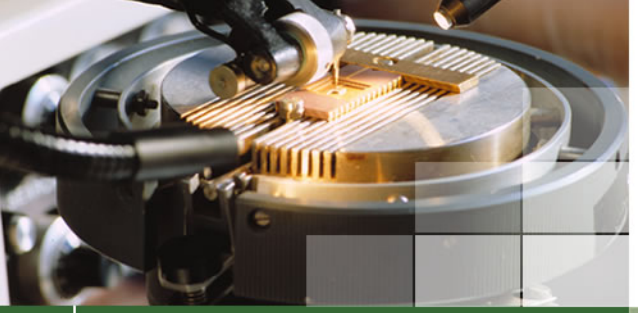

POLITECNICO DI MILANO

Dipartimento di
Elettronica e Informazione

Planning and Managing Software Projects 2012-13

Class 16

Project Control

Controlling of Projects and Earned Value Analysis

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Credits

- 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

- **Project Control**
- Status Reporting
- Earned Value Analysis
- Controlling a Project with Microsoft Project

Project Control

- 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

Project Control

- "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
    - Avoid the extremes:
      - Micro-managing vs. neglect
      - Too much tracking vs. too less tracking

Progress Monitoring

- The three key Progress Monitoring Questions
  1. What is the actual status?
  2. If there's a variance, what is the cause?
  3. What to do about it?

- The three possible responses:
  a) Ignore
  b) Take corrective action
  c) Review the plan

Progress Monitoring

- Monitoring rates
  - Daily, weekly, monthly
  - There is not a formula to define the correct monitor rates
  - It depends by:
    - Project Duration
    - Project Complexity
    - Critical phases
      - 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

Today Agenda

- Project Control
- **Status Reporting**
- Earned Value Analysis
- Controlling a Project with Microsoft Project

Status Reporting

- 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
- Status reporting "From Team to PM"
  - Email notes, chats, one minute talks, …
  - Weekly meetings
  - More frequent meetings during crises
- Typical format for status reporting "From PM to Stakeholders"
  - Summary
  - Accomplishments for this period (done)
    - Tasks, milestones, metrics
  - Plans for next period (to-do)
  - Risk analysis and review
  - Issues & Actions

Measuring Status Reporting

- A programmer reports that he's 80% done
  - What does this mean?
  - He completed 4,000 LOC on estimated 5,000 LOC effort
  - And what about the quality control?
  - How much work was estimated to complete the task?
    - Estimates could have been wrong
- "90% Complete Syndrome"
  - Software is 90% complete for 90% of the time
  - It's unbelievable how much work is needed to complete a work from 90% to 100%
- If you can't measure scope or quality, then you don't know "reality"
  - You really only know the cost so far (hours spent)
- How can you improve this?

Binary Reporting

- Tasks can only be in one of two states
  - Completed or Uncompleted
  - No partial credit
  - This is preferred to anything subjective!
- If you need more granularity than 0% ←→ 100%
  - Use lower-level task decomposition
  - Each lower-level task is measured with binary reporting
- Use a tangible criteria to declare that a task is completed
  - E.g. Achieving sign-off for requirements
  - E.g. All regression tests pass
  - E.g. Achieving sign-off of final system

Today Agenda

- Project Control
- Status Reporting
- **Earned Value Analysis**
- Controlling a Project with Microsoft Project

Earned Value Analysis (EVA)

- Also known as 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 for *time* and *cost*
    - Planned time vs. Actual time
    - Planned costs vs. Actual costs
  - Progress is defined as comparison between planned and actual
  - It doesn't not consider the value of performed tasks
- EVA approach
  - It adds a third dimension on costs:
    - Planned Cost, Actual Cost, **Earned Value**

