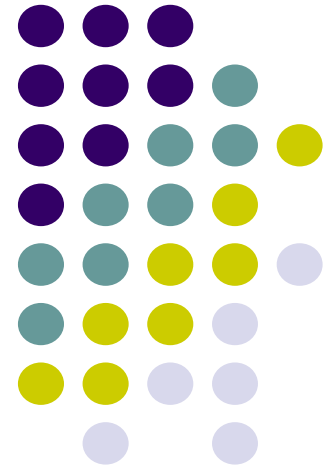




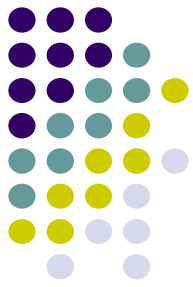
Critical Chain Project Management

The application of the critical chain project
management methodology to project
management

Presented by Ted Hutchin
I & J Munn Ltd

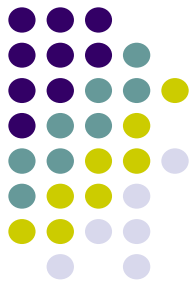


What is the goal of project driven organisations?

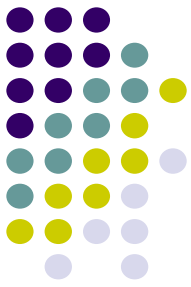


- To make money from sales
- To satisfy the market by
 - Delivering on time
 - Meeting the specification of the client
 - Meeting the budget
- To satisfy the team

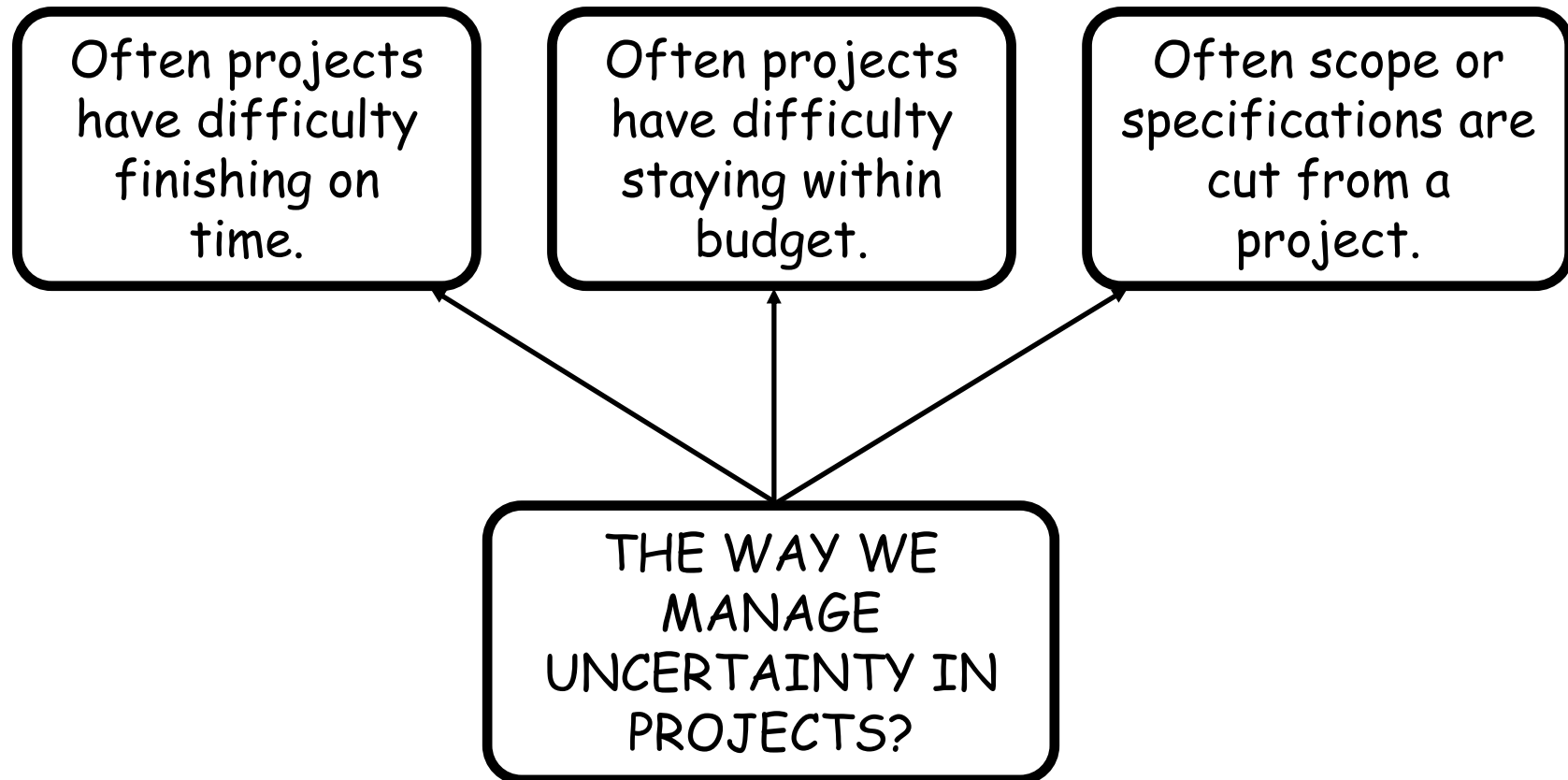
The importance of value to the customer and ourselves



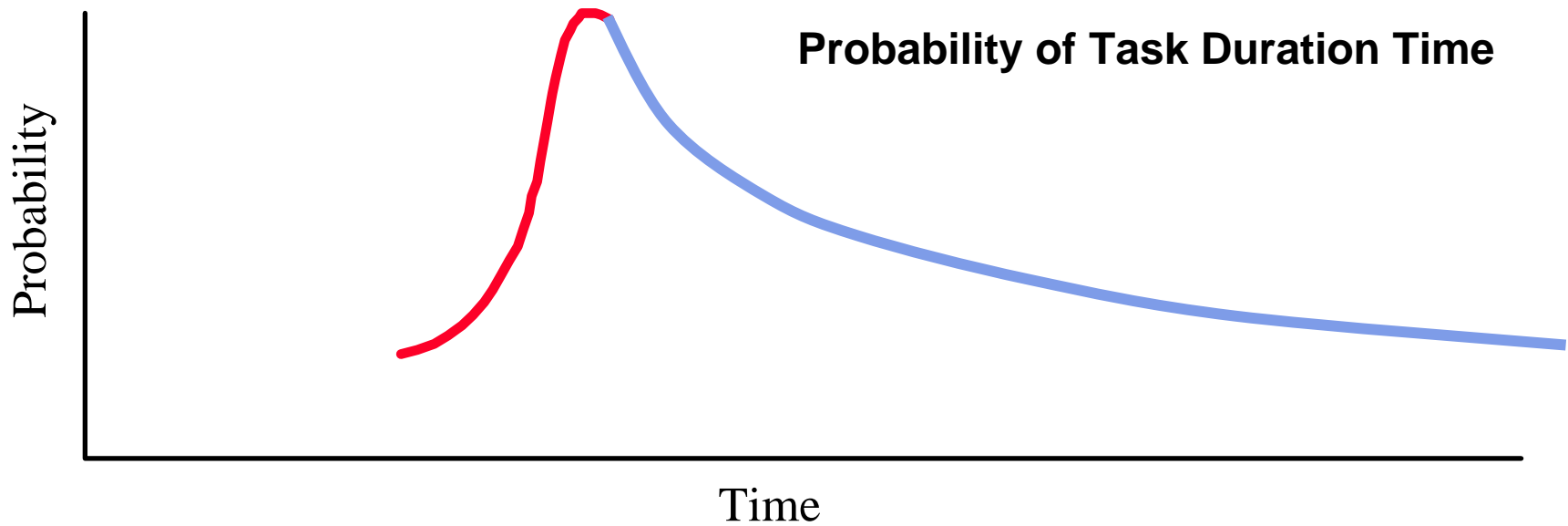
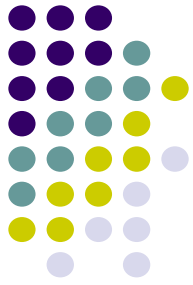
- Certainty of delivery on:-
 - Time
 - Cost
 - Quality
 - Safety
 - Environment
- The ability to do more projects than today with little or no increase in cost/resources
- To enhance the productivity of the resources available to us
- But what of the uncertainty that exists in the market?



How do we manage uncertainty!

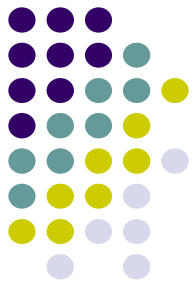


Which Time Are You Likely to Promise?

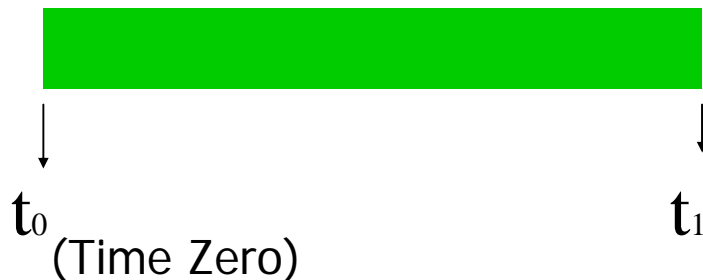


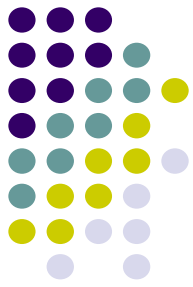
Estimation: The 1st element of uncertainty

What's contained in a task estimate?



- The amount of time the task will take if everything goes reasonably well.



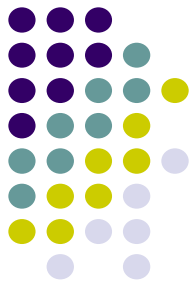


Determining a task estimate

The amount of time the task will take if everything goes reasonably well.

The amount of time to cope with uncertainty in the task.



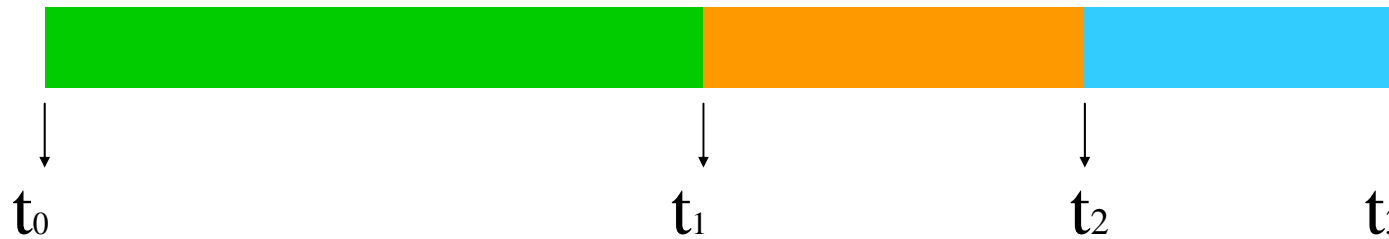


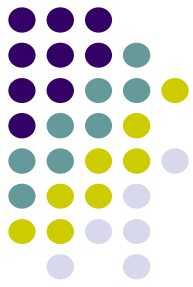
Task estimates

The amount of time the task will take if everything goes reasonably well.

The amount of time to cope with uncertainty in the task.

The amount of time spent working on other activities.





Task estimates

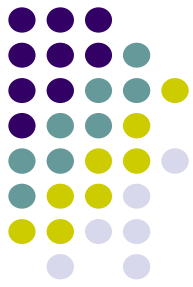
The amount of time the task will take if everything goes reasonably well.

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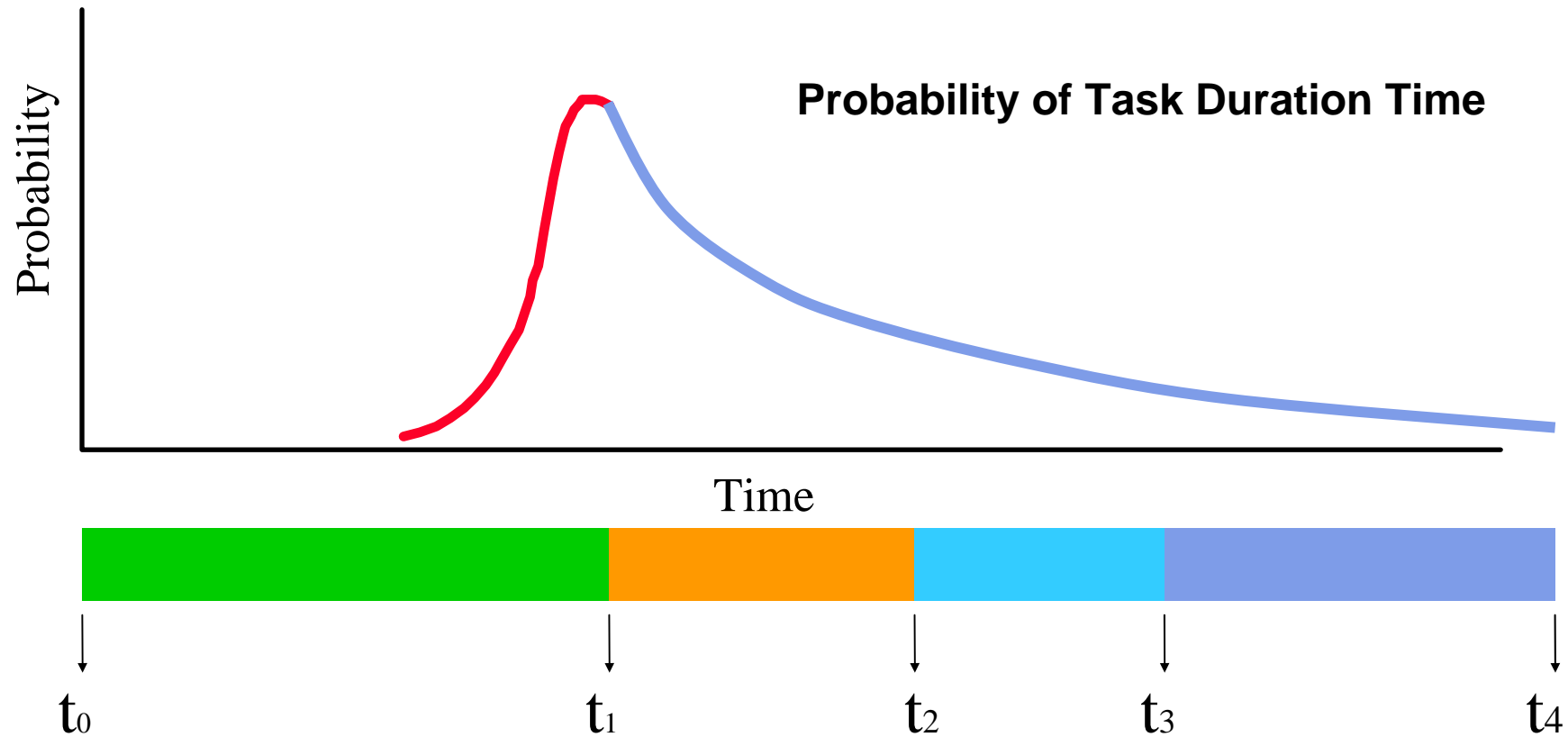
The amount of time spent working on other activities.

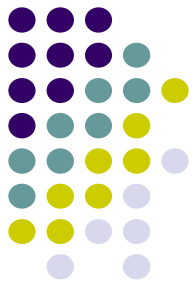
The amount of time we allow for interruptions.



