EFFECTIVE COST AND TIME MANAGEMENT TECHNIQUES IN CONSTRUCTION INDUSTRY

Article · May 2019

1 author:

Shanmuga Nathan N
Sri Krishna College of Technology
11 PUBLICATIONS **40** CITATIONS

EFFECTIVE COST AND TIME MANAGEMENT TECHNIQUES IN CONSTRUCTION INDUSTRY

Shanmuganathan N[1], Dr. G.Baskar[2]

Address for Correspondence
[1]Assistant professor, Department of Civil Engineering, SKP Institute of Technology, Tiruvannamalai, Tamilnadu, India
[2]Associate professor, Department of Civil Engineering, Institute of road and transport technology, Erode, Tamilnadu, India

ABSTRACT
Effective cost and time management play an important role to achieve the project success in the construction industry. Various cost and time management techniques which help to control cost and time overrun in the construction project. Now a day's various software's are used in constructions to monitor and control the cost and time in a construction project. This research was conducted to identify the most successful cost and time management techniques and software's used to control the projects in the construction industry .The data's were collected through questionnaire survey from engineers, contractors and clients worked in the various construction industry. According to the collected data's were analyzed using relative importance index (RII) and ranking the factors based on percentage of relative importance. The results will help the construction industry to take measures in improving the cost and time performance and also identifies the most popularly used software's such as primavera, Microsoft project in the construction industry.
KEYWORD: cost management techniques, time management and time management software's.

1 INTRODUCTION

In every construction industry, the successful completion of the project is the main goal. To achieve this aim the construction industry is to control the cost performance and time. Without proper control of time in the c the cost overruns in the construction project. In this paper is to identify the most valve able various cost and time management techniques and time management software's used in the construction industry and the data are formed structured questionnaires and send this question to the various professionals such as engineers, contractors, and clients. Based on their suggestion the data were analysed and rank through relative importance index. They are various cost management techniques used in the construction industry are budgeting, estimating, cash flow forecasting, cost planning and control, cost code and financial reporting and cost reporting and judgement. Most important time management techniques followed by the construction communities are critical path method, programme evaluation and review technique, Gannt chart, milestone chart, and precedence network diagram. Nowadays there is a lot of development in the construction industry, they are used much software to control and monitor the project .The most important software is used to control and monitoring process are Microsoft excel, Microsoft project and primavera.

1.1 Cost Management Techniques

Cost management is the important components to control the project success and also it is the important tool to control and improve cost performance of construction projects. The cost management helps to keep the project within the budget. Poor cost management often results in the cost overrun of a project. The important techniques in the cost management are budgeting, estimating, cost planning and control, cash flow forecasting, cost code system, financial cost reporting and judgement. The overall planning process in a project budget plays an important role, it evaluates the financial consequences of the plan and provides financial feedback so that plans can be monitored and revised [1]. A budget in a construction could be a financial analysis of the long run action during a business plan. it's a detailed plan which sets out in terms of money, the plans for financial gain and expenditure in respect of a future period of time [2], [3]. A good project management practices in a project is to attain the

effective cost management .the project cost control is cooperation within the construction industry and also the definition of such things as governance, owner organization and rosters, roles and responsibilities for the project execution methods, reporting and communications[4], [5], [6]. A complete history of all cash handling and all earnings are received as a result of cash flow. The period of the project, the retention conditions, the days of receiving payments from the client, are the factors affecting the cash flow etc. [7]. The purpose of value code system is to modify huge of value data to be identified and coded for the foremost economical application of cost management throughout the contract period [8].

The successful contractor must have a solid and accurate financial plan, a good knowledge about the costs of the project, accurate and honest cost report, etc.[9] .The financial and cost report is to record of financial transactions like payment inside and outside together with amounts owed and owing[10]. Judgement is very important in the cost management .without judgement any cost management techniques can be used [11]. The good forecasting technique must include both historical trend based data and competent .the judgement is based on construction experience and knowledge [12]. The relationship between judgement and alternative techniques may be summarized as technique and judgment are termed recommendation [13].

