

 POLITECNICO DI MILANO

Dipartimento di  
Elettronica e Informazione

Session 10

# Project Control

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- This slides are largely based on Prof. John Musser class notes on “Principles of Software Project Management”
- Original slides are available at <http://www.projectreference.com/>
- Reuse and republish permission was granted

## Today Agenda

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- **Session 9 Review**
- Project Control
- Status Reporting
- Earned Value Analysis
- Project Control with Microsoft Project

## Session 9 Review

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- Software Quality Assurance
- Integration
- Test planning
- Types of testing
- Test metrics
- Test Environments

## Today Agenda

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- Session 9 Review
- **Project Control**
- Status Reporting
- Earned Value Analysis
- Project Control with Microsoft Project

- Ongoing effort to keep your project on track
- 4 primary activities:
  1. Planning performance
    - A Software Development Process (SDP), schedule, and a control process
  2. Measuring status of work performed
    - Actual
  3. Comparing to baseline
    - Variances
  4. Taking corrective action as needed
    - Response
- Prerequisite to good control is a good plan

- “Control”
  - Power, authority, domination. No.
  - Guiding a course of action to meet an objective. Yes.
- Principles
  - Work is controlled, not workers
    - Control helps workers be more effective & efficient
  - Control based on work completed
    - Use concrete deliverables (no fuzzy milestones!)
  - Balance
    - Appropriate level between too much and too little
    - Includes:
      - Micro-managing vs. neglect
      - Too much tracking vs. too less tracking

- The three key Progress Monitoring Questions
  - What is the actual status?
  - If there's a variance, what is cause?
  - What to do about it?
  
- The three possible responses:
  - Ignore
  - Take corrective action
  - Review the plan

- Monitoring rates
  - Daily, weekly, monthly
  - If problems occur – then adjust
    - You may have to monitor problematic areas more closely
    - Almost always there's one or more areas under closer scrutiny, for some period of time

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- Status Reporting
  - Part of the communications management plan
    - Which is usually just a section of Software Development Plan (SDP)
- Two levels of reporting
  - From team to PM
  - From PM to stakeholders
- Typical format for latter
  - Summary
  - Accomplishments for this period (done)
    - Tasks, milestones, metrics
  - Plans for next period (to-do)
  - Risk analysis and review
  - Issues & Actions
- Shoot for weekly updates
  - Email notes, then hold brief meeting
  - More frequently during crises

- A programmer reports that he's 80% done
  - What does this mean?
  
- A programmer reports completing 4,000 LOC on estimated 5,000 LOC effort
  - Is this 80% complete?
  - What about the quality control?
  - How much is estimated to complete the task?
    - Your estimates could have been wrong
    - It's unbelievable how much work is needed to complete a work from 80% to 100%
  - If you can't measure scope or quality you don't know "reality"
  - You really only know the cost so far (hours spent)
  - How can you improve this?

- Tasks can only be in one of 2 states
  - Completed or Uncompleted
  - No partial credit
  - Preferred to anything subjective!
- “90% Complete Syndrome”
  - Software is 90% complete 90% of the time
- If you need more granularity than 0% ↔ 100%
  - Use lower-level task decomposition
  - Each lower-level task must be measurable
- Tangible exit criteria
  - E.g. Achieving sign-off for Requirements
  - E.g. All regression tests pass

## Today Agenda

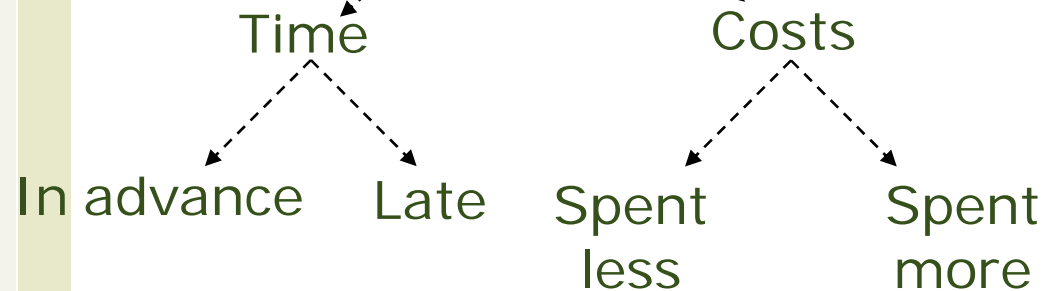
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- Session 9 Review
- Project Control
- Status Reporting
- **Earned Value Analysis**
- Project Control with Microsoft Project

- a.k.a. Earned Value Management (EVM) or Variance Analysis
- It's a metric of project tracking
- It measures the **real physical progress**
  - "What you got for what you paid"
- "Traditional" non-EVA approach
  - Two dimensions: *time* and *cost*
    - *Planned* time and costs vs. *Actual* time and costs
  - Progress is defined as comparison between planned and actual
  - It doesn't not consider the value of performed tasks
- EVA approach
  - It adds third dimension
    - Planned Cost, Actual Cost, **Earned Value**