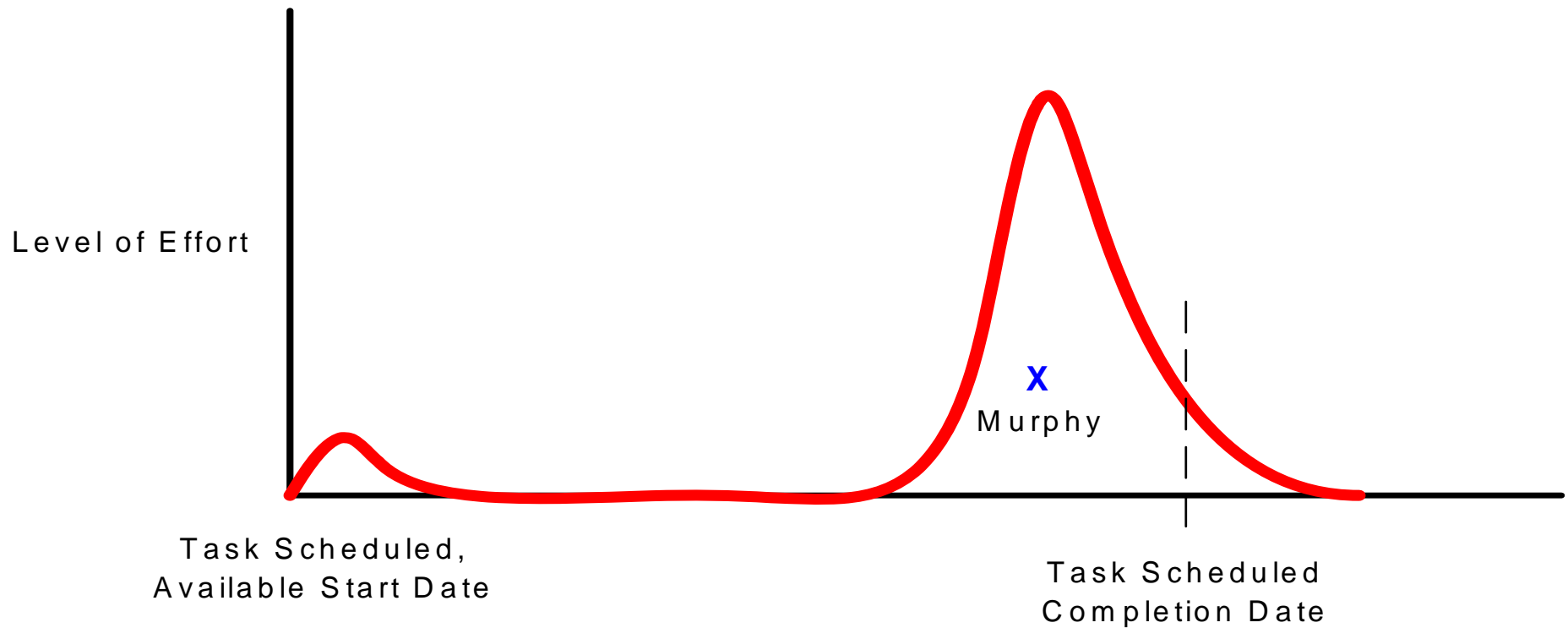


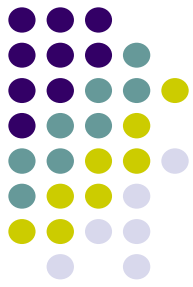
Which Time Are You Likely to Promise?



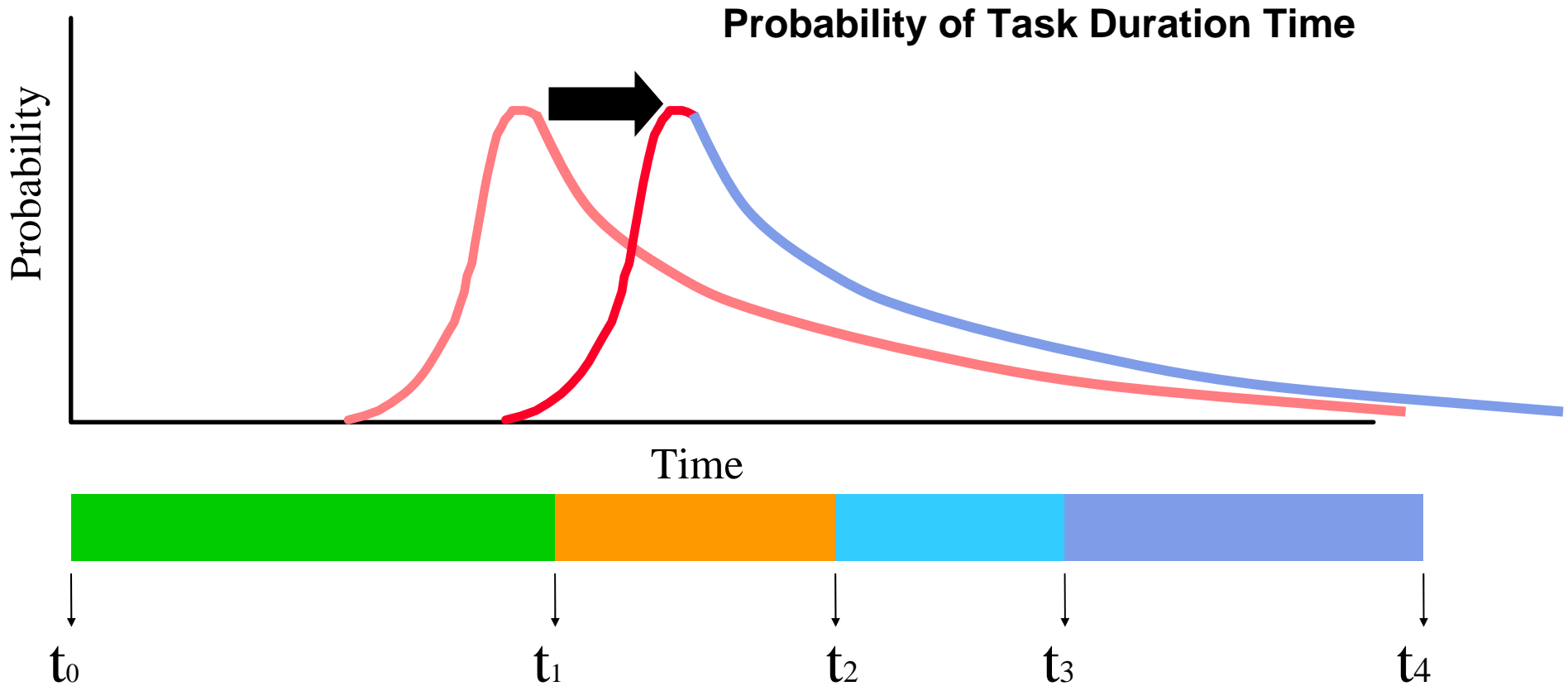


The “last minute” or “student” syndrome

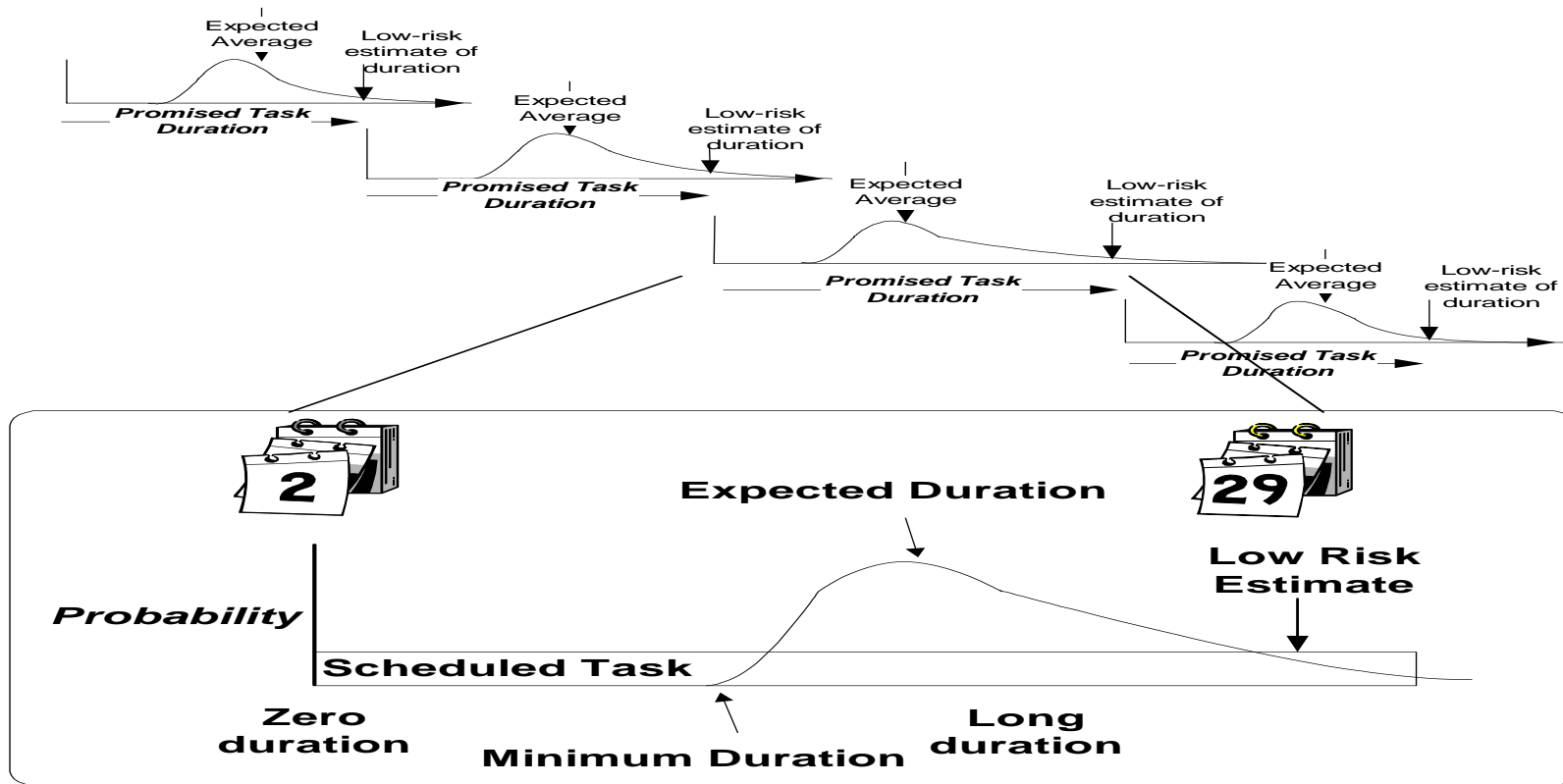
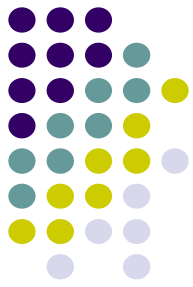




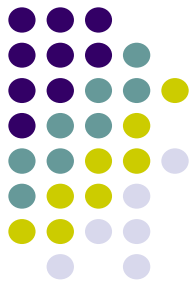
The effect of student syndrome!



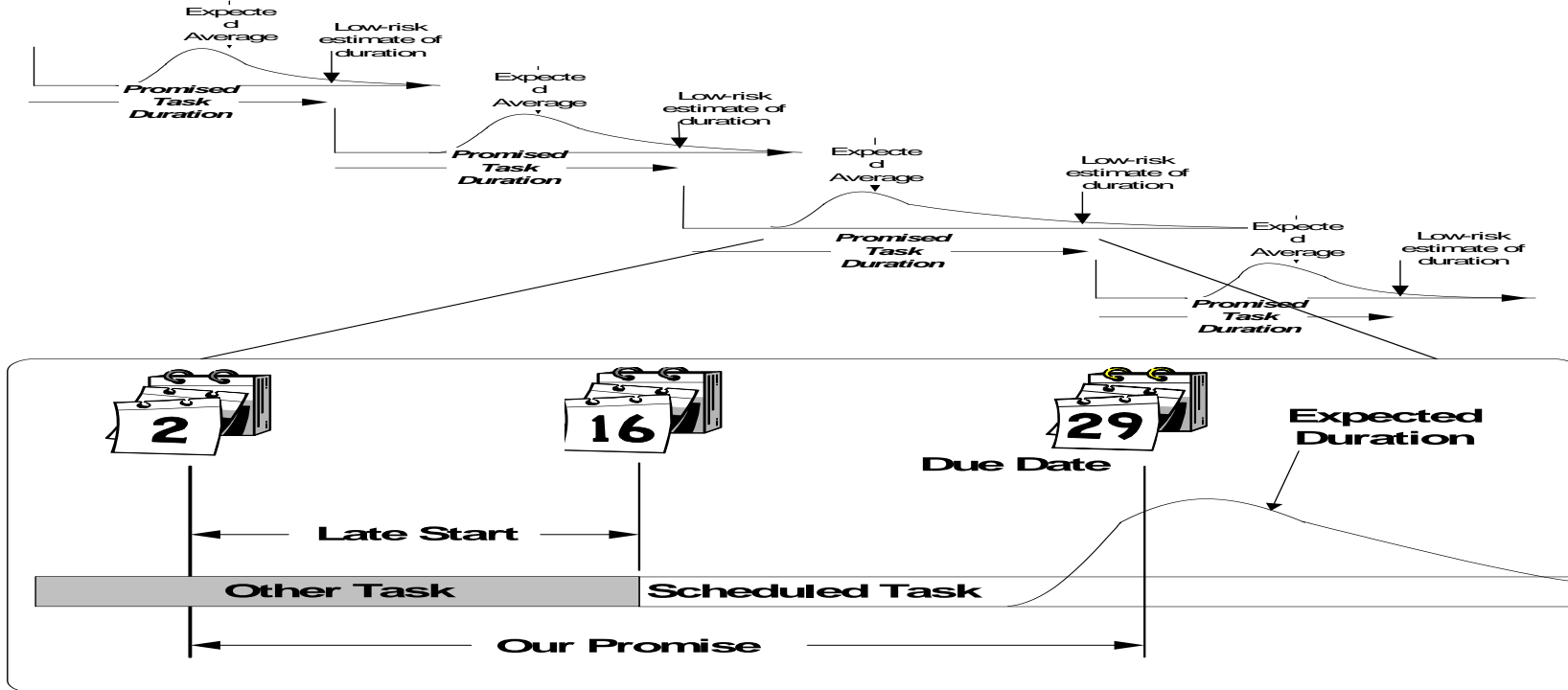
Our response to the System



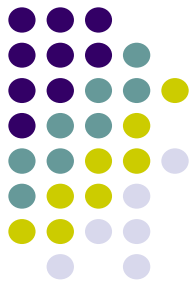
- Does it ever happen that we get dragged off onto some other task when we begin the currently scheduled task?



Our response to the System

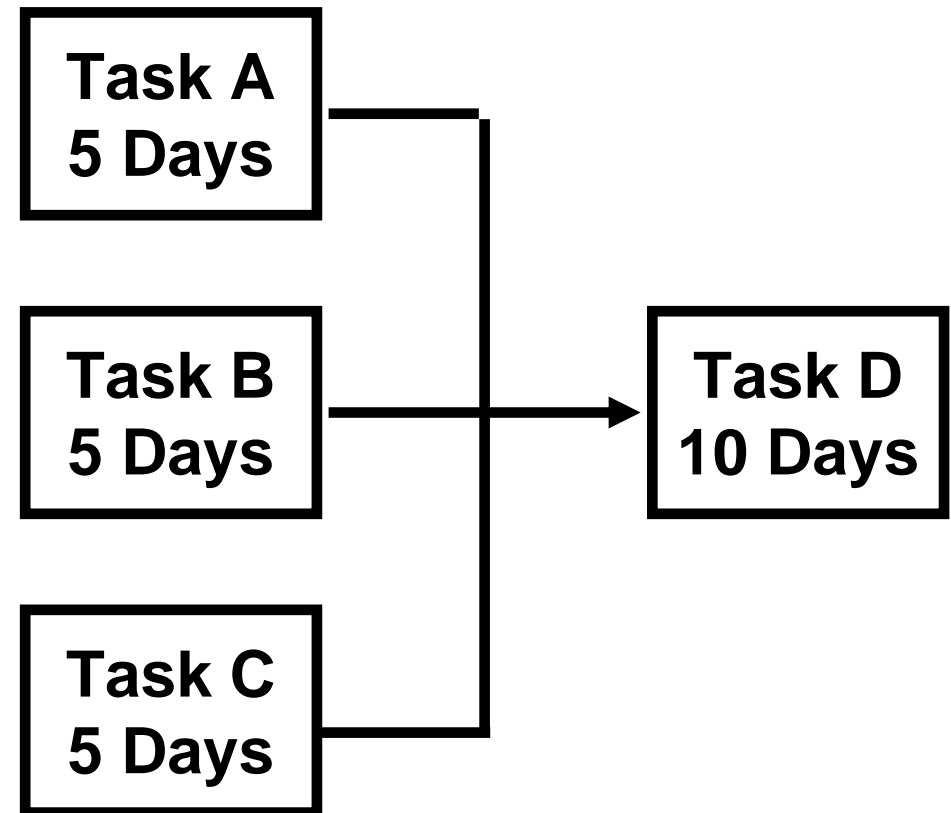


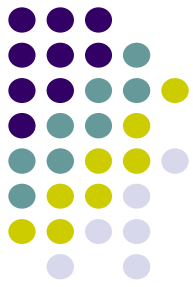
- Does our due date correspond to a low risk estimate now?
- If we start working the currently scheduled task now, do we have any protection against the unforeseen?



