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Multi-Project Management using Critical Chain Project Management (CCPM) – The Power of Creative Engineering

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Abstract:
CCPM) is a method of planning and managing projects that puts the main emphasis on the resources required to execute project tasks. This is in contrast to the more traditional Critical Path and PERT methods, which emphasize task order and rigid scheduling. A Critical Chain project network will tend to keep the resources levelly loaded, but will require them to be flexible in their start times and to quickly switch between tasks and task chains to keep the whole project on schedule. In this paper we analyze the Critical Chain (CC) approach to managing projects. Is CC as some authors assert one of the most important breakthroughs for project management since the introduction of the Critical Path concept (CP) or does CC merely consist of known concepts presented in a different way? Our discourse compares systematically CC and CPM on three conceptual levels to reveal the differences between the two approaches. We conclude that the philosophy behind the CP and CC approaches is remarkably different resulting in a different mindset for managers and a different set of management practices. The main difference is the application of the Theory of Constraints (TOC) in the CC case. As a result, CC focuses at improving the systems performance by laying out specific policies many of which are focused on resource management especially in multiproject environments that are not explicitly addressed by CP. We conclude that while the application of CC is complex, many of its ideas can be easily adapted by practicing managers.

Keywords: Theory of Constraints, Critical Chain, Buffer Management, Construction industry

Introduction:

Critical Chain Project Management is based on methods and algorithms derived from Theory of Constraints. The idea of CCPM was introduced in 1997 in Eliyahu M. Goldratt's book, Critical Chain. Application of CCPM has been credited with achieving projects 10% to 50% faster and/or cheaper than the traditional methods (i.e. CPM, PERT, Gantt, etc.) developed from 1910 to 1950's.From numerous studies only 44% of projects typically finish on time, projects usually complete at 222% of the duration originally planned, 189% of the original budgeted cost, 70% of projects fall short of their planned scope (technical content delivered), and 30% are cancelled before completion.

These traditional statistics are mostly avoided through CCPM. Typically, CCPM case studies report 95% on-time and on-budget completion when CCPM is applied correctly. Implementing Critical Chain resulted in mean reduction in lead-times of 69%, mean reduction of cycle-times of 66%, mean improvement in due date performance of 60%, mean reduction in inventory levels of 50% and mean increases in revenue / throughput of 68%.

How CCPM is different from traditional project management methods:

With traditional project management methods, 30% of the lost time and resources are typically consumed by wasteful techniques such as bad multi-tasking, Student syndrome, In-box delays, and lack of prioritization.

In project management, the 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. If resources are always available in unlimited quantities, then a project's critical chain is identical to its critical path.

Critical chain is used as an alternative to critical path analysis. The main features that distinguish the critical chain from the critical path are:

- The use of (often implicit) resource dependencies. Implicit means that they are not included in the project network but have to be identified by looking at the resource requirements.
- Lack of search for an optimum solution. This means that a "good enough" solution is enough because:

1. As far as is known, there is no analytical method of finding an absolute optimum (i.e. having the overall shortest critical chain).
2. The inherent uncertainty in estimates is much greater than the difference between the optimum and near-optimum ("good enough" solutions).

The identification and insertion of buffers:
1. Project buffer
2. Feeding buffers
3. Resource buffers. (Most of the time it is observed that companies are reluctant to give more resources)

Monitoring project progress and health by monitoring the consumption rate of the buffers rather than individual task performance to schedule.

CCPM planning aggregates the large amounts of safety time added to tasks within a project into the buffers in order to protect due-date performance, and to avoid wasting this safety time through bad multitasking, student syndrome, Parkinson's Law and poorly synchronized integration.