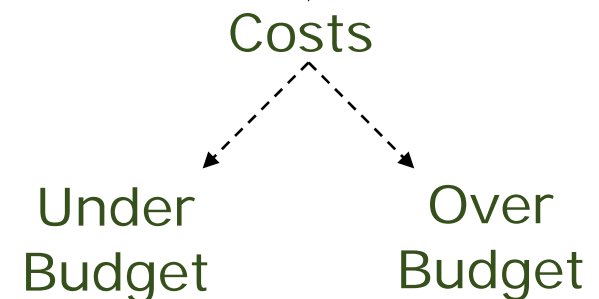
## Traditional Measurement

Merely economic evaluation comparing *planned* and *actual*



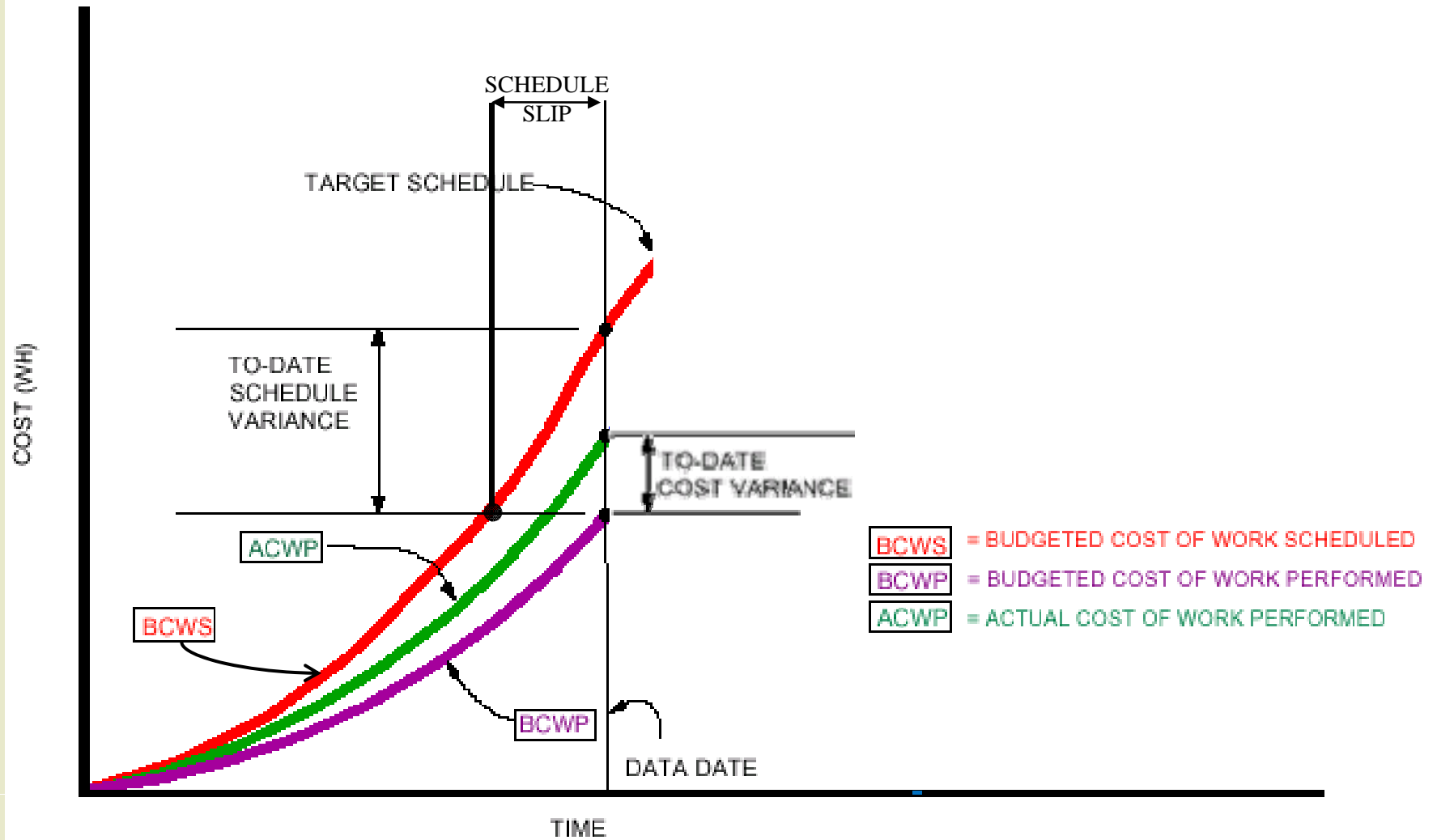
## Earned Value Measurement

Time/Costs/Value Integrated Monitoring



Are there more/less costs because of in advance/late status or because inefficiencies?