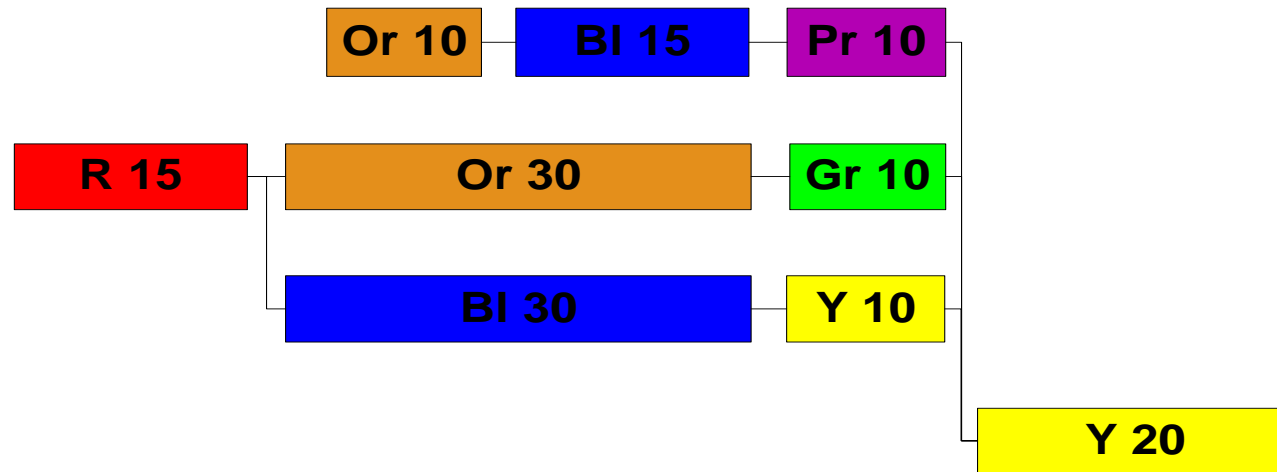
Delays Are Passed On — Gains Are Not

- Merging paths don't allow us to benefit from tasks completed early - What's the impact on the total project if Task A is done in only 3 days?
- What if Task C takes 8 days?
- What if Tasks A, B, and C, through some miracle, all get done in 2 days? (Will Task D be ready to start 3 days early?)

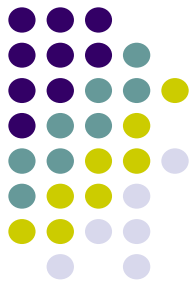




A Simple Project: PMG - 1

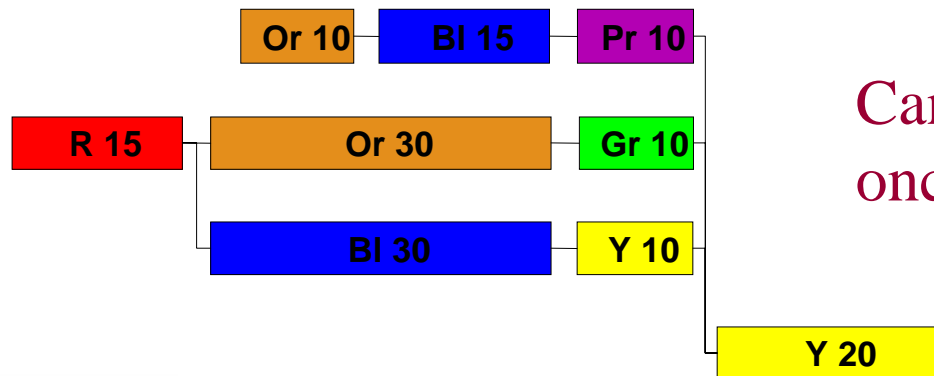


- Each bar represents one task
- The dependencies are indicated by the lines
- Each colour represents one resource
- The number in each bar represents the time to complete the task, assuming that the task has no real difficulties. It is NOT the elapsed time for the task

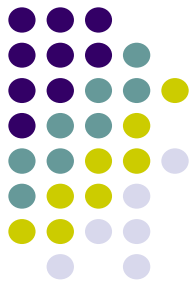


First Pass Schedule

- A project network containing the necessary logic connections
- Tasks are scheduled to their latest start dates
- Task durations that represent the estimate of the actual time, as opposed to elapsed time, are used.

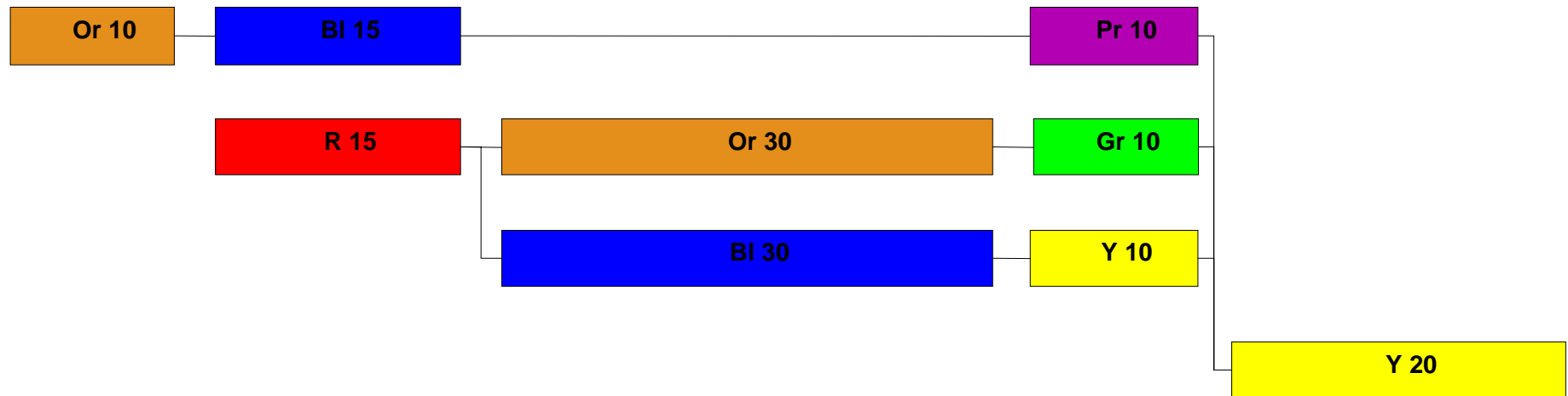


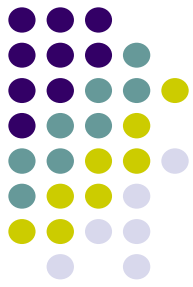
Can one resource do two things at once?



Resolve Resource Contention

- Allocate Resources and Stagger Resource Conflicts

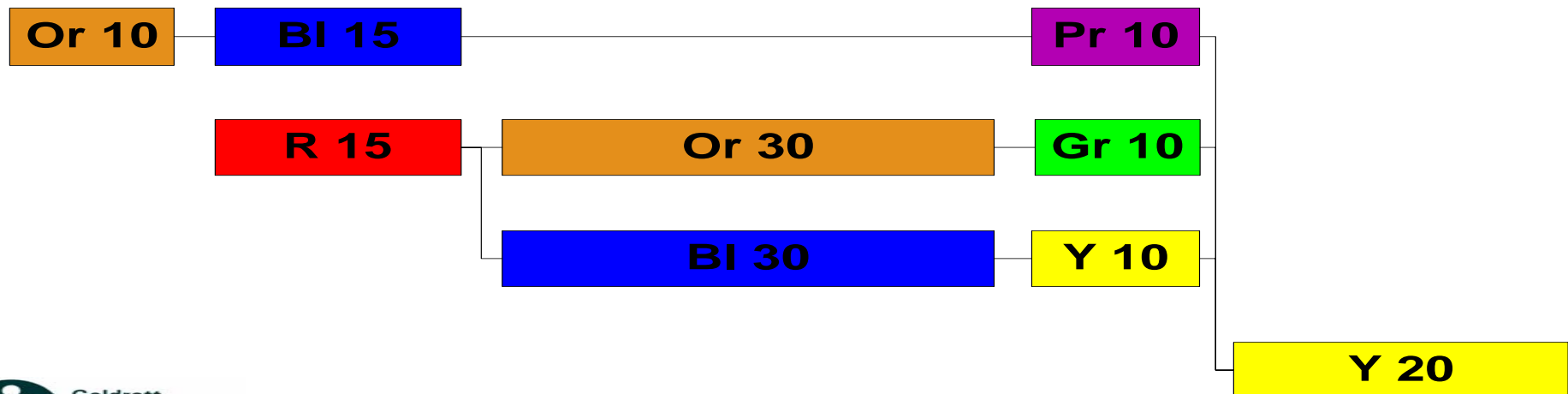




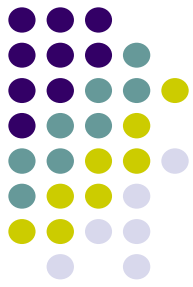
Step 1: Identify the Constraint

- If the goal of a project team is to finish a project as soon as possible, within specifications, and if the **CRITICAL CHAIN** is what prevents the project team from making further progress toward its goal,

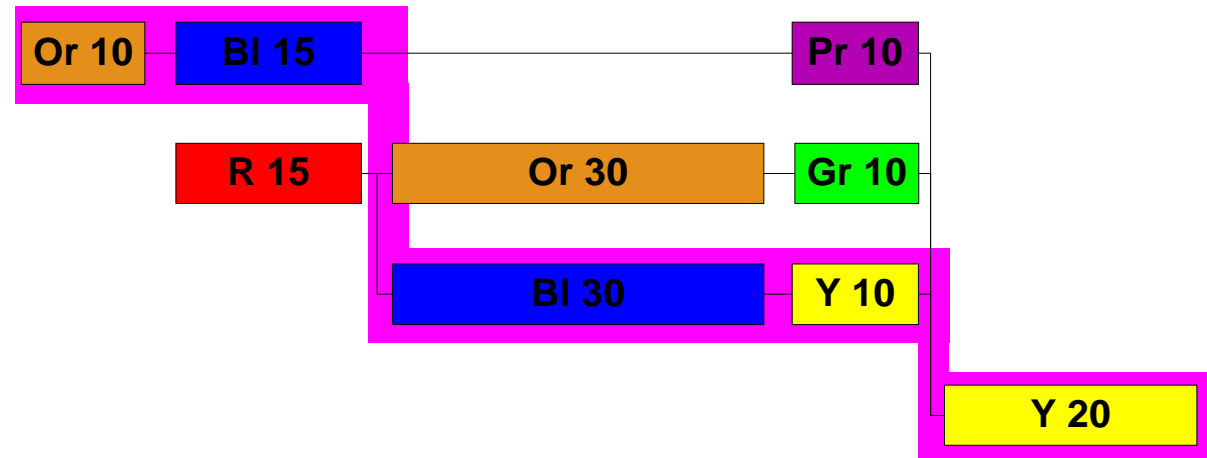
then the CRITICAL CHAIN must be the constraint of the project team.



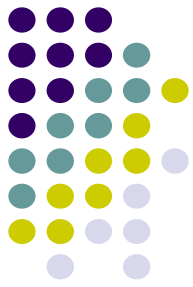
Step 1: Identify the Constraint



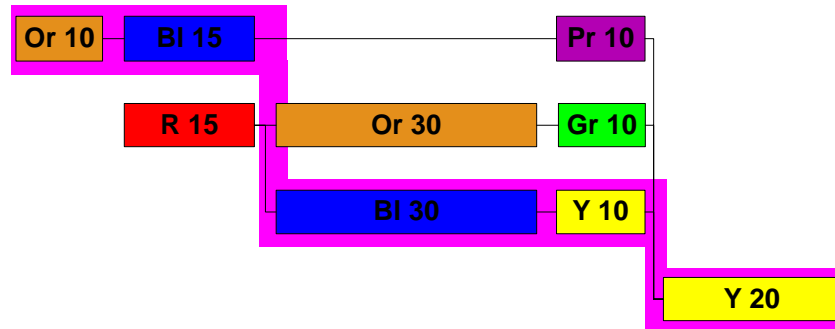
- The Critical Chain is the sequence of dependant events that prevents the project from being completed in a shorter interval, given finite resources.



How must people perform their work?



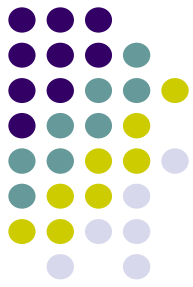
Step 2: Exploit the Constraint



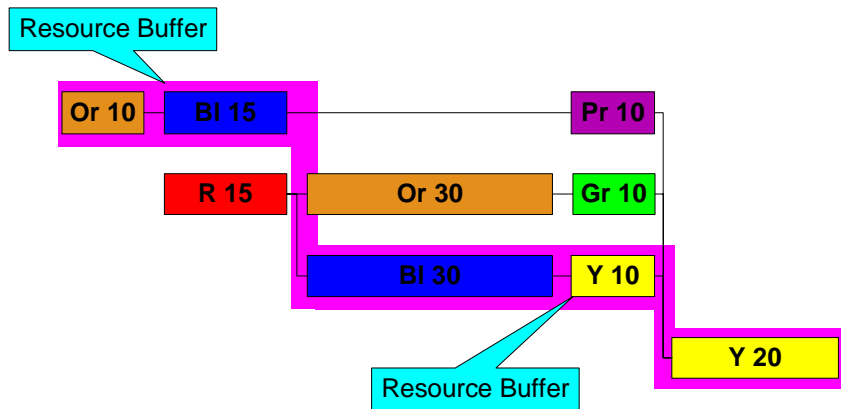
- People work at a full level of effort for the entire duration of each task.
- People turn over their output as soon as that output is ready.

Do people always show up on time?

What happens to the duration of the project if Mr. Blue is late for the start of the Blue-15 task?

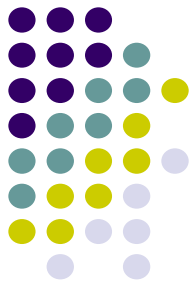


Step 2: Exploit the Constraint

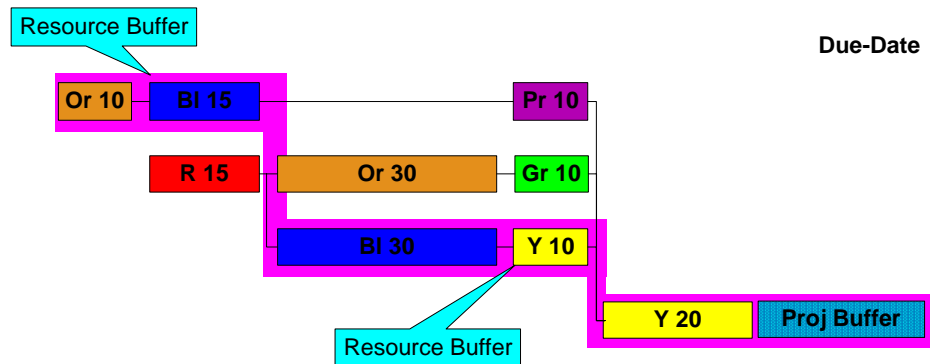


- Protect the start-dates of the Critical Chain tasks, from the untimely availability of resources, with resource buffers.

If we've used estimates that assume everything goes well, what is the probability the project will finish when this layout shows it finishing? Should we promise the project for the duration indicated here?



Step 2: Exploit the Constraint

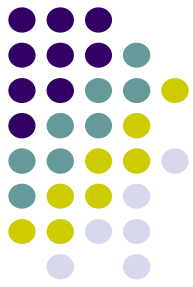


- Protect the entire project from variability in the duration of the Critical Chain tasks, with a project buffer.

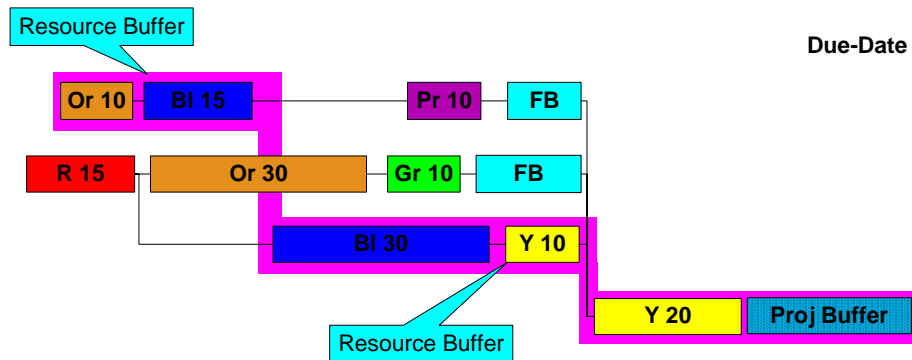
What about the non-critical chain tasks?

