

Project Management

Lecture 7- Project Monitoring and Control

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In this Lecture

- Project Monitoring and Control
 - Purpose of monitoring and control
 - The process
 - Progress Monitoring- Reporting
 - Corrective Actions
 - Tools- EVA

Purpose of Monitoring and Control

- It provides the means by which the **project manager can know the progress and status** of the project at any given time
- To provide a **framework for action planning**
- To **provide the options** available to the project manager in order to respond to any deviations

Purpose of Monitoring and Control

- The overall objective is to be able to respond to the following (simple) questions:
 - “Have we achieved the progress we expected to at this time?”
 - “Are we spending more or less than anticipated at this point?”
 - “Are we likely to complete on schedule and within the project budget?”
- If necessary, decisive management action can then be triggered, e.g. project crashing, additional resources, scope reduction etc

Monitoring and control concepts

- **Control is the act of reducing the difference** between the baseline plan and what actually happens in practice
- Plans can never be perfect so monitoring and control activity is inevitable
- Tracking and monitoring without control (intervention) is pointless?
- The worse the planning process, the greater the need for controls?

Monitoring vs Control

- Monitoring is about **collecting sufficient data** to measure progress and making sure that the project team implements the plan correctly
- Control is the process of ensuring that the **project delivers** everything it is supposed to according to schedule , cost and quality by **taking corrective action** when necessary

Monitoring and Control Steps:

1. Establish project baselines
2. Monitor and measure performance
3. Compare with baselines
4. Take corrective action, as necessary

Step 1 - Establish baselines

In effect, part of planning. Control needs planned benchmarks

Typical baselines include:

- Cost (budgets),
- Time (schedules),
- Performance (specifications, quality plan).
- Scope (WBS)

Changes to baselines only made after review & approval using change control system

Baseline plans updated as authorised changes occur.

All appropriate stakeholders notified of authorised changes

Step 2 - Monitor & measure performance

Project progress measured regularly to identify variances from plan

Collect accurate information related to baselines, eg:

- Percentage completion,
- Cost expended
- Quality tests,
- Scope change reports

Timely collection of this data is critical and will be an ongoing activity throughout the duration of the project lifecycle

Step 3 - Compare performance to baselines

- Contrast actual performance against planned performance -**variance analysis**
- Formulation of progress reports and forecasts to completion
- Tools - earned value, cash flow analysis, schedule appraisal.
- Causes & effects analysed and understood

Step 4 - Take corrective action

- Once deviations are identified then corrective action, if necessary, is taken. The options available to the project manager include:
 - No action taken if the variances are small
 - Re-planning activities to recover the ambitions of the original plan
 - Revising the original plan in light of the current situation
 - In extreme situations terminating the project
- Causes of change and reasons for selected corrective action should be documented

Basic options for corrective action

1. Find Alternative Solution - Rearrange workload or do work in different order or alternative way whilst not impacting on TCQS
2. Compromise Cost –
 - Put in more resources or effort, from existing resources (e.g. working overtime, increasing productivity)
 - The input of new resources
 - Redeploy existing resources (e.g. talented to critical area)
3. Compromise Time - Move milestone date
4. Compromise Quality
5. Compromise Scope - Lower level of ambition

Basic options for corrective action

6. Abort the project:

Difficult decision when project members committed to project.

Sometimes it is easy to think or suggest that:

“So much has been spent already that project must be completed”.

This very often is an invalid route to take.

It can often be more effective to abort the existing project, learn from the mistakes, risks issues and successes and start afresh.

Managing Progress

Managing Progress

- There are many ways in which information may be gathered and include:
 - Team meetings
 - **regular progress reports**
 - specific technical meetings
- Information required by the project manager must be:
 - timely, clear, relevant and accurate.

Periodic Reporting



Reporting Intervals

- **Event based-** at the end of a particular stage or task
- **Time based-** at the end of a particular time period
- **Problem or Hazard based-** when there has been a significant unplanned event or occurrence of a known or unknown project risk

Effective Reporting

- Reports should be made against the plan
- There should be defined criteria for control
- The control tools should be simple and friendly
- Reports should be made at defined intervals
- Reports should be discussed at formal meetings
- The reports should stimulate creative discussions

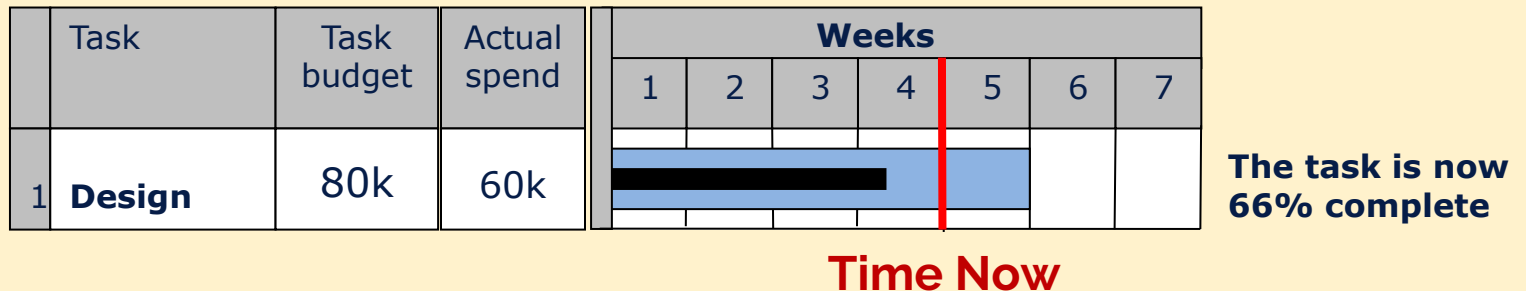
Progress Report

- Should include at minimum:

1. Work completed
2. RAG Status
3. Forecast

Progress Report		Report No.		
RAG Status*: RED / AMBER / GREEN				
Headlines				
Tasks, Milestones, Outcomes delivered this period			Completion dates	
Tasks, Milestones, Outcomes		Comments	Plan	Actual
Major Risks and Issues Include an assessment of the impact and any actions taken				
Recommendations and Requests for Decisions or Support				
Tasks, Milestones, Outcomes scheduled for next period			Completion dates	
Tasks, Milestones, Outcomes		Comments	Plan	Forecast
* RED	*Major concern - escalate to the next level! ¹ <u>Slippage</u> greater than 10% of remaining time or budget, or quality severely compromised. Corrective Action not in place, or not effective. Unlikely to deliver on time to budget or quality requirements			
AMBER	*Minor concern – being actively <u>managed</u> ² <u>Slippage</u> less than 10% of remaining time or budget, or quality impact is minor. Remedial plan in place.			
GREEN	*Normal level of attention! ³ <u>No material slippage</u> . No additional attention needed			