- EVA is measured in money or time
  - We'll measure it in money
- Calculated as comparison of the Performance Measurement Baseline (PMB)
  - Time-phased budget plan against which contract performance is measured
  - It establishes the scope, schedule and budget targeted for the project
    - it's a plan
- Different methods are available for comparison
  - Binary Reporting (suggested)
  - Based on % complete
  - Weights or costs applied to milestones



- 3 major components
  - **BCWS**: Budgeted Cost of Work Scheduled
    - Also called “Planned Value” (PV)
    - “Wished”
    - How much work should be done?
  - **ACWP**: Actual Cost of Work Performed
    - Also called “Actual Cost” (AC)
    - “Burned”
    - How much did the work done cost?
  - **BCWP**: Budgeted Cost of Work Performed
    - Also called “Earned Value” (EV)
    - “Earned”
    - How much work is done?
    - Calculated considering the BCWS related to *what has been really done*

- As showed, EVA can be plotted on 'spending curves'
  - Monotonic cumulative cost (Y axis) vs. Time (X axis)
  - Typically in an 'S' shape
  
- "What is the project status" ?
  - You can use Derived EVA variances to answer this
- **SV**: Schedule Variance
  - $BCWP - BCWS (=EV - PV)$
  - Planned work vs. Work completed
- **CV**: Cost Variance
  - $BCWP - ACWP (=EV - AC)$
  - Budgeted costs vs. Actual costs
  
- Negatives are termed 'unfavorable'