What happens to the project if Gr10 takes longer than planned?

How can we protect the start-dates of the Critical Chain tasks from variability in the non-Critical Chain tasks?



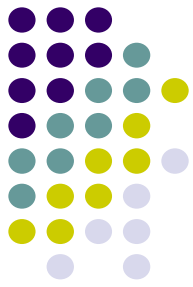
Step 3: Subordinate



Subordinate everything else to your decision to exploit the Constraint

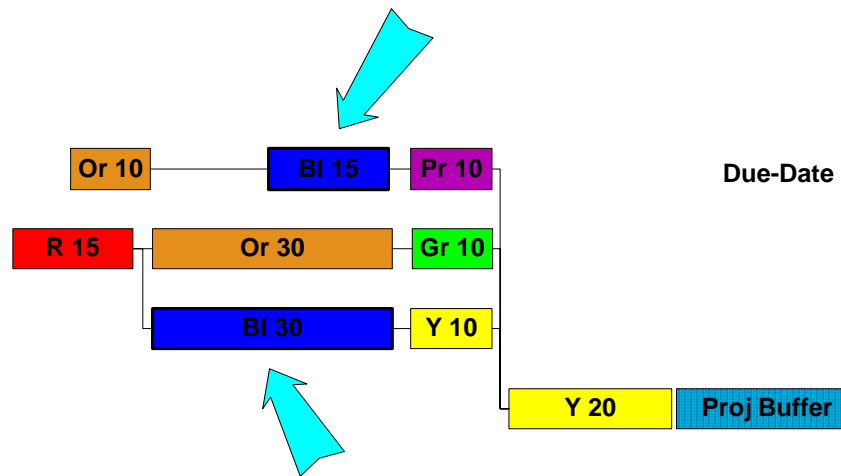
- Protect the start-dates of the Critical Chain tasks, from variability in the duration of the non-Critical Chain tasks, with feeding buffers.

What if the project doesn't meet the necessary due date?

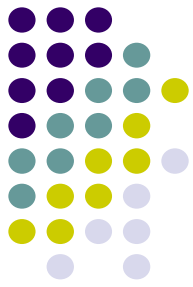


Step 4: Elevate the constraint

- Get more of the right resources, so that key segments of the Critical Chain can happen in parallel.

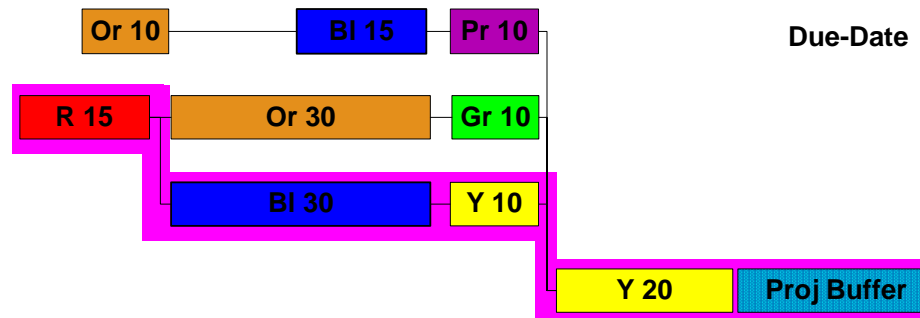


Then what?



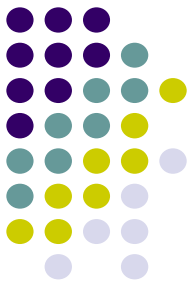
Step 5: Go Back to Step 1

- If a constraint is broken, i.e., if it is no longer a constraint, then go back to Step 1, and find the new constraint. In other words, find the new Critical Chain.



Are we done?

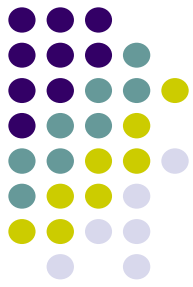
How do we manage the project?



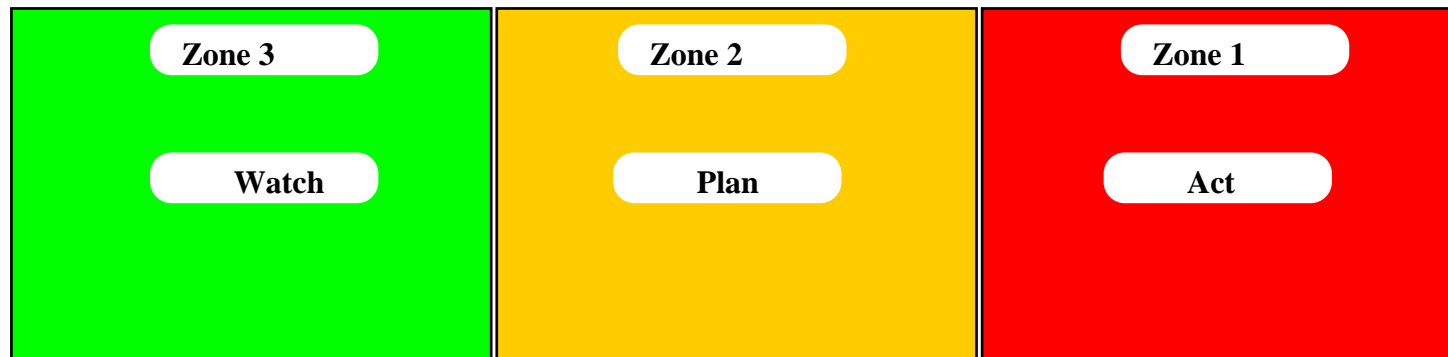
Objectives of Control

- Induce the links in the chain (tasks, paths, resources and/or projects) to do what is good for the chain (project or company) as a whole.
- Identify the links that need help

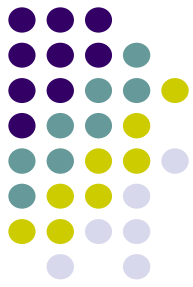
Buffer Management is the control mechanism for
Critical Chain Project Management.



Buffer Management

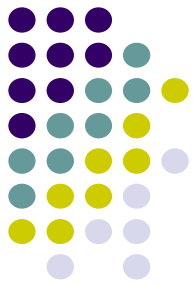


The Necessary Conditions to Achieve a CCPM Project



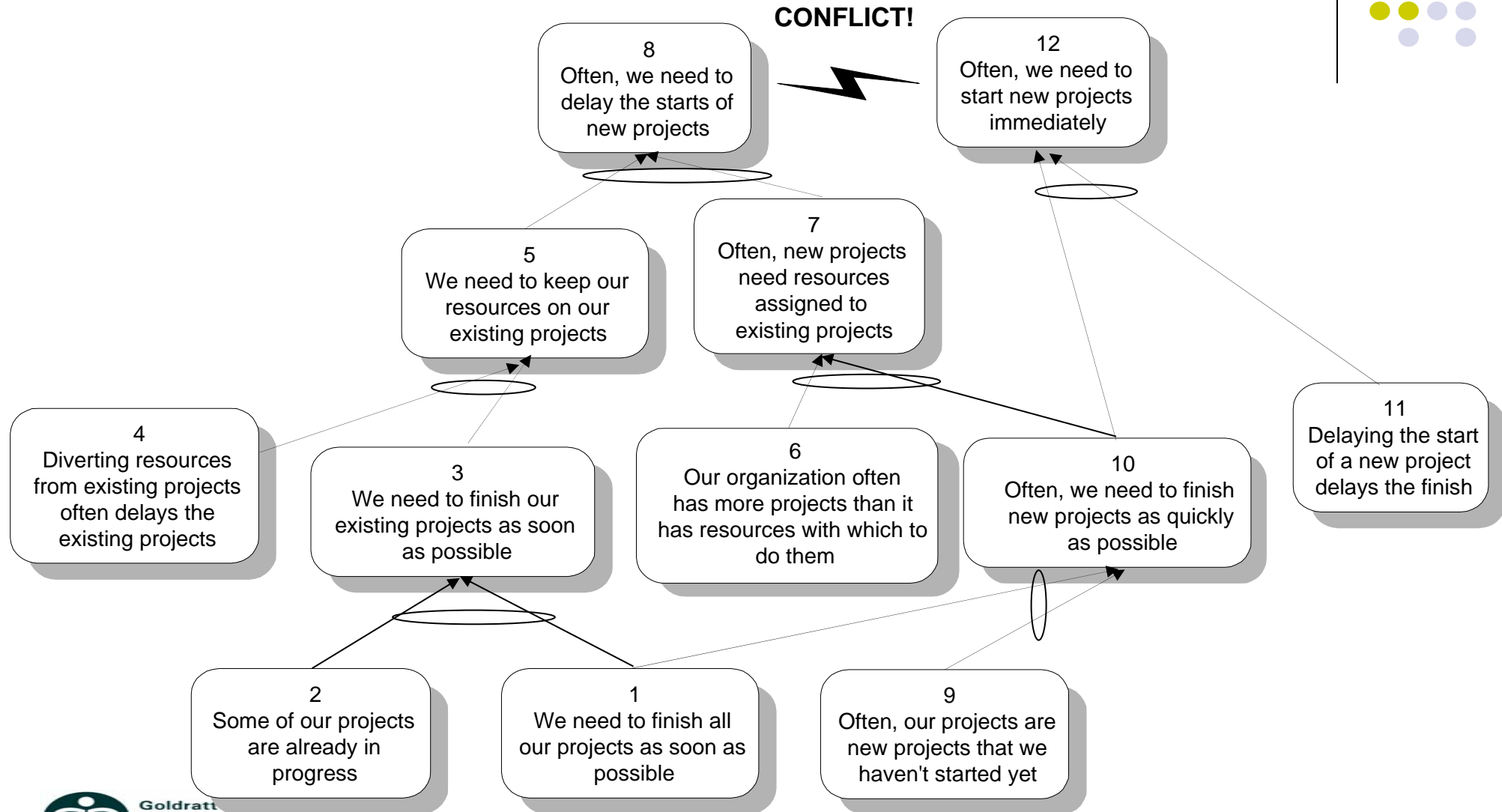
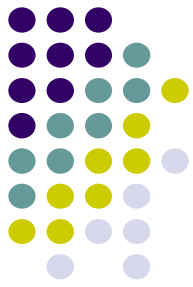
- Stop spreading safety everywhere, locate it in strategic places that protect the project.
- Stop the behaviours that waste time in the project:
 - Student syndrome, Multi-tasking, Unnecessary Due-dates
- Identify and eliminate non-value adding activities
- Perform risk management to reduce variability and protect buffers
- Develop visible performance/information system across key players

But what happens in multi-project environments?

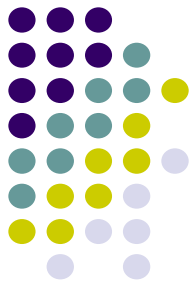


- Resources spread across a number of concurrent projects
- Continual demand from resource managers for more people
- Does our delivery performance improve?
- Do we still comply with the specs?
- What about budgets?

Characteristics of the Multi-Project Environment



Result: Compromises

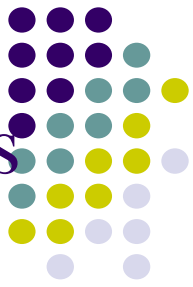


1. Some (many!) people work on more than one project at the same time.
2. Project managers compete for common resources (e.g., I.T., engineering, CAD,...).
3. Resources get pulled off one project to work on another, when delivery due date or milestones are threatened.
4. Resources get pulled off projects to do remedial work on completed projects.
5. Resource managers base their allocation on criteria that are often different than the project manager criteria.

DOES IT “WORK”?

IS IT EFFECTIVE?

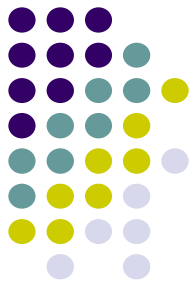
The Constraint of an individual project versus the collection of all concurrent projects



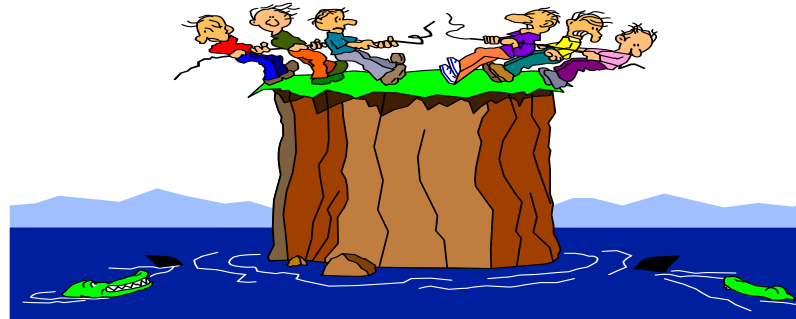
Whatever single factor most increases the cycle time of a project must be its constraint - the thing that blocks the project from doing better.

We begin by examining what stops us from significantly reducing the combined cycle time of all projects?

The Constraint Management Approach



In systems, conflicts are a sign of breakdown.

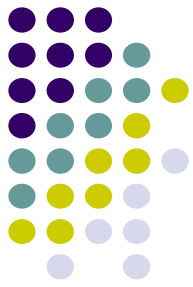


Why do we have trouble managing the multi-project environment:

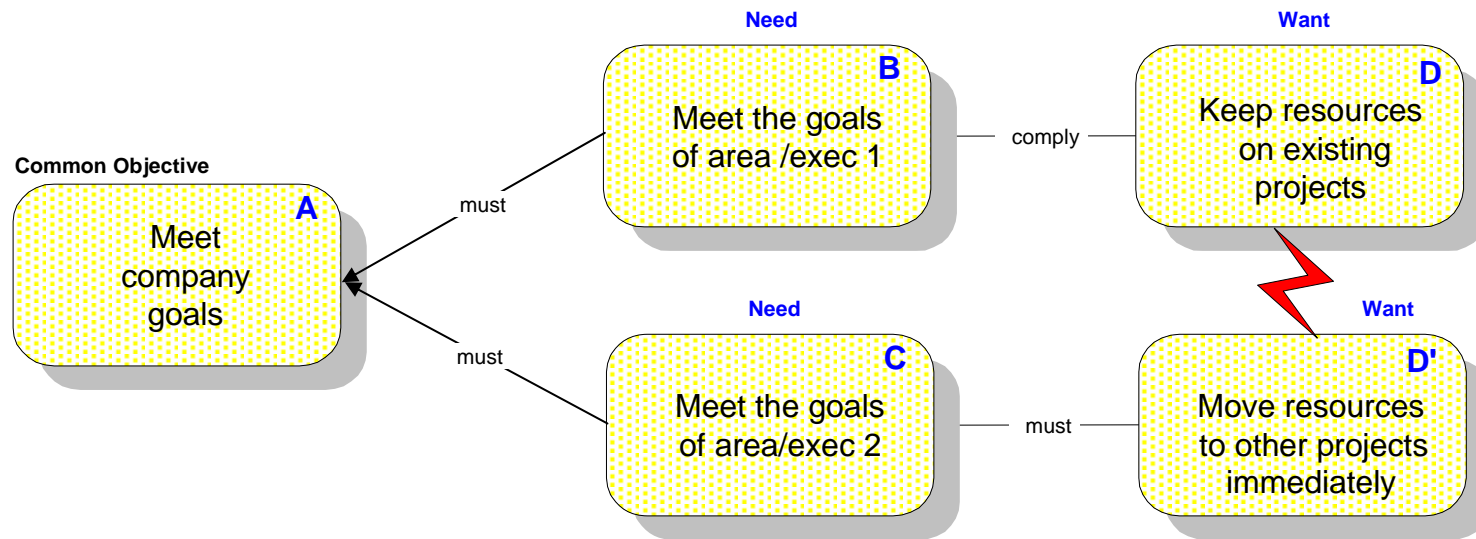
- **Without excessive expediting?**
- **Without excessive overtime?**

What makes it difficult to:

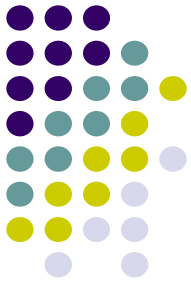
- **Resolve conflicts between projects?**
- **Decide whether or not to start a new project?**



Why is it so difficult to manage the Multi-Project Environment?