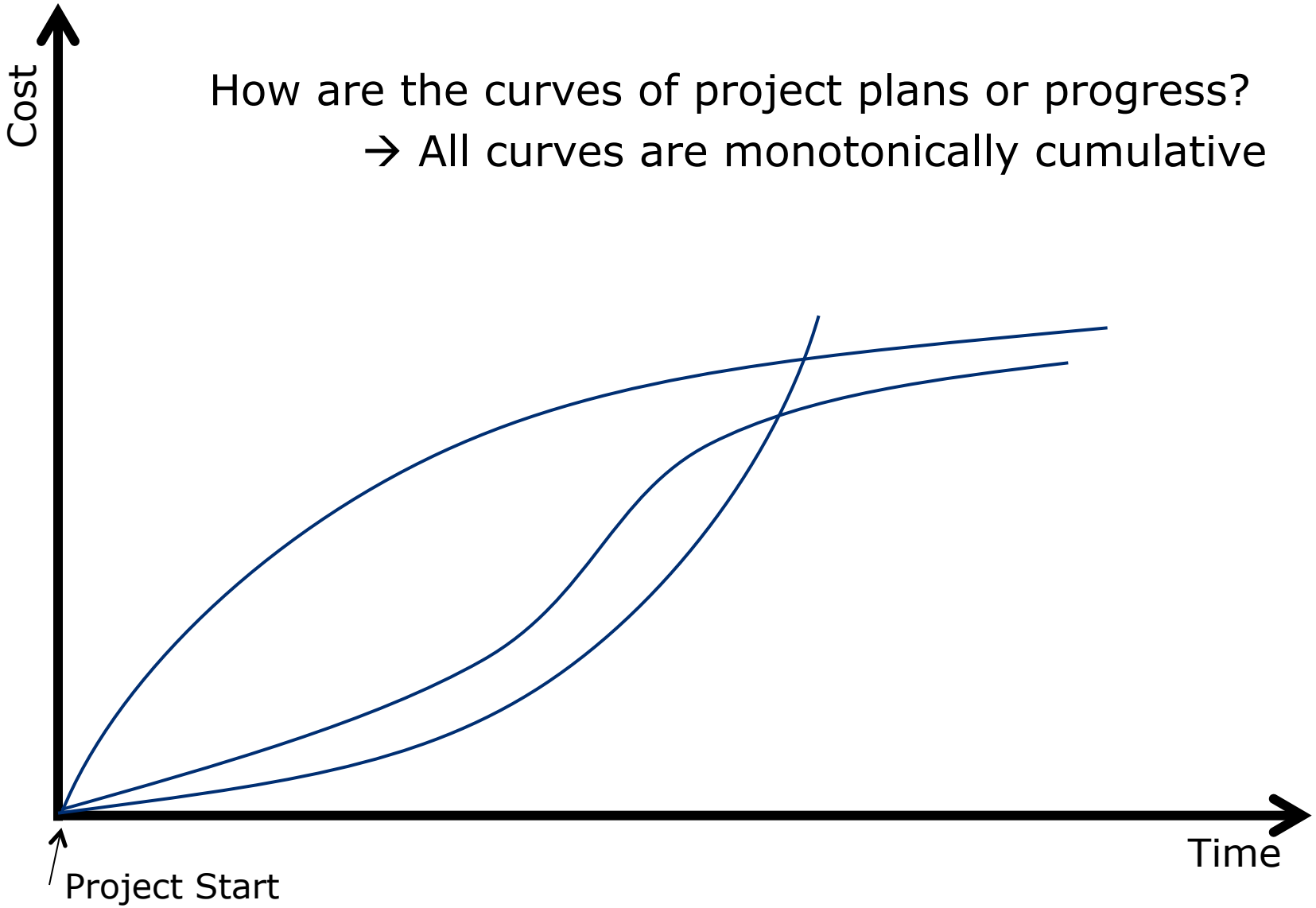
Earned Value Analysis

- EVA is calculated as comparison to the Performance Measurement Baseline (PMB) that is:
  - Time-phased budget plan against which contract performance is measured
  - It establishes the scope, schedule and budget targeted for the project
  - The PMB is a plan with well-defined milestones upon which contract is based
- Comparison with the PMB is usually done by using costs applied to milestones
  - PMB at minimum is a list of milestones with dates
  - Each milestone has its own planned and actual cost

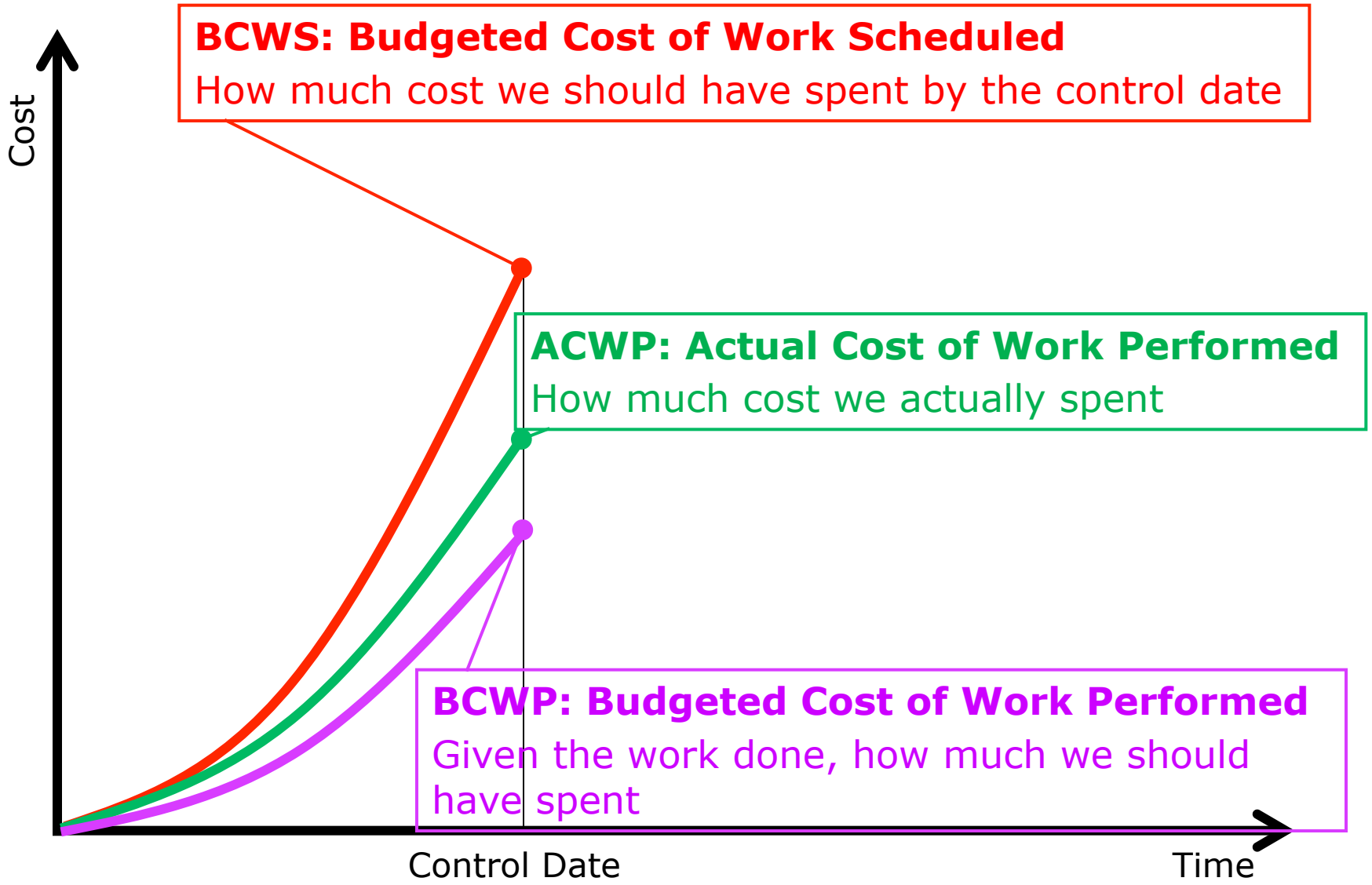
The Time and Cost chart

How are the curves of project plans or progress?