## Derived EVA Variances

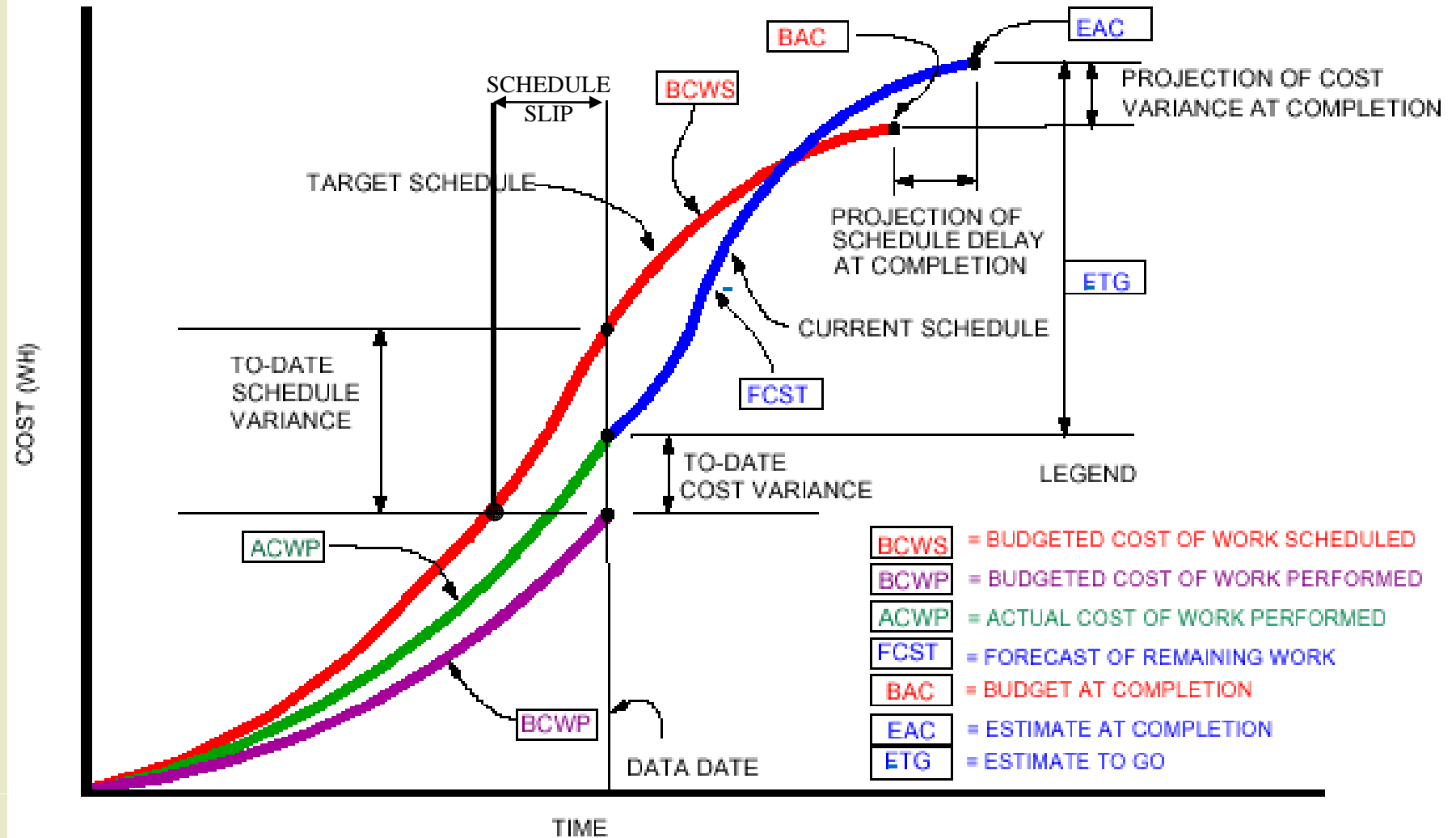
### The 4 cases

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- 4 combined cases for SV and CV
  1.  $SV > 0$  and  $CV > 0$ 
    - In advance
    - Efficient
  2.  $SV > 0$  and  $CV < 0$ 
    - In advance
    - Inefficient
  3.  $SV < 0$  and  $CV > 0$ 
    - In late
    - Efficient
  4.  $SV < 0$  and  $CV < 0$ 
    - In late
    - Inefficient

- SPI: Schedule Performance Index
  - $BCWP / BCWS (=EV/PV)$
- CPI: Cost Performance Index
  - $BCWP / ACWP (=EV/AC)$
- Problems in project if either of these less than 1 (or less than 100%)
- CR: Critical Ratio
  - $SPI \times CPI$
  - $1 \rightarrow$  everything on track
  - $> .9$  and  $< 1.2 \rightarrow$  acceptable
  - $< .9$  or  $> 1.2 \rightarrow$  need inspection and actions

# Forecasts based on Earned Value Analysis



- Forecasted Values
  - BAC: Budget At Completion
    - Sum of all budgets till the end of project (BCWS)
    - The end of the original budget curve
  - EAC: Estimate At Completion
    - Forecast of total cost at completion
    - $EAC = ((BAC - BCWP)/CPI) + ACWP$
    - Unfinished work (= BAC – BCWP) divided by cost performance indicator (= CPI) and added with costs spent so far (= ACWP)
    - If  $CPI < 1$ , EAC will be  $> BAC$ 
      - We'll finish the project in overspending since we are less efficient than estimated
  - ETG: Estimate to go
    - Forecast of additional cost from today to the end of project
    - $ETG = EAC - ACWP = ((BAC - BCWP)/CPI)$

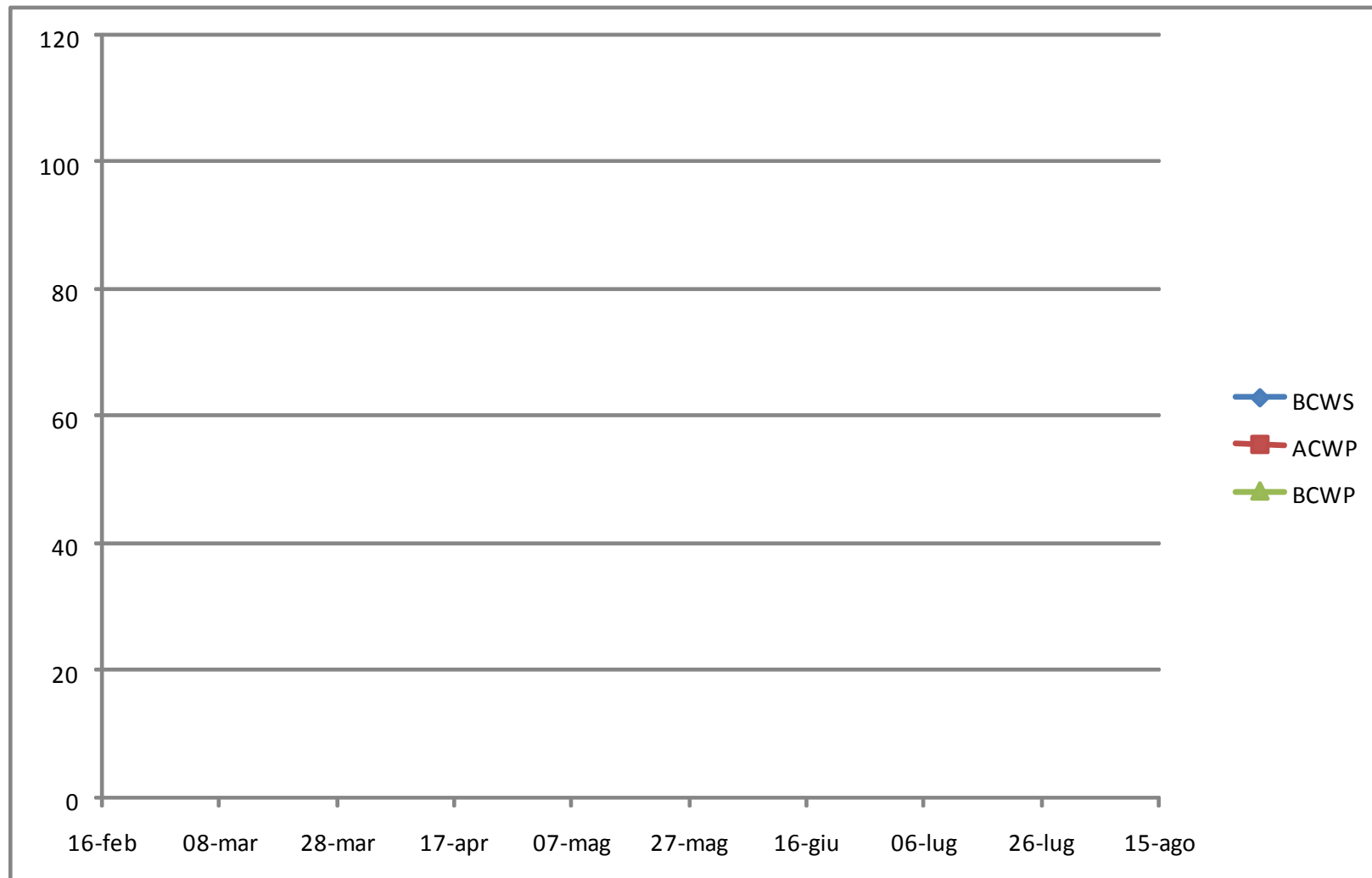
WBS	Completion Date		Cost	
	Planned	Actual	Planned	Actual
Project Start	01-mar	01-mar	€ 0	€ 0
Milestone A	01-apr	20-apr	€ 25.000	€ 20.000
Milestone B	01-mag	28-mag	€ 15.000	€ 10.000
Milestone C	01-giu	18-giu	€ 10.000	€ 15.000
Milestone D	01-lug		€ 15.000	
Milestone E	01-ago		€ 10.000	
<b>TOTALS</b>			<b>€ 75.000</b>	<b>€ 45.000</b>

