

IMPLEMENTATION OF CRITICAL CHAIN PROJECT MANAGEMENT IN CONSTRUCTION INDUSTRY.

¹Deep D. Patel, ²Prof. Jayraj V. Solanki

¹P.G. Student, ²PG Head & Assistant Professor,

¹Civil Engineering Department,

¹U.V. Patel College of Engineering, kherva, Mehsana, India.

Abstract: Critical chain project management is a new project management method for scheduling the projects. This method is derived from the theory of constraint by Eliyahu M. Goldratt. CCPM method is very effective and efficient method than other traditional methods i.e. CPM, PERT, etc. CCPM method achieving the projects 10% to 50% faster and cheaper than the traditional methods. CCPM method helps to improve due dates, productivity, profitability, team work, etc. of the project. According to traditional project management studies, only 44% of projects usually finished on time. The projects are generally completed at 222% of the initially planned duration, at 189% of the budgeted cost, 70% of the projects do not reach their planned scope and 30% are cancelled before completion. CCPM method consider as a promising method but still it is not widely use. The problem with the adoption of the CCPM is that the workers of the project resist to working according to the principle of the CCPM.

This research gives an overview of critical chain project management method. The first step of this research is to identify the parameters of implementation of CCPM in the construction industry. Literature review has done to find the best parameters of implementation of critical chain project management. These parameters are: CCPM and Change, CCPM and perception of work, The CCPM process and Contribution to CCPM. These parameters are sub divided into the CCPM implementation questions related to respective parameters. Data analysis on the parameters of implementation of CCPM has been done. As per the result, this research find out best possible parameters/questions for the implementation of CCPM in construction industry. CCPM implementation helps improve punctuality in order delivery, improve communication and standardization of processes related to order delivery.

Index Terms – Critical chain project management, Project Scheduling, Critical Chain.

I. INTRODUCTION

Critical chain project management (CCPM) is a method of planning and managing projects that values the resources (people, material, equipment) required to complete project tasks. It was developed by Eliyahu M. Goldratt. It differs from other traditional methods that derive from critical path and PERT algorithms, which emphasize task order and rigid scheduling. Methods and algorithms of critical chain project management is mainly derived from the Theory of Constraints that is developed by the Eliyahu M. Goldratt.

Critical chain project management gives a necessary time to project manager for planning and managing project's schedule by concentrating on resources used in Critical chain (also called as the Critical Path). Critical Chain is the longest path in the network diagram that also consider task dependency and availability of resources in path. CCPM is modified method of Critical Path Method. In critical path method activities are use aggressive time and have unlimited resources availability. Critical Path Method uses Float, where CCPM uses buffers as strategic points that reduce uncertainty of the projects.

CCPM is another methodology that project managers can adopt to complete the project on schedule, reducing the duration consumed by the activities which in turn help to reduce the total duration of the project and help to reduce time and costs. CCPM is based on the philosophy of Theory of Constraints. This philosophy has mainly focused on finding the constrain that acts as an obstacle to the timely completion. CCPM is done through buffer management. There are several types of buffers, such as project buffers, feeding buffers, resource buffers that prevent the critical chain and feeding chains from adding delays on project completion dates.

The use of CCPM and TOC is not only limited to construction projects, but also finds its application in other fields, such as the production and software development. This study can help planners and schedulers to adopt a new methodology to schedule and monitor the project on time and avoid unnecessary safety to achieve the organization's goals. Benefits of CCPM are:

- It allows people to focus more on their tasks that helps in increasing team productivity and efficiency.
- It helps to overcome Student Syndrome phenomena (people start working harder as the deadline approaches.)
- It avoids mismanagement of floats.
- It takes minimum time to complete the project.
- It helps in reducing the project completion time.
- It brings a significant reduction in capital requirements.

II. LITERATURE REVIEW

Implementation of CCPM method can help the company to organize the project management processes. CCPM also helps in improving the communication to the company and among the company and their workers. Implementation of CCPM method increase the satisfaction of customers by improving the timely delivery of the project and quality of work.

Some major findings form literature are follow:

1. Different parameters which is use for implementation of CCPM.
2. Comparative analysis between critical path method (CPM) and critical chain project management (CCPM).
3. Scheduling of project with CCPM method.

III. RESEARCH METHODOLOGY

For achieving the objective of the research, questionnaire was made. Questionnaire survey has been done for finding the best possibility for adoption of critical chain project management (CCPM) in construction projects. To keep data collection simple questionnaire was answer directly in person. Questionnaire consists of 4 categories along with 32 sub categories, which can help in identifying the best possibility for adoption of critical chain project management

Questionnaire survey carried out across different Building construction industry in the Surat district (Gujarat). The questionnaire was sent to nearly 65 construction companies out of which 50 responses are received and 45 responses was selected for data analysis.

IV. DATA ANALYSIS

This section aims to analyze and present the collected data with respect to the research objective. This section is intended to discuss the characteristics of the respondents as well as their knowledge about this research topic. Questionnaire have been divided into three parts:

1. Brief information about questionnaire.
2. General information about respondent i.e. Company name, Respondent name, Qualification, Experience, Designation, and Contact no.
3. Questions regarding critical chain project management (CCPM).

For analyzing the data here we use one way analysis of variance (one way ANOVA) method.

1. Prioritizations of implementation questions regarding CCPM in Construction Industry

A survey was conducted for 45 companies to finding the best possibility for implementation of critical chain project management (CCPM) in construction projects Parameters and questions was prepared from literature and the organisations were asked to indicate on 5 point scale (1-disagree to 5-agree). The reliability analysis was conducted on the questionnaire scale. The reliability of the questionnaire regarding this item was tested and it is shown in table 5. For analyzing and ranking the data here we use one way analysis of variance (one way ANOVA) method.