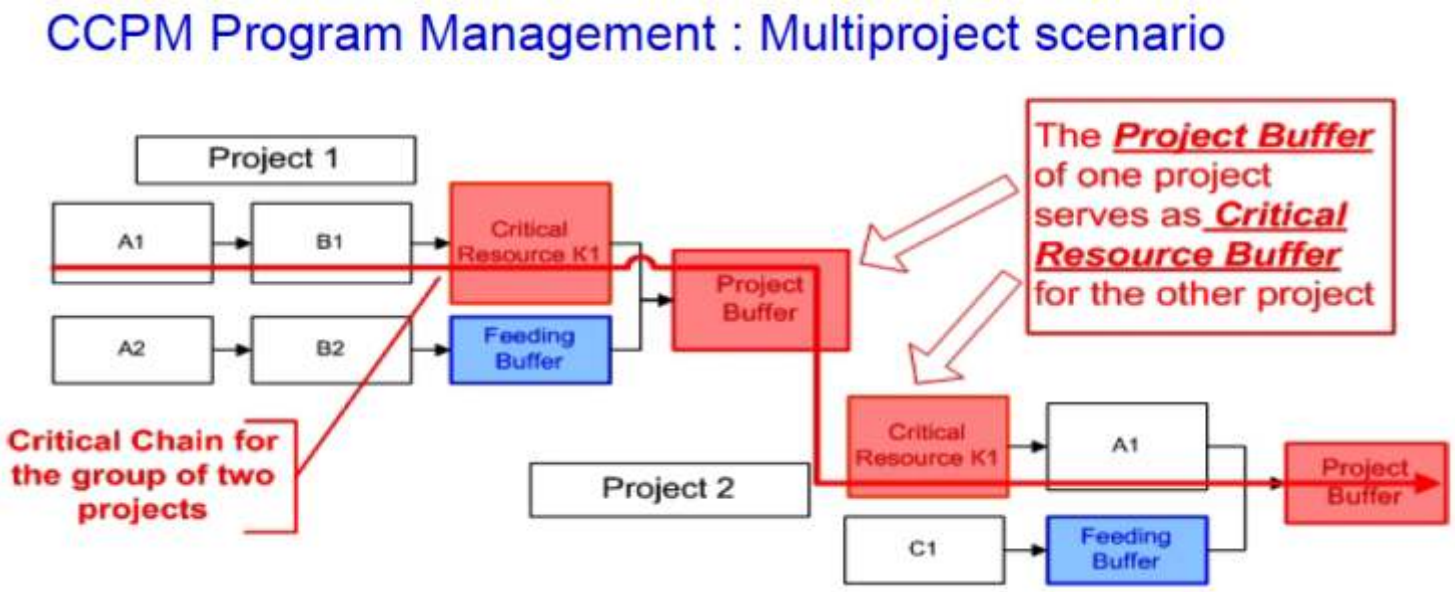
Critical chain project management uses buffer management instead of earned value management to assess the performance of a project. Some project managers feel that the earned value management technique is misleading, because it does not distinguish progress on the project constraint (i.e. on the critical chain) from progress on non-constraints (i.e. on other paths). Event chain methodology can be used to determine a size of project, feeding, and resource buffers.

Literature review:

This section sets the scene by outlining the core elements of CCPM before reviewing critical literature, evaluating recorded practice and outlining the recently published implementation guide (Goldratt, 2007).

CCPM in outline:
A central driver for adopting CCPM is enabling more predictable and shorter project lead times. The argument being that this will not only enhance time related order winning criteria but also reduce cost and improve adherence to specification. To achieve this the focus is on improving the flow of projects using similar logic to that of lean manufacturing and the operations based TOC application.

The main conceptual elements of CCPM are presented below in the context of planning, execution and continuous improvement together with the distinctions with conventional project management.(fig 1)



CCPM takes account of resource as well as precedence dependencies in determining the project duration – this is termed the critical chain. In Figure 1 the critical path would be denoted by activities 1-3-4 whereas in CC it is denoted by 1-3-2-4 due to common resource B. In such cases the critical chain is shown to be longer than the critical path and all four activities need to be managed accordingly.

Project planning:

• CCPM introduces the concept of project and feeder time buffers to accommodate the effective management of buffer time that is commonly wasted when managed locally at the activity level. The project buffer is located at the end of the project to protect the critical chain and feeder buffers isolate activity sequences with float from the critical chain (see Fig.1). Thus, such buffers enable aggregation of the buffer time as well as better control, enabling both shorter and more controllable lead times. In establishing these buffers the proposed start point is to halve existing activity times and put half of the remainder into the aggregated buffer, therefore, the buffer is equal to a third of the activity and buffer combination (see Fig. 1 for illustration).

• When planning in a multi- project environment CCPM advocates staggering the release of projects around a designated resource that acts as a drum. This is used to ensure flow and avoid too many open projects that result in excessive multitasking and missed due dates.