- As of 1-July where are we?
- BCWS =
- ACWP =
- BCWP =

WBS	Completion Date		Cost	
	Planned	Actual	Planned	Actual
Project Start	01-mar	01-mar	€ 0	€ 0
Milestone A	01-apr	20-apr	€ 25.000	€ 20.000
Milestone B	01-mag	28-mag	€ 15.000	€ 10.000
Milestone C	01-giu	18-giu	€ 10.000	€ 15.000
Milestone D	01-lug		€ 15.000	
Milestone E	01-ago		€ 10.000	
<b>TOTALS</b>			<b>€ 75.000</b>	<b>€ 45.000</b>

- SV =
  - CV =
  - SPI =
  - CPI =
  - CR =
- BAC =
  - EAC =
  - ETG =

# EVA Example



- For solution see [http://www.emanueledellavalle.org/slides/P&MSP2009\\_17\\_EAV-example.xls](http://www.emanueledellavalle.org/slides/P&MSP2009_17_EAV-example.xls)

## Earned Value Analysis

### Two final notes

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- BCWS
  - Use 'loaded labor' rates if possible
    - Consider direct pay and also overhead
  
- Remember that EVA variables are aggregate figures
  - They may hide where the problem lies
  - Be aware of counterbalancing issues
    - Over in one area vs. under in another area

- Benefits
  - Consistent unit of measure for total progress
  - Consistent methodology
    - Across cost and completed activity
    - Apples and apples comparisons
  - Ability to forecast cost & schedule
  - Can provide early warnings
    - EVA can signal errors as early as 15% into project
- Success factors
  - A full WBS is required (all scope)
  - Beware of GIGO: Garbage-in, garbage-out
- A useful guide
  - <http://www.projectsmart.co.uk/docs/earned-value.pdf>
- A nice tutorial
  - <http://www.aof.mod.uk/aofcontent/tactical/ppm/downloads/evm/flash/Engine.swf>

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- **Project Control with Microsoft Project**

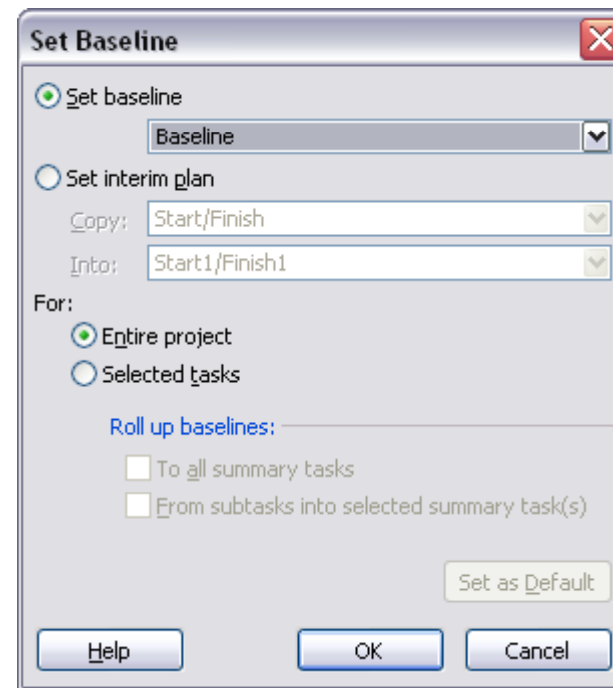
## Project Control with Microsoft Project

