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Apply Critical Chain Project Management in Residential Project

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Abstract - *Nowadays most of the construction project are delayed due to time overrun. Most of the projects are delayed because of improper planning of activity and resources. They use critical path method for work flow to complete project before desired time duration but large projects in critical path method are more complicated for activity duration and each activity buffer. Buffer is not calculated in critical path method, so to further improve the flow of project critical chain project management(CCPM)is used for buffer calculation and resource planning. In critical chain project management, we focus on critical chain and resources for critical activity. We can easily calculate all buffer in critical chain project management for saving each activity buffer duration for project to complete before time period or on time period. Hence, suggestion is made to use or to take advantages of CCPM method in order to successfully complete project before desired time period.*

Key Words: **Critical chain project management, Buffer calculation, Project Buffer, Feeding Buffer, Resource Buffer, Critical Chain, Theory of Constrain.**

1. INTRODUCTION

At present, project management has been more and more attention and has become an indispensable element in the enterprise management. In 1997, Goldratt (1997), an Israel Eli enterprise management, applied theory of constraints (TOC) to the field of project management, then put forward a new project schedule management method—the Critical Chain Project Management (CCPM) [1].

There have been a significant number of international high profile projects failing to be delivered on-time and on-budget. The Channel Tunnel project to provide an undersea connection between France and the UK is probably the most well-known example, but undoubtedly, most reader scan also think back of smaller scale projects closer to their work environment that failed miserably. A number of undesirable characteristics are associated with many failing projects: budget overruns, compromised project specifications, and missed milestones. Consequently, the three basic dimensions of project success (time, cost and quality) are often in jeopardy. In his successful business novel, "Critical Chain", Goldratt reasoned that time was more important than cost for project managers (Goldratt 1997) [2]. Support for this idea can be found in numerous articles. As an example, a McKinsey study reported in Business Week that a project that is on-time but over-budget by 50% will earn 4% less than an on-budget project. In contrast, the study predicted that a project that is on-budget but 6 months late will earn 33% less than an on-time project. Both sources support the strategic importance of reducing project time.

1.1 Project Buffer

A project buffer protects the project deadline against violations in the critical chain. A single project buffer is added at the end of the project network between the last activity and the project deadline [7].

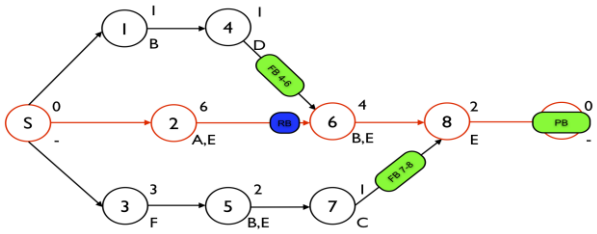

Fig -1: Project Buffer and Feeding Buffer

1.2 Feeding Buffer

It is a buffer that is inserted before the first activity on the Critical Chain. This is to ensure that any tasks feeding into the Critical Chain may not delay the Critical Chain. When a delay does occur in the feeding activities, the feeding buffer is consumed so that Critical Chain is not affected[7].

1.3 Resource Buffer

Resource buffer is inserted just before a critical chain activity where a critical resource is required. It's used to remind the project team that a resource is needed and to finish up prior activities [7].

2. THEORY OF CONSTRAIN

CCPM applies the TOC to project management. Goldratt first described TOC in The Goal (1984) when applied it to production systems. TOC can be summarized by: "Any system must have a constraint. Otherwise, its output would increase without bound, or go to zero." Most people readily accept this statement as self-evident fact. The primary message of The Goal is focus. Focus on the goal of the company. Focus on the constraint that blocks achieving the goal of the company. The Goal ends with five focusing steps, which apply to any physical system. [8].

These steps are:

1. Identify the system constraint.
2. Exploit the system constraint.
3. Subordinate everything else to the system constraint.
4. Elevate the system constraint
5. If, in the previous step, a new constraint has been uncovered, repeat the process.

