

EVALUATION OF CPM/PERT AND EVA ANALYSIS IN PROJECT MANAGEMENT

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ABSTRACT

This research is purposed to evaluate the usage of CPM / PERT (Critical Path Method / Program Evaluation and Review Technique) and EVA (Earned Value Analysis) in a construction project, by comparing the result of those two analysis to evaluate the relationships of those methods. Research results shows that CPM/PERT and EVA have different result, technology intensive tasks has higher value on CPM/PERT, on the other hand, labor-intensive tasks has higher value on EVA. This difference will make different project report to the project owner that will make the project owner confused and give an opportunity for project contractors to make a fraudulent report.

1. INTRODUCTION

In everyday life we have come to meet several kind of projects that must be conducted for our personal, professional, or social life. All activities other than our routine job is considered a project, as defined by Project Management Institute (PMI 1996).

With the increasing amount of projects, there must be a way to manage all activities more efficiently. Project management is the mean to monitor, organize and evaluate on going project. Managing a project has to take a different approach than managing a routine job. A routine job is usually conduct by a full time employee, hence the manager only need to be concerned with exceptional issues. In a project, there is no routine activity. All activities are unique. Project Manager can not rely on past experience to evaluate current situation (Mantel Jr., et al. 2001).

In conducting a research on project management, object that is easily observed is construction project, such as high rise building, apartment, office block, shopping mall, residence, etc. Because of their physical nature, construction project is easier to calculate, evaluate and aranged from managerial point of view. Cost efficiency and time monitoring are easily conducted.

The main problem in project management is resources limit. The ability

to manage and plan those resources is fundamental toward achieving project goals without sacrificing quality.

Initial stage in project planning start with rough cut estimation. Estimation smoothing process is conducted by creating more detailed specification, detailed schedule, and cost budget (Anthony and Govindarajan 2001).

In practice, there is an enourmous gap in project management between project manager and construction supervisor. Even if the supervisor is someone with vast experience, usually they do not have skill and understanding on project management. As a result, reports from supervisor is insufficient for project manager to perform project analysis on computer software. The report format is usually on paper basis and shows little indication of problem that went through on project site.

Project owner also has significant role in project execution (Neap and Aysal 2004). Any form of report to project owner must contain proper information to avoid misconception. According to Yang and Peng (2006), contractor or project consultant should help owner to interpret such report. This is a sign of them appreciating their customer and to maintain high quality level. What is happening nowadays, the contractor

purposely mislead project owner by inserting vague information in their report.

2. PROBLEM FORMULATION

- a. Will analysis using CPM/PERT and EVA yield same result?
- b. How to explain the cause of difference between the two methods, should they occurred?

3. THEORETICAL STUDY

3.1 Definition of Project

Project is a combination of human and non-human resources put together in ad hoc organization to achieve certain goals. Project has activities and planned task with following characteristics:

- The goal has certain criteria
- Budget is limited
- Using resources such as money, man, machine, and so on.
- Formal and non-formal temporary organization
- Strict time line from beginning to end.

3.2 Successful Project

Generally there are 3 (three) indicators of a successful project (Suharto, Iman, 1997):

- a. On time, project finish as schedule.
- b. On specification, all quality aspects are met.
- c. On budget.

As project becomes more complicated, successful project should also finished:

1. within the given time frame,
2. within the specified cost budget or specified target,
3. acceptable by user,
4. with minimum of change from initial agreement,
5. with little interruption to organization main workflow,
6. without disturbing corporate culture.

The last three criteria is specifically concerning projects that have missed one of their defined targets.

3.3 Project Management

Project management is essentially required considering the importance and complexity of decision making in projects. Project management is application of knowledge, skill, tools, and technique in managing activities toward achieving or over-achieving stakeholders' project goals (Project Management Institute, 1996).

Project management is a process of planning, arranging, conducting and controlling of organization resources in relatively short period to achieve specific objectives and goals (Kezner, Harold, 1995).

3.4 Work Breakdown Structure

WBS is an important element since it gives frame in:

- Describing program as summary of small parts
- The making of project plan
- Network planning and control
- Division of duty
- Defining project parts

3.5 Network

One of the main problem in project management is scheduling. The role of network analysis took place here. There are two widely known methods, CPM and PERT.

3.5.1 Critical Path Method

In 1956 Morgan Walker of DuPont Company, used Univac computer - collaborating with James E. Kelly of internal construction planner group Remington Rand- to schedule construction project and came up with rational, smart, and easy-to-understand method.

3.5.2 Program Evaluation and Review Technique (PERT)

PERT focuses on minimizing production delays and conflicts, coordinating and synchronizing all elements as part of job, and finishing the project faster. This method makes manageable and organized task possible.

The two methods are now used simultaneously hence they are known as CPM/PERT method. The input data for CPM/PERT method includes:

1. Activity type,
2. Time required to finish each activity,
3. Activity sequence,
4. Activity cost, in normal or accelerated circumstances.

3.6 Earned Value Analysis (EVA)

Earned Value Analysis is calculated by multiplying budgeted cost per activity and completion percentage and sum all activities in the project. This process is harder than at first imagined. Actual percentage of activity budget in any given time, generally, is not a reflection of activity completion. For example, biggest cost of activity is machine mobilization, a cost that incurred before any progress take place.

