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Optimization of Multi Contruction Project Implementation with Limited Human Resource, Time, and Capital Using the Resource Leveling Method

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ABSTRACT: The quality and quantity of the number of projects that can be done in units of time into their own selling points for construction service companies in order to continue to compete in the industry. The limitations of human resources, time, and capital are often the problems experienced by companies to meet ever-increasing client demands. This situation needs to be evaluated further. The evaluation of the construction of several construction projects in time can be done by Critical Part Method (CPM) approach to analyze the critical path of a project, Project Evaluation Review Technique (PERT) to know the porsentation of the same project work if done in the future, and Resource Leveling for human resource allocation to avoid recruitment and retraining of workers. Based on research with CPM method, it is found that critical activity is a reference activity that should not be delayed, by using PERT, it can be concluded that some of the allocation and acceleration options of the project can be done based on Z table, and with Resource Leveling, the result of improvement of worker efficiency. This research uses CPM and PERT algorithm to see the allocation of work for multi level and resource leveling as field reference. Effectiveness and efficiency of company performance obtained result of efficiency improvement equal to 24,95% for worker payment and 33,35% for acceleration of project development according to result of research.

KEYWORDS: CPM, Multi Project Construction, PERT, Resource Leveling

1. INTRODUCTION

Development of infrastructure in Indonesia by project consultants who undertake various activities as well as benefit from institutions/institutions. Some of the most common areas of human resource (HR) services, machinery, capital, job risk, and time with satisfactory results, and some unpredictable external factors such as weather and location. PT Sarana Bangun Perkasa includes a company engaged in services with multi tasks of construction in units of time. PT Sarana Bangun Perkasa in 2017 undertook multi construction project management at several locations prioritized for the island of Java, currently in Solo.

PT Sarana Bangun Perkasa has limited Human Resources (HR), due to the availability of human resources that are difficult to obtain. PT Sarana Bangun Perkasa in this 2 (two) years develop multi construction projects that are known in the scheduling of labor is still less than optimal. This less-than-optimal scheduling leads to delay in project completion time resulting in large payout payments. Based on the problems that occur, the need to optimize existing human resources to improve the efficiency and effectiveness of the performance of the company.

2. METHODOLOGY

The employed methodology in this study is experimental empirical research. The experimental empirical research method is carried out by designing and testing the tool in real time, so that data is obtained directly from the designed tool. As shown here, the employed methodology consists of two distinct steps. Each of these steps are further discussed in subsequent sections.

2.1 Critical Path Method (CPM)

CPM is the basis of system planning and control of work progress based on network or network. The CPM was first used in the UK in the mid-50s on a power plant project, and was developed by the Intergrated Engineering Control Group of E.I du Pont de Nemours and Company initiated by Walker and Kelly jr. in 1957, both from Reningtone Rand, Univac Computer Division, called Critical Path Scheduling (CPS). There are 2 methods of calculation in CPM analysis, other:

1) Advanced calculations

The calculation of forward and backward moves start from the initial event to the terminal event (meaning is to calculate the most fastest time of events).

2) Countdown.

The countdown moves from the event terminal to the initial event. The purpose of the countdown is to calculate the slowest event and at the very least the commencement and completion of activities (TL, LS, and LF).

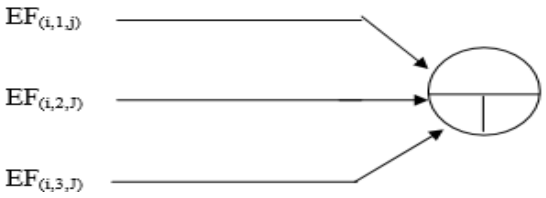

Fig. 1. Events That Combine Multiple Activities

2.2 Project Evaluation Review Technique (PERT)

PERT is a network analysis technique used to estimate the length of time of the project if there is a degree of uncertainty about individual activities. PERT applies the critical path method to estimate the average duration.

Olson states that uncertainty in the PERT method for the duration of project activity is required, there are three estimates of the duration of activity, including minimum time, average time, and maximum time.