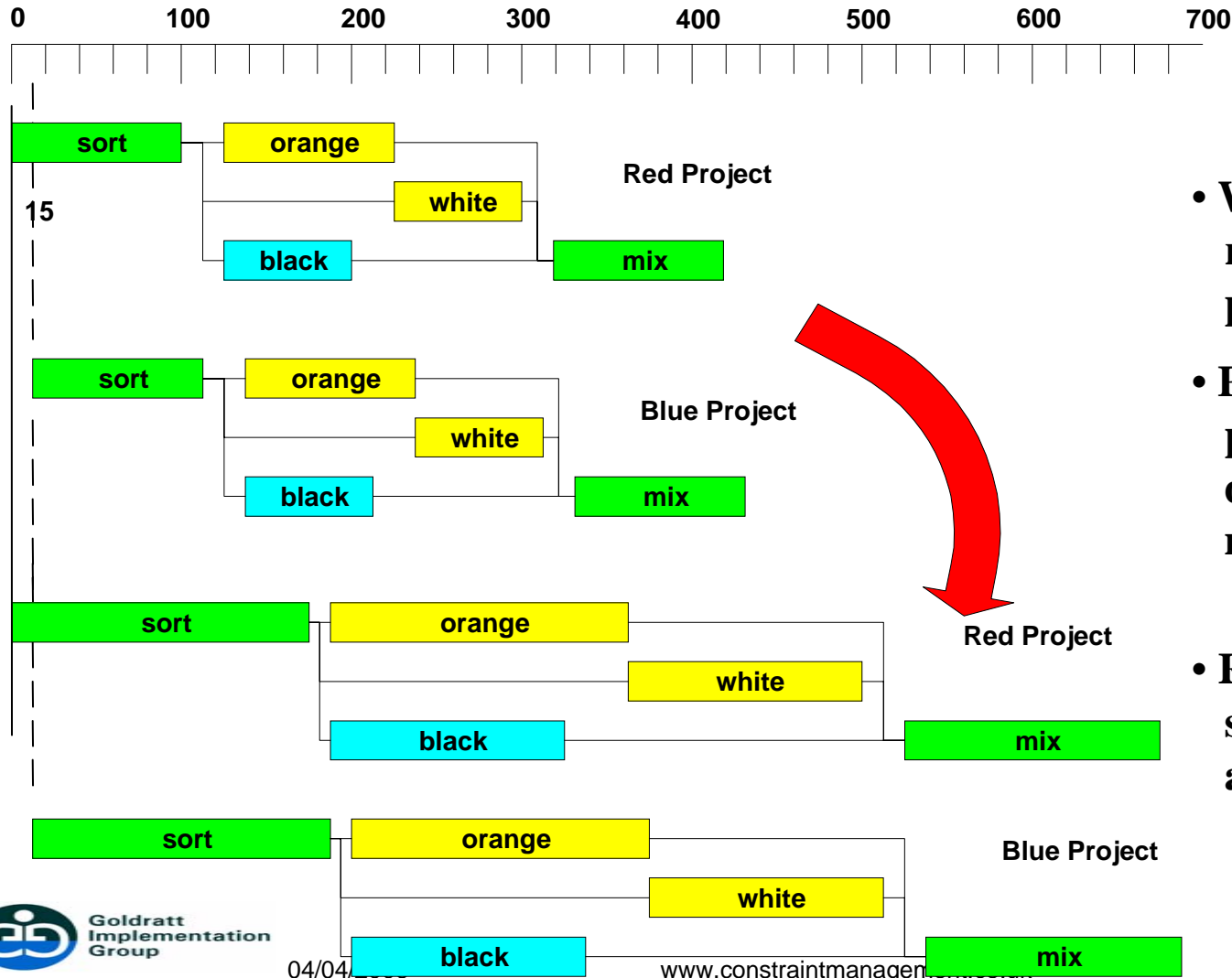
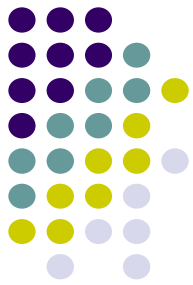


Why do conflicts exist?

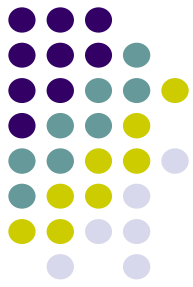


1. Customers want to see progress on their work
2. Executives demand progress on *their* projects
3. Company needs better results this quarter / year
4. Relative priorities of projects are different, at different times
At the same time as there is pressure to move or share resources, there are all kinds of good reasons to keep resources on existing projects.

Traditional Behavior in Multi-Project Environments



- Work is released to resources as soon as a project is approved.
- People multitask between projects, either to satisfy demands of project managers or customers, or to stay busy.
- Resource pools are often split between several active projects.



The Role of Multi-tasking

Task A
Project 1
One Week

Task B
Project 2
One Week

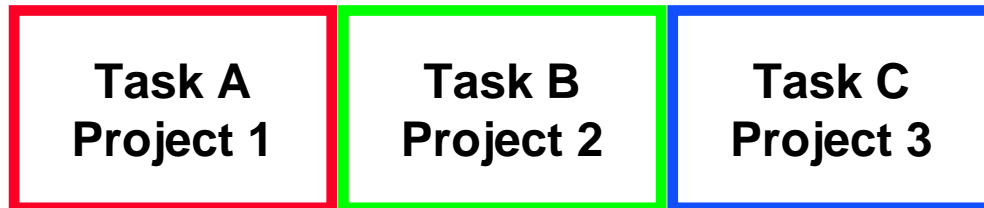
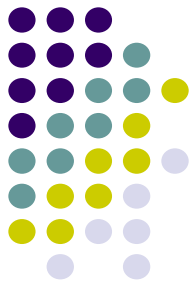
Task C
Project 3
One Week

In order to keep each project on track, the resource does half of task A, then half of task B, then half of task C, then finishes task A, then B, then C.

How long does each task take to complete?

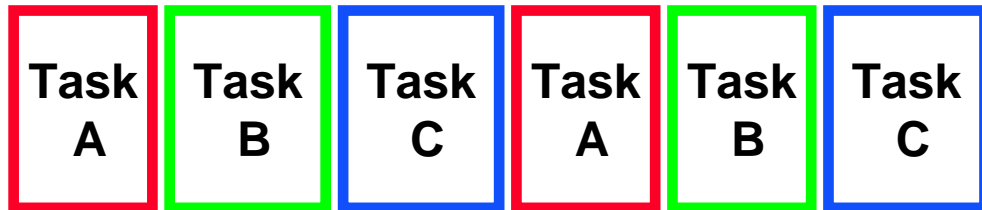
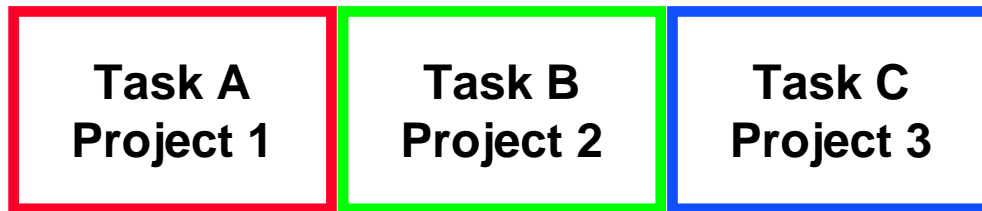
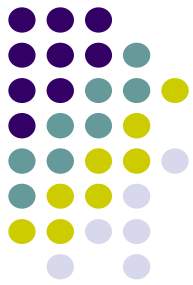
What happened to the safety time?

The effect of multi-tasking



The objective

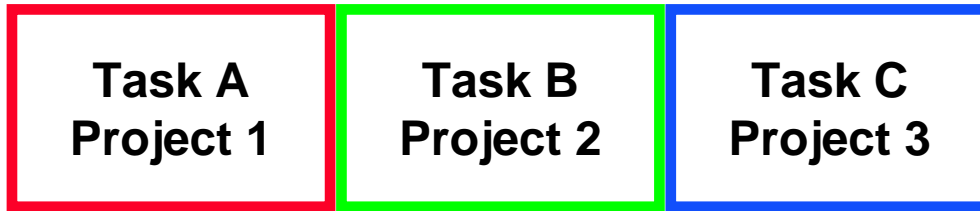
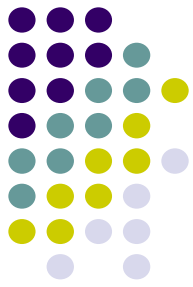
The effect of multi-tasking



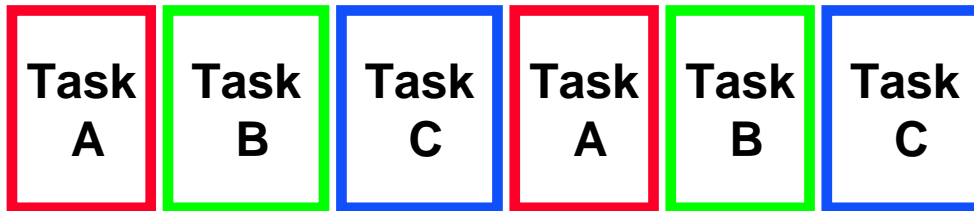
The objective

What we set out to do

The effect of multi-tasking



The objective



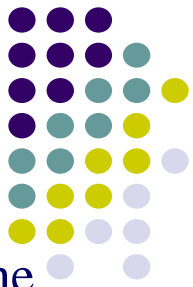
What we set out to do



Reality

- By splitting a task into multiple parts, each such task's completion date is delayed, which delays the entire project end date.
- There is start-up time when each task is worked on, after a time delay.
- How does this impact your estimate for task time?
- What is happening on the other allocated tasks?

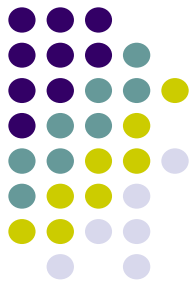
Multi-Project's Big Problem



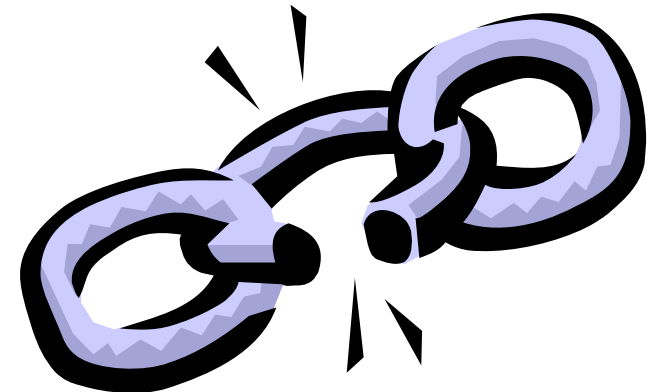
- Our current system can be described as a PUSH system. We push work into the system.
- There is no FEEDBACK in the system to control work entering it.
- Our multi-project systems are choking on uncontrolled work from two sources:
 - Work is pushed into the system with no consideration given to the capacity of the SYSTEM to do the work. How can any consideration be given when we do not know where the constraint is?
 - Too much unplanned work sneaks into the system, either through poorly planned projects or ill considered activities.
- Let's build a better solution - a PULL system!

CCPM Enterprise Environment

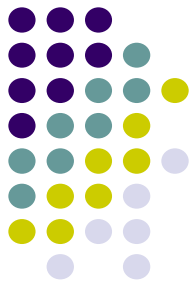
The First Step



- Identify the constraint
- What is the constraint in a multi-project organization?
- It must apply to all or most of the projects



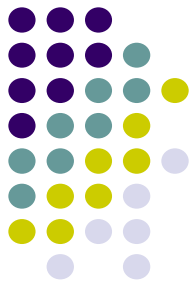
The Critical Resource



1. Definition of Critical Resource
2. Difference between critical and non-critical resources
3. Fighting over critical resources and behavior of resource managers
4. What is the impact on project duration?

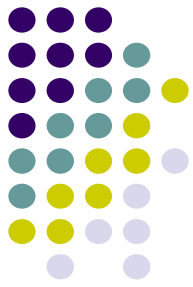
CCPM Environment

The Second Step



- Exploit the constraint
- Never let the constraint be starved of work:-
however it must be the right work!
- How else might we exploit the constraint?

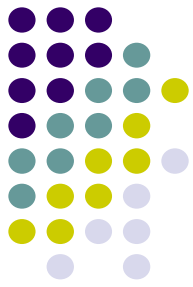
Setting Priorities



	Project A	Project B
Duration	18 months	18 months
Throughput	£12M	£9M

Which project would be given higher priority by most managers?

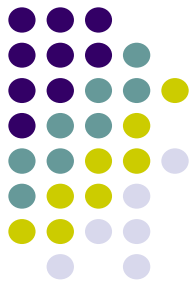
Setting Priorities a Different Way



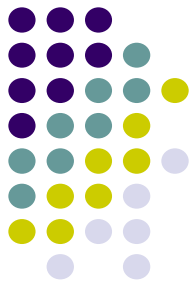
	Project A	Project B
Duration	18mths	18 months
Throughput (T)	£12M	£9M
Constraint Usage	6 months	3 months
T/(constraint unit)	£2M/month	£3M/month

Which project lets our constraint and, consequently, our entire system work more efficiently?

Throughput Environment The Third Step



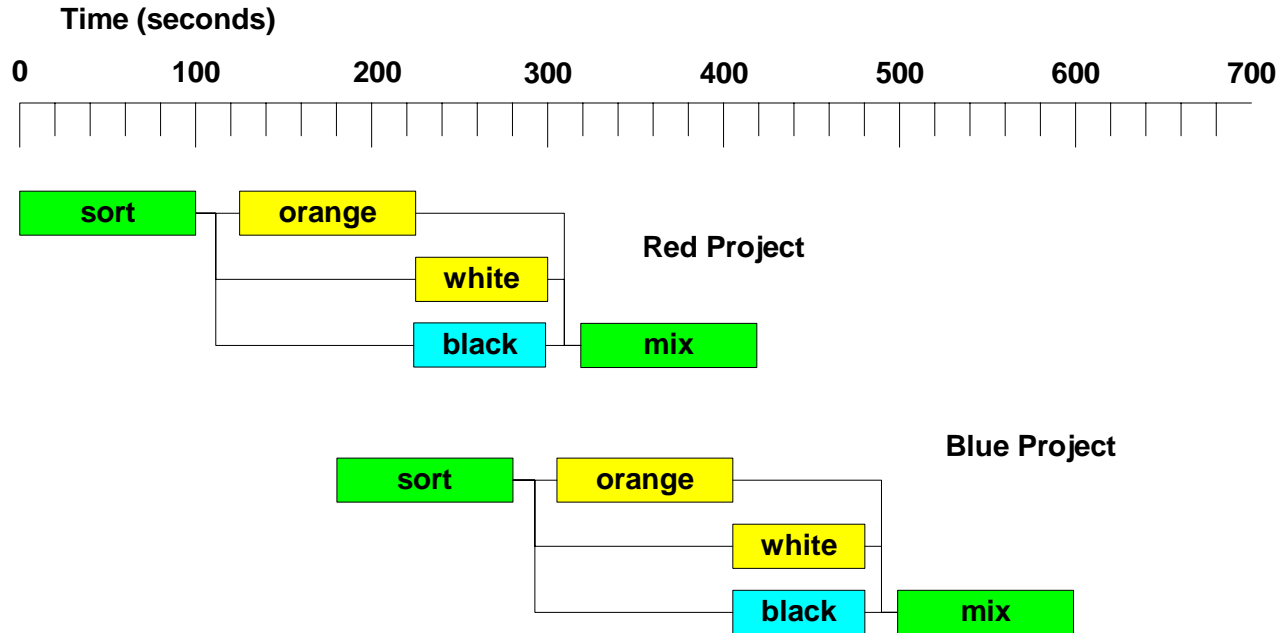
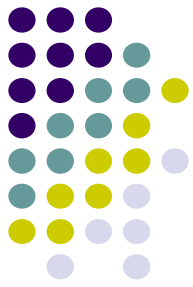
- Subordinate everything to the decision to exploit the constraint
- Prevent the system from choking on uncontrolled work entering the system.



