Comparative Study of the Fast Track Method with the Crash Program Method in Accelerating Time and Costs

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Abstract

In many projects, delays are common, so it's important to make efforts to speed up the process and avoid them. This study investigates two methods of acceleration: the Fast Track method and the Crash Program method. The normal duration for this project is 180 days with a total cost of Rp. 14,666,588,288.29. The study uses MS Project to identify critical path activities that can be accelerated. The Fast Track method reduced the project time to 149 days at a cost of Rp. 14,287,701,424.18, while the Crash Program method reduced it to 144 days at a cost of Rp. 14,318,586,553.16. The study compares the time and cost outcomes of the two methods. The difference is due to the Fast Track method not incurring an increase in direct costs, only reducing indirect costs by changing predecessors. On the other hand, the Crash Program method resulted in additional direct costs but reduced indirect costs by adding 2 hours of overtime work.

Keywords: *acceleration, fast track, crash program, time, cost.*

1. Introduction

The construction industry is growing rapidly, leading to an increased demand for engineering graduates. Successful construction projects rely on careful planning. According to Siti Hardayanti et al. (2022), a successful construction project meets quality requirements, is completed on time, and stays within the specified budget. Large construction projects need to be finished in a matter of months, requiring effective project management to plan, organize, and monitor available resources. Quality, time, and cost are the three primary components influencing project success, and optimizing one aspect may impact others, as noted by Gede Wira Hadinata (2013).

Contractors must manage construction projects systematically to ensure timely completion, turning costs into profits and avoiding fines resulting from delays. Failure to start construction on time could lead to fines or administrative sanctions as per Presidential Decree No. 12 of 2021 concerning Government Procurement of Goods and Services. Delays can also incur costs, reduce competitive value, and harm future project opportunities for contractors, ultimately impacting the project owner.

For example, the Simalas - Simalungun Regency boundary road improvement project, with a lane width of 4.5 m and a road length of 4,994 km, has a contract value of Rp. 16,279,913,000.00. This road connects Serdang Berdagai Regency and Simalungun Regency. To avoid delays and associated fines, accelerating construction projects' time and costs is crucial.

When scheduling construction projects, the fast track and crash program methods are essential to expedite project completion. The fast track method employs overlapping or parallel activities to shorten the project duration, while the crash program utilizes additional labor, changing shifts, and increased working time to expedite completion.

The primary objective is to determine the time and cost acceleration using the crash program and fast track methods and to compare the results for efficiency in completing the project with the shortest duration and optimal costs.

2. Material and Methods

2.1 Crash Program

One way to accelerate project completion is through a scheduling method called a crash program. The critical path of a project can be determined using the Critical Path Method (CPM), which helps identify activities that can be expedited. Employing a crash program will escalate direct costs and

resources on the critical path. There are several parameters to consider when determining how to accelerate project time.

a. Daily Productivity

$$= \frac{\text{Volume}}{\text{Normal Duration}} \quad (1)$$

b. Hourly Productivity

$$= \frac{\text{Daily Productivity}}{\text{8 hours of work}} \quad (2)$$

c. Daily Productivity After Crash

= (8 hours of work x Hourly Productivity) + (a x c x Hourly Productivity) (3)

Table 1 Coefficient of reduction in work productivity

Overtime Hours (a)	Productivity Index Decrease Coefficient (b)	Performance (%) (c)
1 jam	0,1	90
2 jam	0,2	80
3 jam	0,3	70
4 jam	0.4	60

Source: (Soeharto, 1997)

Where :
a = Length of additional working hours
b = Coefficient of decrease in productivity by increasing working hours

d. Crash Duration

$$= \frac{\text{Volume}}{\text{Daily productivity after the crash}} \quad (4)$$

e. *Crash Cost* Total

- Normal Cost a hour
  = Hourly productivity x (Unit price of labor + Unit price of equipment) (5)
- Normal Cost of Workers a day
  = 7 hours x Normal Cost of workers a hour (6)
- Worker overtime costs a day
  = (first hour of overtime work x1.5 x normal hourly wagel) + (next overtime hours x 2 x normal hourly wage) (7)
- Crash Cost of Workers a day
  = Normal worker costs a day + overtime costs a day (8)
- Crash Cost Total
  = Crash Cost of workers per day x crash duration) + (Unit price of material x volume) (9)

f. Slope

$$= \frac{\text{Crash Cost - Normal Cost}}{\text{Normal Duration - Crash Duration}} \quad (10)$$

2.2 Fast Track

In construction projects, a fast track is an effort to complete a project faster than normal time by implementing an overlapping (parallel) strategy or starting work earlier than planned. The main principles of implementing fast track in project scheduling planning include the following (Tjaturono, 2014):

1. The principle of parallel systems is used to perform logical activities on critical paths. They can also complete one activity after another according to the start-to-start principle.
2. Logical relationships between activities must be logical, empirical, and utilize real productivity.
3. Consider the number, timing, resources, and productivity of critical path activities.
4. Fast track the critical path.