→ All curves are monotonically cumulative



The Three Major Variables of EVA



The three major Components

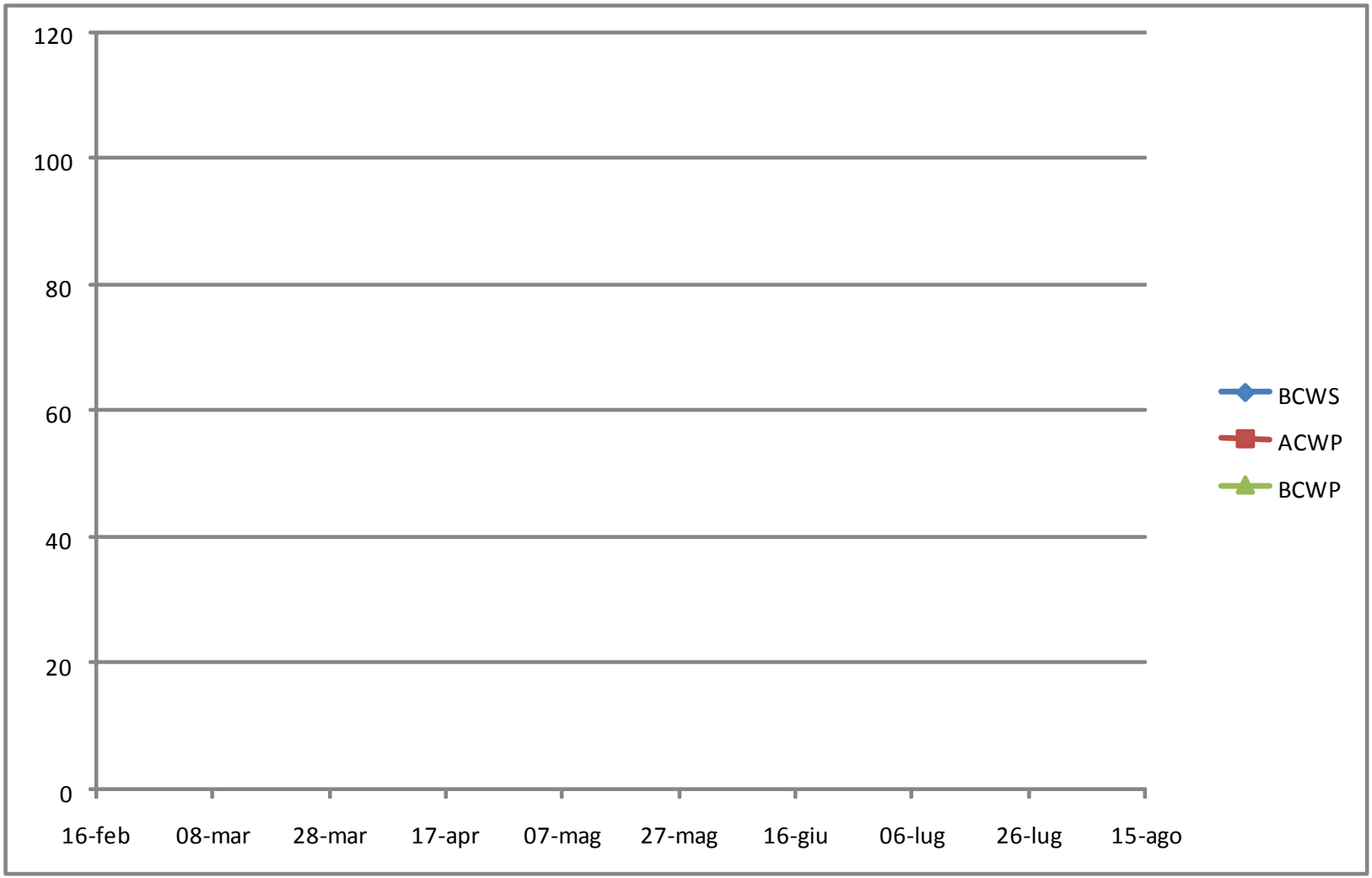
- **BCWS**: Budgeted Cost of Work Scheduled
  - Also called "Planned Value" (PV)
  - "Wished"
  - How much work should be done?
- **ACWP**: Actual Cost of Work Performed
  - Also called "Actual Cost" (AC)
  - "Burned"
  - How much did the work done cost?
- **BCWP**: Budgeted Cost of Work Performed
  - Also called "Earned Value" (EV)
  - "Earned"
  - How much work is actually done?
  - Calculated considering the BCWS related to the milestones actually achieved

EVA Example (as in your final exam)