Table 1: Reliability Statistics

Sr. No.	Cronbach's Alpha	No. of Items
1.	0.5025	32

Table 2: Result of one way ANOVA

Sr. No.	Category	Groups	Count	Sum	Mean	Variance	Rank
1.	CCPM and Change	Introduction and implementation of CCPM went well.	45	163	3.622222	0.590617	9
2.		Initially staff appeared quite sceptic about the methods of CCPM.	45	171	3.8	0.648889	5
3.		Staff well known the principles of CCPM.	45	93	2.066667	0.151111	31
4.		Staff has been well trained with the methods of CCPM.	45	87	1.933333	0.551111	32
5.		Due to CCPM staff get different tasks.	45	147	3.266667	0.328889	20
6.		CCPM includes total different mindset of project thinking.	45	160	3.555556	0.646914	11
7.		Transition with CCPM is easily done.	45	111	2.466667	0.782222	29
8.		Staff easily falls back towards old	45	173	3.844444	0.709136	4

		patterns.					
9.	CCPM and Perception of Work	I perceive CCPM a simple way of working.	45	115	2.555556	0.469136	28
10.		I perceive CCPM a counter intuitive way of working.	45	139	3.088889	0.747654	21
11.		I recognize the advantages of working according to CCPM.	45	148	3.288889	0.472099	19
12.		As soon as we score a project, I want to start it up as soon as possible.	45	186	4.133333	0.693333	1
13.		I rather focus on achieving due dates than shortening the lead times.	45	153	3.4	1.084444	17
14.		I prefer to do more tasks at a time.	45	181	4.022222	1.043951	2
15.		Shortening the task times is nice.	45	132	2.933333	0.995556	23
16.		Project buffer is nice	45	131	2.911111	0.436543	24
17.	The CCPM process	The CCPM system determine priorities.	45	124	2.755556	0.718025	25
18.		The CCPM determines what actions must be undertaken.	45	170	3.777778	0.261728	7
19.		CCPM requires very solid schedule.	45	171	3.8	0.915556	5
20.		CCPM requires obedience.	45	160	3.555556	0.735802	11
21.		CCPM requires team work.	45	160	3.555556	0.646914	11
22.		The senior management is in-charge of progress meetings.	45	123	2.733333	0.773333	26
23.		The project manager is in-charge of progress meetings.	45	157	3.488889	0.472099	15
24.		The CCPM tool is user friendly.	45	121	2.688889	0.658765	27
25.	The CCPM tool is sufficient.	45	107	2.377778	0.590617	30	
26.	Contribution of CCPM	CCPM appears a good method of controlling the projects.	45	165	3.666667	0.444444	8
27.		CCPM appears a good method of managing bottle necks within a multi project environment	45	177	3.933333	0.24	3
28.		CCPM increases project throughput.	45	134	2.977778	0.599506	22
29.		CCPM decreases lead time of the project.	45	150	3.333333	0.711111	18
30.		CCPM leads to timely project delivery.	45	163	3.622222	0.546173	9
31.		CCPM contributes to the project cost reduction.	45	160	3.555556	0.51358	11
32.		CCPM contributes to increase the profitability of the company.	45	157	3.488889	0.472099	15

Table 7: Result of one way ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	456.0333	31	14.71075	23.43188	7.4E-105	1.45937
Within Groups	883.9556	1408	0.627809			
Total	1339.989	1439				

After the analysis of the data, we conclude that the value of F is greater than the tabulated value of F (F critical) i.e. F value (23.4318) > tabulated F value (1.45937). As per the result null hypothesis is rejected. It means that our data accept the alternative hypothesis that indicates that there is a difference between the means of groups. After the analysis we found the most important questions that affect the implementation of critical chain project management (CCPM) in construction projects. That questions are: As soon as we score a project, I want to start it up as soon as possible, I prefer to do more tasks at a time, CCPM appears a good method of managing bottle necks within a multi project environment, Staff easily falls back towards old patterns, CCPM requires very solid schedule, Initially staff appeared quite sceptic about the methods of CCPM, The CCPM determines what actions must be

undertaken, CCPM appears a good method of controlling the projects, CCPM leads to timely project delivery, Introduction and implementation of CCPM went well.

V. CONCLUSION

This study conclude that there is an advantages for Construction Company to work according critical chain project management (CCPM). CCPM helps to deliver the project on the scheduled time, increase the profitability of the company, shortening the lead time, minimize the waste, and reduce the inventory storage. CCPM also helps in reducing the project completion date. Critical chain project management method is far better than other traditional methods i.e. critical path method and PERT because CCPM fulfill some limitations of the traditional methods and helps in completing the project on time and reducing the delays. It is become more advantageous for the project managers to take aggressive decision against uncertainties of the project. CCPM is a promising method but still doesn't widely adopted. CCPM implementation helps improve punctuality in order delivery, improve communication and standardization of processes related to order delivery.

In this research some questions were identified that affect the implementation of critical chain project management in construction industry. Questionnaire was made on the basis of that criteria and survey was conducted. On the basis of that survey data analysis was carried out with the help of one way ANOVA method. After the analysis top 10 questions that affect the implementation of critical chain project management. This questions plays an important role to make a decision for the implementation of CCPM in your company.

Top 10 questions are;

1. As soon as we score a project, I want to start it up as soon as possible.
2. I prefer to do more tasks at a time.
3. CCPM appears a good method of managing bottle necks within a multi project environment.
4. Staff easily falls back towards old patterns.
5. CCPM requires very solid schedule.
6. Initially staff appeared quite sceptic about the methods of CCPM.
7. The CCPM determines what actions must be undertaken.
8. CCPM appears a good method of controlling the projects.
9. CCPM leads to timely project delivery.
10. Introduction and implementation of CCPM went well.

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