Activity- Tracking Gantt charts

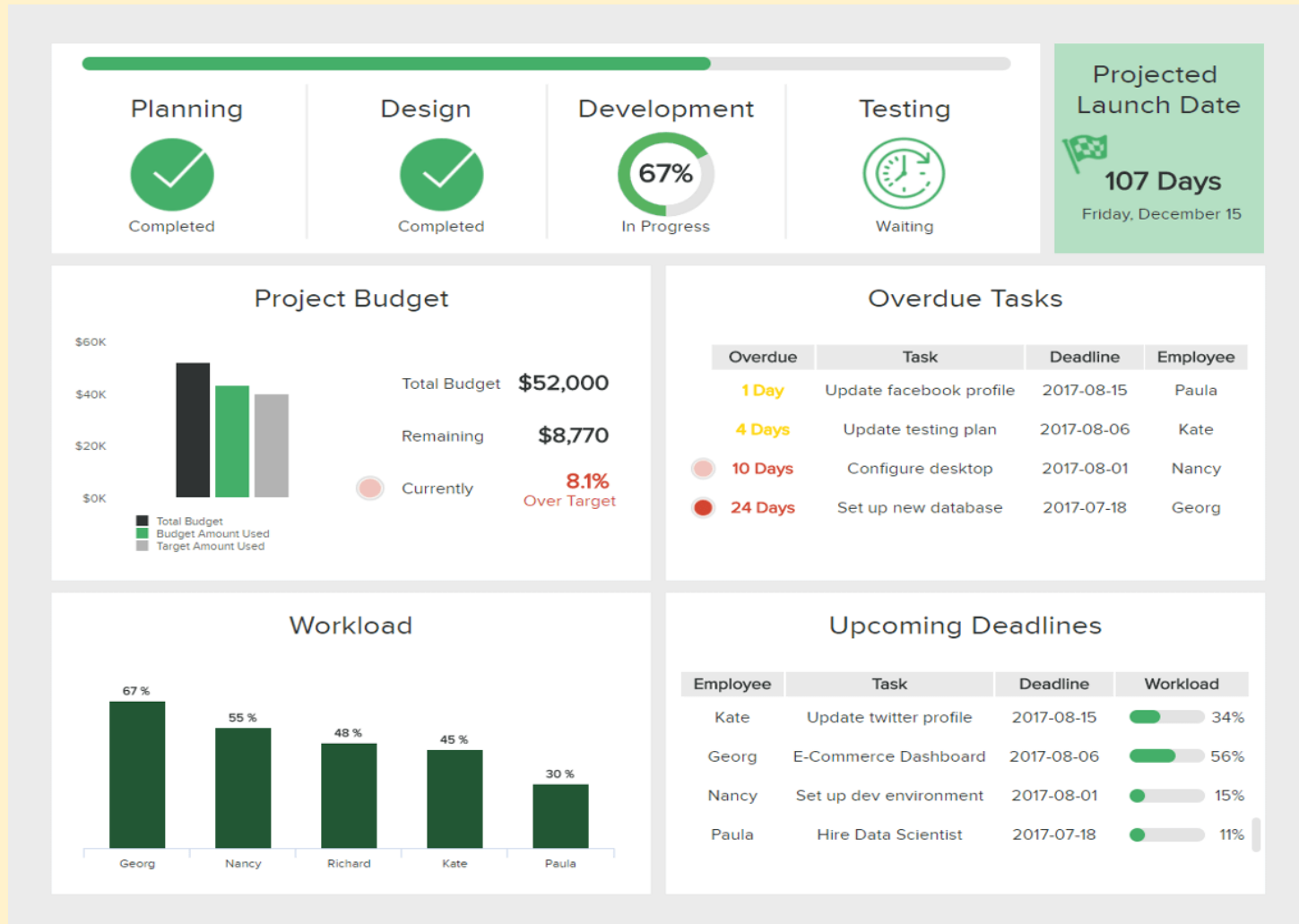


- Time Now (the time of assessment) is at the end of Week 4 (see vertical red line)

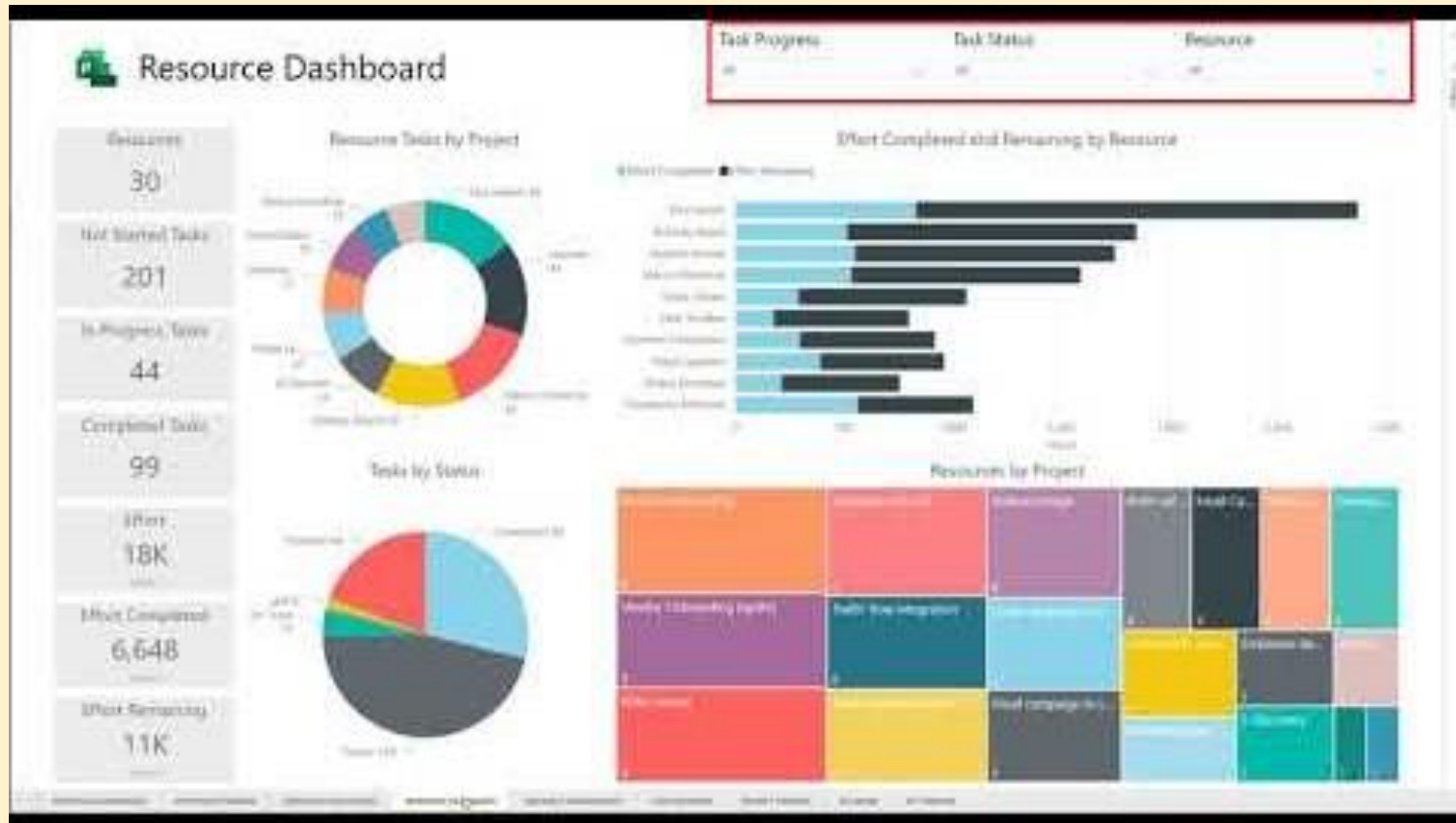
🗨️ How is the task progressing? Ahead or behind schedule?

🗨️ What is the financial position of the task?

