LEADING & LEARNING INCORPORATED

Lead-zine E-Magazine

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Leading and Learning, Inc. ™ is a 45-member **organizational management consulting firm** based in Los Angeles with clients across the U.S., Canada, Europe and Asia. We support leaders during change processes with focus on organizational change management, leadership development, and personal, professional effectiveness. Our client roster includes CEOs and other leaders in corporations and organizations spanning **banking, utilities, manufacturing, hospitality/entertainment, hospitals/health systems, technology/ aerospace, service industries, government and nationally-based nonprofits.**

EACH MONTH, LEAD-ZINE®, the on-line electronic leadership newsletter of Leading and Learning, Inc., focuses on a specific leadership/ management topic. Articles are contributed by Dr. Billie Blair, President of Leading and Learning, Inc., and the LLI team of organizational professionals. Other professionals with specific expertise join the LLI staff each month offering national and international perspectives. These combined views provide informative, focused and balanced balanced perspectives on the ***Lead-Zine®*** topic-of-the-month to our readers – approximately 250,000 CEOs, executives, and other leaders.

This month's issue focuses on the **"Critical Path Method"** and **"Critical Chain Program Management",** their relationships and conflicts. This issue is of particular importance to leaders managing large, complex or critical projects.

◊ ***For those wishing to contribute to a Lead-Zine® issue*** contact the ***Lead-Zine® editor, Eli Isaacs: eli@puzzlespress.com.***

February 2008 – "Utilizing Critical Path and Critical Chain in Project Management "

BILLIE G. BLAIR, PhD

The Critical Path Method (CPM) has been used to plan and manage projects for decades. Its acceptance in industries from construction to electronics, and in commercial and government markets is universal. CPM, integrated with Earned Value Management (EVM) (See January, 2008 Lead-Zine), is the standard in government contracting.

Critical Chain Program Management (CCPM) proponents use CCPM to manage schedule *buffers* for project control. Buffers are effectively schedule pads or reserve time derived by estimating *best* and *safe* costs and collecting the difference into a project buffer. CCPM focuses on resource management along the precedence, or dependent related, chain of tasks required to complete a project. Indeed, if resources are unlimited then the Critical Chain and Critical Path are the same, dependent solely on the time constraint.

CCPM, utilizing buffers, attacks the phenomena of Parkinson's Law and the Student Syndrome. Articulated by C. N. Parkinson in the 1950's, Parkinson's Law contends that "work expands to fill the time available." The Student Syndrome, a form of procrastination, indicates that people will only start to fully apply themselves to a task at the latest possible time and that resources are consumed by bad multi-tasking, in-box delays, and lack of prioritization. The relationship between the two is obvious.

CCPM was introduced by Eliyahu M. Goldratt in the late 1990's, thus it is a relatively new comer to the field of project management. Industry and government cultural changes will be required before it is universally accepted.

Regardless the project methodology chosen the goal is to be successful – deliver a quality product that meets customer's expectations, on time and within budget. A very tall order for the large and complex projects with which many companies deal.

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THE LEAD-ZINE NOW

INCLUDES MULTIPLE PAGES!

IN THIS ISSUE

ENJOY THE WRITINGS OF AUTHORS WHO DISCUSS VARIOUS TECHNICAL ASPECTS OF

Critical Path and Critical Chain Project Management

THE CONTRIBUTING AUTHORS THIS MONTH TALK ABOUT

Critical Path Method (CPM)

Sean Noonan, Lead Engineer, EES

CPM was originated in the 1950s to manage plant maintenance projects. It is now commonly used on many types of projects, including construction, software development, research projects, product development, engineering, and more. Any project with interdependent activities can apply this method of scheduling and monitoring. In our firm, Enhanced Engineering Solutions, we adapt and apply CPM to all projects regardless of size of duration. We specialize in construction projects for utilities and municipalities but each project is unique in some way. We find the application of CPM critical to our success.

The first few times that I personally used CPM was before the automated software tools that support the process were mature and robust. Some software tools existed but the care and feeding of them took as much time as construction and analysis of a schedule and CP Network by hand. Plus, the analysis and output from the tools was marginal useful. This was also before personal computers (PC) had achieved today's capabilities, thus purchasing or competing for main-frame time was often required. *Real-time* often meant over night, if not a few days. Though somewhat labor intensive, using CPM significantly improved our performance tracking, project development visibility, and reacting to and planning for change. On a six-month duration electrical substation construction effort for a utility company we used a "work wall" approach on which we mounted the CP Network and red-lined it weekly. Complete redraws were seldom as this was quite time consuming, and the red-line version provided history. *Red* red-lines were bad, *blue* red-lines were good. Some of our networks became quite colorful.

