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APPLICABILITY REVIEW OF CRITICAL CHAIN PROJECT MANAGEMENT FOR CONSTRUCTION PROJECTS

R. Gilani

Assistant Professor, Department of Architecture, Jamia Millia Islamia.

ABSTRACT

There is sufficient acceptance in the construction industry that present practice of managing project through conventional approach is unrealistic and ineffective in terms scheduling and monitoring leading to lack of project control resulting in failure of time goal.

Considering the fact that nothing significant has been innovated or adopted in construction industry for improving project performance, project execution scheduling and planning are the top potential areas needing improvements.

Critical chain management offers an innovative approach to best address the resource limitations and uncertainties involved in the construction projects. Through its mean duration estimates and buffer management provides a robust and reliable project plan.

CCPM has been adopted by many industries as a beneficial project management tool but the construction industry is yet to adopt this concept. The study interrogates the possible solutions proposed by Critical chain project management and its rationale of concepts and determines it's applicability for improving construction project performance.

KEYWORDS

Critical chain, Critical Path, Construction, Theory of Constraints.

BACKGROUND

Considering the fact that nothing significant has been innovated or adopted in construction industry for improving project performance, project execution scheduling and planning are the top potential areas needing improvements.

Critical Chain is the Theory of Constraints (TOC) application for project management. It was developed by Eliyahu Goldratt was to contrast the popular critical path method and Project Evaluation and Review Technique - PERT. While these two methods focus on the order of the tasks and schedules, critical chain management allows tasks to be evenly distributed by focusing more on start times and the tasks themselves. Critical Chain Project Management was originally invented to manage engineering projects in a manufacturing environment, but it has since been used by enterprises in virtually all goods and services

sectors [1].

Construction projects are much vulnerable to time over run considering many reasons. Mechanized industries have adopted the concept of critical chain but it is yet to be ground tested in construction projects.

CRITICAL CHAIN

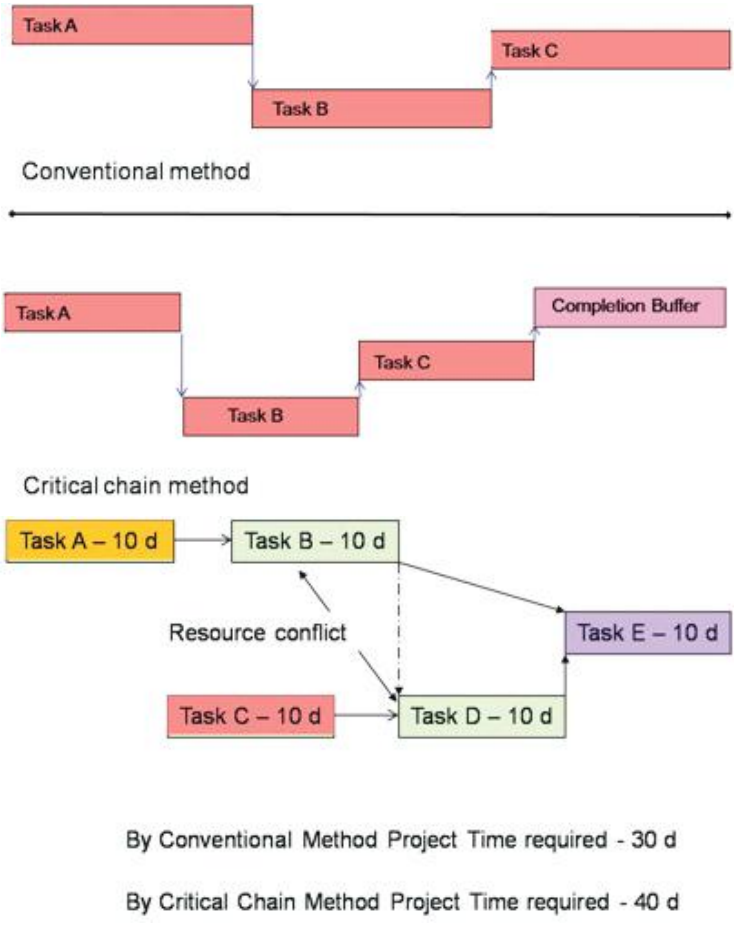
Critical chain is the sequence of both precedence and resource dependent terminal elements that prevents a project from being completed in a shorter time, given finite resources.

Critical chain project management uses buffer management instead of earned value management to assess the performance of a project [1]. Event chain methodology can be used to determine a size of project, feeding, and resource buffers.

CRITICAL CHAIN – A DIFFERENT APPROACH

The main features that distinguish the critical chain from the critical path are:

- Use of resource dependencies.
- Lack of search for an optimum solution. This means that a "good enough" solution is enough.
- The identification and insertion of buffers.
- Monitoring project progress and health by monitoring the consumption rate of the buffers rather than individual task performance to schedule.



By Conventional Method Project Time required - 30 d

By Critical Chain Method Project Time required - 40 d

CRITICAL CHAIN PROJECT MANAGEMENT

The goal of Critical Chain is to help projects finish on time, within budget, and without cutting scope.