# Set a Baseline

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- A snapshot of the current project data
- Useful to be used as comparison in future
- Up to 11 baselines per .mpp file

1. Tools
2. Tracking
3. Set/Save Baseline
4. Select "Entire Project"
5. OK



# Update the progress of a task

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1. Double click on the task (to open the Task Information form)
  2. Change the percent complete
- Or
1. Right click on a column
  2. Insert column
  3. % Complete
  4. Set the percentage

Task Information

General | Predecessors | Resources | Advanced | Notes | Custom Fields

Name: Activity 1.1 Duration: 5d  Estimated

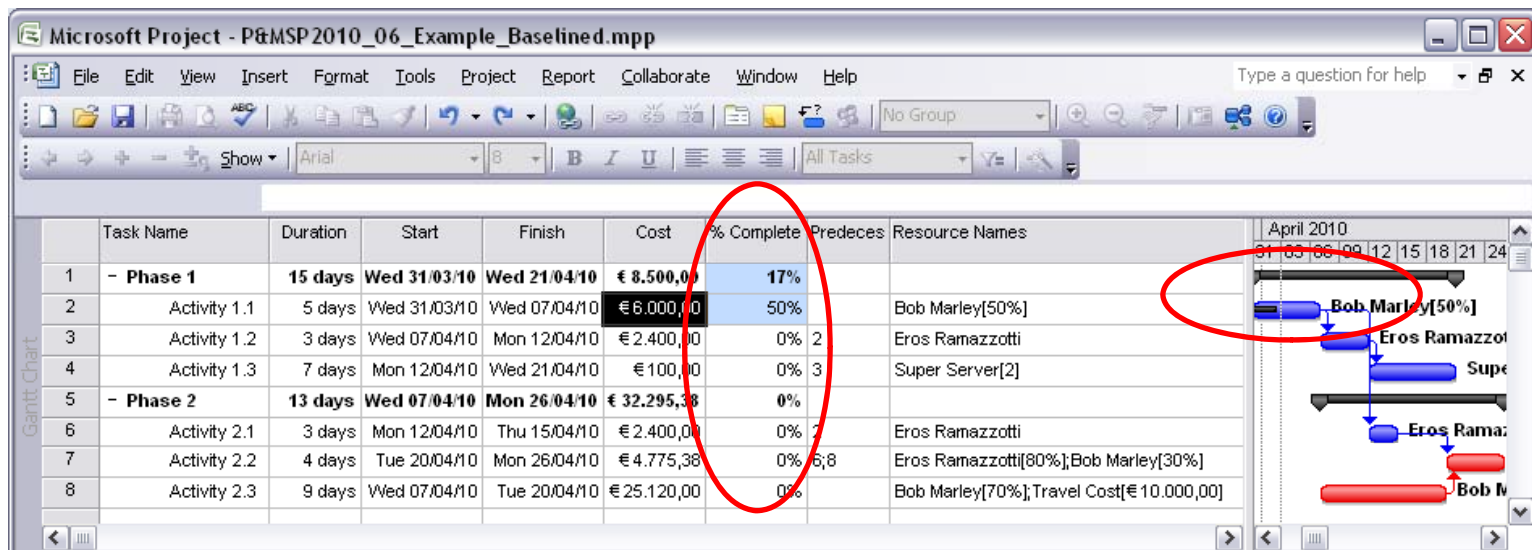
Percent complete: 50% Priority: 500

Dates

Start: Wed 31/03/10 Finish: Wed 07/04/10

Hide task bar  
 Roll up Gantt bar to summary

Help OK Cancel



# Update the actual finish of a task

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Select Actual to set the actual finish

Warning 2: when you set the actual finish date of a task, MS Project sets the hour to the end of the working day (e.g. 17.00)

To view the hour behind dates:

Tools → Options → View → Date Format and choose a format with hour

Task Name	Duration	Start	Finish	Work	% Complete	Cost
1 - Phase 1	17 days	Wed 31/03/10	Fri 23/04/10	52 hrs	41%	€ 10.900,00
2 Activity 1.1	7 days	Wed 31/03/10	Fri 09/04/10	28 hrs	100%	€ 8.400,00
3 Activity 1.2	3 days	Fri 09/04/10	Wed 14/04/10	24 hrs	0%	€ 2.400,00
4 Activity 1.3	7 days	Wed 14/04/10	Fri 23/04/10	0 hrs	0%	€ 100,00
5 - Phase 2	13 days	Fri 09/04/10	Wed 28/04/10	107,38 hrs	0%	€ 32.295,38
6 Activity 2.1	3 days	Wed 14/04/10	Mon 19/04/10	24 hrs	0%	€ 2.400,00
7 Activity 2.2	4 days	Thu 22/04/10	Wed 28/04/10	32,98 hrs	0%	€ 4.775,38
8 Activity 2.3	9 days	Fri 09/04/10	Thu 22/04/10	50,4 hrs	0%	€ 25.120,00