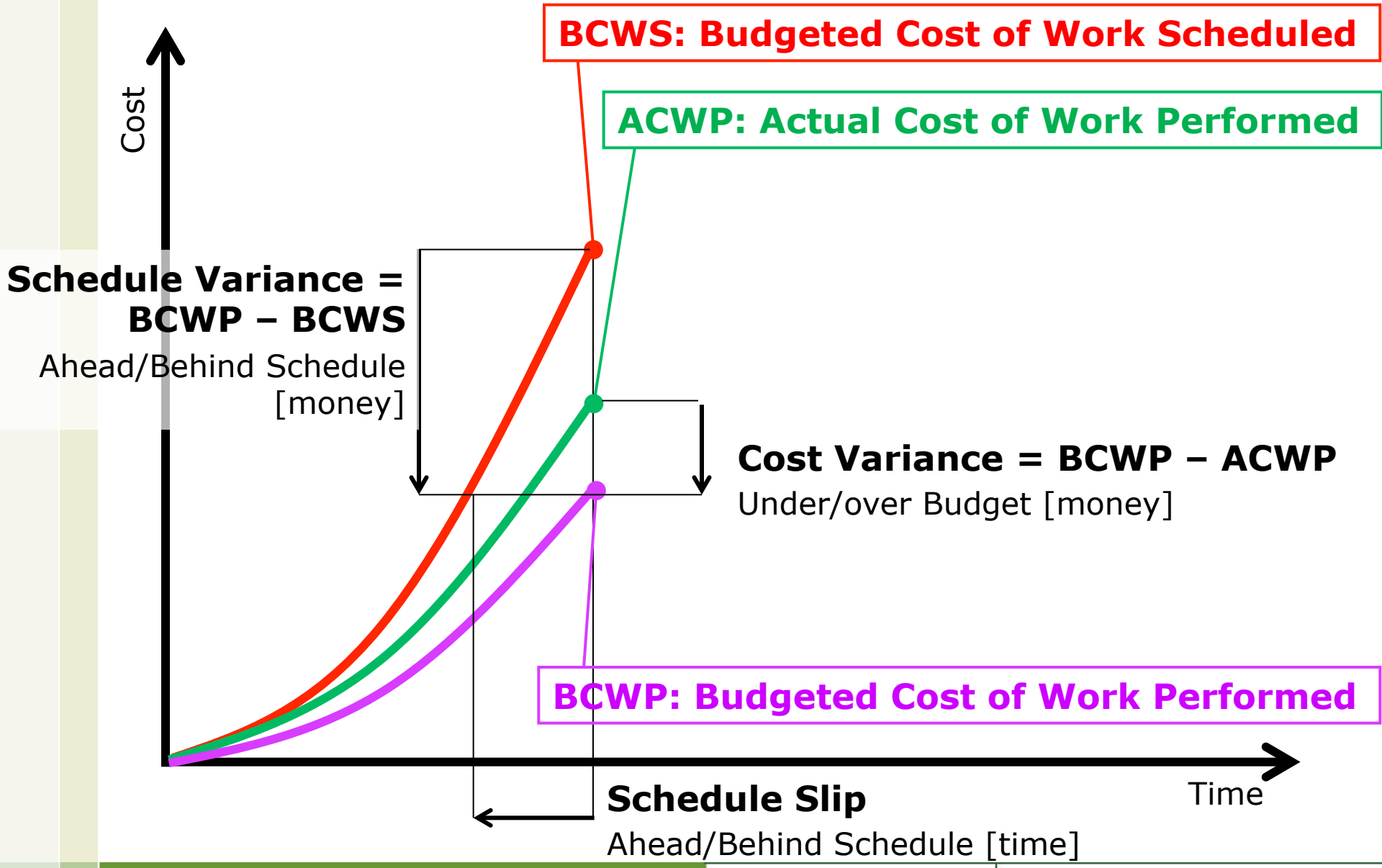
WBS	Completion Date		Cost	
	Planned	Actual	Planned	Actual
Project Start	01-mar	01-mar	€ 0	€ 0
Milestone A	01-apr	20-apr	€ 25.000	€ 20.000
Milestone B	01-mag	28-mag	€ 15.000	€ 10.000
Milestone C	01-giu	18-giu	€ 10.000	€ 15.000
Milestone D	01-lug		€ 15.000	
Milestone E	01-ago		€ 10.000	
TOTALS			€ 75.000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

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

EVA Example


120
100
80
60
40
20
0
16-feb
08-mar
28-mar
17-apr
07-mag
27-mag
16-giu
06-lug
26-lug
15-ago
BCWS
ACWP
BCWP

Derived Variances



Derived Variances

- "What is the project status"?
  - You can use Derived EVA variances to answer this
- **CV**: Cost Variance
  - BCWP – ACWP (=EV-AC)
  - Budgeted costs vs. Actual costs
  - >0 → Under Budget (spending less) ☺
  - <0 → Over Budget (spending more) ☹
- **SV**: Schedule Variance
  - BCWP – BCWS (=EV-PV)
  - Planned work vs. Work completed
  - >0 → Ahead of Schedule ☺
  - < 0 → Behind Schedule ☹

Derived Ratios

- **CPI**: Cost Performance Index
  - BCWP / ACWP (=EV/AC)
- **SPI**: Schedule Performance Index
  - BCWP / BCWS (=EV/PV)
- Problems are when these indexes are less than 1
- **CR**: Critical Ratio
  - SPI x CPI → it's a proportional combination
  - 1 → everything is on track
  - < 1 → project is performing worse than planned
  - > 1 → project is performing better than planned
  - Pragmatically:
    - > 0.8 and < 1.2 → acceptable performances
    - < 0.8 → too bad performances, project is under-performing
    - > 1.2 → project seems over-performing
      - but plan may be too pessimistic and easy to follow

EVA Example

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
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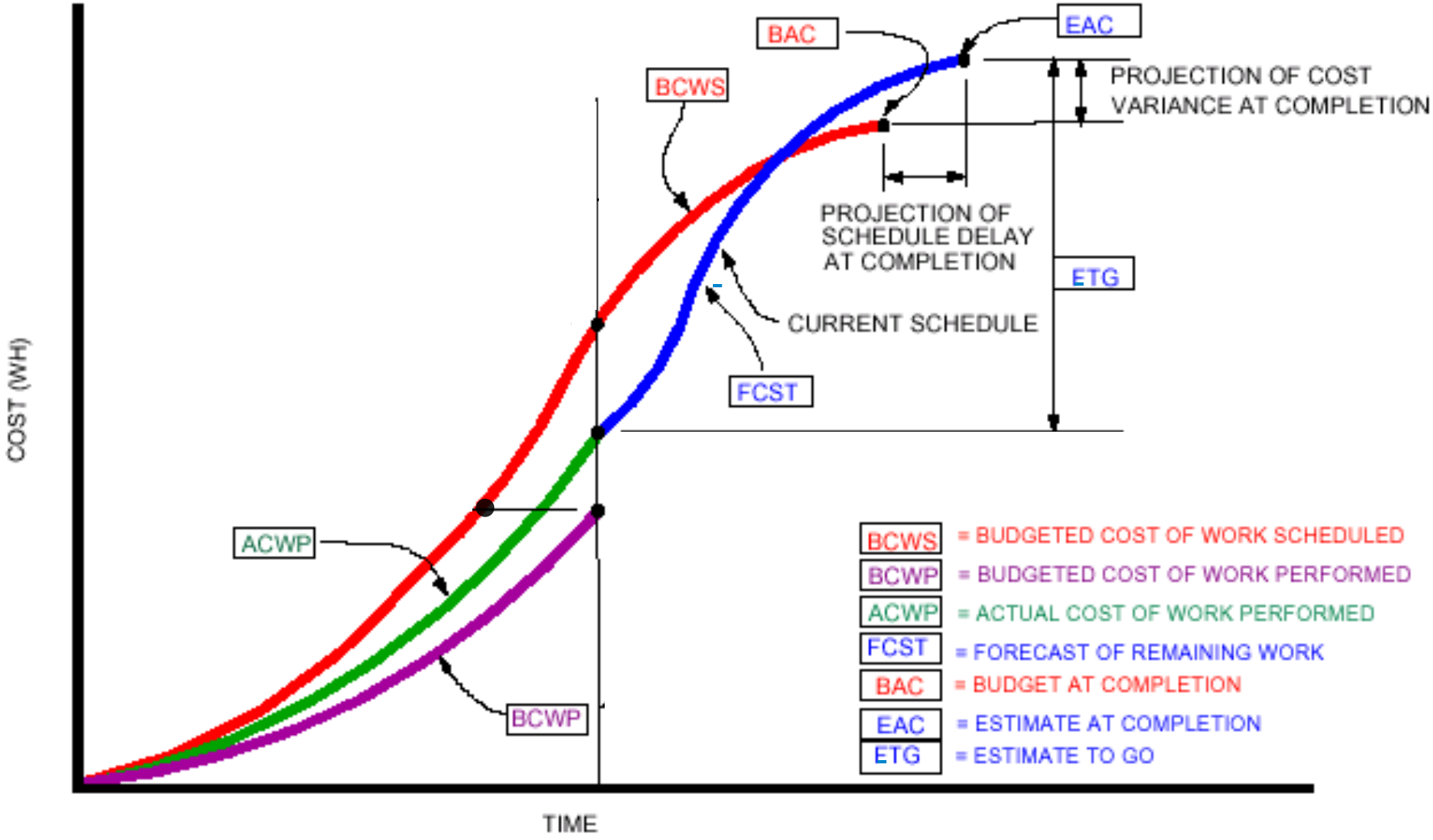
Milestone C	01-giu	18-giu	€ 10.000	€ 15.000
Milestone D	01-lug		€ 15.000	
Milestone E	01-ago		€ 10.000	
TOTALS			€ 75.000	€ 45.000