Project Management Dashboard



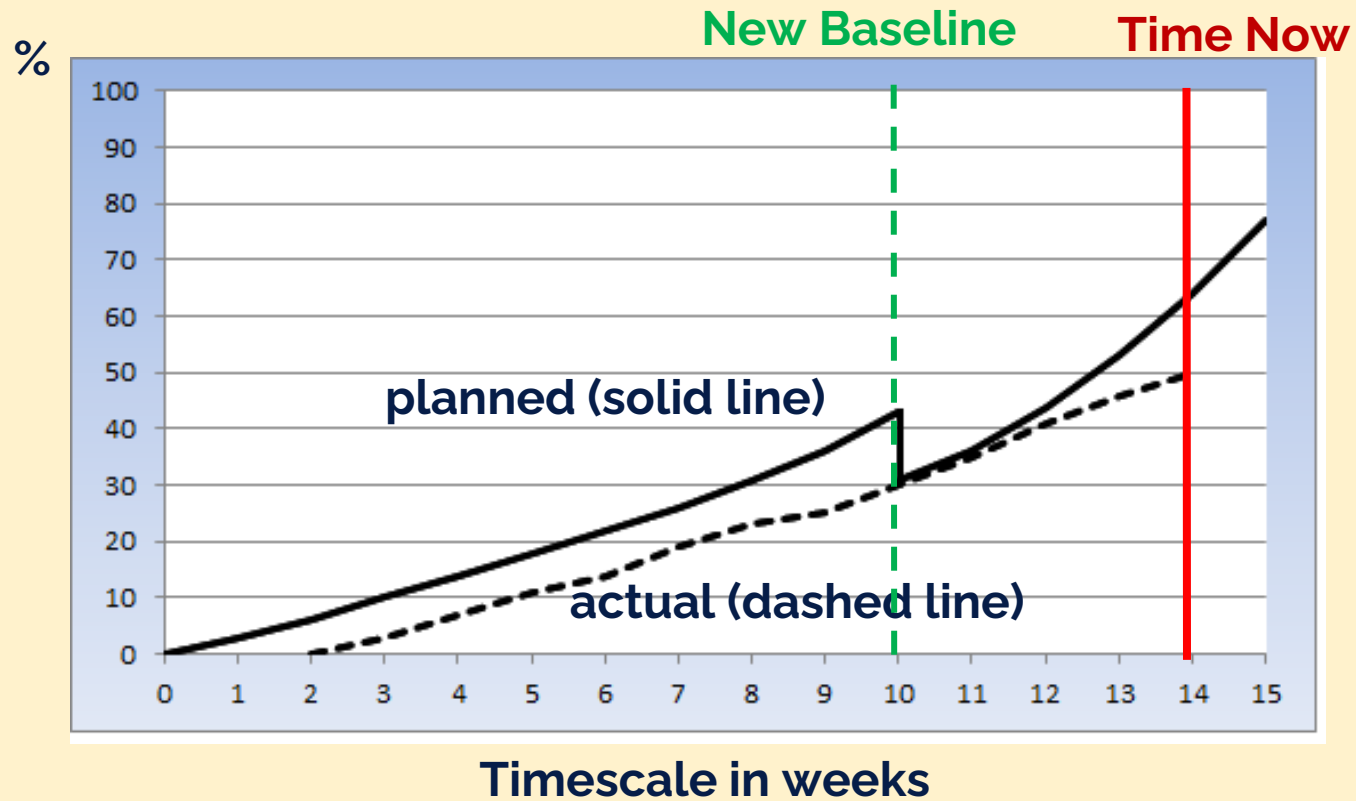
Microsoft Project for the web – Power BI Template



<https://youtu.be/C4TWvmiAR6Y>

Progress S-curve

- What is this showing? Good or bad news?

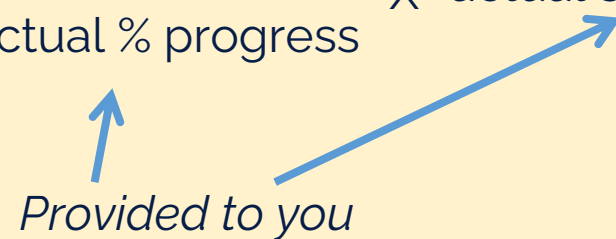


Projected spending

- It is often useful to be able to calculate the projected spending on a task based on actual progress and actual spending so far:
- The formula is:

$$\text{projected spending} = \frac{100}{\text{actual \% progress}} \times \text{actual spending}$$

Provided to you



Activity- Projected spending

- A project task is reported as being 40% complete and has spent £35,000 so far.
- The task budget is £75,000 and the project manager is concerned whether the budget will be exceeded.
- According to the formula:

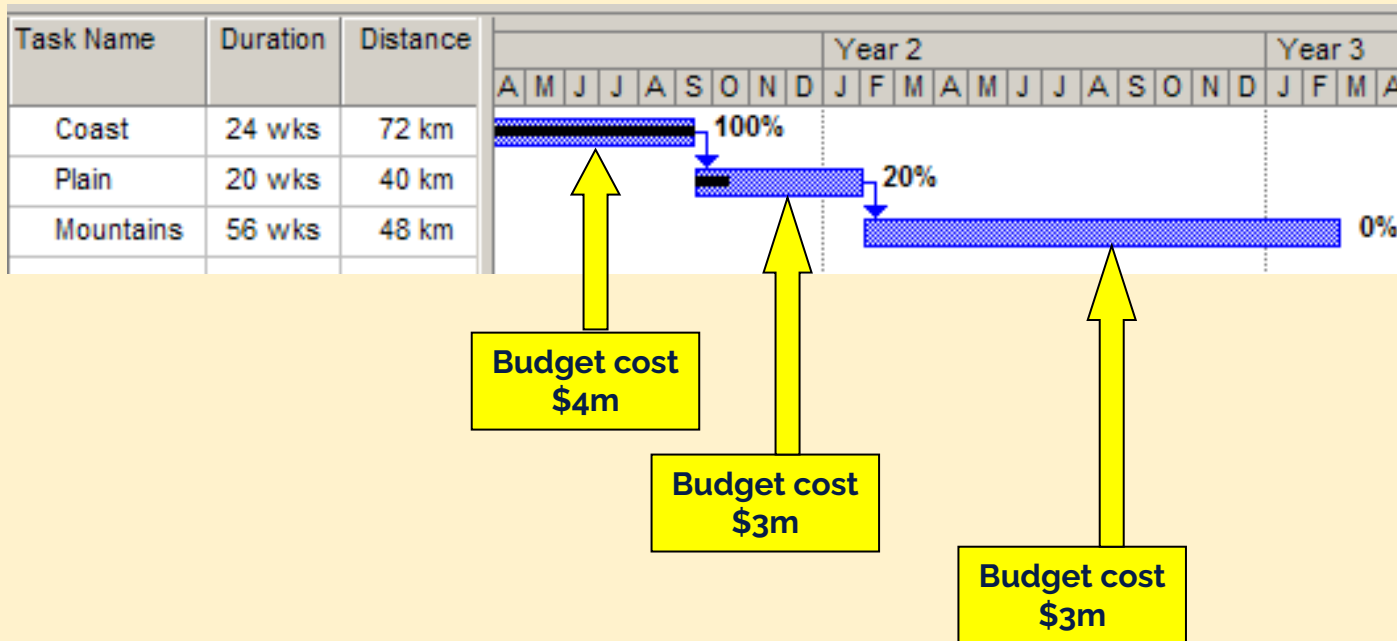
$$\text{projected spending} = \frac{100}{40} \times 35,000$$