1.2 Time Management Techniques

Time management is that the vital techniques to confirm the completion of projects within stipulated time. Without a proper time management, many problems will occur such as an extension of time or time overrun in the construction project. The important time management technique is Gantt chart, milestone chart, critical path method, programme evaluation and review technique, precedence network diagram

Gantt chart technique is widely used for project scheduling and control .it is the easy technique for getting ready a schedule and also it's a graphical representation technique [14]. The C.P.M or critical path method was developed by DuPont and Remington rand Univac in 1957.the main aim of this team was to reduce the time required to perform routine plant overhaul, maintenance, and construction work. It was developed as a project [15] .The Management tool helps to improve the scheduling and project administration, supporting project

managers to ensure the project is completed on time and on the budget [16].

PERT or program analysis review technique is a tool used for planning, controlling and reviewing a project is a management practice Firm for its loadstar missile program [15], [17]. PERT provides an assessment of chance of reaching certain milestones by fixed dates or of achieving overall project completion among a nominal time period [18], [19]. Precedence Network Diagram is kind of almost like CPM and it in addition wide utilized within the construction industry. The arrows used to connect the nodes wherever it became a network to define the relationships between the activities [20].

1.3 Time Management Software

The time management software system helps to control and monitor the project whether or not the project the most advantages of time management software's using for construction planning is that the mathematical computations are instant and errors free. The commonly used software within the construction industry for time management are Microsoft excel, Microsoft's project, and primavera project planner. In Microsoft excel there various kind of templates which will be used for the project planning like excel project management templates, Gantt Chart and project planning, project reporting, Microsoft Excel formulas for project managers and etc[12], [21]. Microsoft Project has various choices to support project management like manual planning where this choice could also be accustomed set task durations and, starts and finish date with purpose and clicks on [12], [21]. Primavera Project Planner can be presented as numbers, PERT, Gantt charts, bar chart, and diagrams [12], [21].

2 DATA COLLECTION

The data for this research were collected via structured questionnaire survey from the engineers, contractors and clients involved in various types of construction projects

1. Identify the cost and time management techniques.
2. Identify the important time management software's
3. Analyse through relative importance index (RII)
4. Ranking of factor based on their importance level
5. Make a suggestion to control the cost and time management in the construction project.

3 QUESTIONNAIRE SURVEY

3.1 Questionnaire Design

The questionnaire design took into the consideration the objectives of the study with the aim to answer the research question. The Research questions were referred from the literature [1] to [23], and finalized with the help of the most experienced professionals, helps to identify the right questions required and present them in a clear format and also Special care was done for phrasing the questions that are easily understood by the respondents. A content involved in the questionnaire was divided into two major sections. The first part is about general information about the respondent such as (1) Name, (2) Contact address, (3) Year of experience, (4) Designation of the respondent, (5) Type of project they work,(6) Educational qualification and second part respondents were asked about cost and time management tools and techniques and also the software were used for time control in their project. A 5-point Likert scale was used to understand the perception of practitioners as 1.representing very little effect, 2.Little effective, 3. Average effective, 4. High Effective, 5.very high effective according to the degree

4 RESEARCH METHODOLOGY

The most of the factors were identified through questionnaire survey from the professional working in the various construction industries. This survey was made through questioner distributed to different construction professionals. These professionals include engineers, contractors and clients. Moreover, all of the professionals are selected based on their experience and special care should be taken for their educational qualification. All the respondents participated in this survey their minimum educational qualification is (D.C.E) most of the respondent are completed (B.E) and few respondent completed (M.E).

The collected data were analyzed through relative importance index (RII) method. These analyses include ranking the different causes according to relative important indices.

- Personal information of the respondent
- Types of projects the respondent worked
- Identify the important cost and time management tools and techniques
- Identify Important Software to control the cost and time in a construction project
- Make a suggestion to control the cost and time management.

4.1 Collected Data

Table .1 Respondents Involved In the Survey

No of questionnaire distributed	172
No of response received	136
No of invalid (Incomplete) responses	15
No of valid responses	121
% of responses received	88.97
% of invalid responses received	11.03

Table1 represents the total 172 numbers of questionnaires were distributed but only 136 valid questionnaires were returned, from this 11.03 % are invalid or incomplete that means 88.97 % of valid response is received. In table 2 shows the professionals those who are involved in the survey the total of 72 engineers that means 59.50%, contractors of 34 in numbers that is 28.10% and 15 numbers of clients are involved is 12.40% were involved.