The Multi-Project Solution

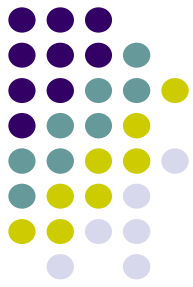
- No new project is begun any sooner than the constraint resource permits. This is the Control Mechanism. We use the constraint as the DRUM by which the entire system marches.
- Resources perform only one task at a time, as much as possible.
- Resources apply a full level of effort to each task at all times.
- Resources communicate early finishes **immediately**.

The Multi-Project Solution

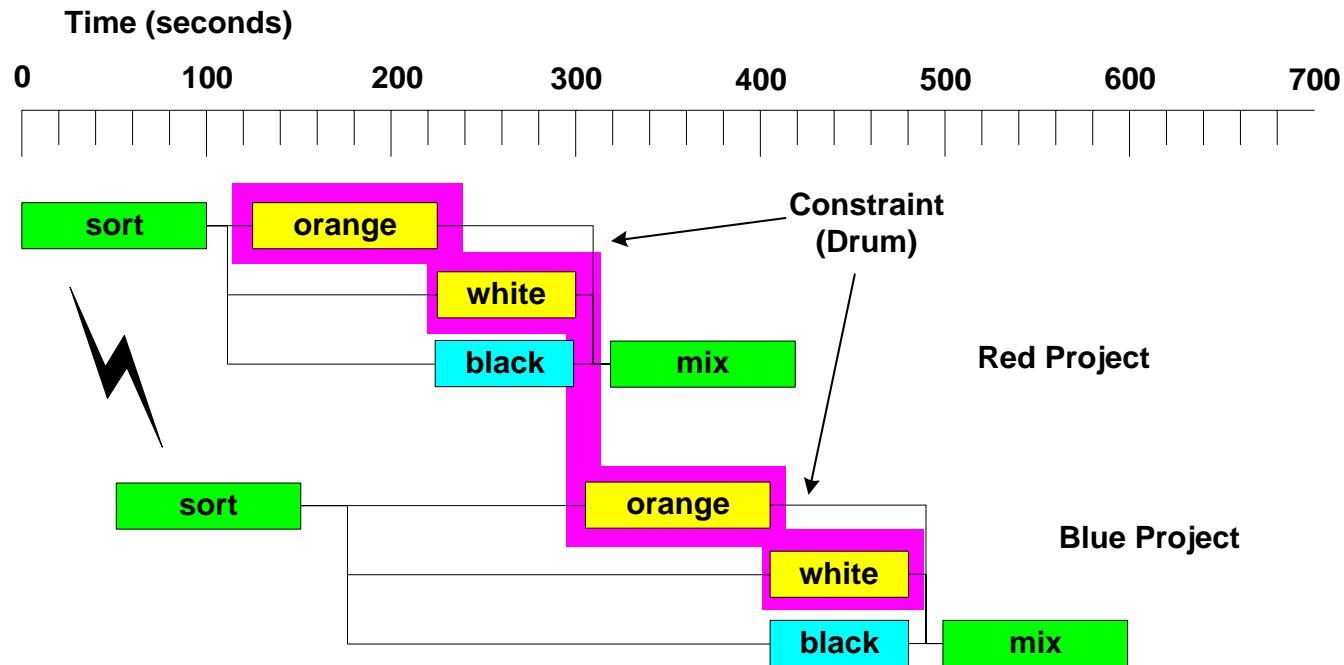


- Can you find this organization's multi-project constraint resource?
- If we use that resource as the drum for the system, will any of the other resources become overloaded?

The Multi-Project Solution

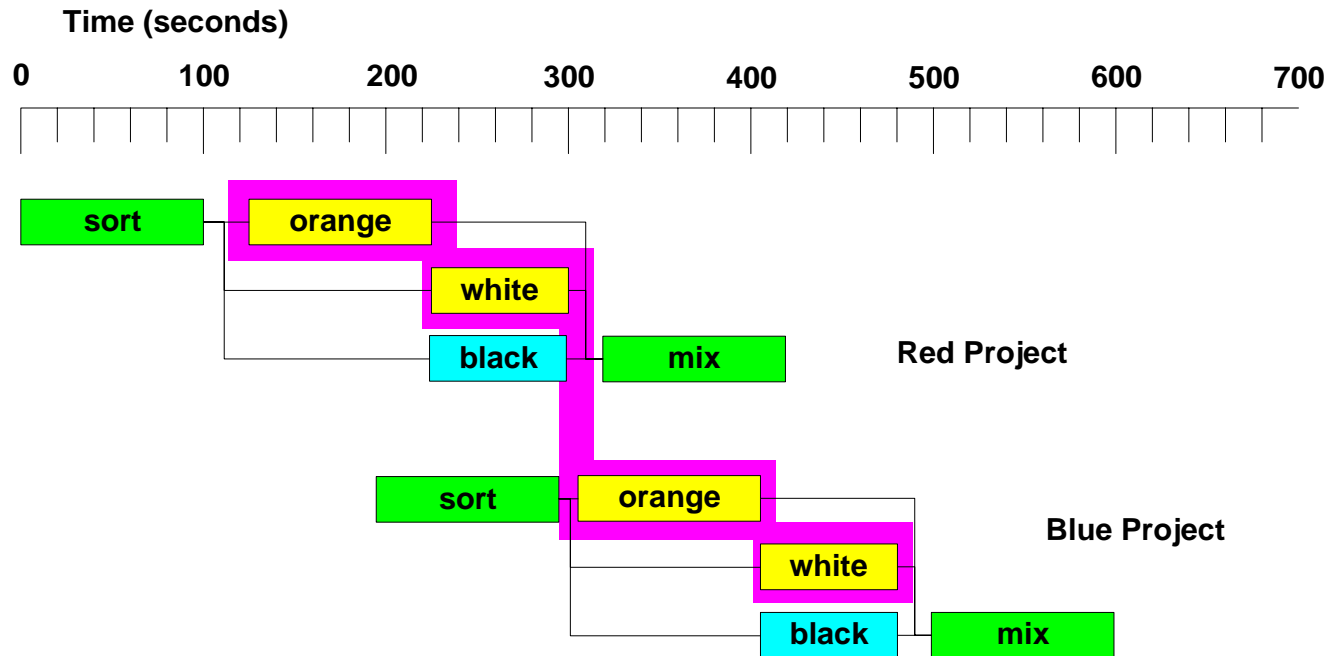
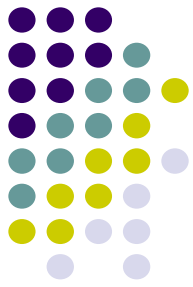


What happens if we start the Blue project's sorting task too soon?



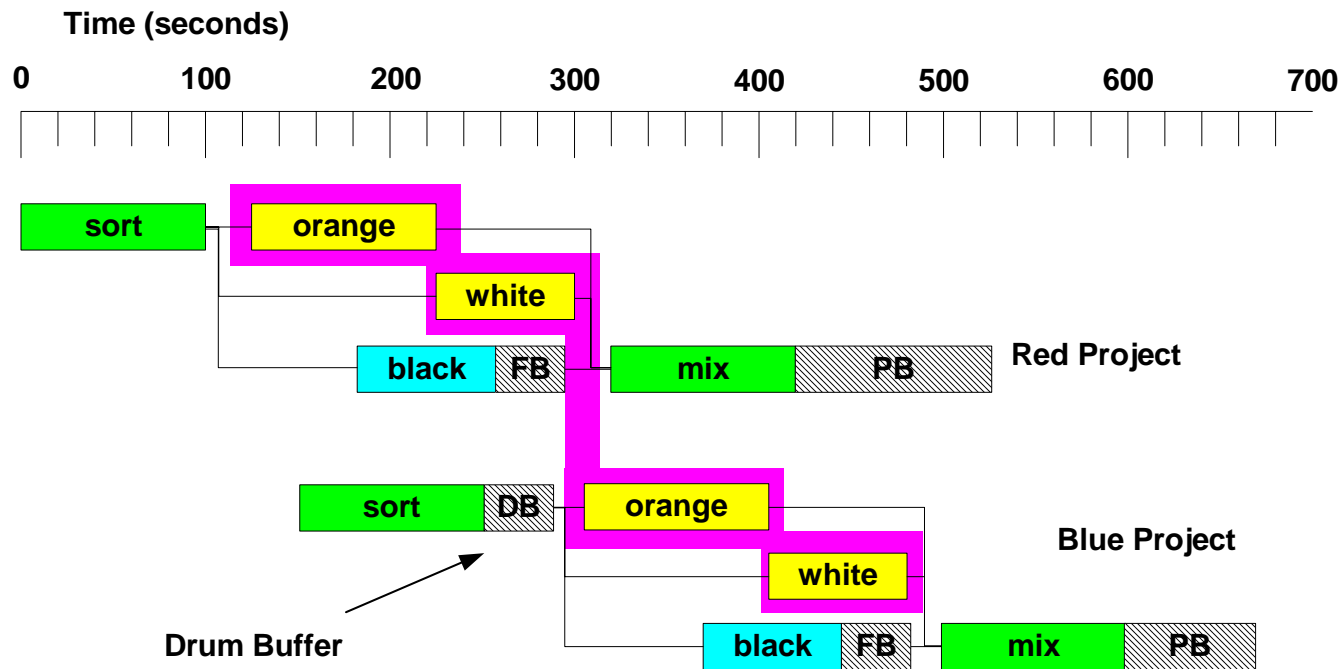
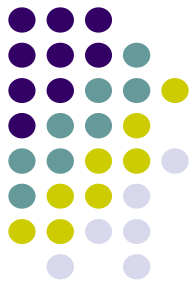
Do we damage only the next project?

The Multi-Project Solution



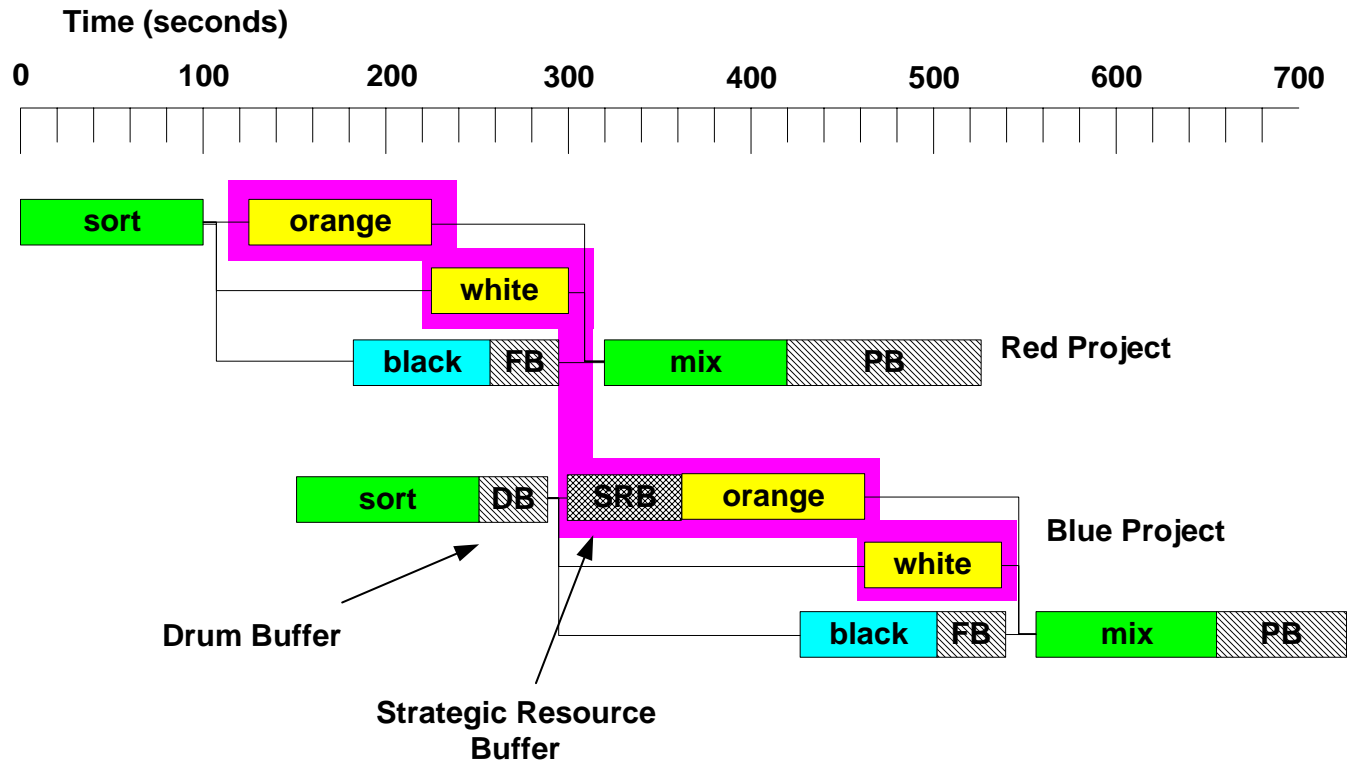
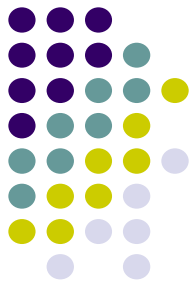
Deming principle: Predictability & common cause variation
To avoid chaos, where should we buffer?

The Multi-Project Solution



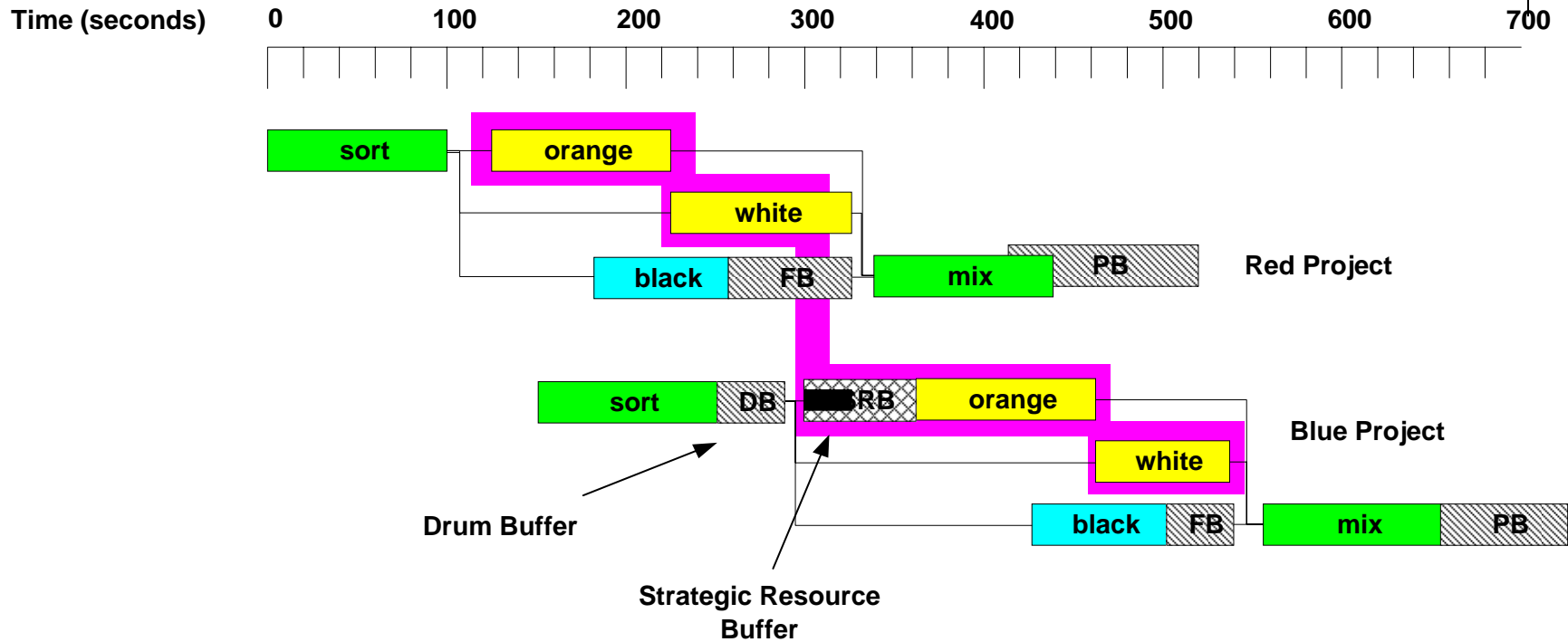
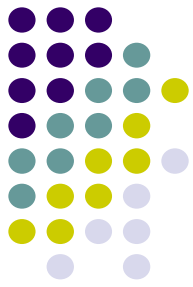
Should we isolate projects from each other?