- SV =
- CV =
- SPI =
- CPI =
- CR =

Forecasts based on Earned Value Analysis



Forecasts based on Earned Value Analysis

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

EVA Example

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
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Milestone D	01-lug		€ 15.000	
Milestone E	01-ago		€ 10.000	
TOTALS			€ 75.000	€ 45.000

- BAC =
- ETG =
- EAC =

EVA Examples

- For solution see the course Web site and download

P&MSP2013_16_EVA-example1.xls

- For another example, download

P&MSP2013_16_EVA-example2.xls

Final notes

- Benefits of EVA
  - 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
  - Beware of GIGO: Garbage-in, garbage-out

Final notes

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

- A guide on Earned Value Analysis
  - http://www.projectsmart.co.uk/docs/earned-value.pdf

Optional Readings

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

Today Agenda

- Project Control
- Status Reporting
- Earned Value Analysis
- **Controlling a Project with Microsoft Project**

Today Agenda

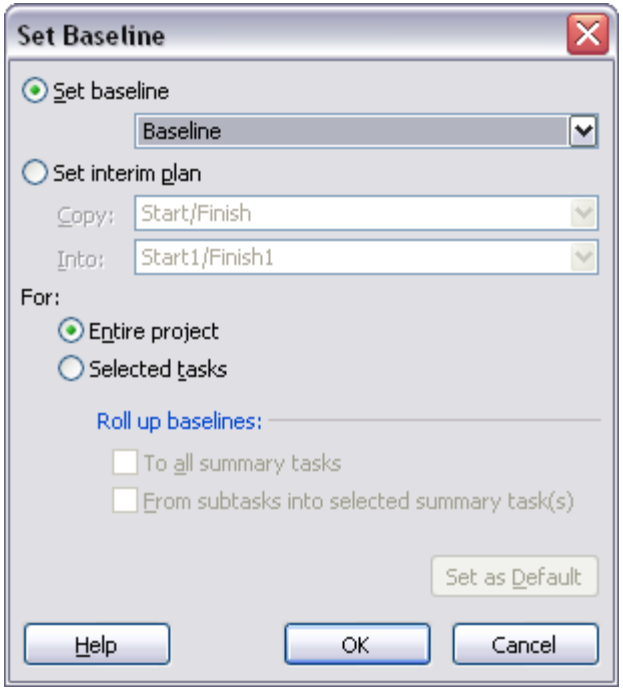
- Microsoft Project Fundamentals

1. Define Activities (WBS)
2. Sequence Activities
3. Estimate Work
4. Define Resources
5. Allocate Resources
6. Inspect Schedule (so far, these have been discussed in class 10)
7. Refine Schedule (this has been discussed in class 15)
8. Level Resources (this has been discussed in class 15)
9. **Control Project**