Table.2 Professions of the Respondent

Sl.No	Professionals	No of respondents	Percentage of respondent	Cumulative percentage
1	Engineer	72	59.50	59.50
2	Contractor	34	28.10	87.60
3	Client	15	12.40	100.00

In table 3 represents the year of experience of the professionals. From this table shows 40 members are having six to ten year of experience and 32 members are 11 to 15 year of experience and only 22 are having more than 15 years of experience.

Table.3 Respondent Year of Experience

Year of experience	1 – 5	6 - 10	11- 15	>15	Number of respondent
Engineer	20	25	16	11	72
Contractor	5	12	9	8	34
Client	2	3	7	3	15
Total	27	40	32	22	121

4.2 Method of Data Analysis

Data was collected using questionnaire survey. A 5-point likert scale was used to understand the perception of Practitioners as 1 for very low effective, 2 for low effective, 3 for average effective, 4 high effective and 5 for very high effective. The hierarchal assessment of effectiveness of cost management techniques was calculated using Relative Importance Index (RII).A total 15 questionnaires of three groups such as (cost management, time management and time management software). Where dispensed to each category of the respondent-engineers, contractors and clients. The same approach has been used by various researchers to analyze the data collected from questionnaire survey as indicated in literature. Sambasivam et al., also used same approach to investigate the causes and effects of construction delay in Malaysian construction Industry. RII will be calculated with following expression [22]. Where

$$RII = \frac{\sum_{i=1}^{5} W_i X_i}{AN} \quad (1)$$

RII = Relative importance index
w = weighting given to each factor by respondents and it ranges from 1 to 5
x = frequency of i_{th} response given for each cause
A = highest weight (i.e. 5 in this case)
N = total number of participants

The relative importance index for all the factors using equation (1). The index was ranked for engineers, contractors and clients. The group index is the average of relative importance index of the delay factors in each group.

Agreement analysis

The group index is the average of the delay factors in each group. The agreement between the rankings of any two parties was measured using the rank correlation coefficient. The rank correlation coefficient (p) is calculated as Follows (Mendenhall et al. 1993) and also this method is used by Aadi. A. Assaf [23]. The spearman's rank correlation coefficient (r_s) was used to show the degree of agreement between the rankings of any two parties. The spearman's rank correlation is a nonparametric test. The nonparametric test is also referred to as the distribution-free test. These tests do not require the assumption of normality or the assumption of homogeneity of variance. The spearman rank correlation coefficient (r_s) was calculated as follows in (2)

$$r_s = 1 - \frac{6 \sum d^2}{n(n^2 - 1)} \quad (2)$$

Where d is the difference between the ranks given by any two respondent for an individual cause and n the 1"number of the cause, which in this case is 15 factors. The rank correlation coefficients for the delay factors are 0.96, 0.95 and 0.98 for engineers, contractors and clients respectively.

Significance test

To determine whether the parties displayed significant agreement in their rankings the null hypothesis that null hypothesis that engineers and contractors, contractors and clients, clients and engineers do not agree with the ranking of the factors was tested using t-test at a 95% confidence level. The null hypothesis was rejected in all three cases. The alternate hypothesis that all the three parties generally agreed on the rank was accepted.

5 RESULTS AND DISCUSSION

This research identifies important techniques to control the cost and time performance in a project and also most successful time management software's used by the construction industry. Based on the relative importance of the engineer's contractors and clients the overall ranking of cost management techniques are Cash Flow Forecasting(RII =81.73) , Cost Planning And Control (RII=80.86) and Estimate(RII=80.25) these three factors are having highest relative importance almost these three factors having more than 80 % of RII from engineers ,contractors and clients. In Time management techniques five important factors are to control the project successfully from this top most three successful techniques are critical path method (RII=81.17), Programme Evaluations and Review Technique (RII=79.66) and Gantt chart (RII=79.62) these three factors are more than 75 %RII. Time management software's like primavera (RII=81.86), Microsoft project (RII=81.63) and Microsoft excel (RII=4.86) .This three software were popularly used in construction industry, but Microsoft excel is now oldest one while comparing these three tools.

