Critical Chain
Project Management

Control Over Chaos

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Conceive, Believe, Achieve
End in Mind

The Goal

- All Projects On or Ahead of Schedule
- All Projects On or Under Budget
- All Projects Requisite Quality
Current Project Management Environment

• **Uncertainty & Variability Exist**
  – Work Scope Changes
  – Emergent Work
  – Schedule Conflicts
  – Conflicting Priorities
  – Different Skill Levels
  – Murphy’s Law

• **Resources Limited**
  – Not Enough Capacity (Labor & Material)
  – Right People with Right Skills & Right Experiences Limited
  – Have enough Tasks open at all times so that resources do not run out of work
  – Subordinate all actions to keeping resources busy
  – High Overtime

• **Aggressive Schedules**
  – Timelines/Deadlines are Shrinking
  – Most Tasks Urgent

• **Commitments are Essential**
• **Can Not Turn Work Away**
• **Other?**

*Must Get More Work Done with Less People in Less Time*
Current Project Management Problems

• **No Credible Schedule**
  – *Multiple Scheduling Tools & Work Lists*
  – *Too Many Scope Changes*
  – *Task Durations Padded with Contingency, yet Still Miss Dates*
  – *Bad Duration & Cost Estimates*
  – *Critical Path Constantly Changing*
  – *Unable to Accurately Predict Milestone Dates During Execution*

• **Changing/Conflicting Priorities**
  – *Daily Firefighting, Pulling Resources from One Task to Another*
  – *Too Many Worksites Open*
  – *Multitasking & High Work In Process (WIP)*
  – *Resource Allocation Nightmare*
  – *Stress, Frustrated Workers & Supervisors*
Current Project Management Problems (cont)

• **Lack of Resources**
  – People, Experience, Skills, Material, Tools, Space
  – Workload to Work Force Imbalance
  – Lack of Supporting Documents

• **Projects Get Delayed & Require Heroic Efforts to Finish**

• **Too Much Rework**

• **Missed Due Dates**

• **Too Much Overtime**

• **Budget Overruns**

• **Other?**
Current Project Management Behaviors

• Use Back Pocket Schedules
• Accept Poor Work Breakdown Structure
• Front End Load the Schedule
• Schedule Too Many Starts on the Same Day
• Complain About New Work & Scope Changes vice Planning for it
• Build Contingencies into Each Task
• Base Duration & Cost Estimates on Worst/Last Performance
  – Parkinson’s Law Self Perpetuating
  – Student Syndrome Self Perpetuating
• Work Easy Tasks instead of Right Tasks
• Fast Start Many Tasks to Get Ahead
• Multitask, Open Too Many Tasks, creating High WIP
• Wait until Last Minute to Start/Finish Tasks
• Focus on Just Meeting Task Dates vice on Finishing Sooner
Current Project Management Behaviors (cont)

• **Use All Available Float on Each Task**
• **Focus on Task Costs More Than on Task Throughput**
• **When Problems Occur, Start New Tasks**
• **Hoard “A Players”, Increasing Costs & Depriving Other Projects**
• **Request More Resources Than Necessary to Accommodate WIP**
• **Request More Overtime Than Necessary to Accommodate WIP**
• **Request More Overtime Than Necessary to Recover Lost Time**
• **Update Official Schedules Weekly with Additional Contingencies**
• **Fail to Claim Actual Starts**
• **Fail to reflect impact of Work Stoppages on Scheduled Finish Dates**
• **Fail to Claim Early Finishes**
• **Try to Predict Milestones Based on Percent Complete**
• **Try to Predict Milestones Based on Costs and Earned Value**
What is Theory of Constraints (TOC)?

Critical Chain Project Management (CCPM)?

• **TOC** was developed by Dr. Eliyahu Goldratt
  – Presented in his Business Novel *The Goal*
  – Scientific Principles applied as a set of **logical thinking processes** to develop **transformational, breakthrough business solutions**

• **CCPM** was developed by Dr. Eliyahu Goldratt
  – Presented in his Business Novel *Critical Chain*
  – **Application of Theory of Constraints (TOC) to Project Management**
  – **Set of logical Concepts, Principles, and Tools to Manage Project Systems Significantly Better**
Theory Of Constraints

Thinking Processes
• Current Reality Tree
• Conflict Resolution Diagram
• Future Reality Tree
• Prerequisite Tree
• Transition Tree

Five Focusing Steps
1. Identify the System Constraint
2. Exploit the Constraint
3. Subordinate Everything Else
4. Elevate the Constraint
5. Go back to Step 1