$$\text{projected spending} = \text{£}87,500$$

 *Is this definitely going to be a financial problem?*

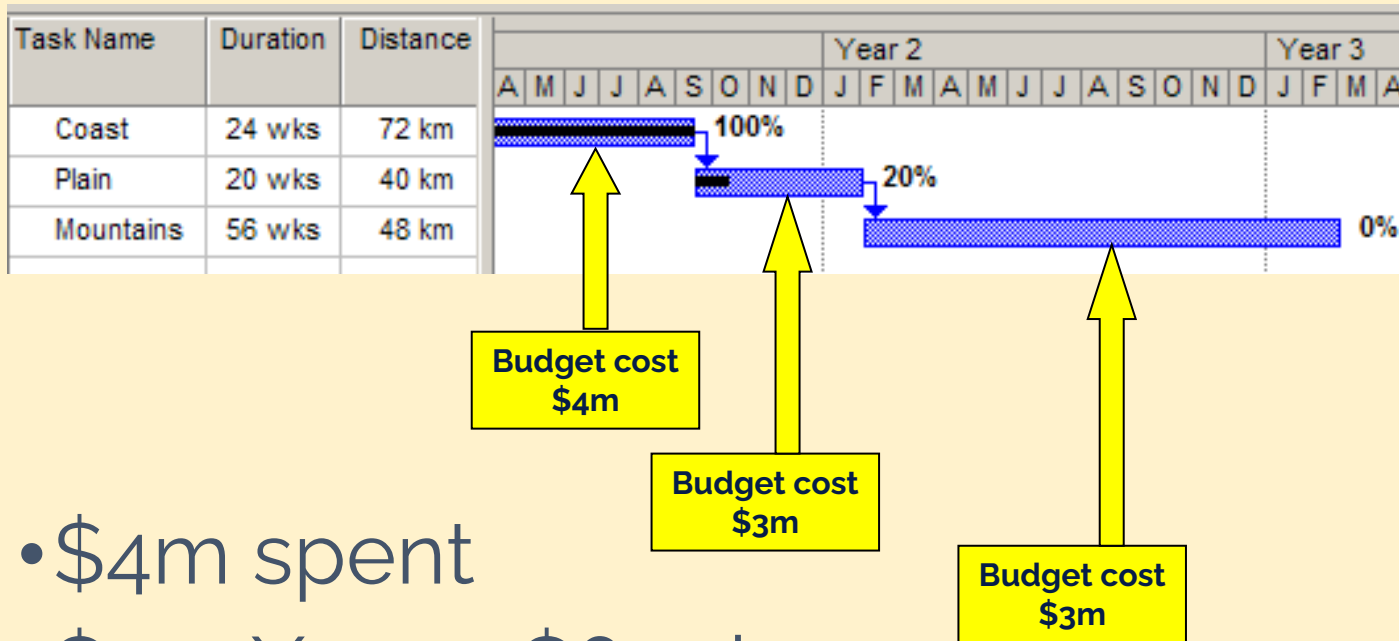
Does knowing the budget cost make any difference?

☕ What is progress based on cost?



Activity- Consider cost

☝️ What is progress based on cost?



- \$4m spent
- $\$3m \times 0.2 = \$600k$
- $4.6m \text{ spent} = 46\%$

Project Crashing

Project Crashing

- **“Crashing”**

- reducing project time by expending additional resources – typically people

- **Crash time** = *Planned Duration - Crash Duration*

- an amount of time that a task duration may be reduced

- **Crash cost** = *Cost of the Add resources to Red Dw.*

- The cost of reducing each task duration

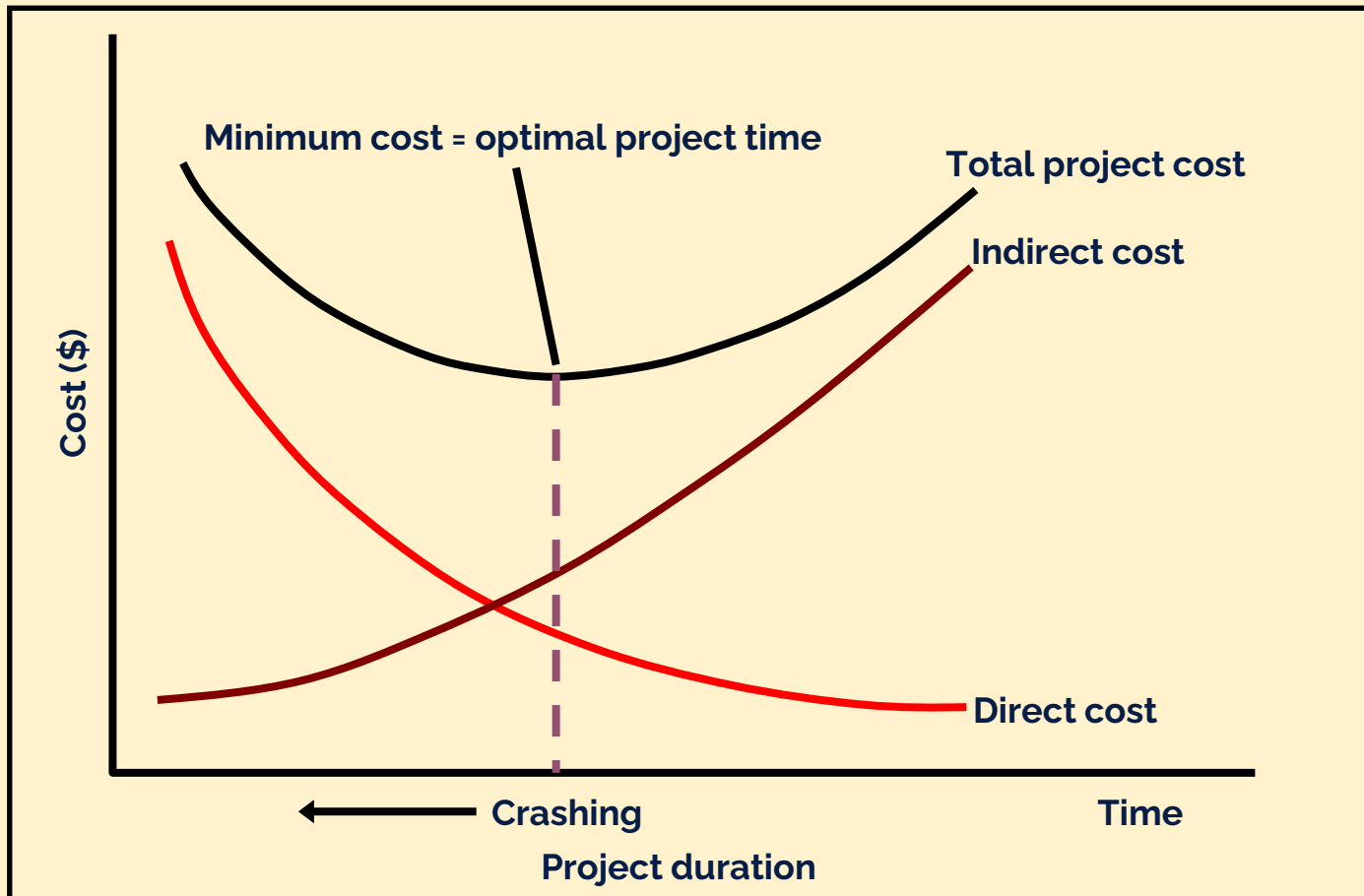
- **Goals**

- To reduce project duration at minimum cost
- And/or to seek a preferable solution

Time-Cost Relationship

- Crashing costs generally increase as the project duration decreases (more time being saved)
- Indirect/overhead costs relating to time increase as project duration increases
- The objective is to reduce project length as long as crashing costs are less than the increase in indirect costs
- How best to do this?