Table.4 Overall Relative Importance Index and Rank of the Professionals

FACTORS		ENGINEER		CONTRACTOR		CLIENT		AVERAGE	
		RII	RANK	RII	RANK	RII	RANK	RII	RANK
COST MANAGEMENT TECHNIQUES									
CM1	Budgeting	81.39	2	77.06	4	80.00	3	79.48	4
CM2	Estimate	80.00	3	79.41	3	81.33	2	80.25	3
CM3	Cost Planning And Control	78.61	4	85.29	1	78.67	4	80.86	2
CM4	Cash Flow Forecasting	81.94	1	80.59	2	82.67	1	81.73	1
CM5	Cost Code Systems	69.17	7	69.41	6	62.67	7	67.08	7
CM6	Financial Reporting And Cost Reporting	75.00	5	70.00	5	76.00	5	73.67	5
CM7	Judgement	74.17	6	67.06	7	64.00	6	68.41	6

TIME MANAGEMENT TECHNIQUES									
TMT1	Gantt Chart	79.44	3	79.41	2	80.00	3	79.62	3
TMT2	Milestone Chart	64.17	4	74.71	4	77.33	4	72.07	4
TMT3	Critical Path Method(C.P.M)	80.83	1	80.00	1	82.67	1	81.17	1
TMT4	Program Evaluation And Review Technique (PERT)	80.00	2	77.65	3	81.33	2	79.66	2
TMT5	Precedence Network Diagram (PND)	59.72	5	74.12	5	70.67	5	68.17	5
TIME MANAGEMENT SOFTWARE									
TSM1	Microsoft Excel	60.00	3	80.59	3	84.00	1	74.86	3
TSM2	Microsoft Project	79.44	2	84.12	1	81.33	3	81.63	2
TSM3	Primavera Project Planner	80.56	1	82.35	2	82.67	2	81.86	1

5.1 Cash Flow Forecasting

A cash flow forecasting is a very important factor in cost management technique in this research cash flow forecasting overall index (RII=81.73).A good cash flow analysis could be the most important for a business plan in construction. All the strategy, tactics, and ongoing project activities mean nothing if there isn't enough cash to pay the bills and cash flow projection is predicting your cash needs in advances.

5.2 Cost Planning and Control

Cost planning and control is the important one in the construction industry to control the cost performance .from this research the overall relative importance (RII=80.86).The perform of cost planning and control involves the establishment of cost targets in a project and success .In cost planning and control the variance analysis was used to determine however close the particular performance is against planned performance from deviation from the plan

5.3 Critical Path Method

The Critical Path Method (CPM) is one of the several related techniques for doing project planning. CPM is for projects that are made up of a number of individual "activities." If some of the activities require other activities to finish before they can start, then the project becomes a complex web of activities. In this research, the critical path technique is that the important time management tool was to identify the longest path. CPM was the important factor and their overall rank (RII=81.17).

5.4 Programme Evaluation and Review Technique

The pert is ranked second within the time management tool its overall relative importance index is (RII =79.66) This program evaluation and review technique (PERT) could be applied as a decision-making tool, it is designed for the purpose to save time in the project for achieving end target and is of particular interest to those engaged in research and development programs for which time is a critical factor. This technique takes recognition of three factors that influence the successful achievement of research and development program objectives like workman resources, time, and money

5.5 Primavera

It is the effective project planning software now utilized in the construction industry it was ranked first in time management software (RII=81.86). Primavera is the high-performance Project Management software .now the recognized standard for high-performance project management Primavera P6 professional Project Management. It handles large-scale, highly refined and varied projects. Organize projects of up to 100,000 activities with unlimited resources and a vast number of target plans.

5.6 Microsoft Project

Microsoft project attains second effective software and also the overall relative important index (RII=81.63) Microsoft Project could be a project management software program, developed and oversubscribed by Microsoft, that is designed to assist a project in developing a concept, distribution resources to tasks, following progress, managing the budget, and analyzing workloads.