2.1 Parkinson's Law

Most project schedules have milestones associated with activity finish times, meaning that an early finish will not be especially rewarded, but a late finish is undesirable. The worker will probably not pass on the output of his/her programming others our assigned to successor activities, but rather start streamlining his/her code, adding extra nice graphical features or so This is an illustration of what is called "Parkinson's law". [1]

2.2 The Student Syndrome

What would be the work planning of any 'regular 'student? He or she will mostly postpone the real start of research and preparation to only some 4 weeks before the deadline. Undoubtedly, similar behavior can be observed in project management practice. This effect is known as the "student syndrome" [1]

3. NETWORK SCHEDULING TECHNIQUES

1. Critical path method
2. Program evaluation and review technique
3. Gant or bar chart
4. Milestone charts
5. Line of balance
6. Critical chain project management

we used critical path method for create the critical chain project management network diagram.

3.1 CCPM History

Critical Chain Project Management (CCPM) is a method of planning and managing projects that can reduce project delivery time drastically. CCPM is based on methods derived from Aliyah M. Goldratt's Theory of Constraints (TOC). It is a completely new thought process with emphasis on aggressive timelines for tasks, management of project buffer instead of task buffer and emphasis on resources to execute them. critical Chain Project Management (CCPM) was first introduced in 1997 by the Israeli physicist Aliyah in his book 'Critical Chain'. Critical Chain Project Management is a planning method to better manage projects. With Critical Chain Project Management, organizations are not only able to run projects faster, but also to execute them more cheaply. Practice shows that, in about 70% of the cases, problems occur with project management; for example, projects don't start on time, projects exceed the budget or projects aren't completed within the agreed timeframe. Every project has to deal with a so-called 'critical chain'. This is the longest chain of tasks, which ultimately determines the entire project duration. This 'critical link' has the most influence on turnaround time, and it's this link that plays an important role within CCPM. CCPM is a method that allows you to better plan, execute and manage projects.

3.2 What is CCPM?

Critical Chain Project Management (CCPM) is a methodology for planning, executing and managing projects in single and multi-project environments that puts the main emphasis on the resources required to execute project tasks.

The key features of Critical Chain Project Management are:

- Task times are reduced from conservative to realistic task estimates.
- Resource Conflicts are removed.
- Critical Chain is identified as the longest path considering both task logic and the resource contention.
- Project Buffer is placed at the end of the critical chain.
- Resource Buffers are also placed to ensure the availability of resources at right time in right quantity.
- Feeding buffers are placed at the joints where non-critical chains feed into the critical chain.
- Activities are started on 'As Late as Possible' philosophy after taking into account; the task logic, resource contention, and project completion time etc.
- Buffers are used as measures to control project performance.

3.3 CCPM Control of the execution

Delays are caused primarily by tasks that take longer than planned and tasks that cannot start when they should. The delays are legitimate as they are natural consequences of the inherent nature of performing tasks in an uncertain environment. TOC handles the uncertainty though the use of buffers in the planning phase and in the control of the execution phase. The CCPM solution mechanism to compensate for the delays is by protecting them with time from the corresponding buffer. Any delay in the Critical Chain consumes time from the PB, Project Completion Buffer. Any delay on the feeders consumes time from the FB, Feeding Buffer; of the specific feeder (every feeder has its own FB). Penetration of the Project Completion Buffer prevents the expected completion of the whole project, assuming that the rest of the tasks on the Critical Chain will behave precisely according to the estimated time. The role of the Feeding Buffer is to protect the Critical Chain from

fluctuations of the feeding tasks. However, when the accumulative fluctuations consume all the FB, further fluctuations will be passed to the Critical Chain and will cause penetration of the Bathe number of days consumed from the buffer and, thus, the number of extra days that the project may need after the original planned completion date is the penetration. Penetration of the planned buffer is presented as a percentage. [6].