The Multi-Project Solution



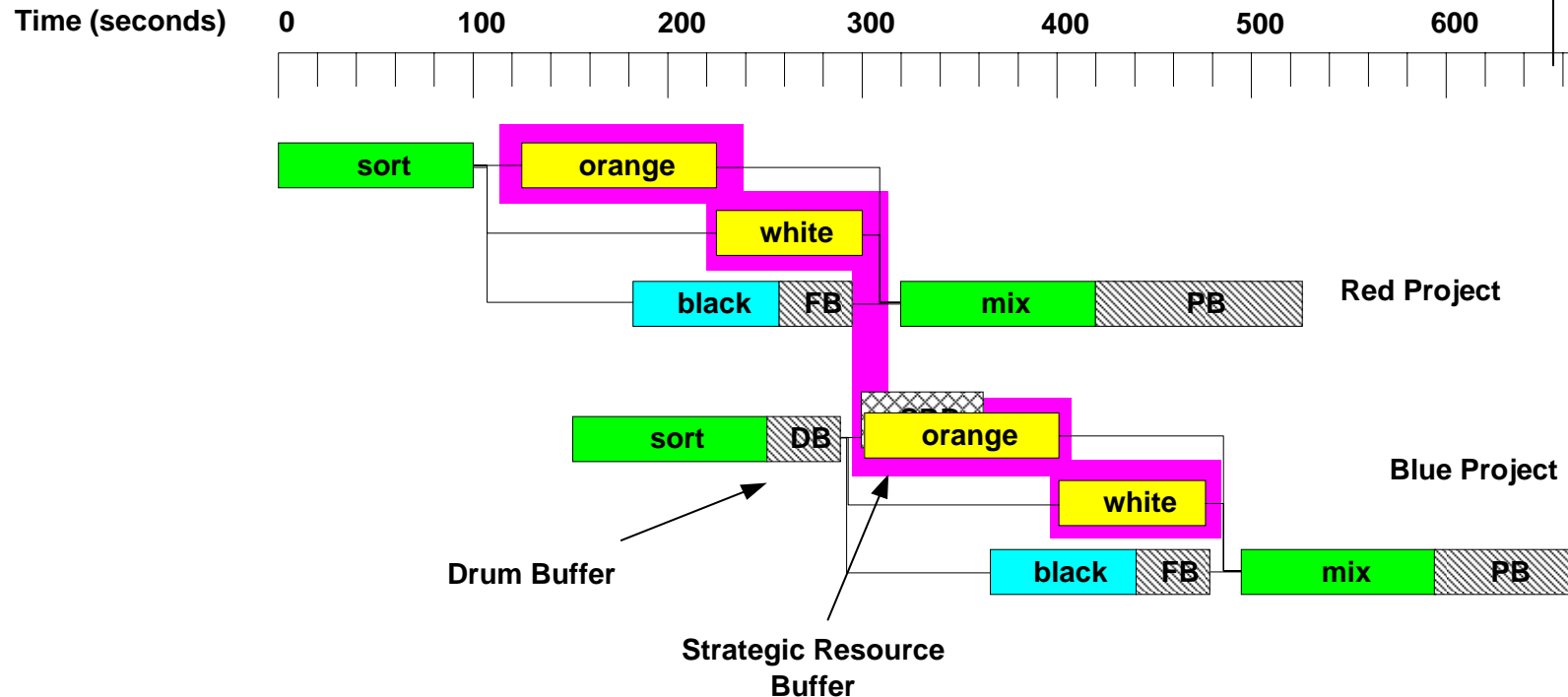
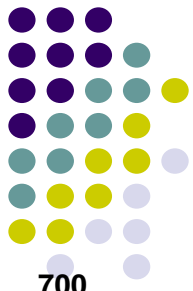
What do we do with all these buffers?

If the Drum is late....



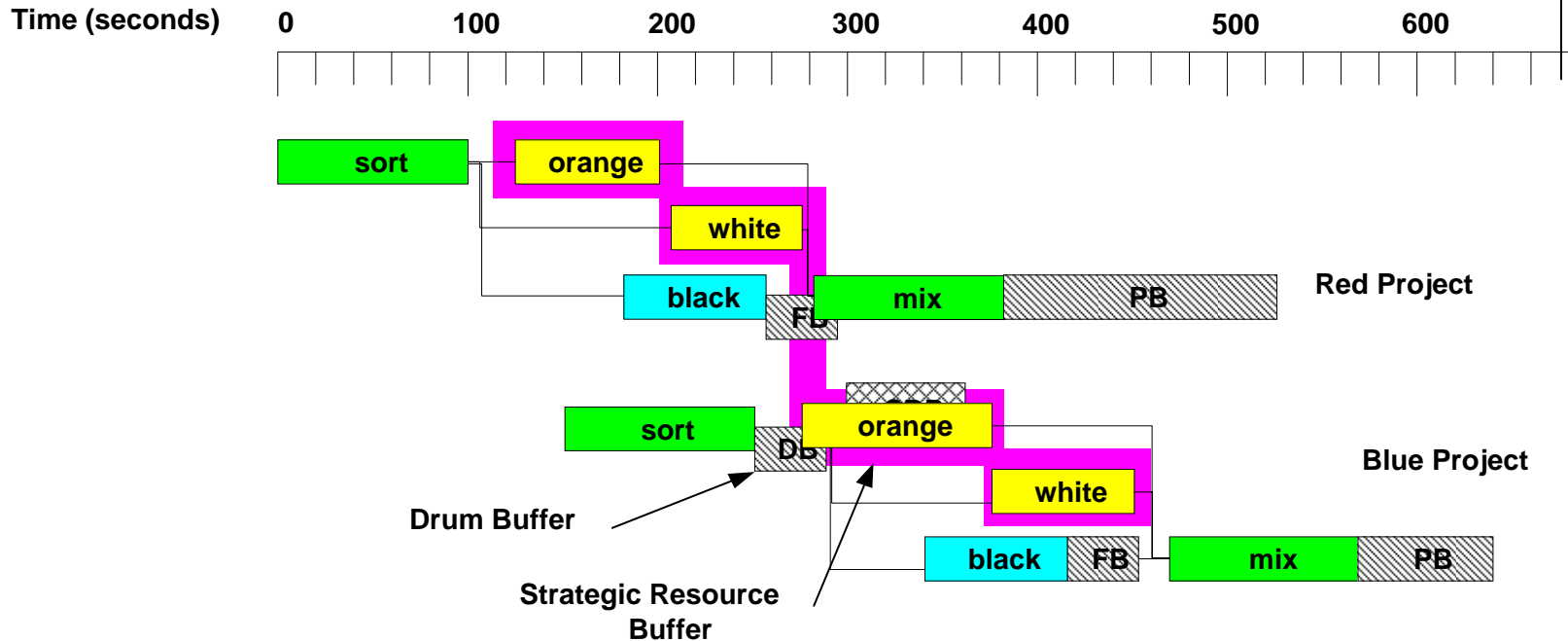
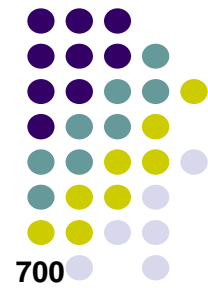
- The Project Buffer for the Red project protects the Red project's due-date.
- The Strategic Resource Buffer protects the blue project
- NO PROBLEMS!

If the Drum is on time....

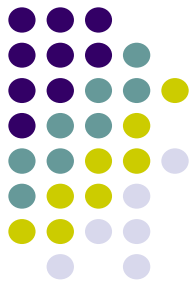


- The Red project is in great shape.
- The Blue project starts early and is in even better shape!
- ALL future projects move ahead of schedule.
- Earnings from all future projects happen sooner than expected.

If the Drum is early....

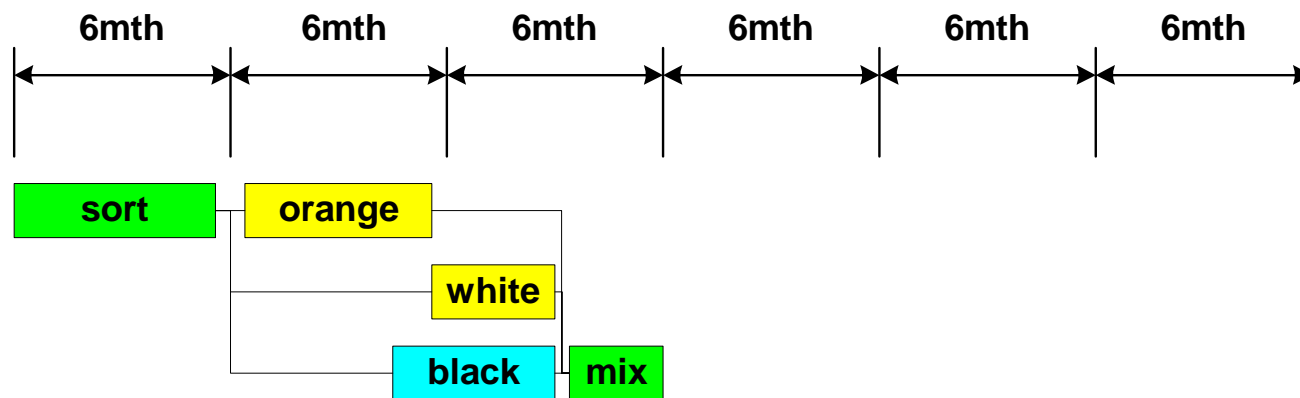


- The Red project's feeding buffer shows us where to expedite, so that the Red project can finish early.
- The Drum Buffer in the Blue project shows us where to expedite, so that the Blue project can start early and finish early.
- The Blue project starts earlier still and is in even better shape than before!
- ALL future projects move ahead of schedule even more.
- Earnings from all future projects happen sooner still!

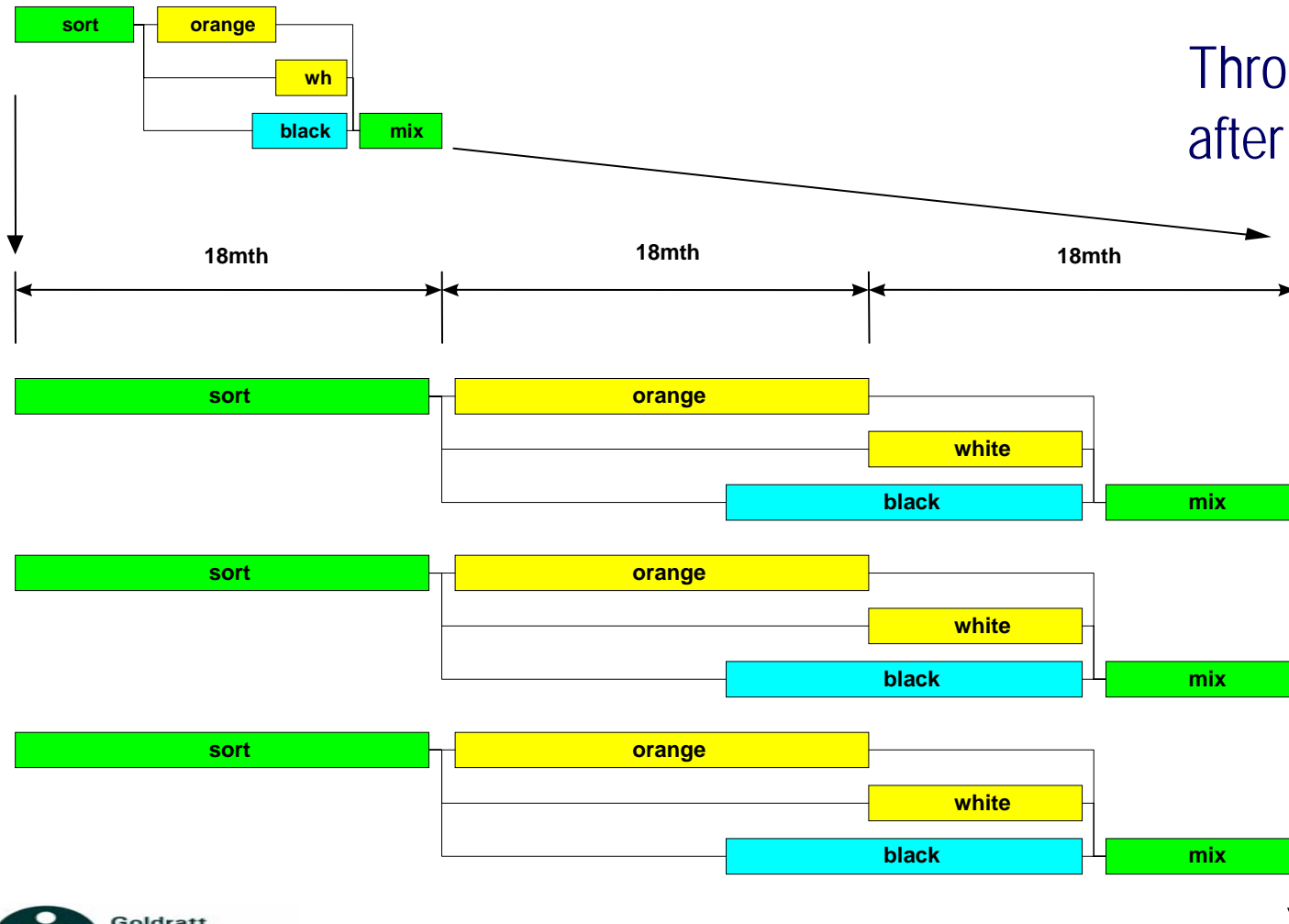
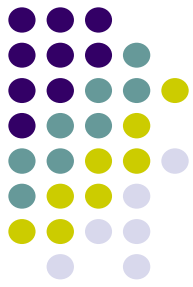


Traditional vs Lean

- Lets have a look at:
 - Lead time per project.
 - Throughput over time.
- Let's assume that we have three projects and that Throughput =£18M upon completion, for each.

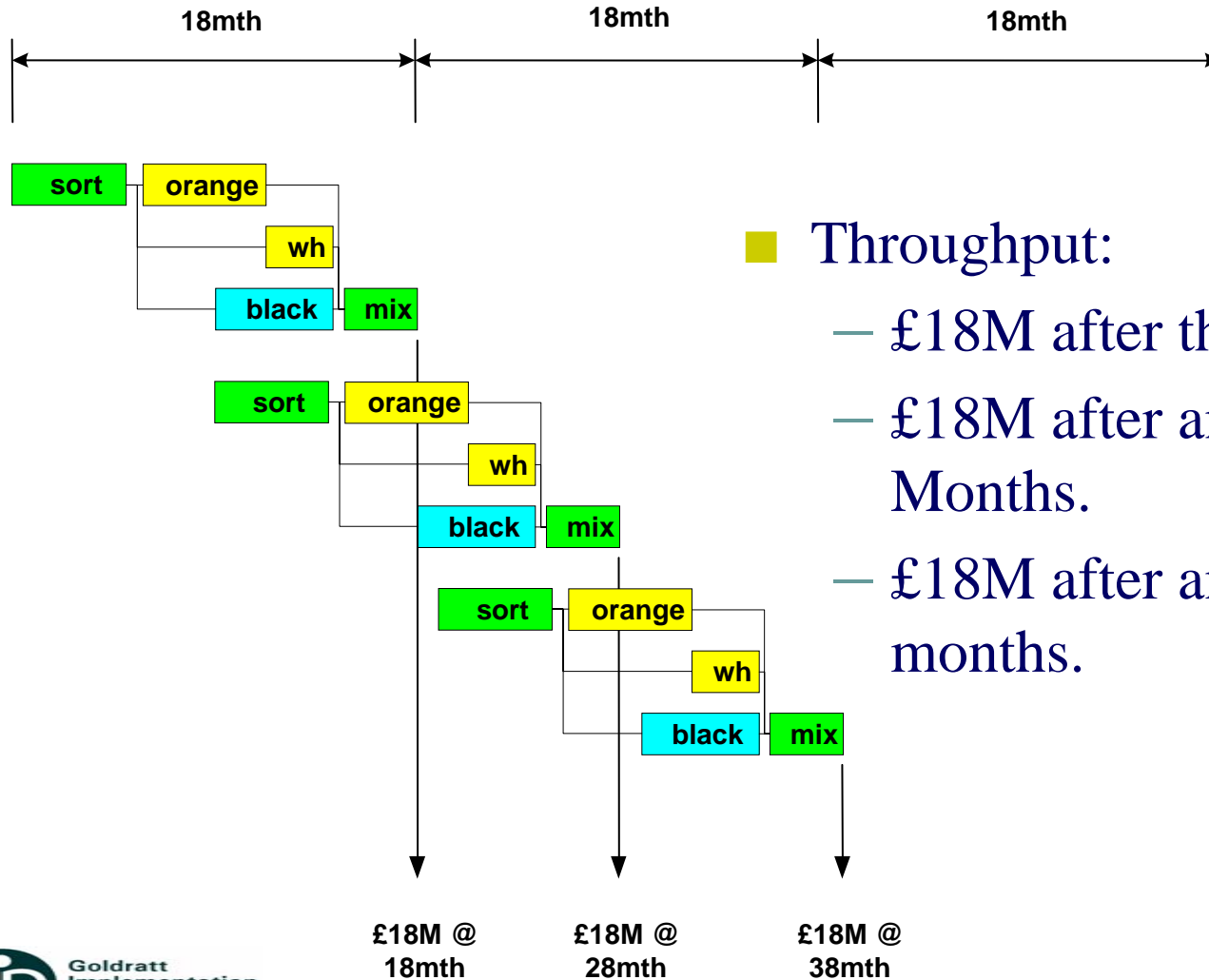
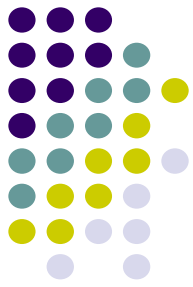


Traditional Environment Results (3 Projects)



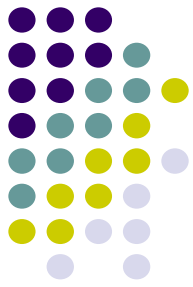
Throughput = 3 x £18M
after 54 months.