6 CONCLUSIONS

Cost management and time management techniques are important to succeed the project in the construction industry. Time management software helps to control and monitor the project whether the project goes in right path or not. Based upon this research cost management techniques like cost flow forecasting (RII=81.73) and cost planning control is the important one to control the cost. Time management technique CPM (RII=81.17) and PERT (RII=9.66) are the effective time management technique in the construction and Primavera, Microsoft Project and Microsoft Excel are the most common and effective software packages used in construction industry.

REFERENCES

1. Marsh C. 2009. Mastering Financial Management, *Pearson Education Limited*, Britain.
2. Weetman P. 2003. Financial & Management Accounting an Introduction, *Pearson Education Limited*, England.
3. Ashworth A. 2010. Cost Studies of Buildings, *Pearson Education Limited*, England.
4. Basak BG. 2006. Cost Management in an Imperfect World: Bridging the Gap Between Theory and Practice, *ICEC Cost Management Journal*.
5. Halpind DW. 1985. Financial & Cost Concepts for Construction Management, *John Wiley & Sons*, America.
6. Tang WK. 2005. Cost management for Building Contractors in Hong Kong, The University of Hong Kong: *Master of Science in Construction Project Management*.
7. Hyung KP. 2005. Cash Flow Forecasting Model for General Contractors Using Moving Weights of Cost Categories, *Journal of Management in Engineering*, Volume 21, No.4, 64-172.
8. Pilcher R. 1985. Project Cost Control in Construction, *Collins*, UK.
9. Frisby TN. 1990. Survival in the Construction Business: Checklists for Success, Kingston, Mass, R. S. Means.
10. Burke R. 1992. Project Management: Planning and Control, *Burke Publishing*, New York.
11. Fortune CJ, and Lees,M.A. 1996. The relative performance of new and traditional cost models in strategic advice for clients, *RICS Research Paper Series*, Volume 2, No.2.

12. Abdul Azis A, Memon AH, Rahman IA, Alias Imran Latif QB, Nagapan S. 2012. *IEEE Symposium on Business*, Engineering and Industrial Applications, 623-627.

13. Al-Tabtabai H, and Diekmann JE. 1992. Judgmental Forecasting in Construction Projects, *Construction Management and Economics*, Volume 10, No.1, 19-30.

14. Smith NJ. 2002. Engineering Project Management, Second Edition, *Blackwell Science Ltd*, United Kingdom.

15. Seetharaman S. 2012. Construction planning and scheduling, first edition, *Anuradha publication*, India.

16. Kim K, and Garza MJ. 2003. Phantom Float, *Journal of Construction Engineering and Management*, Volume 129, No.5, 507-517.

17. Cottrell DW, 1999. Simplified Program Evaluation and Review Technique (PERT), *Journal of Construction Engineering and Management*, Volume 125, No.1, 16-22.

18. Callahan TM, Quackenbush GD, and Rowings EJ. 1992. Construction Project Scheduling, *McGraw Hill*, New York.

19. Lu M, and Abourizk MS. 2000. Simplified CPM / PERT Simulation Model, *Journal of Construction Engineering and Management*, Volume 126, No.3, 219 –226.

20. Olawale YA, and Sun M, 2010. Cost and Time Control of Construction Projects: Inhibiting Factors and Mitigating Measures in Practice, *Construction Management and Economics*, Volume 28, 509–526.

21. Ismaaini Ismail, Aftab Hameed Memon. 2013. Comparative Study of Time Management Practices in Construction Industry between Kedah and Kelantan, *Proceedings The 2nd International Conference On Global Optimization and Its Applications* , Malaysia ,August, 28-29.

22. Sambasivam M, Soon Y. 2007. Causes and effects of delay in construction industry, *International journal of project management*, Volume 25, No.5, 517-526.

23. Assaf SA, Ai-Khalil M, and Ai-Hazmp. 1995. Causes of delay in large building construction projects, *Journal of management in engineering*, Volume 11, No.2, 45-50.