Time-Cost Tradeoff

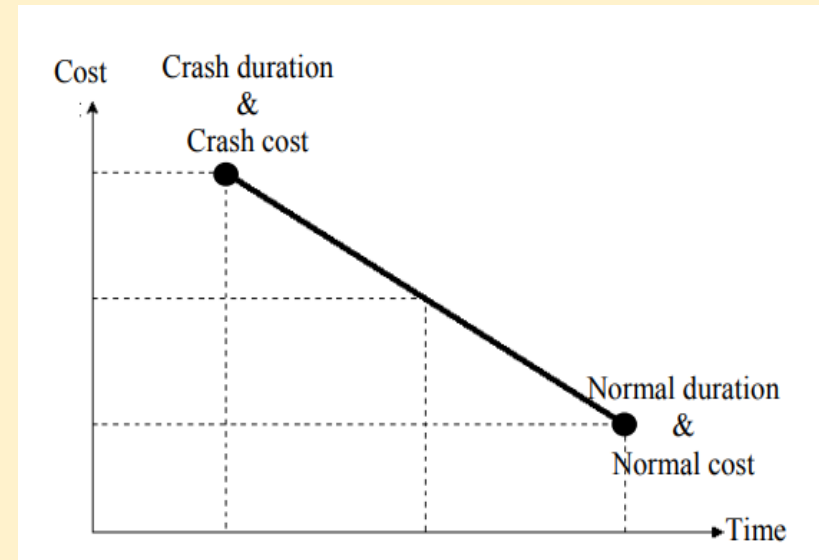


Time and Cost Curve

- Time–cost trade-off problems mostly **concentrated on shortening overall project duration by crashing the time** required to complete individual activities.
- Under the **assumption that time and cost trade-offs for individual activities are linear, the relationship can be represented as a straight line** on a graph depicting the relationship between activity time and cost (Wiest and Levy, 1997).
- Then the cost of completing the activity varies linearly between the normal time and the crash time (Fulkerson, 1961).

Time and Cost Curve

- In order **to reduce the time** estimate and save time on the project, there will almost certainly be a requirement to **increase resources and** result in a cost increase.
- This will result in the typical negative time-cost curve
- The slope of the line connecting the normal point (lower point) and the crash point (upper point) is called the **cost slope**



$$\text{Cost slope} = \frac{\text{crash cost} - \text{normal cost}}{\text{normal duration} - \text{crash duration}}$$

Project Crashing Example

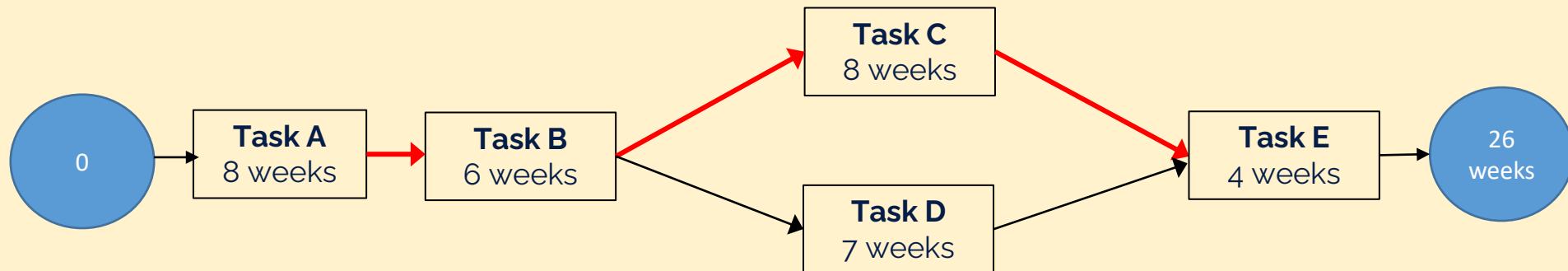
Activity	Normal Duration (wk)	Crash Duration (wk)	Normal Cost (\$)	Crash Cost (\$)	Crash Increase	Crash Cost per week
A	8	6	20000	40000	20000	10000
B	6	4	25000	49000	24000	12000
C	8	7	18000	36000	18000	18000
D	7	6	30000	45000	15000	15000
E	4	3	38000	54000	16000	16000

Cheapest to most expensive cost to crash:

Activity	Crash Cost per week (\$)	Normal Duration (wk)	Crash Duration (wk)	Time Saved (weeks)
A	10000	8	6	2
B	12000	6	4	2
D	15000	7	6	1
E	16000	4	3	1
C	18000	8	7	1

Project Crashing Example

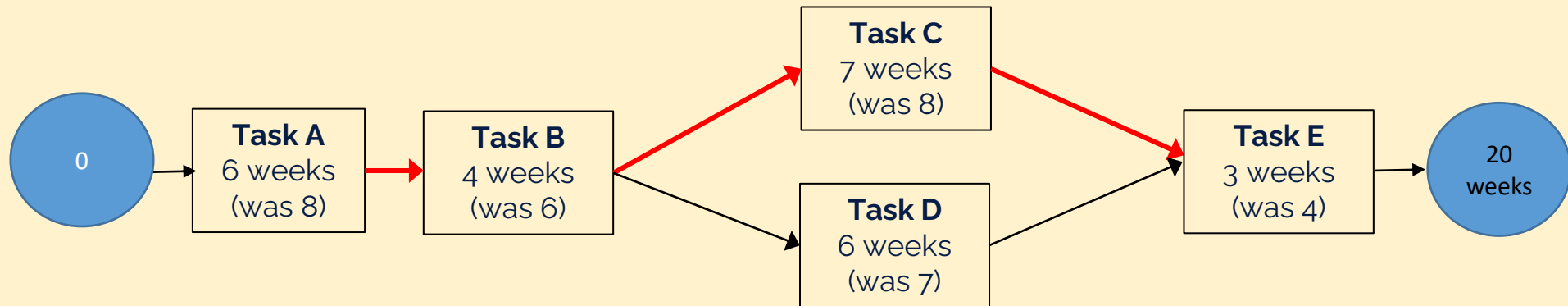
- Need to Identify the **original** Critical Path to finalize crash sequence, as shortening critical tasks will shorten project duration



- Critical Path: A-B-C-E

Project Crashing Example- Add crash durations

- Identify the **new** critical path (if new) and new project duration

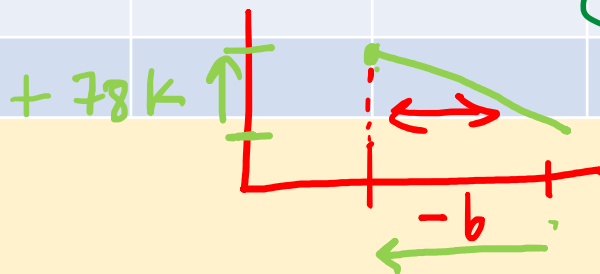


- Critical Path: A-B-C-E (did not change)