Critical Chain Project Management

What to change?  What to change to?  How to effect the change?
TOC Principles

• *All Systems Have a Goal & Necessary Conditions*

• *Projects Succeed or Fail as an Integrated System*, not as a Collection of Discrete Tasks

• *A System’s Optimum Performance IS NOT the Sum of Local Optima*

• *Systems are Analogous to Chains*
  – *Weakest Link is the System’s Constraint*
  – *The Critical Chain is the Critical Path with Resource Constraints (Labor & Non-Labor) Accounted for & Buffered for Uncertainties & Variability*

• *A System has Only One Constraint at a Time*

• *Constraints Can Never Really be Eliminated*
  – *Can Move From One Part of the System to Another*

• *All Systems Function According to Cause & Effect (If, Then Logic)*
CCPM Basic Principles
Five Focusing Steps

1. Identify the System Constraint
   – Build a **Single** Integrated Schedule
   – Fix Work Breakdown Structure!
   – Identify **Resource (Labor & Non-Labor) Constraints** with **Ties in Network**
   – Include **Anticipated New Work**
   – Identify the **Critical Chain**
   – **Stagger Starts** of Non-Critical Chain Tasks

2. Exploit the System Constraint
   – Use **Aggressive durations** to counter Parkinson’s Law & Student Syndrome
   – **Insert Buffers** for Uncertainty and Variability

3. Subordinate Everything Else to the System Constraint
   – **The Focus: Non-Stop Execution of the Critical Chain**
   – **Never let the Critical Chain slow down or stop!!**
   – **Finish What You Start!**
   – Low WIP, No Multitasking
   – Whole Team **Focus** (People, Paper, Parts, Tools, etc.)

4. Elevate the System Constraint
   – Increase Capacity Applied to the **Critical Chain**
   – Increase Work Days, Shifts, Equipment, Tools, Material, Overtime

5. Go back to **Step 1**
   – Update **Actual Starts, Remaining Durations, Work Stoppages, & Actual Finishes Daily**
   – Monitor **Daily** for New **Constraints** to the **Critical Chain**
End in Mind

**The Goal**

- All Projects **On or Ahead of Schedule**
- All Projects **On or Under Budget**
- All Projects **Requisite Quality**

**The Focus**

Non-Stop Execution of the Critical Chain
Once Work Breakdown Structure has been corrected, Critical Path Method puts all Tasks at their earliest possible Start Date to conserve float.

The path with the least amount of float, the longest path for the Project, is the Critical Path (red boxes).
Step 1: Identify the System Constraint

Identify Resource Constraints with Ties in Network

**Critical Chain vs Critical Path**

The **Critical Chain (red boxes)** is the **Critical Path** taking into consideration **resource (labor & non-labor) limitations/constraints**.

Any slippage of Tasks on the **Critical Chain** will **negatively impact the Milestone** and possibly the completion of the Project.

![Diagram showing the critical chain and network ties](image)
Step 1: Identify the System Constraint (cont)

Include **Anticipated New Work**

Including **Anticipated New Work** into the Network *reduces the float*, of course, but reflects the *reality* of the *high risk* of New Work after the Test.
Step 1: Identify the System Constraint (cont)

Stagger Starts of Non-Critical Chain Tasks

*Staggering the Start Dates* so that the Tasks *do not all start on the same day* ensures good *Focus on the Critical Chain* and *lower costs* due to fewer resources being required at the same time.
Step 2: Exploit the System Constraint

Use Aggressive durations

An estimate is not a single number. It’s a range of possibilities—a statistical entity.

"Safe" estimate (85-95% confidence)

Aggressive estimate (with significant safety removed)

Minimum time to complete work

Many Duration Estimates provide for a full range of contingencies
Step 2: Exploit the System Constraint (cont)

Use Aggressive durations

- **Parkinson’s Law**: “Work expands to fill the time allowed”
- **Student Syndrome**: “Wait until last minute to start”
- Kicks in when Task duration is too long or looks easily achievable, **date driven**
- Chance to finish early is minimal when **Sense of Urgency** is Lost
- **Problems** are discovered later, sometimes too late to mitigate impact to Key Events
- As **WIP** expands, mechanics get tied up on other Tasks, missing original dates
Step 2: Exploit the System Constraint (cont)

Use Aggressive durations & Cover Task Contingencies with Buffer
Step 2: Exploit the System Constraint (cont)

**Insert Buffers** for Uncertainty & Variability

Inserting a **Buffer** into the Network *reduces the float*, of course, but reflects the **reality** of Murphy occurring at some time during the Project.