Set a Baseline

- 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

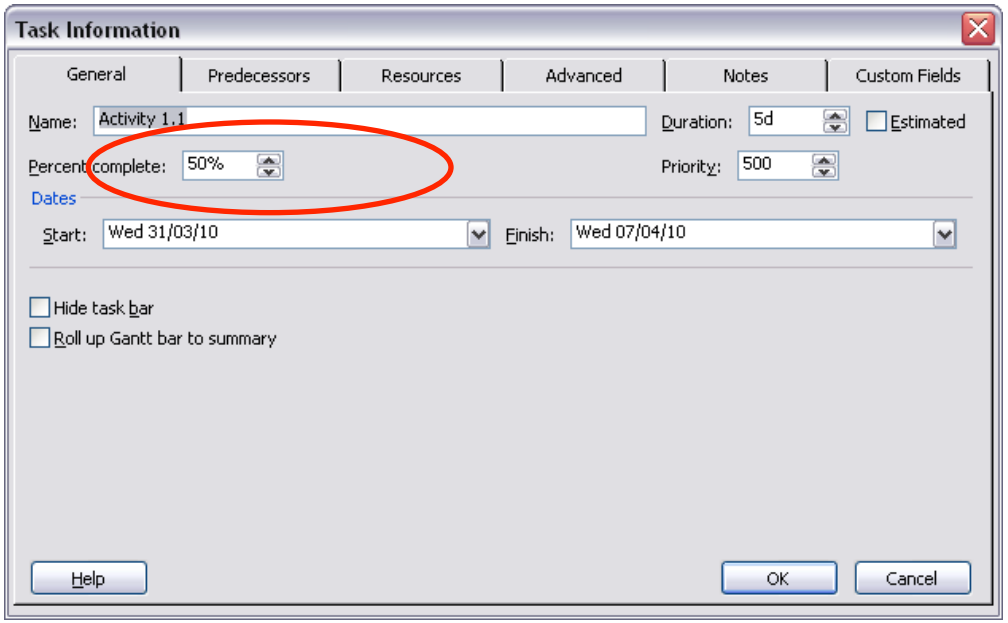


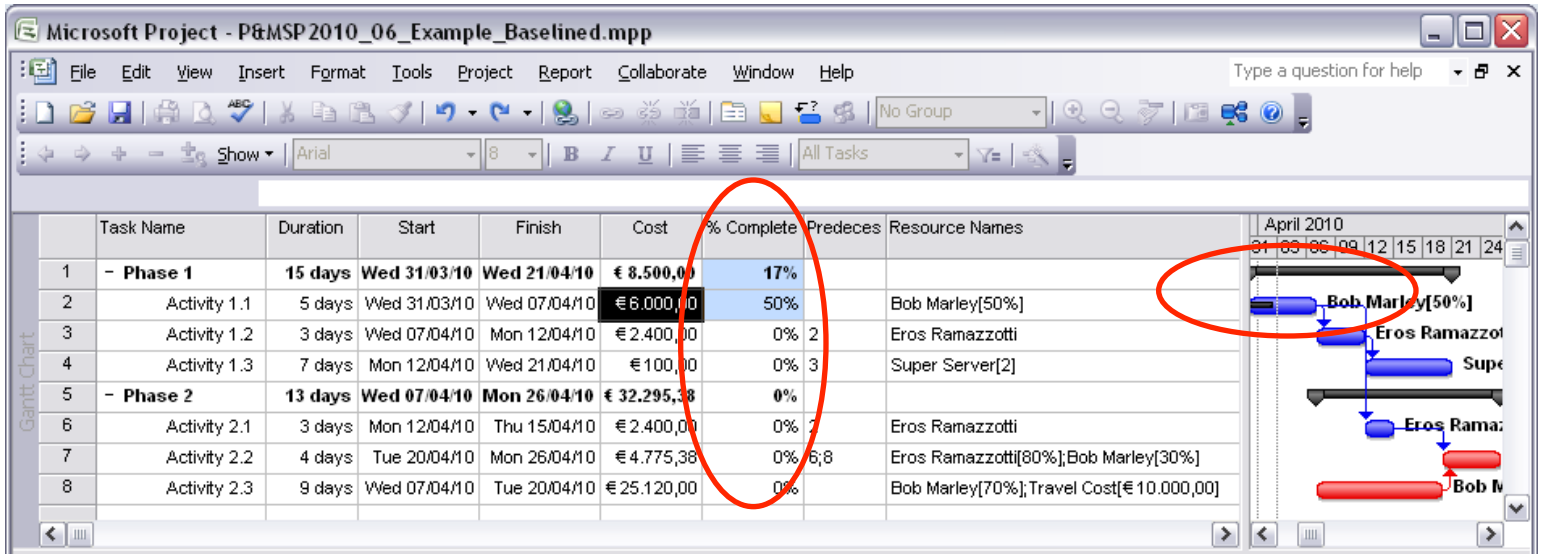
Update the progress of a task

1. Double click on the task (to open the Task Information form)
2. Change the percent complete

Or

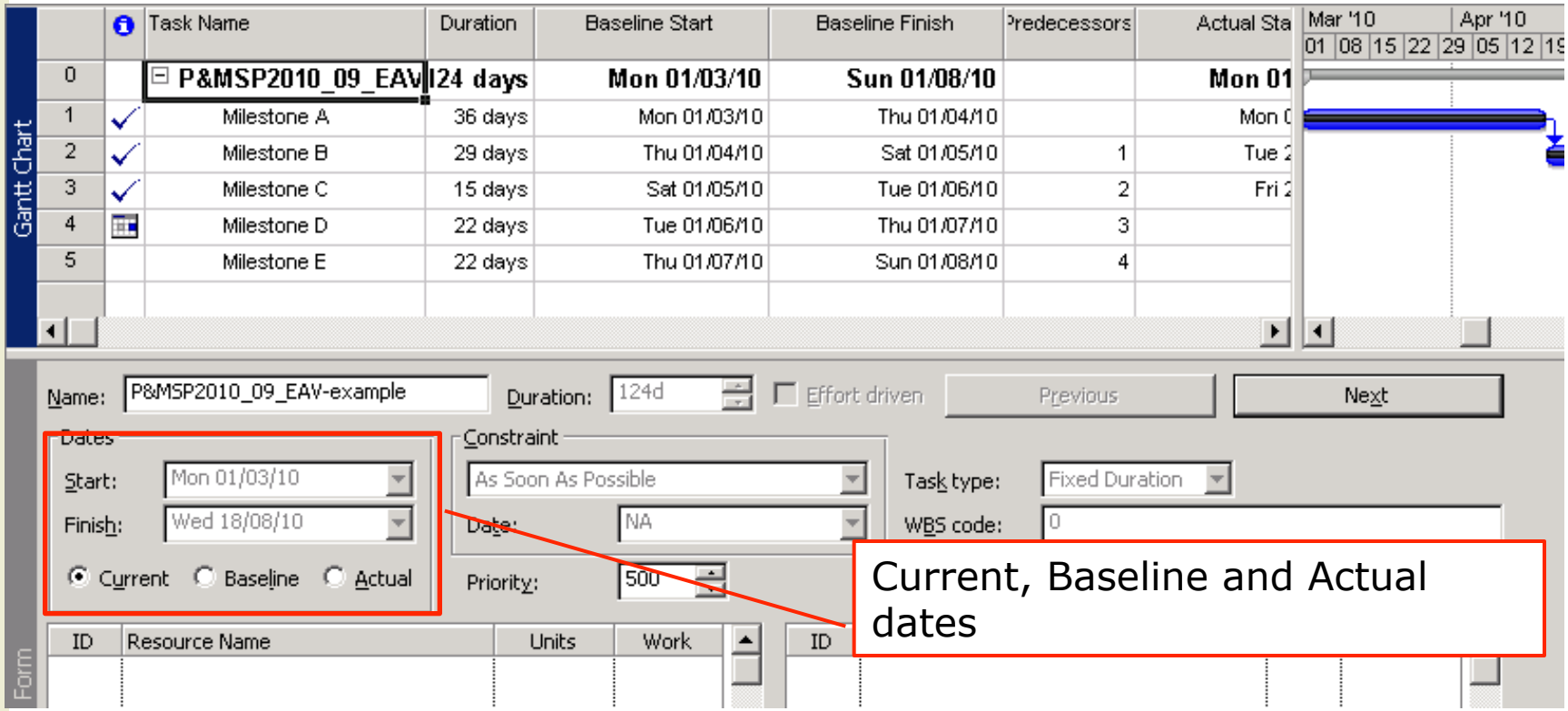
1. Right click on a column
2. Insert column
3. % Complete
4. Set the percentage