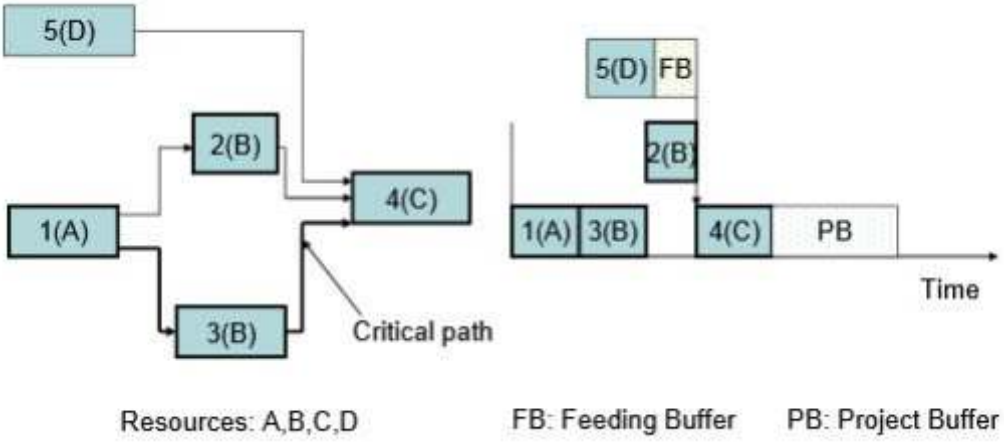


Fig 2: Network Diagram and Critical Chain Schedule showing buffers

CCPM: Where does it apply?

1.Are the individual tasks/milestones targets low on importance for business compared to project completion commitment?
2. Are the projects fed into the system with strict 'time to market' deadlines to beat/meet competition or regulation?
3. Is the 'Return discount factor' (risk associated with every project) very high because of rapid technology obsolescence, market competition and ever-changing business demands? (NPV = FV / (Discount factor)^^(Project duration)).
4. Is the firm focus on earliest delivery of business value instead of optimized resource utilization (Bigger Top line impact vs minor bottom line gains).
5. Project business value is measured by NPV and not only by ROI.

CCPM Case Study: Synergies Technologies Group

Imagine a system capable of concurrently managing over 200 complex projects. Imagine a system providing on-time delivery in an industry where lead times are being significantly slashed, and where a new key measurement of a company's performance is on-time delivery. Two years ago, Synergis Technologies Group was only imagining this. They didn't have the solution. They were trying everything they knew and used the best of their skills to do what they could to make this dream reality. Synergis was a very successful company. It had excellent engineering, excellent manufacturing, excellent try out – everything needed for a tool and die shop to be successful.

That success brought a lot of new work and growth through acquisition, but the project management techniques and the ability to manage the system did not change with the company's growth. Synergis struggled. Synergis is a group of nine companies. Because of the nine locations and the nature of the tool and die industry, theirs is a very complex environment. As in many industries, they are forced on a daily basis to make quick decisions on what must be done to keep the projects moving, keep them on time. Synergis has about 500 employees and is currently doing more than $60 million in sales per year. They concurrently manage over 200 projects, with each project having over 150 tasks. The strategy of the company is to be a single source solution, being a global supplier, taking projects from concept to reality. Typically, projects at Synergis start in Capital Engineering, move to Pattern Building, then to Casting, to Machining and Assembly, to Try-Out, and finally to Quality Control.

In this environment they deal with a lot of uncertainty. For example, it is usually hoped that the Try-Out phase of a project lasts only six week. But Murphy can strike, dragging it out to three or four or five months. It not only delays that project, it also creates for the die shop the inability to turn over, an inability to meet the customer's needs, and kills the budget.Synergis' TOC journey began with the book The Goal followed by Critical Chain. A 2-Day Project Management Workshop was held for all Project Managers, Resource Managers, and the Executive Management Team.

Prior to TOC and Critical Chain the Synergis project environment had:
- No strong project management system
- Low visibility of problems
- Clouded view of priorities
- Difficulty coordinating between facilities
- Travelling bottlenecks
- Late deliveries
- Local versus global focus

During the 2-Day Project Management Workshop all accepted that Synergis had a problem. They now had to decide where to go from there.

Their goal/ambitious target was stated:"A successful implementation of the Critical Chain solution in a multi-project environment in order to increase throughput, meet due dates, and decrease lead time to improve the overall profitability of Synergis."They had to develop a roadmap on how to get there. Using the TOC Thinking Processes, they built their Prerequisite Tree, identifying all of the obstacles to reaching their goal, and the intermediate objectives necessary to overcome these obstacles. Synergis managed the implementation like a project and came up with a detailed implementation plan which integrated the project management software implementation requirements with the business processes, as well as the cultural issues of the company. The core team then identified representatives from all departments. This team attended the

Project Management Program to develop a thorough knowledge/understanding of TOC an Critical Chain. The team next had to be trained in the Project Management software that was going to be used. Following this training phase, these team members had to then train the users of the system in the conceptual and technical issues specific to each department's needs. Once this was complete, putting Synergis' 200+ projects into the system was next.Throughout the implementation, addressing cultural change issues was important. A "Critical Chain Action Plan" meeting was called during which old priority lists were deemed obsolete, and the executive team showed that "being late" would no longer be acceptable. Actions taken to support the new philosophy included outsourcing some work done by overloaded areas, as well as moving projects to less loaded resource centers within Synergis.