Project Crashing Example- Identify Crash Sequence

- Will usually start with the cheapest unit-crash-cost item and progress to the most expensive unit-crash cost item.
- Calculate Project Cost Increase relative to reduce duration

Crash Sequence	Crash Cost per week \$	Normal Duration (wk)	Crash Duration (wk)	Time Saved (wk)	Cumulative Project Cost Increase	Cumulative Project Duration Reduction (wk)
A	10,000	8	6	2	+20,000	-2
B	12,000	6	4	2	+44,000	-4
E	16,000	4	3	1	+60,000	-5
C	18,000	8	7	1	+78,000	-6

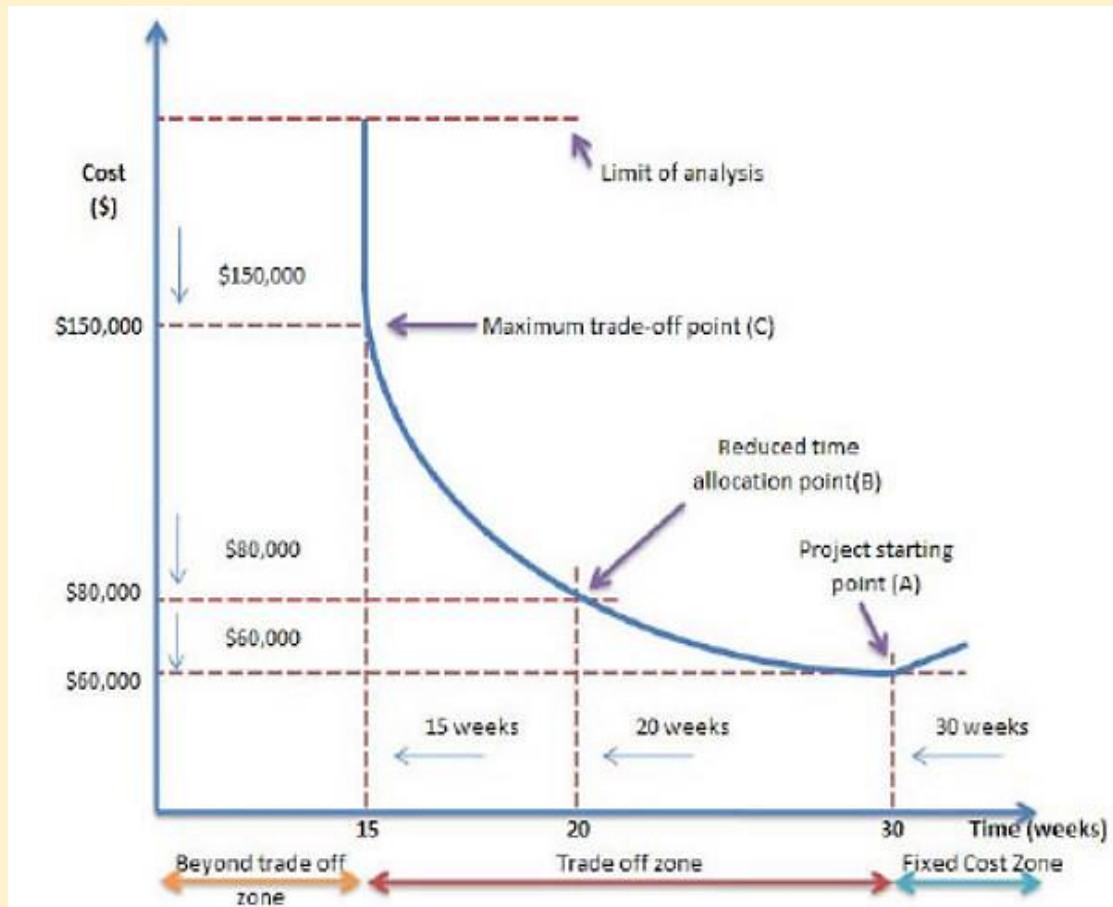


Optimization is Key

- The most obvious way is to work out which activity can be speeded up at least cost, and then crash (i.e., reduce the overall activity duration) that one first, followed by the next cheapest, and so on.
- This curve will reach a point **where all critical-path activities have been speeded up as far as possible.**
- Beyond this point, no further time can be saved on the project. Any further crashing will result in cost increases, and no further time will be saved.

Optimization Illustrated

- Point (A) represents the original starting point, where the project will take 30 weeks to complete.
- Point (B) is where the time allocated is reduced to 20 weeks, and the cost increases to \$80 000.
- Point (C) represents the shortest time possible, in this case 15 weeks, and cost increases to \$150 000. Beyond point (C), no further time-savings are possible.



Crashing strategies- Summary

- Prioritise those tasks on the critical path
- Saving time on these tasks should reduce the overall project duration
- Re-model the critical path
- Check for any NEW critical paths
- Recalculate the new overall budget
- And compare with the original schedule and budget combination
- Assess any other opportunities for fine-tuning?

Cost Control

Earned Value Analysis

- EVA evaluates the projects progress by merging the cost and time constraints together
- EVA breaks down the project task by task or by work packages and allocates a dollar value to each
- Progress is measured in terms of dollar value earned not in days
- It allows project managers to assess the percentage of completeness a project using quantitative analysis

- EVA monitors progress by comparing the value earned from completing a task to the planned value that should have been derived from that task
- If the actual value earned is less than the value that should have been derived then the project is in jeopardy
- If the actual value earned is greater than the planned earned value then the project is in a good situation

Objectives of EVA

- To determine schedule variance
- To determine cost variance

- Variances must be tracked and reported
- They should be mitigated through corrective actions

Pre-requisites

- A detailed work breakdown structure
- A correspondingly detailed cost coding system
- Timely and accurate collection and reporting of cost data
- A method for monitoring and quantifying the amount of work done, including work in progress

Variables for calculating variances

- **Budgeted Cost of Work Scheduled (BCWS)**- this is budgeted amount of cost for work scheduled to be accomplished in a given time period
- **Budget Cost of work Performed (BCWP)**- is the budgeted amount of cost for completed work within a given time period referred to as “earned value”
- **Actual Cost of Work Performed (ACWP)**- is the amount reported as actually expended in completing the work accomplished within a given time period

Example- Software Project

- Budgeted Cost at Completion (BC)- \$ 5 million over a time period of 24 months
- BCWS after nine months- \$ 600,000.00
- BCWP- \$ 400,000.00
- ACWP- \$ 700,000.00