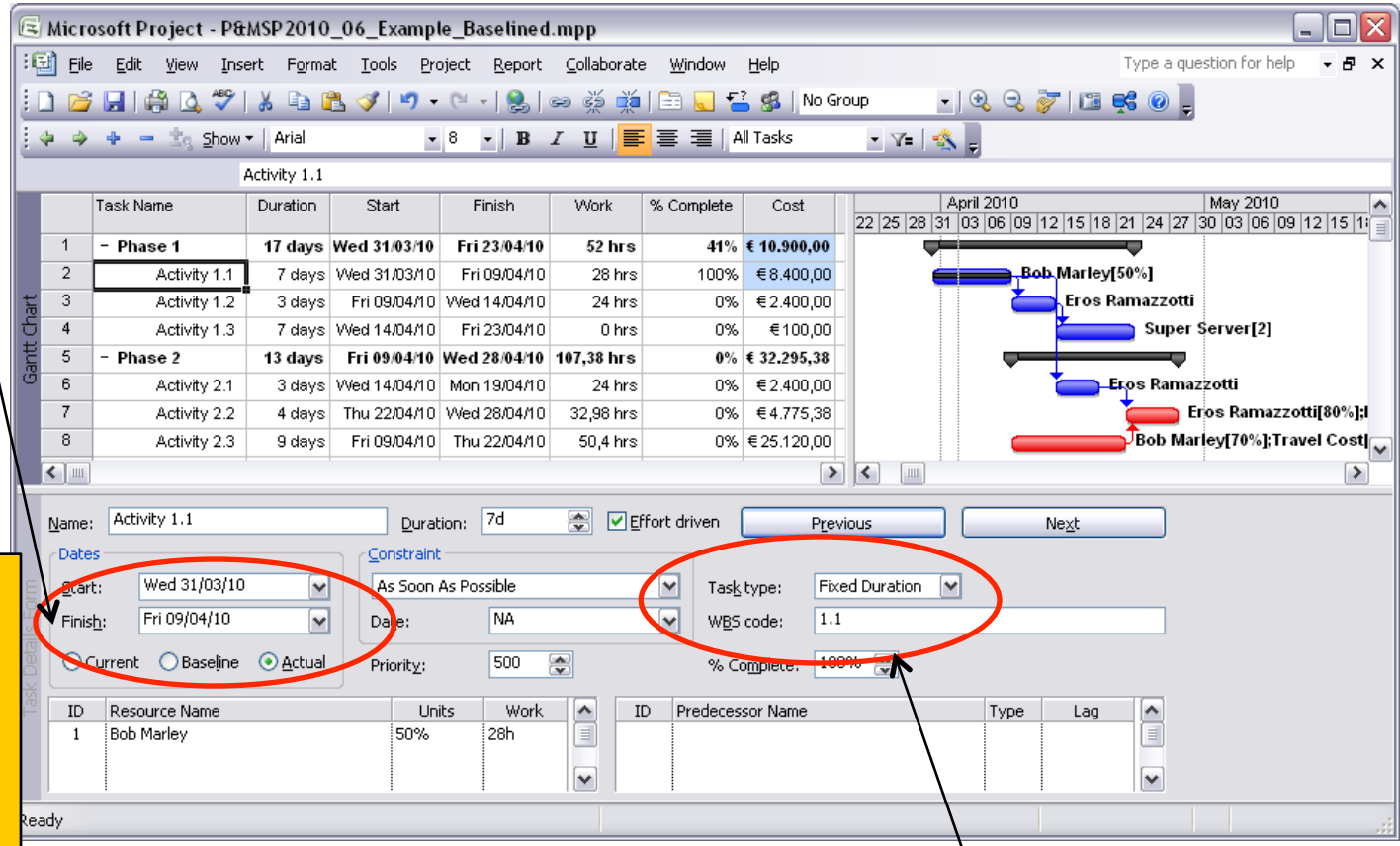
Visualize Task Details Form

1. Return to Gantt Chart
    1. View (from Menu) -> Gantt Chart
2. Visualize Task Detail Form
    1. Windows (from menu) -> Split
    2. Select bottom window
    3. View (from menu) -> More Views -> *Task Details Form* -> Apply



Update the actual finish of a task

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)

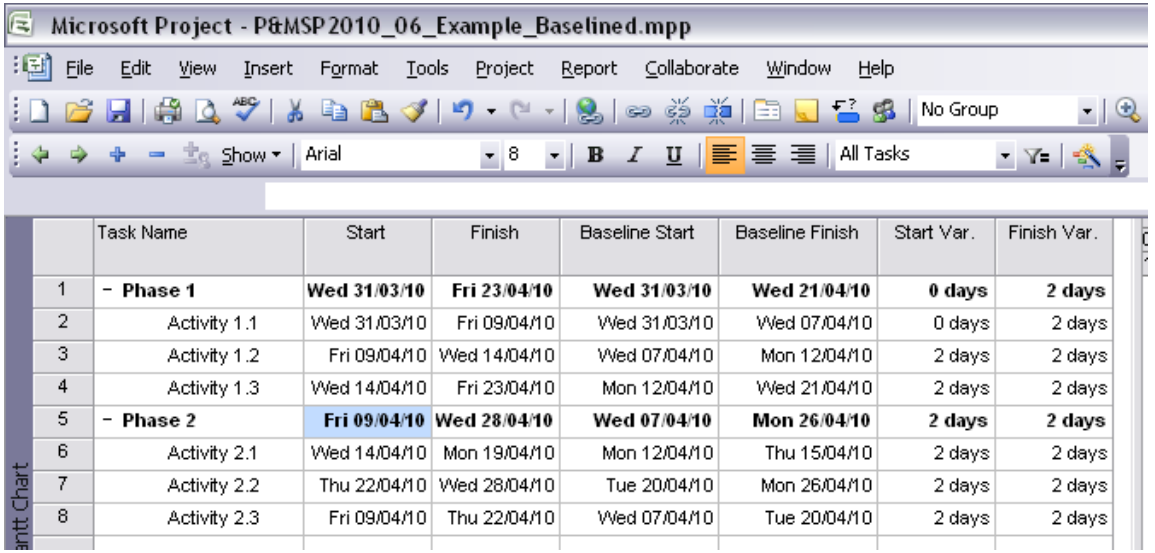
To view the hour behind dates:

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

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

Compare with Baseline (by values)

1. View
2. Table
3. Variance



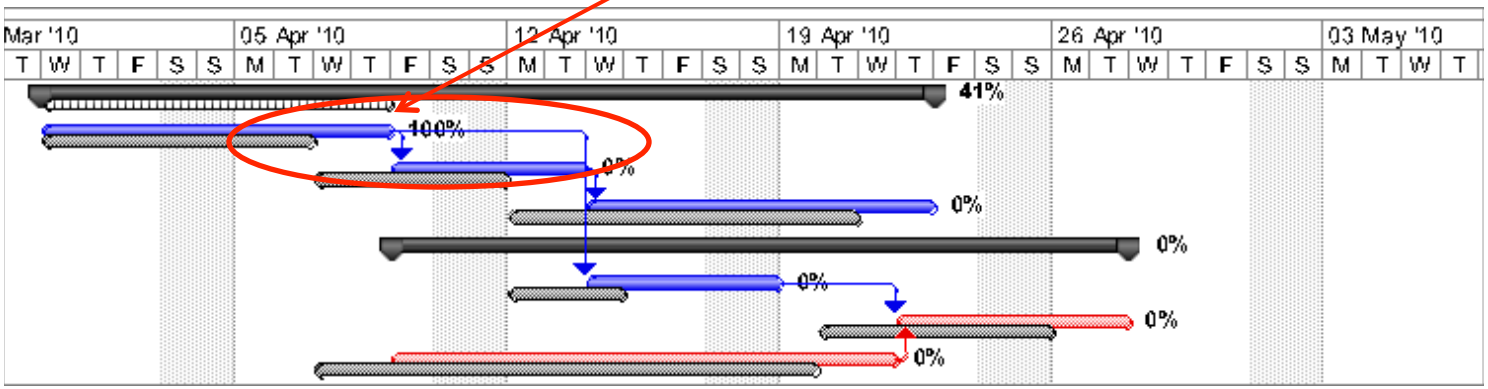
	Task Name	Start	Finish	Baseline Start	Baseline Finish	Start Var.	Finish Var.
1	**– Phase 1**	**Wed 31/03/10**	**Fri 23/04/10**	**Wed 31/03/10**	**Wed 21/04/10**	**0 days**	**2 days**
2	Activity 1.1	Wed 31/03/10	Fri 09/04/10	Wed 31/03/10	Wed 07/04/10	0 days	2 days
3	Activity 1.2	Fri 09/04/10	Wed 14/04/10	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 (by graphics)

1. View
2. Tracking Gantt

ID	Task Name	Duration	Start	Finish	Work	Cost	% Complete	Duration Variance	Work Variance	Cost Variance
1	**Phase 1**	**17 days**	**31/03/10 9.00**	**23/04/10 9.00**	**52 hrs**	**€ 10.900,00**	**41%**	**2 days**	**8 hrs**	**€ 2.400,00**
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	**Phase 2**	**13 days**	**09/04/10 9.00**	**28/04/10 9.00**	**107,38 hrs**	**€ 32.295,38**	**0%**	**0 days**	**0 hrs**	**€ 0,00**
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

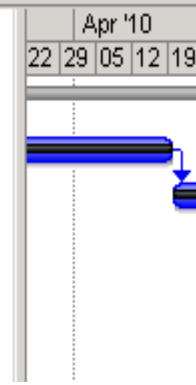


Earned Value Analysis

1. View -> Gantt Chart
2. View -> Table -> More tables -> Earned Value

P&MSP2010_09_EAV-example

	Task Name	Planned Value - PV (BCWS)	Earned Value - EV (BCWP)	AC (ACWP)	SV	CV	CPI	SPI	BAC	EAC
0	P&MSP2010_09	€ 65.397,73	€ 50.000,00	€ 45.000,00	-€ 15.397,73	€ 5.000,00	1,11	0,76	€ 75.000,00	€ 67.500,00
1	Milestone A	€ 25.000,00	€ 25.000,00	€ 20.000,00	€ 0,00	€ 5.000,00	1,25	1	€ 25.000,00	€ 20.000,00
2	Milestone B	€ 15.000,00	€ 15.000,00	€ 10.000,00	€ 0,00	€ 5.000,00	1,5	1	€ 15.000,00	€ 10.000,00
3	Milestone C	€ 10.000,00	€ 10.000,00	€ 15.000,00	€ 0,00	-€ 5.000,00	0,67	1	€ 10.000,00	€ 15.000,00
4	Milestone D	€ 15.000,00	€ 0,00	€ 0,00	-€ 15.000,00	€ 0,00	0	0	€ 15.000,00	€ 15.000,00
5	Milestone E	€ 0,00	€ 0,00	€ 0,00	€ 0,00	€ 0,00	0	0	€ 10.000,00	€ 10.000,00



- To see EVA values, be sure to have
  - At the beginning: set the baseline
  - When each task is completed
    - Set actual start and actual finish
    - Set actual cost

Optional Readings

- Schwalbe: 7 “Project Quality Management”
- URLs
  - “Introduction to Software Testing”
    - http://www.iplbath.com/pdf/p0820.pdf

Questions?