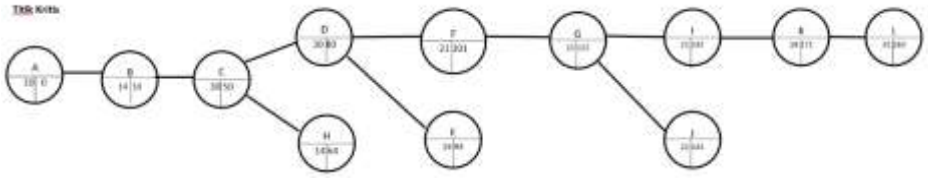
In implementing a work network with Quick Time, the stages taken are basically the same as a work network with normal duration (Samudera, 2019). This refers to the summary data from the project activities listed in Table 1.

Tabel 3. Activities Quick Time

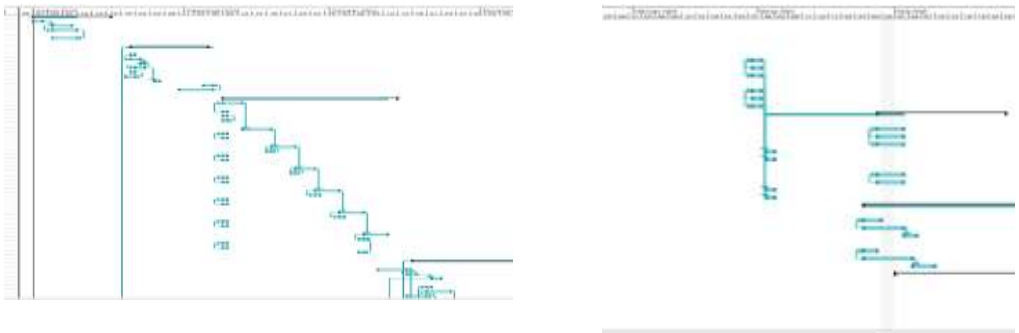
No	Work	Work Code	Duration (Day) *Quick Time*	Predecessor
1	Preparation	A	10	-
2	Excavation, Embankment and Piling	B	14	10
3	Concrete Work	C	30	50
4	Wall work and wall finishing	D	30	80
5	Roofing Work	E	14	94
6	Electrical Work	F	21	101
7	Ceiling Work	G	21	122
8	Door and Window Frame Work	H	14	64
9	Sanitation and Water Works	I	21	143
10	Floor Works	J	21	143
11	Painting and Finishing	K	28	171
12	Other Works	L	25	283

Source: Data Processed (2025)

Based on data from Table 3. The construction process of the shophouses began on August 1, 2024 and was completed on May 10, 2025. This resulted in a fast-paced network diagram as shown in the following figure.



Picture 3. Plan Scheme Quick Time



Picture 4. Gantt Chart in Microsoft Project

Picture 3 shows the identification of the critical path along with the calculation of the duration required for each activity in the project, according to the approach to the scheme at normal time. The difference lies in the accumulation of the duration of the implementation of the entire series of activities. In the normal time diagram, the critical path is consistently and defined as the sequence A – B – C – D – H – F – G – I – J – K – L.

As per Figure 3, the critical path provides a comprehensive overview of which jobs play a very important role in the total duration of the job (Anggraini dkk., 2022). This sequence will be used as the main reference in the construction process to be used as material for further analysis, because if there is a delay on the critical path, it will have a direct impact on the completion time (Perwitasari dkk., 2021). To estimate the project's completion time, the Critical Path Method (CPM) is applied, focusing on the sequence of critical activities. This method enables a more organized and precise calculation by summing the durations of each task along the critical path, ensuring a clear and structured projection of the overall project timeline. (Sepriano dkk., 2025).

A 50-day project development can incur significant costs. In terms of labor, costs may increase due to the need for additional workers, overtime hours, or a more intensive shift system, while time pressure risks reducing productivity and causing inefficiencies in the use of labor. In terms of materials, drastic schedule changes can trigger additional costs for emergency procurement, including more expensive expedition costs or the need for additional storage facilities. The risk of material damage also increases due to hasty handling, such as building materials that are not stored properly.

On the positive side, faster project completion allows the building to immediately generate income through rentals. However, this acceleration may require additional costs to complete various operational aspects prematurely, such as completing utility installations and building completions.

Following the established sequence, the estimated completion time for the boarding house construction project can be determined using the Critical Path Method (CPM) model. To identify the shortest possible project duration, the total time is calculated by aggregating the durations of each activity within the network scheme.(Tubaka, 2017). The analysis revealed that the minimum time needed to complete the boarding house construction project was 283 days.

CONCLUSION

The calculation of the duration of time using the CPM method shows that the critical path of the boarding house construction project is A – B – C – D – H – F – G – I – J – K – L. Using this method results in an estimated time of 283 days from the initial 333 days, which means saving 15% of the first estimate. Meanwhile, delivery of goods, weather, and supervision can affect project implementation, with factors causing delays such as humans, materials, and the environment.

Small contractors can implement the CPM method too without having to use complicated software. By utilizing visual approaches such as work boards, manual methods, and team collaboration, CPM can still be run effectively. This simple method can help in time management, job prioritization, and efficient use of resources. The success of its implementation depends on the simplicity of the approach, active involvement of the team in the field, and regular and consistent monitoring.

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