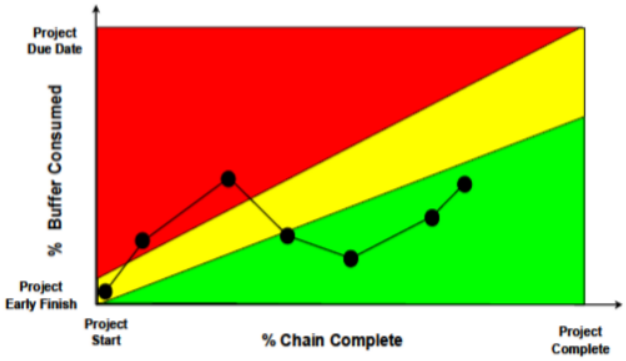

Fig -1: Buffer zones Green, Yellow and Red (Source: Goldratt, 1997)

TOC uses the color system to prompt management attention and action. Green means the project is moving OK – do not interfere. When it is Yellow – it signals "get ready" to take extra actions to ensure that the project will be on time because the situation is becoming risky. When it is on the RED – managers must interfere and take corrective actions to restore the level of protection the project needs. As the buffer status is based on a predication of the penetration to the buffer, it is possible to restore some of the buffer. Any activity that causes the remainder of the Critical Chain to be shorter than planned will add time to the project buffer and, therefore, will reduce the level of penetration. This in effect restores the buffer. The color Black usually denotes that the project is already past the due date. Most CCPM software packages do not use the black buffer status.

Buffer status colors:
As I wrote before the Buffer is split into three zones – green, yellow, and red. Traditionally each zone shall be 1/3 of the buffer size, green being the first zone, followed by yellow and red.

3.4 Buffer Calculation

Calculating Chain Percent Complete for Critical Chain: % Chain Complete = (original Critical Chain duration - remaining duration of longest chain) /original Critical Chain duration

Calculating Chain Percent Complete for Feeding Chains:
% Chain Complete = (original duration of longest feeding chain – remaining duration of longest chain) / original duration of longest feeding chain

-Calculating Percentage of Buffer Consumption: The percentage of buffer consumed (% Buffer Consumption) for a buffer is the consumption rate byte chain leading to it.

4. CONCLUSIONS

We assume that in critical chain project management in each activity have their own buffer, so we provide whole project buffer at the end of critical chain as a project buffer for proper resource planning in order to complete project before or on desired time. Critical chain project management network diagram created from critical path method diagram by reducing duration of all activities by 50% and provide 50% of duration as a feeding buffer and project buffer. Maximum duration path is known as a critical chain of whole project. Critical chain activities duration reduces by 50% and 50% as a project buffer. Non critical path duration reduce by 50% and 50% provide as a feeding buffer.

We created critical path method network diagram in MS Project as per data collection. Total number of activities are 70, non-critical activities 15 and critical activities 50. critical chain duration is 101days as a total project duration. CCPM network diagram created from CPM network diagram and total project duration reduces by 50% as a 64 days and 50% as a project buffer 37 days. Non critical path duration reduce by 50% and 50% as a feeding buffer. After applying CCPM we can easily calculate whole project buffer for upcoming critical path activity. Focus is put on critical chain in CCPM for improving or changing of resources planning. After applying CCPM we can easily find out about resource constrains. We can easily know how much buffer we have after completion of 50% of project. If by any means buffer used becomes more than 50% of provided buffer then, we have to change critical path or improve in resources planning or add extra resources. If we use buffer less than 50% at the mid of project then, no need of making any changes in critical chain. If we focus on success of critical path activities then, we can smoothly complete project before or on planned date.

The essential changes introduced by critical chain project management are:

1. Develop the critical chain, using both activity logic and resource constraints.
2. Reduce activity-estimated times to 50% probability estimates to account for aggregation of the activity contingency times.
3. Add a project buffer to protect completion of the critical chain
4. Add critical chain feeding buffers to immunize the critical chain from delays in the feeding chains and merging effects.
5. Add resource buffers to ensure critical chain resources are available when needed.

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