These actions have shown both employees and customers that Synergis is firmly committed to contract dates and deliveries. Some of the results seen at Synergis since implementing Critical Chain include:

- Global rather than local view of all projects
- Clear identification of bottlenecks in the system
- Ability to predict problems and issues ahead of time – avoiding fire-fighting with proactive behavior
- Customers' new found confidence in Synergis' commitment to them

Synergis no longer has to imagine a system capable of managing over 200 complex projects concurrently. It no longer has to imagine a system in an industry where lead times are being slashed, and being capable of delivering jobs on time. The company has made these dreams a reality with TOC and Critical Chain.

Conclusion

Some of the people and industries who have already benefited from Critical Chain Project Management are as follows:

aerospace, agriculture, automotive, building & construction, computers, consulting, electronics, engineering, farming, food, government, health care, IT, manufacturing, medicine, media & publishing, military, pharmaceuticals, quality professionals, research, sales & marketing service, software development and telecommunications.

CCPM is not a panacea. Problems still occur in the CCPM world. However with CCPM,

- We have better tools to detect these potential problems before they are reality. We can then devise back-up plans to prepare us for these eventualities
- We can put better monitoring & measuring systems to give us early detection & warning if these adverse conditions are growing from possibility towards probability.
- We can rally the team and quickly respond to a crisis
- We can track our progress, readily see other opportunities, and with a project post mortem, we can quickly improve our system and habits so next project is even better. With CCPM, the link between cause & effect is made plainly visible to all.

If CCPM had not been used, then one or more of the following would surely have occurred:

- The project would have been refused before being rewarded as no longer possible due to client's delay,
- Scope would have been scaled down drastically from original scope,
- Wild and impossible promises would have been made to the client that had an extremely low probability of coming true. The Project Team would have been stressed out throughout the project due to their involvement in the "Big Lie". The project would have been very late, accusations made, refusal to pay, etc.
- The customer would have abandoned the project in mid stream due to the situation going from bad to worse, or their realization that they had not been informed the true state of affairs.

Obviously, none of the above would have resulted in maximum profits nor customer satisfaction.

REFERENCES

Bowers, J.A., "Criticality in Resource Constrained Networks," Journal of the Operational Research Society 46:1 (1995), pp. 80-91.

Clark, K.B., and S.C. Wheelwright, Managing New Product Development-Text and Cases, The Free Press (1993).

Cohen, I., A. Mandelbaum, et al., "Multi-Project Scheduling and Control: A Process-based Comparative Study of the Critical Chain Methodology and Some Alternatives," Project Management Journal, 35:2 (2004), pp. 39-50.

Demeulemeester, E.L., and W.S. Herroelen, "New Benchmark Results for the Resource-Constrained Project Scheduling Problem," Management Science 43:11 (1997), pp. 1485-1492.

Forsberg, K., H. Mooz, and H. Cotterman, Visualizing Project Management, 2nd ed., J. Wiley and Sons (2000).

Globerson, S., "PMBOK and the Critical Chain," PM Network, 14:5 (2000), pp. 63-66.

Goldratt, E.M., and J. Cox, The Goal, revised 2nd ed. North River Press (1986).

Goldratt, E.M., "Critical Chain, IIE Transactions, 30 (1998), pp. 759-763.

Gutierrez, G., and P. Kouvelis, "Parkinson's Law and its Implications for Project Management," Management Science, 37:8 (1991), pp. 990-1001.

Heroelen, W., R. Leus, and E. Demeulemeester, "Critical Chain Project Scheduling: Do Not Oversimplify," Project Management Journal, 33:4 (2002), pp. 48-60.

Herroelen, W., and R. Leus, "On the Merits and Pitfalls of Critical Chain Scheduling," Journal of Operations Management, 19 (2001), pp. 559-577.

Herroelen, W., B.D. Reyck, et al, "Resource-Constrained Project Scheduling: A Survey of Recent Developments," Computers and Operations Research, 25:4 (1998), pp. 279-302.

House, R.S., The Human Side of Project Management, Addison-Wesley (1998).

Leach, L.P., "Critical Chain Project Management Improves Project Performance," Project Management Journal, 30:2 (1999), pp. 39-51.

Leach, L.P., Critical Chain Project Management, Artech House Proffessional Developement Library (2000).

Synergis Technologies Group – www.CriticalChain.co.uk – http://theoryofconstraints.blogspot.com – www.focusedperformance.com