Cost
'000

700

600

400

9

mths

Time

Budgeted

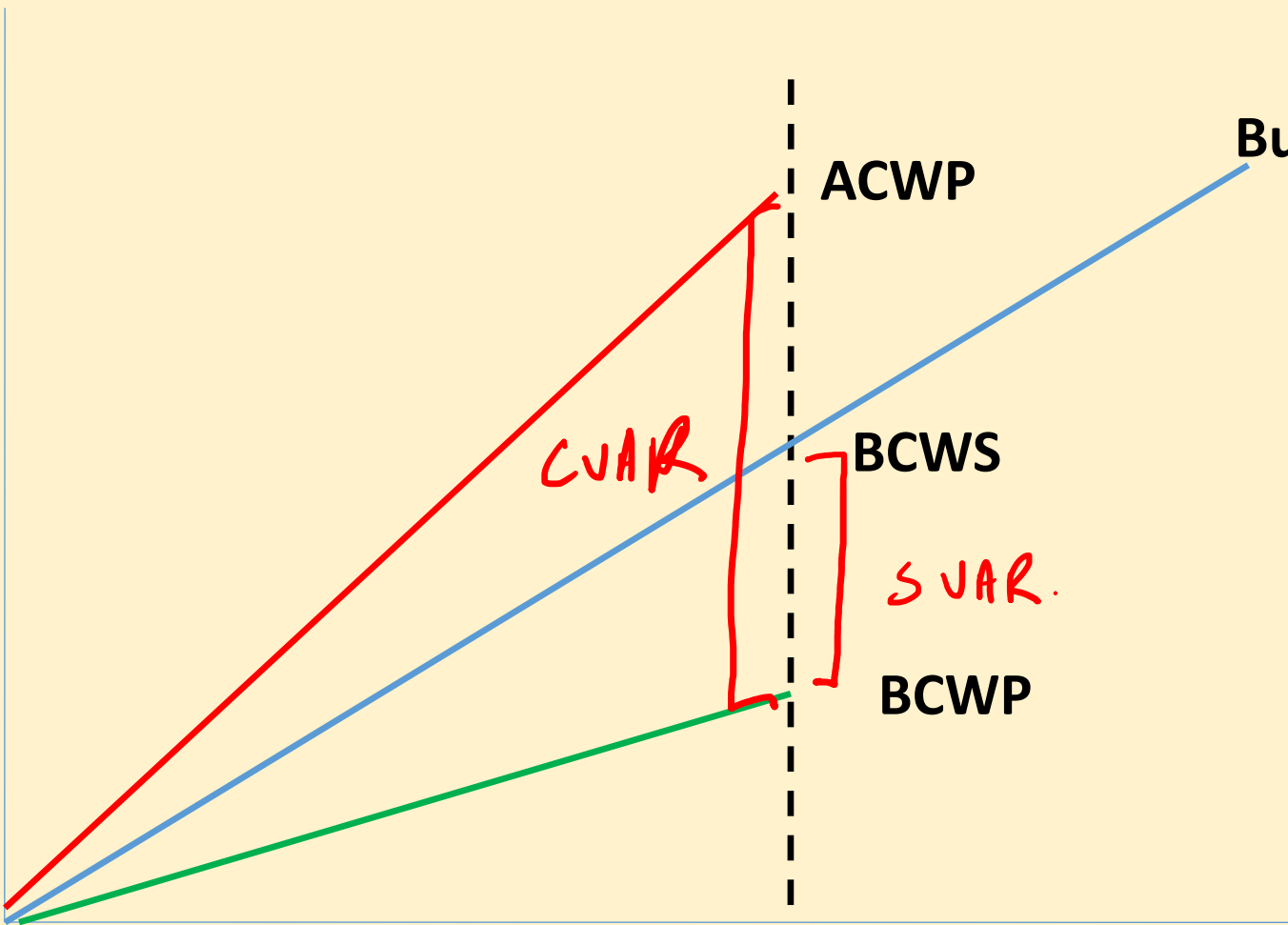
ACWP

BCWS

SVAR.

BCWP

CVAR



Calculating Variances

- Cost Variance (CV) =
 $BCWP - ACWP$
- Cost Variance % (CVP) =
 $CV / BCWP$
- Cost Performance Index (CPI) = $BCWP / ACWP$

- Schedule Variance (SV)
 $= BCWP - BCWS$
- Schedule Variance % (SVP) = $SV / BCWS$
- Schedule Performance Index (SPI) = $BCWP / BCWS$

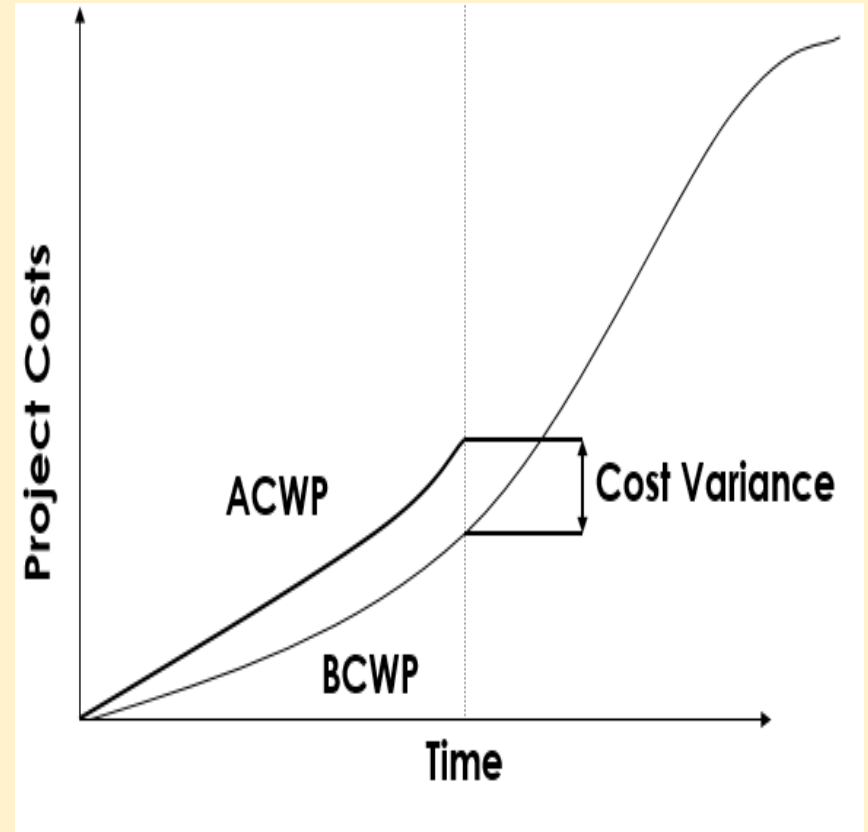
a negative variance (< 0) indicates a cost overrun or behind schedule
Less than or equal to 1 or 100% (resources are not being used efficiently)

Cost Variance

$$\begin{aligned} CV &= BCWP - ACWP \\ &= 400,000.00 - \\ &\quad 700,000.00 \\ &= (300,000.00) \end{aligned}$$

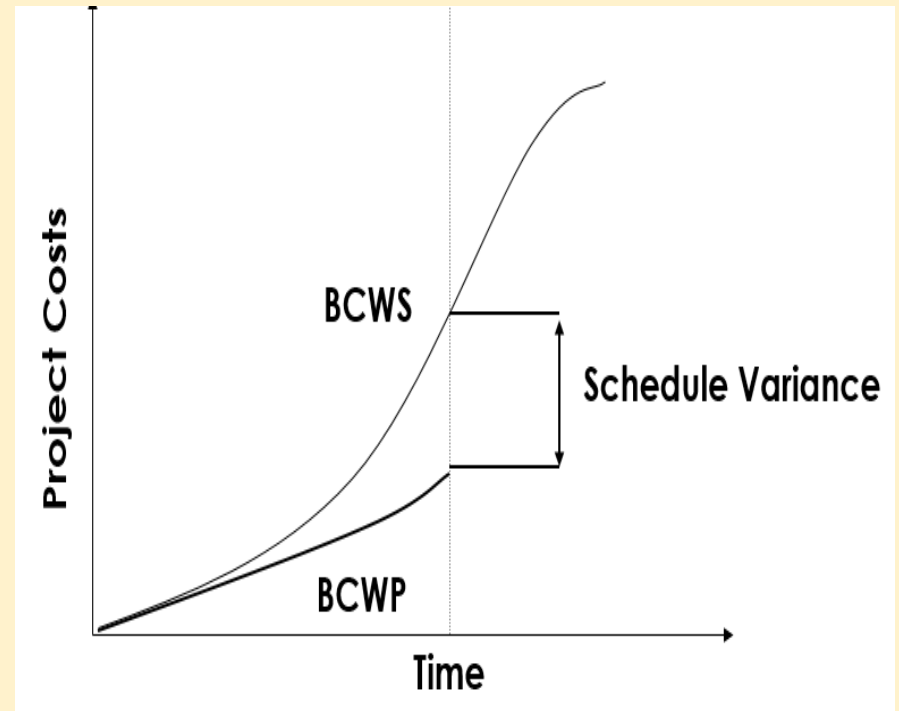
$$\begin{aligned} CVP &= 300,000.00 / \\ &\quad 400,000.00 \\ &= 75\% \end{aligned}$$