5. Acceleration should be no more than 50% of normal time.
6. Speed up time, particularly for activities with the longest duration and those with the shortest duration, which is at least one day.

3. Results and Discussion

3.1 Critical Path Determination Results

According to the analysis, the connection between jobs (predecessor and successor) in the schedule varies based on the start and end times of the work. After arranging the job relationships using Microsoft

Figure 1 Job Relatedness

From the results of predecessors which have been prepared using the Microsoft project program, it is found that work is on a critical path, which can be seen in Table 2 as follows:

Table 2 Jobs that are on the critical path

No	Job Name	Duration	Volume	Unit
1	Selected Stockpiles from Excavated Sources	42 days	1.296,96	M^3
2	Road Body Preparation	21 days	25.420	M^2
3	Class A Aggregate Foundation Layer	49 days	4.942	M^3
4	Structural Concrete fc'20 MPa	28 days	67	M^3
5	Welded Wire Mesh	28 days	1.689,2	M^3
6	Install Stones	14 days	7,89	M^3
7	Thermoplastic Road Markings	14 days	358,57	M^2

3.2 Fast Track method analysis results

The results of scheduling using the Microsoft Project program show a critical path that can be completed more quickly. The accelerated completion time is 31 days, leading to a reduction in indirect costs of Rp. 378,886,864.11. You can see the acceleration results in Figure 2 below.

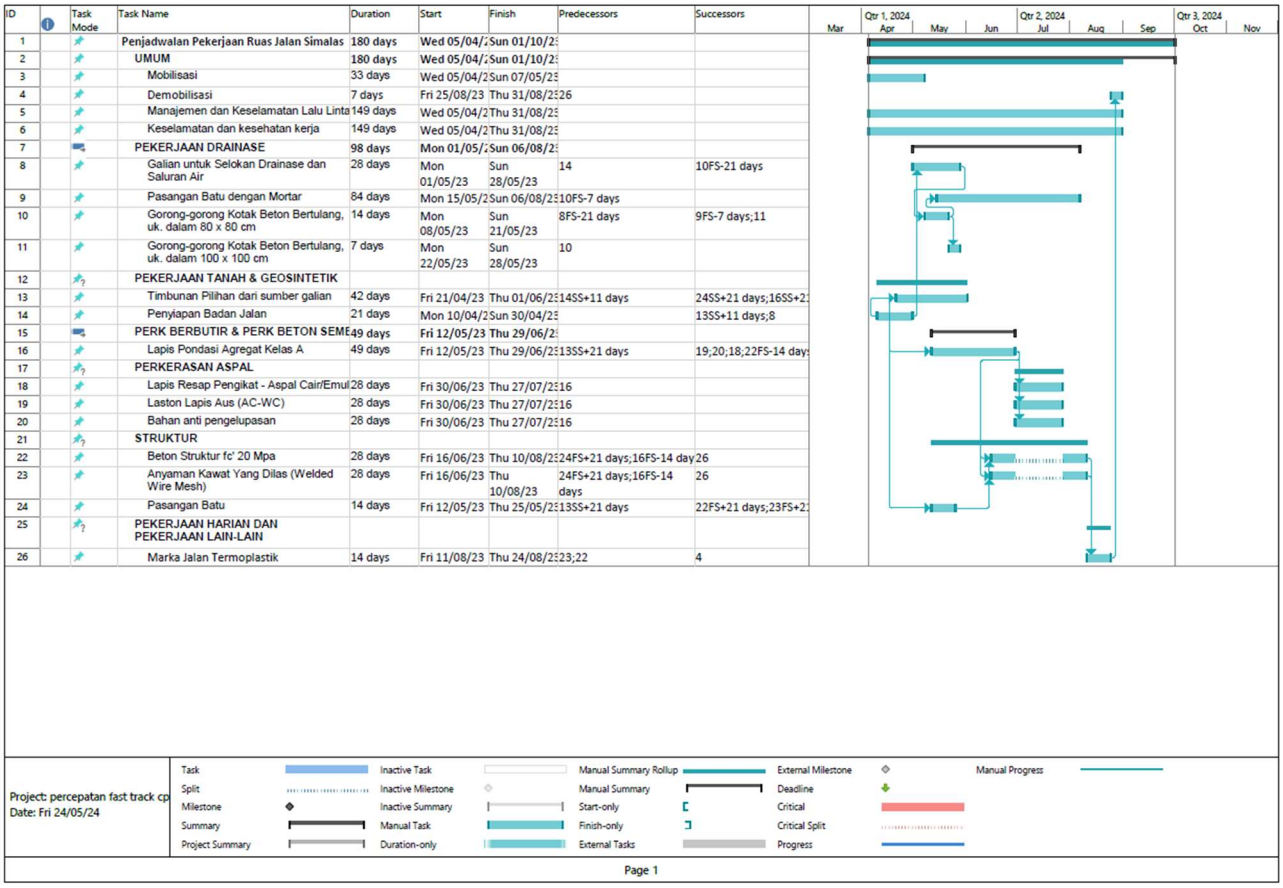

Figure 2 Analysis Results using the Fast Track Method

3.3 Results of Program Crash Method Analysis

In order to avoid project delays, we applied the crash program method to minimize problems caused by various factors. By scheduling with the Microsoft Project program, we identified critical paths for work that could be completed more quickly by utilizing the Crash program method to optimize costs. The results showed an acceleration of the project by 36 days and a cost reduction of Rp. 348,000,753.13, which can be seen in Table 3 below.

