GSOE9820 – Engineering Project Management

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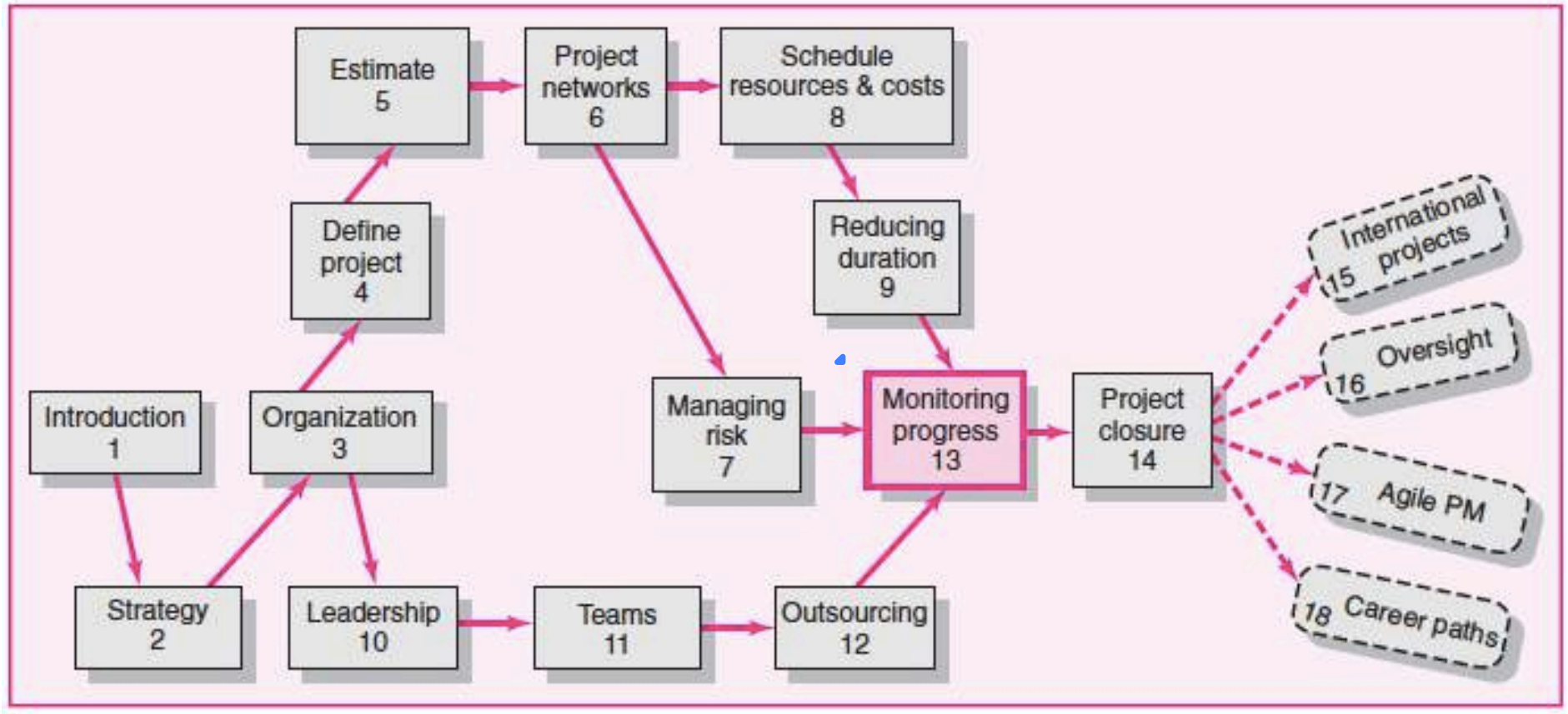
Never Stand Still | Faculty of Engineering | School of Mechanical and Manufacturing Engineering