It encompasses:

- Cultural change in how to manage projects and evaluate team members [2].
- Avoid multi-tasking while on the Critical Chain
- Protect against uncertainty by aggregating all safety time at the end of the project
- Concentrate on the constraint of the project: the longest chain of dependent tasks or resources

Critical chain management offers an innovative approach to best address the resource limitations and uncertainties involved in the construction projects.

PECULIARITIES AND ISSUES ON CONSTRUCTION

In such a giant industry, we have a lot of strains due to peculiarly irrational Risk-sharing arrangement coupled with its competitive character. Because of complexity of such interwoven responsibilities, superimposed by statutes, monitored by environmentalists, exposed to vagaries of nature and uncertainties of markets, it is believed to be a miracle if any construction project can come out without getting greatly distorted on Time-money or concept scale [3]. The very nature of construction introduces challenges typically not encountered in other industries.

Construction differs widely from manufacturing in that:

- The work is often seasonal
- Each project is unique
- Often involves remote sites with various access problems
- The process is not as predictable
- Difficulty in applying automation
- There is high potential for encountering unforeseen conditions
- Costs can vary according to conditions
- Difficult to manage and supply utilities and other resources.
- Technical innovations are adopted slower.
- Success is dependent upon the quality of involved skilled people
- Customizable in nature
- Project scale can be of mind-boggling size, cost, and complexities
- The work is not performed in controlled conditions, therefore highly impacted by weather and other environmental conditions

PROBLEMS WITH CONSTRUCTION PROJECTS

- Targets not met
- Numerous changes (client and internal)
- Tight budgets
- Re-work and cost thereof
- The conflict of time vs. money
- Uncertainty factor in all aspects resulting in misestimating, omissions and the unknown
- High conflict environment (internal and external with vendors, sub-contractors and with the client)
- Highly chaotic environment
- Project Managers accountable but with limited line authority.

PROJECT TIME OVER RUNS – TIME PERFORMANCE FAILURE

Researchers and industry practitioners have acknowledged construction time over the past three decades as one of the most important performance criteria of many successful projects.

There is substantial acceptance on the fact that complex or large projects are most likely to have

major overrun on both time and cost. Even some projects have been abandoned after eating up the allotted budget mid way. A number of studies conducted shows that only 10% to 40% projects finish approximately on time whereas a majority of projects overruns 20% to 200% of projected time.

CONVENTIONAL PROJECT SCHEDULING

In today's intensely time driven business environment, superior planning, scheduling, and control are vital. Projects must be comprehensively construction operations plan and closely monitor progress.

Schedule preparation requires managers to think the project through prior starting the work and provides a structured approach to planning. Comprehensive schedules provide a means of communicating the work plan to others. Schedules must be an accurate portrayal of the work plan to realize the full value. A good, regularly updated schedule in the hands of a competent construction manager is a powerful tool. Good schedules are critical to project success; however they are only tools. Events or conditions that cause delays and require appropriate action include weather, lower productivity than anticipated, delivery problems, resource constraints, changes in scope, and differing site conditions [4].

In construction industry project execution schedules are often considered synonymous to project management. Given further are the most commonly applied techniques to prepare execution schedules for construction projects.

1.CPM-PERT

Critical Path or a project is the path that takes the greatest amount of time. This is the minimum amount of time needed for the completion of the project. Thus, activities along this path must be shortened in order to speed up the project.

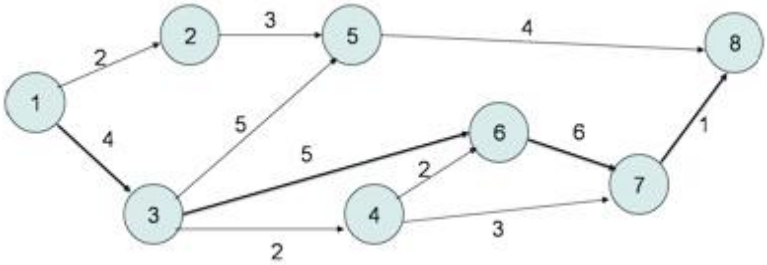


Figure 3.1: A simple PERT/Critical Path (1-3-6-7-8) diagram

Other variation of the same approach is known as PERT - Project Evaluation and Review Technique. The Pert technique involves the diagrammatical representation of the sequence of activities comprising a project by means of a network consisting of arrows representing activities and circles representing events. Overtime CPM and PERT became one technique. A CPM-PERT diagram will help to identify and coordinate various tasks associated with the completion of a project. It provides:

1. The total time to complete the project
2. The scheduled start and finish dates for each task pertaining to the project's completion.
3. The tasks that are "critical" to the project and must be completed exactly as scheduled.
4. The"slack"time available in non-critical tasks, as well as how long they can be delayed before they affect the project finish date.