2.3 Resource Leveling

Resource Leveling is an attempt to level the frequency of resource allocation with the goal of ensuring the number or type of resources to be known from scratch and available when needed. Usually when the amount of resources is reduced, the duration will increase, otherwise when the amount of resources is added, the duration will decrease.

Based on the limited availability of resources due to scarcity by increasing the duration of the project so the project can be slower than planned. Aligning resources can be done with several steps that can help, among others:

1) Create a network, include time for each activity
2) Plot the use of resources for each activity, then describe the network and resources needed in the time graph of human resources, using the earliest time (ES, EF).

3. RESULTS AND DISCUSSION

The following is data from the number of workers:

Table 1. Number of Workers

Type of project	rkers ne od n ount
tel Contruction (10m x 12m)	
spital Contruction (60m x 50m)	
artment Contruction (30m x 60m)	)
Total	)

Here is the data from the applied work station:

Table 2. Number of Work Stations

Jenis Proyek	siun Kerja
tel Contruction (10m x 12m)	21
spital Contruction (60m x 50m)	17
artment Contruction (30m x 60m)	39
Total	77

Allocations conducted in this study include:

1) Human resource allocation with option (50:50)

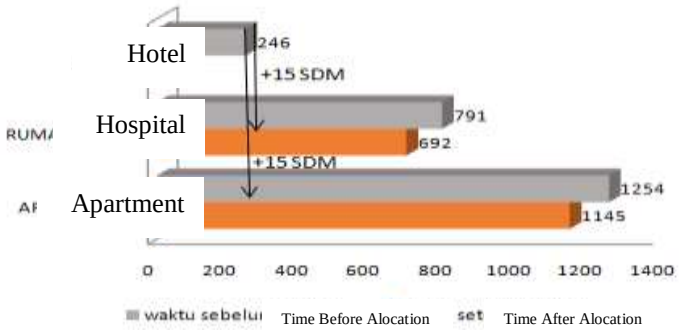

Fig. 2. The Allocation of Human Resources from Hotels by Comparison 50:50

Cost of hospital construction when referring to the company data obtained value as much as Rp.3.203.550.000-, while the cost of apartment development when referring to the company data obtained value of Rp.7.962.900.000-. The data of image allocation calculation 5 is as follows:

a. Hospital construction with additional 15 workers

The optimistic time of the worker can be known that is 692 days. Total hospital construction workers for masons 20, 25 carpenters, and smith 25. So the cost of the company can be calculated by:

i. Fixed cost ((20*65000*692) + (25 *55000*692) + (25*55000*692)) = 2,802,600,000
ii. Variable cost ((5*65000*446) + (5* 55000*446) + (5*55000*446)) = 390,250,000
iii. So the total cost of the company after the allocation of 15 SDM as much (2.802.600.000 + 390.250.000) = 3.192.850.000
iv. The cost efficiency of a company is (3.203.550.000 - 3.192.850.000) = 10.700.000

b. Apartment construction with additional 15 workers

Apartment construction with additional 15 workers. Total construction workers for masonry 30, 40, and smith 40. So that company cost can be calculated by:

i. Fixed cost cost ((30*65000*1145) + (40*55000*1145) + (40*55000*1145)) = 7,270,750,000
ii. Variable cost ((5*65000*899) + (5*55000*899) + (5*55000*899)) = 786,625,000

iii. So the total cost of the company after the allocation of 15 SDM as much (7.270.750.000+786.625.000) = 8,057,375,000

iv. The cost efficiency of a company is (7,962,900,000-8,057,375,000) = -94,475,000

2) Advanced HR allocation after hospital completion.