Task Details for Activity 1.1:

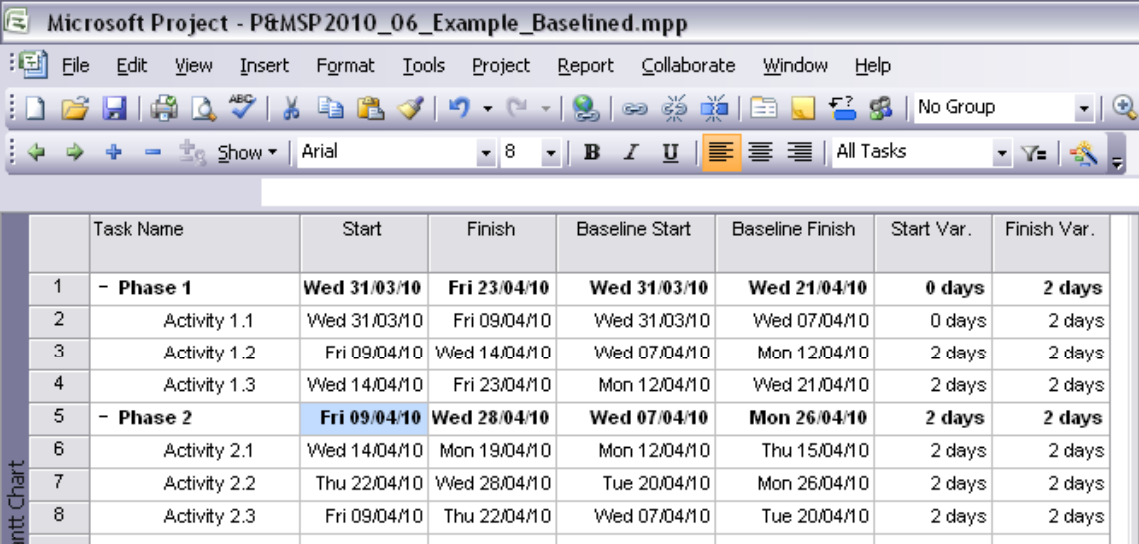
- Name: Activity 1.1
- Duration: 7d
- Effort driven:
- Start: Wed 31/03/10
- Finish: Fri 09/04/10
- Constraint: As Soon As Possible
- Task type: Fixed Duration
- WBS code: 1.1
- Priority: 500
- % Complete: 100%

Warning 1: If you change duration, be aware of the duration-work-unit triangle

# Compare with Baseline (values)

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1. View
2. Table
3. Variance



Microsoft Project - P&MSP2010\_06\_Example\_Baselined.mpp

	Task Name	Start	Finish	Baseline Start	Baseline Finish	Start Var.	Finish Var.
1	- Phase 1	Wed 31/03/10	Fri 23/04/10	Wed 31/03/10	Wed 21/04/10	0 days	2 days
2	Activity 1.1	Wed 31/03/10	Fri 09/04/10	Wed 31/03/10	Wed 07/04/10	0 days	2 days
3	Activity 1.2	Fri 09/04/10	Wed 14/04/10	Wed 07/04/10	Mon 12/04/10	2 days	2 days
4	Activity 1.3	Wed 14/04/10	Fri 23/04/10	Mon 12/04/10	Wed 21/04/10	2 days	2 days
5	- Phase 2	Fri 09/04/10	Wed 28/04/10	Wed 07/04/10	Mon 26/04/10	2 days	2 days
6	Activity 2.1	Wed 14/04/10	Mon 19/04/10	Mon 12/04/10	Thu 15/04/10	2 days	2 days
7	Activity 2.2	Thu 22/04/10	Wed 28/04/10	Tue 20/04/10	Mon 26/04/10	2 days	2 days
8	Activity 2.3	Fri 09/04/10	Thu 22/04/10	Wed 07/04/10	Tue 20/04/10	2 days	2 days