2. BAR CHARTS AND GANTT CHARTS

Bar Charts and Gantt charts are the easiest and most widely used form of scheduling in construction management. Even with other scheduling techniques the eventual schedule is presented the form of a bar

chart. A typical Bar chart is a list of activities with the start, duration and finish of each activity shown as a bar plotted to a time scale. The level of detail of the activities depends on the intended use of the schedule.
The Gantt chart shows the links between an activity and its preceding activities, which have to be complete before this activity can start. The bar charts are also useful for calculating the resources required for the project.

LIMITATIONS OF CONVENTIONAL TECHNIQUES

PERT/CPM considers only causal dependencies, the completion of a prior task. PERT/CPM also assumes that additional resources can be shifted to a project as required. All projects have finite resources to draw on the estimates and expectations are frequently skewed.

1. A central weakness of conventional techniques is the inability to deal with resource dependencies.
2. PERT/CPM also assumes that additional resources can be shifted to a project as required.
3. There can be potentially hundreds or thousands of activities and individual dependency relationships
4. The lack of a timeframe on most PERT/CPM charts makes it harder to show status
5. In Gantt charts if one activity is accelerated or delayed it will be difficult to see the effect that this may have on associated activities.
6. The Gantt chart cannot show the results of either an early or a late start in the activities.
7. It does not reflect true project status because elements behind schedule do not mean that the project is behind schedule.
8. The Gantt chart does not show the uncertainty involved in performing the activity, therefore questions concerning the minimum or maximum duration of the activity are not represented
9. Planning and scheduling are considered simultaneously

PROBLEM WITH CONVENTIONAL PROJECT MANAGEMENT – UNDESIRED EFFECTS

"The system you currently have is designed to give you the results you are getting now."

In traditional project scheduling, uncertainty is managed by padding task durations, starting work as early as possible, multi-tasking, and focusing on meeting commitment dates.
Conventional techniques follow 90% safe estimate approach.

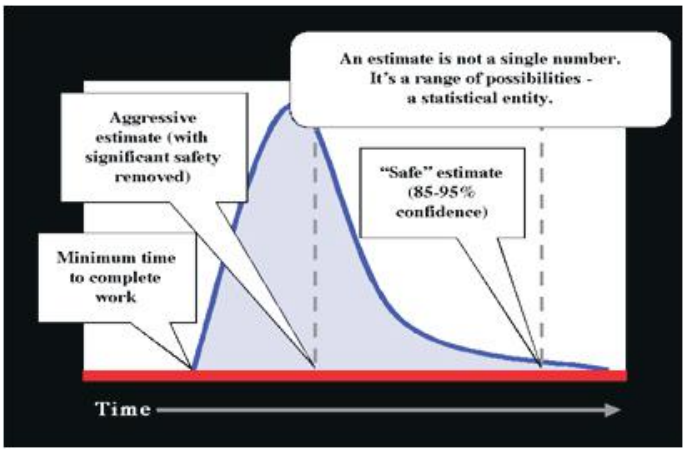


Figure 3.4: activity duration with 50% and 90% estimate (courtesy: Mike Boisseau Project Mgmt)

Although most project task estimates have a significant extra time imbedded, but still its unexplainable why so many projects finish later than planned. An examination of human behavior on projects shows that this safety imbedded in task estimates is often misused.

When planning for an upcoming project, estimates for task durations are required. In order for the plan to be treated as realistic, much time is spent ensuring estimates are accurate. Accurate estimates give

us increased probability and high-confidence in the task completing on time. This allows additional safety time beyond the work content time required to be embedded within the task duration.

CCPM FOR CONSTRUCTION PROJECTS

CCPM in construction industry is about implementing two important paradigm shifts, to get desired benefits. The first one questions the conventional wisdom: early start leads to early finish. The only way to get out of the mess is to control the release of projects in design and procurement. At times, it is also important to control drawings released to site to prevent resources shifting and thin assignment of resources across sites [5]

The second paradigm shift questions the widely held wisdom: in order to complete a project on time, each task should complete on time. This assumption leads to hidden buffers at task level.

Once the buffers are hidden within the milestone, it tends to get wasted as milestones turn into self-fulfilling prophecy. The milestones prevent managers from intervening on a task early and prevent gains from passing on in a chain of activities [5].

CCPM deals with the above problems by staggering the projects and work packets within project based on the capacity limitations. The projects are not planed with so called "accurate estimates". The task estimates are made aggressive and buffers (about 1/3rd of the project lead time) are placed at end of the project as project buffer and end of feeding chains, before the integration point, as feeding buffers [2].

This transparency in buffer consumption provides the early warning system to take expediting actions at right time. The buffer signals also provide way to prioritize tasks across projects (project buffer penetration has higher priority than feeding buffer penetration). The new measurement system to guide projects is no longer expenditure booked on a project. It is % completion along the longest path, compared with the % buffer penetration [2].

The study signifies that in case of construction projects the applicability of CCPM is rather for a single project but the efficiency on multiple projects is yet to be established.

CCPM can be taken as a take of for construction projects by nature unpredictable. It is bound to give positive results to keep a check and control on progress flow w.r.t. time over runs.

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