As the CPM and scheduling software toolsets matured, and the analysis and reporting capabilities of these toolsets offered pertinent information, our company elected to apply the automated capabilities. Desk-top terminals and PCs provided our project leads real-time status and analysis literally at their fingertips. Laptops have given us even more capability as we carry these units directly to field sites, obtain immediate status and show customers precisely which areas of construction we were working and how we were progressing. Currently, we utilize ruggedized laptops, originally built for military applications, but ideal in any construction environment. I will often stop at a local coffee shop as I travel from a job site to job site, complete my schedule and CP updates and email them to the office. A word of caution that applies to many automated toolsets – one can be overcome with the amount of output that can be generated. Adapt and tailor the CPM and scheduling processes to adequately meet your project needs. At EES we commonly apply more or less formal and extensive procedures to some projects than to others.

The essential data for a CPM model of the project is: 1) a comprehensive list of activities required to complete the project, 2) a planned/estimated duration for each activity, and 3) the dependencies between the activities. CPM software calculates the longest time-path of activities to project completion. The earliest and latest start dates each activity can have without delaying the completion is provided as an output and is usually printed on the CP Network, or a supporting schedule diagram, generated by the software. Thus, the *critical path* of activities that add up to the longest duration and therefore drive the schedule is derived.

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CPM cont.d …

There is zero *slack* time on the CP – all the planned schedule time from start to completion is allocated. The CP provides that set of activities to be managed and prioritized to pull completion time left, that is, shorten construction time. In our company we say we want to *collapse the Critical Path.* Doing so most often saves cost and increases profit, and pleases the customer.

As development progresses the CP will change so diligence is required to make sure the right activities receive attention. In addition to the CP our project leads monitor the *near-critical* paths, those that are near the current CP in driving completion and which may easier turn critical. This gives us a heads-up for planning and resource allocation.

A CPM application may only consider dependencies between activities, but it is common and prudent that resources – staff, critical equipment, etc – be integrated into the process. Software toolsets developed for project management make this relatively simple and permit analysis of impact to schedule performance from resource conflicts or shortages to be more easily analyzed. Staff shortages, staff illnesses and vacations can be accounted for. Availability of critical equipment can be better managed. At EES we check activity dependencies; analyze potential for overlap (that is, can we start a task before a preceding task is fully complete, or run them in parallel); determine if adding personnel is feasible, or if additional equipment needs to be leased, and more. For example, our company has a finite number of towable generator/welders that are shared among jobs. Activities on the CP Network that require a generator/welder are scheduled to take advantage of availability. We also manage/allocate personnel with welding tickets as a unique resource on the schedule and CP network. Additionally, we can perform priority analysis between job needs that require these limited resources. The CP may be affected or completed changed by resources. While schedule change is to be expected, CPM allows continual monitoring and tracking of scheduled activities alerting our project leads of potential issues.

Use of CPM is not magic! A schedule and network developed using critical path techniques may not be achieved. The old adage *Garbage In, Garbage Out* could have been coined for CPM. If estimations are poor or mistakes are made, the results and validity of the analysis are questionable. The result could develop into a problem for the entire project plan if not addressed properly. Good schedule and CP development and continual analysis take time but are essential to detect deviation from plan in a timely manner permitting corrective action. As stated, at EES every project is initiated with a detail plan and CP analysis, with resources considered.

Critical Chain Application

George S. Turner, PM
Leading and Learning, Inc.

Our company applied Critical Chain Program Management (CCPM) processes to a very large government contract in an attempt to better control scope creep and resources allocation to complete the project in a timely and cost-effective manner. We had initiated the project using the Earned Value Management System (EVMS) and the Critical Path Method (CPM) with MSProject™ as the scheduling toolset. Critical Chain CC puts more emphasis on the resources required to execute project tasks than does more traditional CP and Program (or Project) Evaluation and Review Technique (PERT) methods, which emphasize task order and rigid scheduling. Most large projects end over budget, past scheduled end date, and vary from the original scope specifications. Adding CCPM, a somewhat different approach, to our project management repertoire we could potentially avoid these results.

CCPM was planned as an alternative to CPM. However, we used our existing EVMS and CPM database as a starting point for CC application. CC calls for a project plan to be created in much the same fashion as with CP application. In both disciplines the plan is worked forward, then backward from a completion date analyzing each task for optimization. In CCM two durations are entered for each task. These are a "best guess" duration, and a "safe" duration, the latter obviously having a higher probability of completion to plan. Using our existing database and plan might not have been the best approach but we were about one-quarter into the program from a schedule point and about thirty-five percent from a cost/budget point. Because we were already behind schedule and over budget, the EV calculations were yielding grim projections. Our lead developers were familiar with the metrics and tasks (activities) in our plan and a full restart was considered risky and time consuming. No one wanted to “start over” on our plan, especially since we felt our tasks defined the project scope as well as would a new effort. Further, our customer required and understood EVMS and CPM.

Cont’d on page 4

CCPM cont'd …

In the textbook definition the CC process is distinguished from the CP in three principal ways.