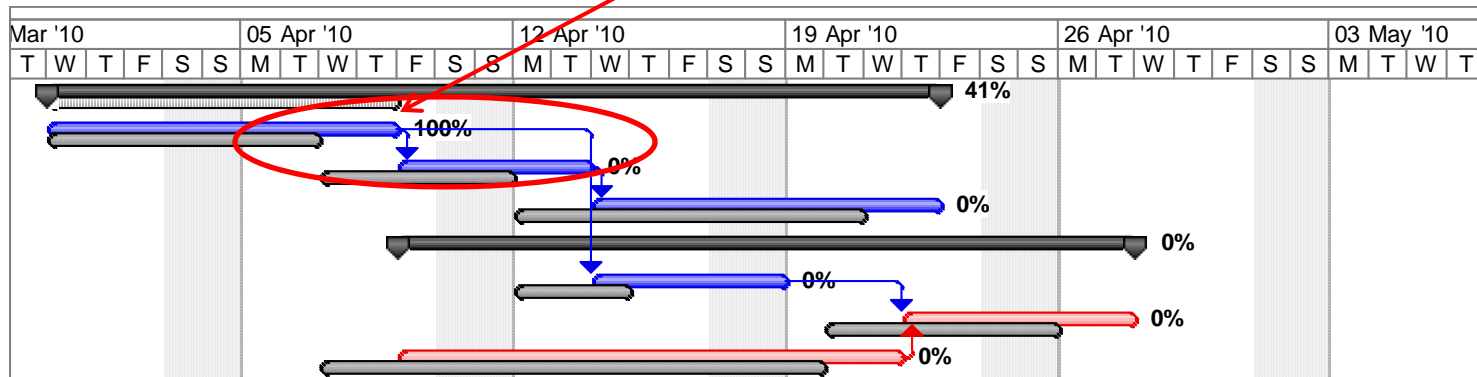
- You can customize the view adding the following columns (Right click on any column and Insert Column):
  - Baseline Duration
  - Duration Variance
  - Baseline Work
  - Work Variance
  - Baseline Cost
  - Cost Variance



# Compare with Baseline (graphically)

1. View
2. Tracking Gantt

ID	Task Name	Duration	Start	Finish	Work	Cost	% Complete	Duration Variance	Work Variance	Cost Variance
1	<b>Phase 1</b>	<b>17 days</b>	<b>31/03/10 9.00</b>	<b>23/04/10 9.00</b>	<b>52 hrs</b>	<b>€ 10.900,00</b>	<b>41%</b>	<b>2 days</b>	<b>8 hrs</b>	<b>€ 2.400,00</b>
2	Activity 1.1	7 days	31/03/10 9.00	09/04/10 9.00	28 hrs	€ 8.400,00	100%	2 days	8 hrs	€ 2.400,00
3	Activity 1.2	3 days	09/04/10 9.00	14/04/10 9.00	24 hrs	€ 2.400,00	0%	0 days	0 hrs	€ 0,00
4	Activity 1.3	7 days	14/04/10 9.00	23/04/10 9.00	0 hrs	€ 100,00	0%	0 days	0 hrs	€ 0,00
5	<b>Phase 2</b>	<b>13 days</b>	<b>09/04/10 9.00</b>	<b>28/04/10 9.00</b>	<b>107,38 hrs</b>	<b>€ 32.295,38</b>	<b>0%</b>	<b>0 days</b>	<b>0 hrs</b>	<b>€ 0,00</b>
6	Activity 2.1	3 days	14/04/10 9.00	19/04/10 9.00	24 hrs	€ 2.400,00	0%	0 days	0 hrs	€ 0,00
7	Activity 2.2	4 days	22/04/10 9.00	28/04/10 9.00	32,98 hrs	€ 4.775,38	0%	0 days	0 hrs	€ 0,00
8	Activity 2.3	9 days	09/04/10 9.00	22/04/10 9.00	50,4 hrs	€ 25.120,00	0%	0 days	0 hrs	€ 0,00



## Optional Readings

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- McConnell: 16 “Project Recovery”
- Schwalbe: 16 “Closing”

# Questions?

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## MEMO for Homework 4

# Effort-driven scheduling

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- Duration = Work / Units ( $D = W/U$ )
- Work = Duration \* Units ( $W = D*U$ )
- Units = Work / Duration ( $U = W/D$ )

In a	If you revise Duration	If you revise Units	If you revise Work
Fixed Duration task	Work is recalculated	Work is recalculated	Units are recalculated
Fixed Units task	Work is recalculated	Duration is recalculated	Duration is recalculated
Fixed Work task	Units are recalculated	Duration is recalculated	Duration is recalculated

Cases on the diagonal are not trivial:

- Microsoft Project recalculates Duration
- If duration is fixed, Microsoft Project recalculates Work

## MEMO for Homework 4

# Resource Usage View

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- View amount of work assigned per resource
- See all tasks for each
- Use the summary and zoom-out ability to identify consistency of task assignments
- Identify over-allocations
- Identify tasks without resource assignments

- Activity shifting
  - Move start/end dates forward or backward
- Activity splitting
  - Break an activity into two or more pieces
- Activity stretching
  - Use less of a given resource continuously
  - → Reduce unit %
- Resource substitution
  - Assign a different resource that is less allocated
- Allocating overtime
  - Make resources work longer