Inserting the **Buffer** at the **end of the Network** just before the Milestone ensures we **protect the Milestone** from Murphy throughout the Project, countering the effect of **Parkinson’s Law** from including contingencies in each individual Task.
Step 3: Subordinate to the System Constraint

• Make **Priorities Accessible & Visible for all Tasks within a Project & Across Projects**
  – Company Prioritized Task List
  – Project Prioritized Task List
  – Second Level Manager Prioritized Task List
  – First Line Supervisor Prioritized Task List

• Develop a **Standard method of Prioritization** based on **Buffer Penetration** using new or existing Scheduling Software

• Clearly Identify the activities and support that needs to happen to enable **Non-Stop Execution of the Critical Chain**

• Provide **Priorities** to the **Resource Allocation Process** – so the **right people** are working the **right Tasks** at the **right time** with **low churn**

• **Control WIP!!**
  – Improves Throughput
  – Reduces Rework/Improves Quality
  – Improves Costs
Step 4: Elevate the System Constraint

- **Increase Capacity** Applied to the **Critical Chain**
  - Labor Resources
    - Resources Per Day
    - Work Days
    - Shifts
  - Equipment
  - Tooling
  - Material
  - Overtime
    - **Do Not Waste OT/Costs on Jobs Not Impacting the Critical Chain**
    - **Overtime** does NOT increase Labor Resources
Step 5: Go Back To Step 1

- Keep All Tasks current with Daily Updates
  - **Claim Actual Start Dates Daily**
    - Pulls Tasks to the left vice riding to the right
  - **Claim Accurate Remaining Duration (RDU) Daily**
    - RDU vice Percent Complete
    - RDU tells you when you will FINISH
    - RDU provides the impact to the Buffer Penetration
    - Percent Complete tells us NOTHING about the FUTURE
  - **Update Work Stoppages Daily**
    - Work Stoppages Affect when you will FINISH
    - Work Stoppages Impact Buffer Penetration
    - Gives Visibility to where to FOCUS
  - **Claim Actual Finish Dates Daily**
    - Pulls Follow On Tasks to the left vice riding to the right
- Monitor DPL Daily for New Constraints to the Critical Chain
CCPM Behaviors

• Single Integrated Schedule
• Plan for New Work & Scope Changes vice Complaining About it
• Fix Work Breakdown Structure
• Stagger Tasks in the Schedule Using Finish to Start Ties
• Eliminate Contingencies from Each Task, Reduce Durations
  – Management Must Not Insist on Each Task Starting & Finishing “On Time”
• Base Duration & Cost Estimates on Average/Bare Bones vice highest
• Start Right Tasks at Right Time using Prioritized Task List
• Work Right Tasks instead of Easy Tasks
• Start Tasks in Relay Racer fashion
• Focus on Meeting Milestone Dates, Not Task Dates
• Focus on Task Throughput, NOT on Task Costs
  – Put it in the Drawer!
CCPM Behaviors (cont)

- **Conserve** Available **Float** on Each Task
- **When Problems Occur,** **Solve the Problem** *vice* Starting New Task
- **Finish What You Start!**
  - **Eliminate** Bad Multitasking
  - **Focus** Resources on **One Task at a Time,** Work to Completion
- **Keep WIP Low!**
- **Do Not Overman**
- **Move Resources** When Task is Done to **Next Priority Task Quickly**
- **Only Work Overtime** on **Priority Work to Recover Buffer**
- **Update Official Schedules Daily** with Actual Starts, Remaining Duration, Work Stoppages, & Actual Finishes
- **Claim Early Finishes** Immediately
- **Predict Milestone Dates** Based on **Buffer Penetration**
CCPM Applications & Results

- **Lucent Technologies**
  - *Project Success Rate Improved from 10’s to 100%*

- **Harris Semiconductor**
  - *Reduced Mean Project Cycle Times from 140 to 36 Days*

- **Israeli Aircraft**
  - *Reduced Maintenance Cycle Times from 45 to 14 Days*

- **AGI Insurance**
  - *Reduced Project Cycle Time from 2 Years to 13 Months*

- **NADEP Cherry Point**
  - *Reduced Cycle Times from 225 to 100 Days*

- **Naval Shipyards**
  - *Doubled the number of Projects On Time, Reduced Maintenance Cycle Times by 32 Days, Reduced Overtime by 6%, Reduced Costs by 13%*
Summary and Conclusion

• **Critical Chain Project Management** can dramatically...
  – Improve project delivery date reliability
  – Shorten overall project duration
  – Provide “early warning” of threats to project delivery
  – Enable earlier, less drastic responses
  – Reduce **Rework**
  – Reduce **Overtime**
  – Reduce **Costs**

**In other words… BETTER CONTROL, LESS CHAOS!**

But, It Takes a Willingness to Dramatically Change our Behaviors. Are YOU Willing?

**Take CONTROL Over CHAOS!!!**