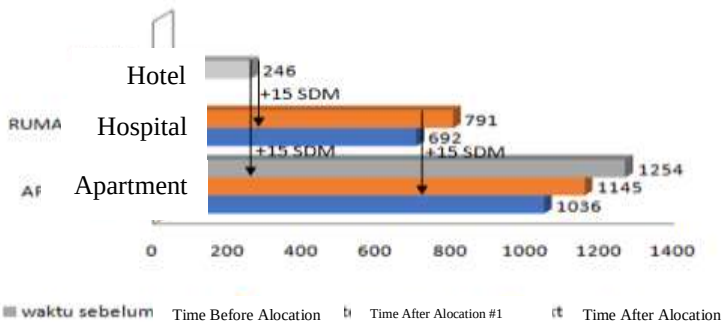

Fig. 3. Supplemental Allocation of 15 SDM After Hospital Construction

Cost of apartment development when referring to data acceleration by PERT method, then known completion for 1145 days obtained value of Rp.7.270.750.000-. The data of image allocation calculation 6 is as follows:

i. Fixed cost cost fixed ((30*65000* 1036) + (40*55000*1036) = 6,578,600,000

ii. Variable cost 1 ((5*65000*790) + (5* 55000*790) + (5*55000*790)) = 691,250,000

iii. Variable cost 2 ((5*65000*344) + (5* 55000*344) + (5*55000*344)) = 301,000,000

iv. So the total cost of the company after the allocation of 30 human resources as much (6,578,600,000+691,250,000+ 301,000,000) = 7,570,850,000

v. The cost efficiency of the company is (7,270,750,000-7,570,850,000) = -300.100.000-94.475.000 = -394.575.000

3) Human resource allocation with option (0: 100)

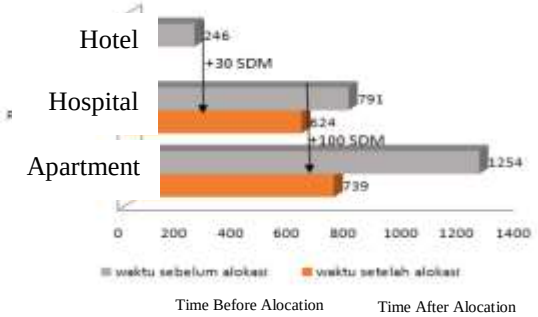

Fig. 4. Human Resource Allocation from Hotel By Comparison 0: 100

It is known that the allocation of human resources is done in full after the construction of the hotel is completed allocated to the hospital, after the construction of the hospital is completed allocated to the construction of the apartment. The acceleration time of the development project can be seen from the orange colored stem diagram which originally had a TM of 791 days for the construction of the hospital and 1254 days for the construction of the apartment.

Cost of hospital construction when referring to the company data obtained value as much as Rp.3.203.550.000-, while the cost of apartment development when referring to the company data obtained value of Rp.7.962.900.000-. The calculation data of image allocation 7 is as follows:

a) Hospital construction with the addition of 30 workers.

The optimistic time of the worker can be known that is 624 days which means the calculation of total cost of hospital construction workers for masons 20, carpenters 25, and iron smith 25 can be calculated by:

i. Fixed cost ((20*65000*624) + (25* 55000*624) + (25*55000*624)) = 2,527,200,000

ii. Variable cost ((10*65000*378) + (10*55000*378) + (10*55000*378)) = 661,500,000

iii. So the total cost of the company after allocation of 15 SDM as much (2,527,200,000+661,500,000) = 3,188,700,000

iv. The cost efficiency of the company is (3.203.550.000-3.188.700.000) = 14.850.000.

b) Construction of apartments with the addition of 100 workers.

Total construction workers for masonry 30, 40, and smith 40. So that company cost can be calculated by:

i. Fixed cost ((30*65000*739) + (40* 55000*739) + (40*55000*739)) = 4,692,650,000

ii. Variable Cost ((34*65000*115) + (33*55000*115) + (33*55000*115)) = 671,600,000

iii. So the company costtotal after allocation of 15 SDM as much (4.692.650.000 + 671.600.000) = 5,364,250,000

iv. The cost efficiency of the company is (7.962.900.000 - 5.364.250.000) = 2.598.650.000

4. CONCLUSION

The result of resource leveling shows:

1. Optimization of human resources can be done by adding 30 workers in the field of construction of hospitals and 100 workers in apartment buildings.
2. Employee payments can be more efficient by 24.95% of the Initial Budget.
3. Project time can be shortened 33.35% from the original plan.

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