First, in being dependent on implicit resources dependencies – these resources are not included in the project network but are identified by looking at resource requirements. *In fact, we had explicitly included resources in our database and used resources as a criteria in our CP and EVMS application. We considered this prudent based on considerable past experience.*

Second, CC does not search for an optimum solution. Rather a good-enough solution is accepted because the inherent uncertainty in estimates negates the value of searching for the shortest chain. *Of course, in CPM we had established the longest, or critical path, to completion and managed accordingly. A "good-enough" solution was not an acceptable term to use for either our management or our customer!*

Third, the identification and insertion of buffers into the time line. Buffers may be a project buffer or task feeding buffers. CCM recognizes that tasks often take more rather than less time due to complete, thus schedule buffers are used to establish completion dates. The extra duration added to each task on the critical chain (the safe estimates less the best-guess estimates mentioned above) is gathered into an end-project buffer. Project buffer consumption protects the completion date from impacts within the critical chain as we proceed. In the same way, buffers are gathered at the end of each sequence of non-critical tasks that feed into the critical chain to avoid non-critical task impact. Consumption, or management, of these buffers is used to monitor project health, that is, schedule and cost. *CP has no buffers, in fact, by definition CP has no schedule slack at all in the critical path. Our issue with buffers was that a buffer had to assume there was some slack or unaccounted for time in the schedule or in the original estimates. We had no such luxury; and did not from project kick-off. Thus, buffers that were "artificially" inserted by taking from task time were basically ignored by development leads. Further, CCPM uses buffer consumption, or buffer management, as the measure of progress rather than Earned Value. But, our customer required EV metrics/reporting and our leads understood EVM. We had somewhat duplicative progress methods to document.*

Reviewing these three items and considering our use of CCMP, CPM and EVMS leads to the following:

•Plan for staff training on CCPM, it is <u>not</u> CPM and it is <u>not</u> EVMS. CCPM is a cultural change. Even if the latter two disciplines are well understood, CCPM training will be required as it requires a shift from traditional process application.

•Begin CCPM at the beginning of the project. Trying to build in buffers in a project that is well underway and indicating trouble is too difficult ... and unacceptable to staff.

•Assume that EVMS is also going to be required, especially on any government contracted projects. EVMS can be used with CCPM as easily as with CPM, buffers are managed while EV data is collected and reported simultaneously. EVMS will continue to be a component of the management process.

Cont'd on page 5 …

CCPM cont'd …

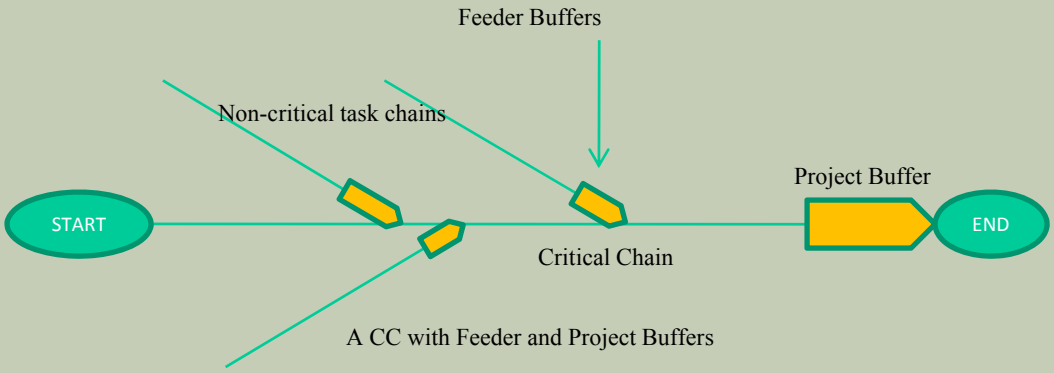
Issues encountered:

• Handling "best guess" and "safe" estimates handled in development. Proposals are most often "to the bone" cost exercises. Getting management to allow cost estimating for "safer" buffers is problematic.

• How best to use buffers in communication with the customer. O.

• Whether or not buffers are revealed to development leads – there are pros and cons.

An overall assessment is that utilization of EVMS, CPM and MSProject™ answered our need. The EV data were a true picture of status. An individual task would indicate good or poor progress from EV data or from buffer consumption. EV data including resource leveling, in my opinion, provide more value in attacking problems, reallocating resources … and adjusting schedule. Others feel that replacing EV's predictive tools with buffer management has served well. Ultimately, what matters is that projects are delivered in a timely and cost effective manner. Project failure can impact the performing organization and it is demoralizing to development staff people. A prudent manager will consider all approaches to project control.



A CC with Feeder and Project Buffers

Note: Critical Chain Management was developed by **Eliyahu M. Goldratt**. It is based on the *Theory of Constraints* and is the subject of his book *Critical Chain.*

We hope you have gained value from this month's Lead-Zine.
Your comments are always welcome.