Lean Environment Results (3 Projects)

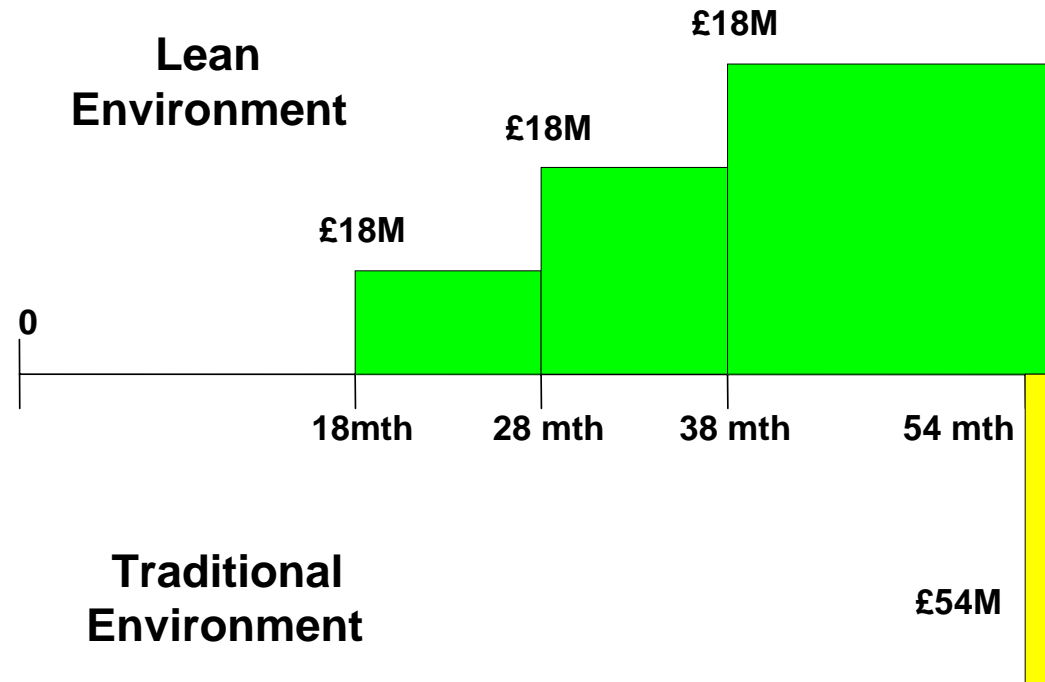


■ Throughput:

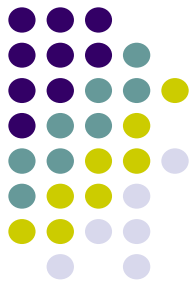
- £18M after the first 18 months.
- £18M after an additional 10 Months.
- £18M after an additional 10 months.



Comparison of Cash Flows

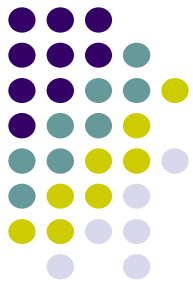


Is cash flow important for your organization?



Problem Summary

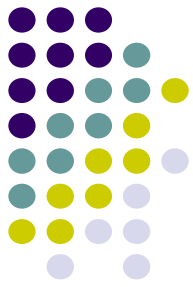
1. Senior managers are measured on meeting their functional / departmental targets.
2. This forces senior managers to frequently authorize new projects.
3. An organization's resources are limited.
4. As a result, new projects compete with existing projects over resources.
5. To please everyone, resources are multitasked between projects.
6. Resource managers attempt to resolve conflicts by diverting resources to projects where work exists or is urgent.
7. Project managers attempt to resolve conflicts by pressuring resource managers to divert resources to their projects.
8. As a result, resource pools are split and multitasked.
9. Project cycle times are increased significantly.
10. Individual tasks take much longer than dedicated/actual time to complete.
11. There is a lot of expediting.
12. The organization suffers in cash flow, new project completion, # of projects completed in any given time period.



Critical Chain Multi-Projects Solution

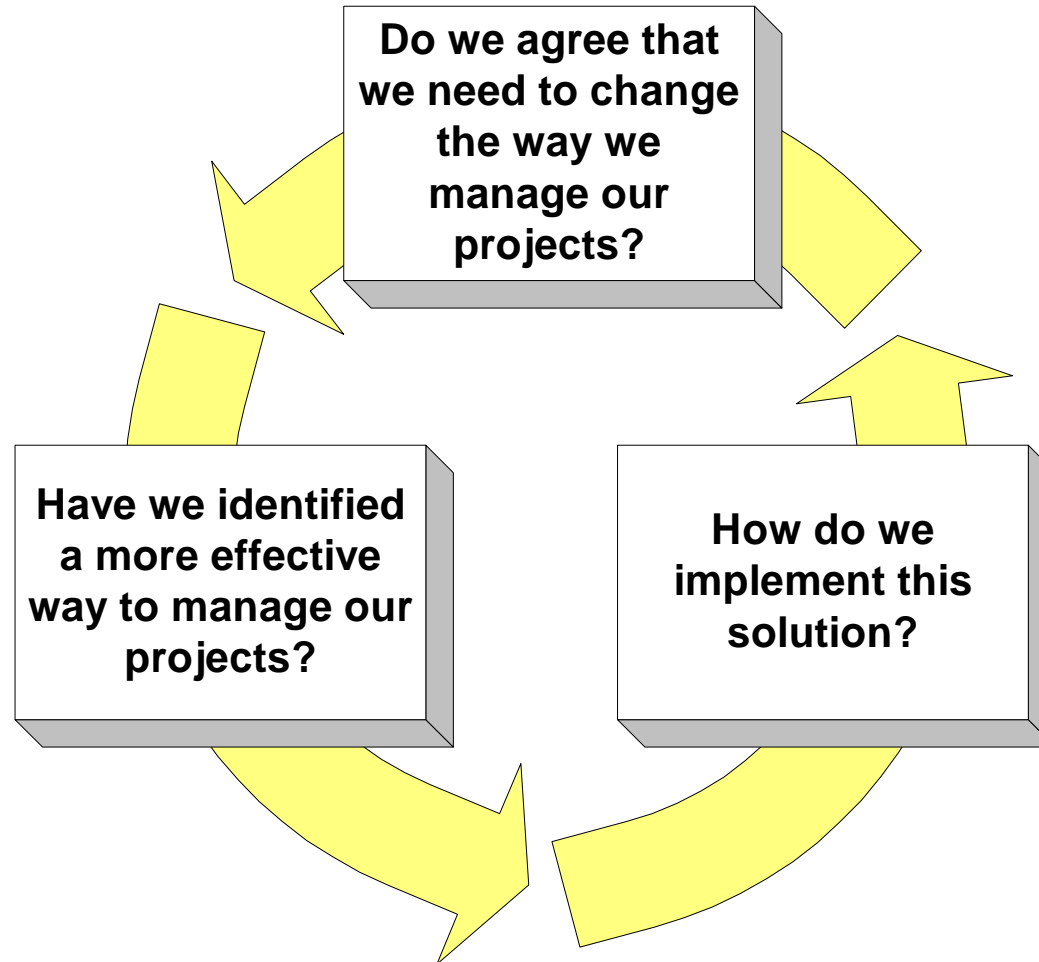
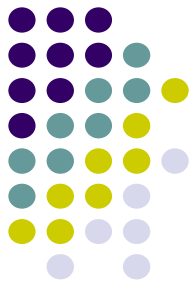
- Choose the Drum resource - the real bottleneck for the organization.
- Prepare the layout of a new project as if it were the only project.
- Resolve the major instances of resource contention within the project.
- Determine the availability of the Drum, from previous projects, and add a Strategic Resource buffer.
- Schedule the new project such that the first task for the Drum resource coincides with the end of the Strategic Resource buffer.
- Size the project buffer and feeding buffers.
- Determine the project's due-date.
- Determine start-dates for the non critical chains.
- Manage the buffers.
 - Generate timely, accurate buffer information for all active projects.
 - Distribute all buffer information to all resource managers (make it available to everyone).
 - Ensure that project managers and resource managers manage according to the buffers.

Summary - Multi-Project Environment

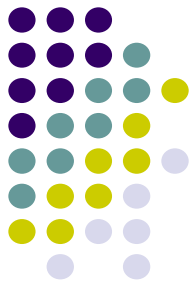


1. The Throughput increase potential from managing by a Drum, and eliminating bad multitasking is huge.
2. To reap the benefits, we must identify, exploit the drum resource, and subordinate the organization to this exploitation.
3. In a multi-project environment, exploiting and subordinating requires changing the policies on managing the Drum - how we manage it will determine the Throughput of the company.

Sanity Check!



The Five Steps of Successful Change



Step 1

“Gaining consensus on the nature of the problem”

Step 2

“Gaining consensus on the direction of the solution”

Step 3

“Gaining consensus on the benefits of the solution”

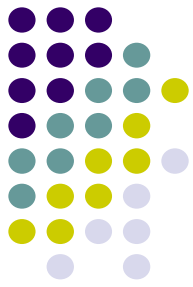
Step 4

“Gaining consensus on how to deal with reservations”

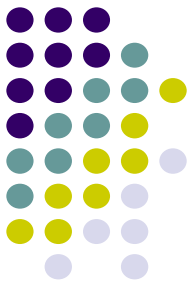
Step 5

“Making it happen!”

The constraint management process for introducing change

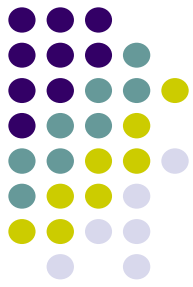


- Use of Logic, Effect-Cause-Effect
- Reservations dealt with properly
- Effective Decision making tools
- Depth and clarity of understanding
- Accurate prediction of effects
- Clear Focus on the Constraint
- Non emotional, fact based
- Support and mentoring enables concurrent development and transfer of new skills



The four key elements of any Critical Chain Implementation

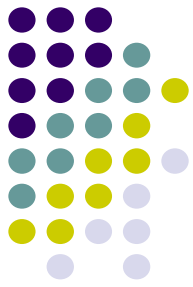
- Sound management methodology – rooted in the constraint management approach
- Sound decision-support system
- Knowledge transfer
- On-going support until self-sufficiency is achieved



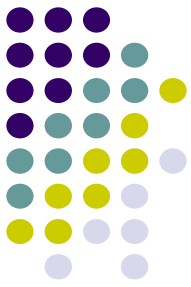
The Planning Phase

- Goal of the overall set of projects/programme
- Goal of the project plan
- Project Team
 - Roles & Responsibility
 - Sphere of control
- Project WBS
 - Churn/variation/.....
- Project Tasks
 - Uncertainty: level of
 - Management Control: scope of...
 - Level of Detail

The Planning Phase

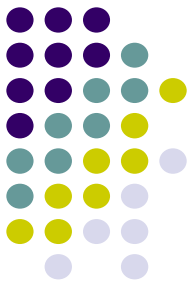


- Logic Connections
 - Internal to the plan
 - External to the plan - other plans
 - External to the plan - suppliers
- Resource Allocation
 - Uncertainty
- Task Durations
 - Not Elapsed time
 - Based on the time taken if everything goes well



Project Execution

- Dissemination of information
- Methods of working
 - Multitasking
 - Relay Runner
 - Other planned activities
 - Unplanned activities
- Reporting task progress
 - Days to complete
- Buffer Management

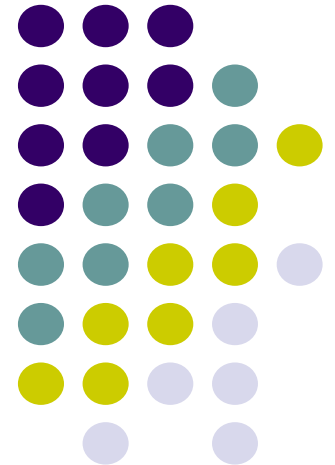


Implementation Model

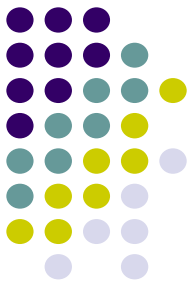
- Education
- Project Team Development
- Integration of the Critical Chain approach into the organisation
- Network Creation and Validation
- Critical Chain Software (if necessary)
- Project Execution through Buffer Management

Multi-Project Readiness

Some simple questions to assess organisational readiness for the Enterprise Solution for multi-project environments using constraint management within the company



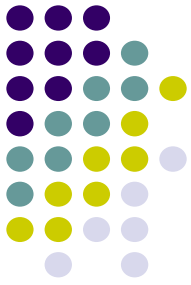
Goldratt
Implementation
Group



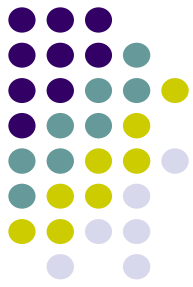
Market Information

- Market size
 - General
 - Specific
- Market growth
- Company Market share
- Company Sales Growth
- Key Competitors

Business Environment

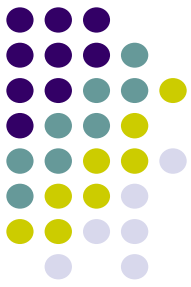


- Time
 - Project Delay
 - Time to Market
 - Due date performance
- Money
 - Financial Overrun
 - Total yearly investment in projects
 - Financing of projects



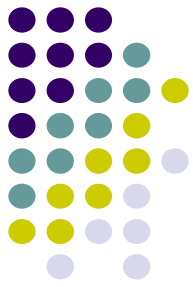
Business Environment ctd

- Scope
 - How much does the scope change?
 - What is the impact, if any, of technology on the ability to meet delivery on time?
- Business Strategy
 - Which specific projects have a major impact on business over the next year?
 - What is the impact of wrong selection of projects on future company performance
 - How often does project priority change and what is the impact on business performance?



Projects Information

- Do you group projects and if so how?
- What are the customers – internal or external?
- What is the profile of the customer?
- How do you define the size of a project? (e.g. money, number of people)
- Number of projects at any one time?
 - Large
 - Medium
 - Small
- Project length – years/months/weeks



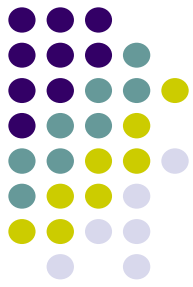
Resource Information

- What is the impact of shortage of resources on meeting business objectives?
- How is the organisation structured to deliver projects?
 - Within each department?
 - Are resources dedicated to projects or shared?
 - Are projects planned and controlled by a central department?



Resource Information ctd.

- Resources involved in delivering projects:
 - Internal – how many people?
 - External – supplier – how many?
 - Which type of resource are constraints for meeting project targets
 - How often are changes made to both number and skills?
 - How flexible are resources?
- How do you measure resource utilisation?



Management of Projects and Resources

- Does management have a true picture of project status, across all projects?
- How much time is invested by management to control projects?
- Is it possible to assess the impact of releasing one more project into the organisation?