There is no perfect way to measure precisely the completion of a job, the parameter used to measure project completion (Mantel, Meredith, Shafer, and Sutton, 2001).

Basic elements needed for Earned Value Analysis:

- Budget At Completion (**BAC**). Total budgeted cost of project.
- Budgeted Cost of Work Scheduled (**BCWS**). Budgeted cost of project at a scheduling point
- Budgeted Cost of Work Performed (**BCWP**). Budgeted cost of work that is completed in given point of time in project.

- Actual Cost of Work Performed (**ACWP**). Actual incurred cost of actual completed job at any given point of time in project.

3.7 Formula for value analysis:

- Schedule Variance $SV = BCWP - BCWS$
- Schedule Performance Index $SPI = BCWP/BCWS$
- Projection at Completion $PAC = \frac{[(BAC/SPI) - BAC]}{\text{Average BCWS/unit time}}$
- Cost Variance $CV = BCWP - ACWP$
- Cost Performance Index $CPI = BCWP/ACWP$
- Estimate at Completion $EAC = ACWP + \frac{(BAC - BCWP)}{CPI}$

4. RESEARCH OBJECTIVES AND BENEFIT

4.1 Research Objectives

From the problem formulation, we can conclude the research objectives as follow:

1. To evaluate the efficiency of CPM/PERT and EVA analysis in construction project.
2. Comparing the result of CPM/PERT and EVA analysis in same construction project.

4.2 Research Benefit

1. Give input to other researcher in project management topic.
2. Give input to construction industry in conducting project more efficiently.

5. METHODS

5.1 Data Gathering

This research requires primary and secondary data. Primary data comes from execution process of two construction projects, which includes:

- activity type
- activity sequence
- time required
- project daily reports.

Secondary data gathered from literature study from journal, articles, and other sources.

5.2 Data Analysis

a. Quantitative Analysis

Evaluation of project execution is conducted using EVA analysis running on MS Excel. Project network analysis conducted using MS Project 2003 to measure project efficiency.

b. Qualitative Analysis

Comparing acquired result with actual report from the two projects.

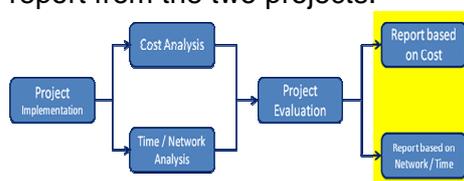


Figure 1. Project Reporting Flow

From the daily reports to project owner, there are two report formats; one is based on cost analysis (EVA), the other is based on time and network analysis (CPM/PERT). Therefore, we must compare our own analysis by using both these methods, and then we must predict the implication of the evaluation result.

6. RESULT AND DISCUSSION

The result of data calculation of the two construction projects using CPM/PERT and EVA yields the following numbers:

Table 1. Cost and Time Task Evaluation Result

Task	Building X		Building Y	
	Cost	Duration	Cost	Duration
Preparation activity	2.35	9.09	1.58	7.04
Structural activity	72.82	48.00	68.04	36.39
Detail activity	9.64	14.91	13.43	29.00
Electrical activity	3.65	8.73	4.38	8.67
Water plumbing activity	1.65	8.00	3.43	9.76
Non Standard activity	9.89	11.27	9.13	9.14

Clustering the evaluation result based on activity type, we found that:

- Preparation activity: using more manpower resource, time comparison is larger
- Structural activity: using more technology resource, cost comparison is larger
- Detail activity: using more manpower resource, time comparison is larger
- Electrical activity: using more manpower resource, time comparison is larger
- Water plumbing activity: using more manpower resource, time comparison is larger
- Non Standard activity: balanced between manpower and technology, balanced comparison

Both projects have typical character, labor intensive with larger time consumption than cost consumption comparison. Activity that is more technology intensive will have more cost consumption than time consumption comparison.

7. CONCLUSIONS AND SUGGESTIONS

7.1 Conclusions

From the analysis, we can conclude that structural activity –activity that requires large portion of total cost budget- can be finished in relatively short space of time. This is because structural activity is technology intensive, compare to other activities that is labor intensive.

This phenomenon can cause some confusion in project owner part. Project owner tends to prefer cost analysis report. When the project is in structural activity phase, the cost analysis report will show accelerated progress. But when the project leaves structural activity phase, it will appear in cost analysis report that the project slows down.

7.2 Suggestion

To come up with consolidated form of report –with both cost and time aspect

analyzed- project management should follow these steps shown in figure below:

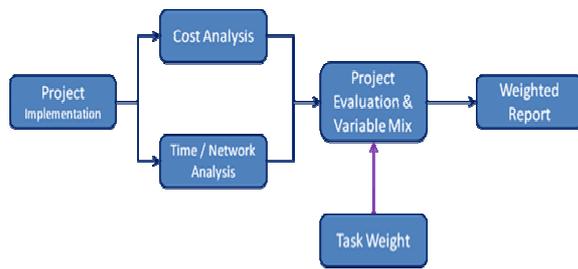


Figure 2. Two Dimensional Analysis Reporting

At each phase of the project, project management should find task weight to combine both evaluation methods. From there, project manager and owner should receive consolidated evaluation report covering two essential dimensions in project –time and cost- in one reporting format.

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