Table 3 Crashing Duration Results

Job description	**Normal Duration**	**Crash 2 Hours**	**Acceleration**
1. Earthfill Work	42	34	8
2.Road Body Preparation	21	18	3
3. Foundation Layer	49	40	9
4. Stone Pair	14	11	3
5. Structural Concrete fc' 20 Mpa	28	23	5
6. Welded Wire Woven	28	23	5
7. Thermoplastic Road Markings	14	11	3
Total Crash Duration			36

The Crash program calculations have determined that the project to improve the road section on the Simalas - Simalungun Regency border can be completed in an accelerated duration of 36 days. This can be achieved by adding 2 hours of overtime work per day. As a result, the total duration for the completion of the Simalas - Simalungun Regency border road section improvement project would be reduced to 144 days. However, it's important to note that the acceleration in the project timeline will lead to an increase in direct costs due to the additional 2 hours of overtime work per day. Details of the increased direct costs can be found in the table below.

Table 4 Results of Additional Costs of 2 Hours of Overtime Work

No	Job description	Normal Fees	Crash Cost	Slope
1	Earthfill Work	Rp763.510.249,09	Rp909.747.412,50	Rp18.279.645,43
2	Road Body Preparation	Rp61.708.943,79	Rp81.166.241,57	Rp6.485.765,93
3	Foundation Layer	Rp4.079.622.131,72	Rp4.659.985.784,62	Rp64.484.850,32
4	Stone Pair	Rp10.791.006,12	Rp11.298.208,47	Rp169.067,45
5	Structural Concrete fc' 20 Mpa	Rp177.574.256,78	Rp181.623.617,87	Rp809.872,22
6	Welded Wire Woven	Rp37.623.114,34	Rp40.659.346,25	Rp607.246,38
7	Thermoplastic Road Markings	Rp61.664.984,49	Rp63.565.432,72	Rp633.482,74
Total Slope				Rp91.469.930,74

The reduction in indirect costs from acceleration using the crash program method from the total project duration of 180 days to 144 days. The indirect cost reductions from the crash program method are as follows:

Indirect Cost = 15% x total cost
= 15 % x *Rp*. 14.666.588.288,29
= *Rp*. 2.199.988.243,24

Indirect Cost $= \frac{Indirect\ cost}{\text{Duration}}$

$= \frac{\text{Rp. 2.199.988.243,24}}{180}$

= Rp.12.222.156,91

Reduced costs = *indirect cost a day* x acceleration duration
= Rp. 12.222.156,91 x 36
= Rp. 439.997.648.65

Total *indirect cost crash* = *indirect cost - reduced costs*
= Rp. 2.199.988.243,24 - Rp. 439.997.648.65
= Rp.1.759.990.594,59

total cost after crash
= *direct cos t+ slope + indirect cost after crash*
= Rp12.466.600.045,05 + Rp.91.469.930,74 + Rp.1.759.990.594,59
= Rp.14.318.060.570,11

3.4 Comparison of the Fast Track Method with the Crash Program Method

In this research, two acceleration methods are considered: the fast track method and the crash program method. The fast track method shortens the time from 180 days to 149 days and costs Rp 14,287,701,424.18, resulting in a cost reduction of Rp 378,886,864.11. On the other hand, the crash program method reduces the time from 180 days to 144 days with a cost of Rp 14,287,701,424.18. These details can be found in Table 5 below.

Table 5 Comparison Results of Two Methods

Condition	Normal	Fast Track		Crash Program	
		Result	Difference	Result	Difference
Budget (Rp)	Rp 14,666,588,288.00	Rp 14,287,701,424.00	Rp 378,886,864.00	Rp 14,318,586,553.00	Rp 348,000,753.00
Duration	180	149	31	144	36

4. Conclusion

The research analysis concluded the following results:

1. This study employed two methods to reduce time and costs. The fast track method and the crash program method each resulted in a time reduction of 149 days with a total cost of 14,287,701,424.18. Meanwhile, the crash program method achieved a time reduction of 144 days with a total cost of 14,318,586,553.16.
2. The fast track method yielded a time reduction of 31 days with a budget decrease of Rp. 378,886,864.11. On the other hand, the crash program method led to a time reduction of 36 days with a cost decrease of Rp. 348,527,718.18.

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