$$\begin{aligned} CPI &= 400,000.00 / \\ &\quad 700,000.00 \\ &= 0.57 \end{aligned}$$



Schedule Variance

$$\begin{aligned}SV &= BCWP - BCWS \\ &= 400,000.00 - \\ &\quad 600,000.00 \\ &= (200,000.00) \\ SVP &= 200,000.00 / \\ &\quad 600,000.00 \\ &= 33\% \\ SPI &= 400,000.00 / \\ &\quad 600,000.00 \\ &= 0.66\end{aligned}$$



EVA answers the following:

- What % of the project has been completed?
- How much should we have spent so far?
- Are we ahead or behind schedule?
- How far ahead or behind schedule are we?
- Are we on or off budget?
- How far on or off budget are we?
- At the rate going, how much will all of this cost?
- How much over or under budget will we be?
- How long will the project really take?

Change Control

Change Control

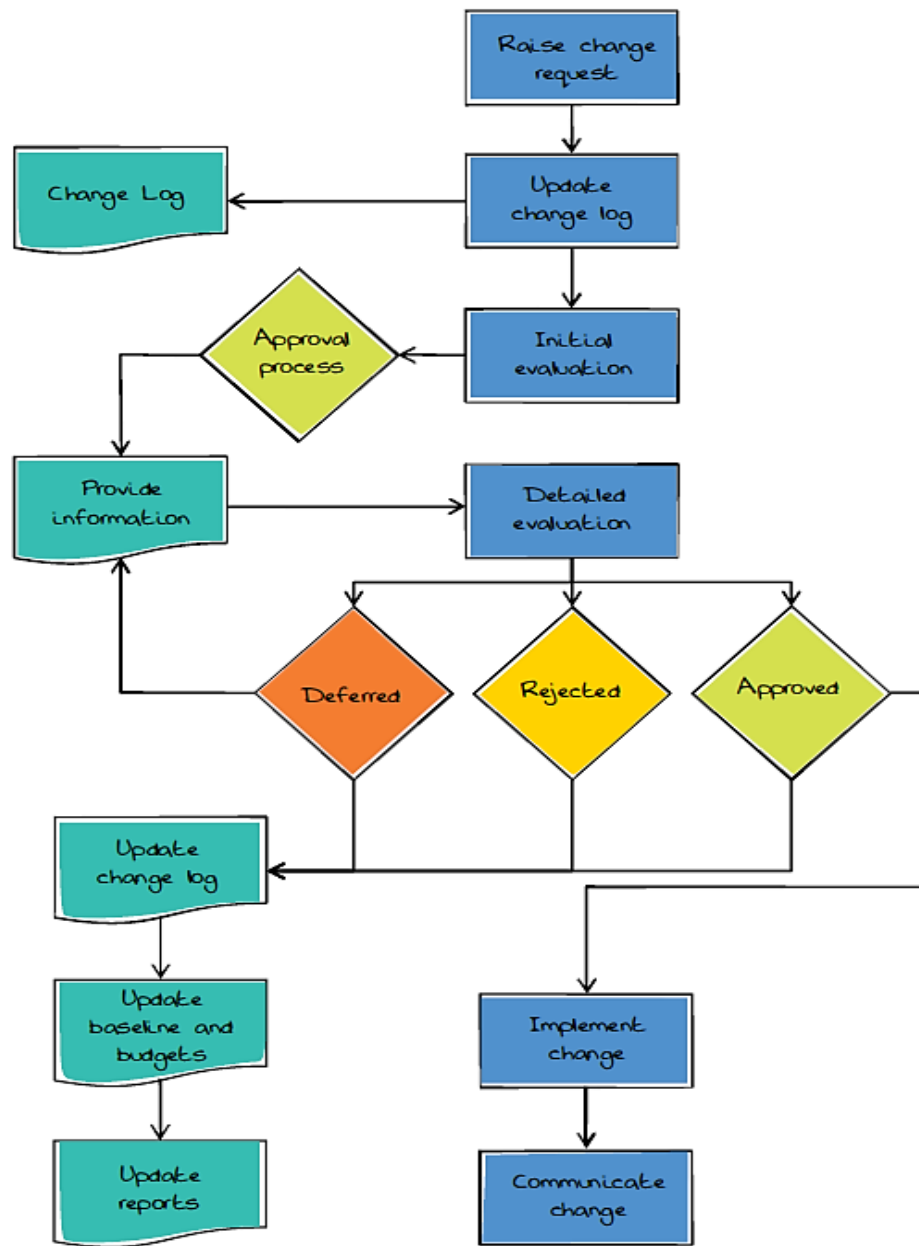
- Used to initiate, record, assess, approve and resolve project changes.
- Project changes are needed when it is deemed necessary to change the scope, time or cost of one or more previously approved project deliverables.
- Most changes will affect the budget and/or schedule of the project.

Change Control Principles

- Manage each change request from initiation through to closure;
- **Setup A Change Control Board/Committee**
- **Process change requests** based upon direction from the appropriate authority;
- Communicate the **impact of changes** to appropriate personnel; and
- Allow small changes to be managed with a minimum of overhead.

Steps to control change:

1. Log change request in a change log
2. Initial evaluation where the change is reviewed
3. Detailed evaluation where the impact on baseline success criteria
4. A recommendation is made to the sponsor and/or wider governance board to approve, reject or defer the change.
5. The plan is updated if a change is approved
6. Implementation where the necessary actions are taken and monitored.



APM (2019) <https://www.apm.org.uk/resources/what-is-project-management/what-is-change-control/>

Impact of Change

Area of project	Change	Impact
Business case		<i>Will it have to be represented? For example, if there is to be a request for more funding or the schedule change impacts other projects and areas of work.</i>
Schedule	<i>Are there dependencies that will be affected? For example, would work stop until the change has been implemented?</i>	<i>Will it affect the end delivery date?</i>
Resource	<i>Will this require extra resource?</i>	<i>Is there sufficient resource? Would there be a requirement for external resource?</i>
Budget	<i>Is there a cost implication?</i>	<i>Are there sufficient funds in the contingency? Would there need to be a request for more funds?</i>
Quality	<i>What areas of the project will be affected</i>	<i>How will they be affected?</i>

APM (2019) <https://www.apm.org.uk/resources/what-is-project-management/what-is-change-control/>

Change Management Tools

- Change Request Form
- Change Log

Reference List

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