Week 8 – Part II

Progress and Performance Measurement and Evaluation

Course Roadmap

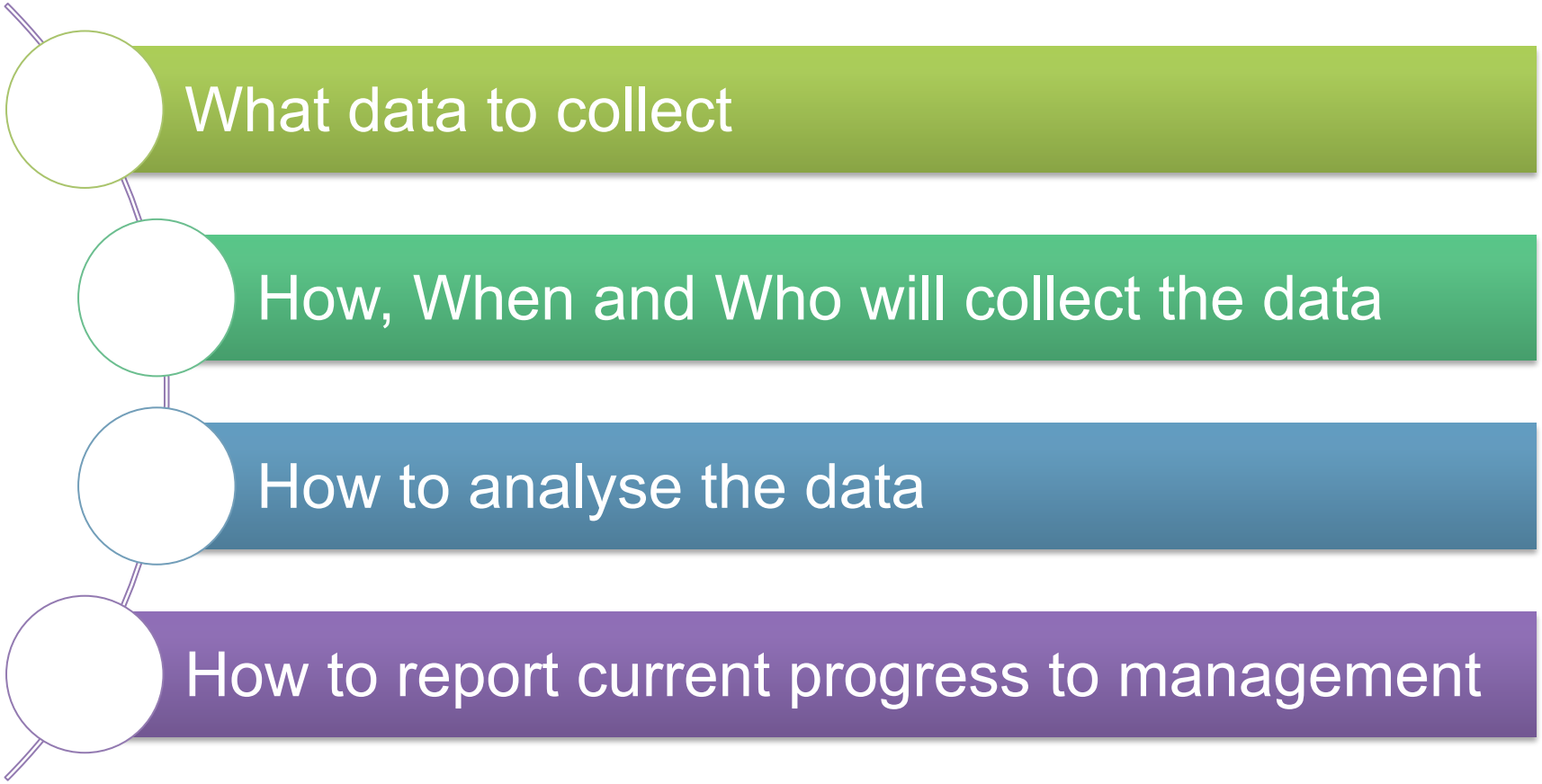


Reference: Gray, C & Larson, E, Project Management, 5th Ed. McGraw-Hill

Key task of the project manager

Evaluation and control are a part of every project manager's job.

A project monitoring information system



Data collection

- Current status of project (schedule and cost)
- Remaining cost to compete project
- Date that project will be complete
- Potential problems to be addressed now
- Out-of-control activities requiring intervention
- Cost and/or schedule overruns and the reasons for them
- Forecast of overruns at time of project completion

Reporting

- **Common formats**
  - Progress since last report
  - Current status of project (schedule, cost, scope)
  - Cumulative trends
  - Problems and issues since last report (actions and resolutions)
  - Corrective action planned

- **Decisions on reporting circulation**
  - Who will receive the reports?
  - How will the reports be transmitted?
  - When will the reports be distributed?

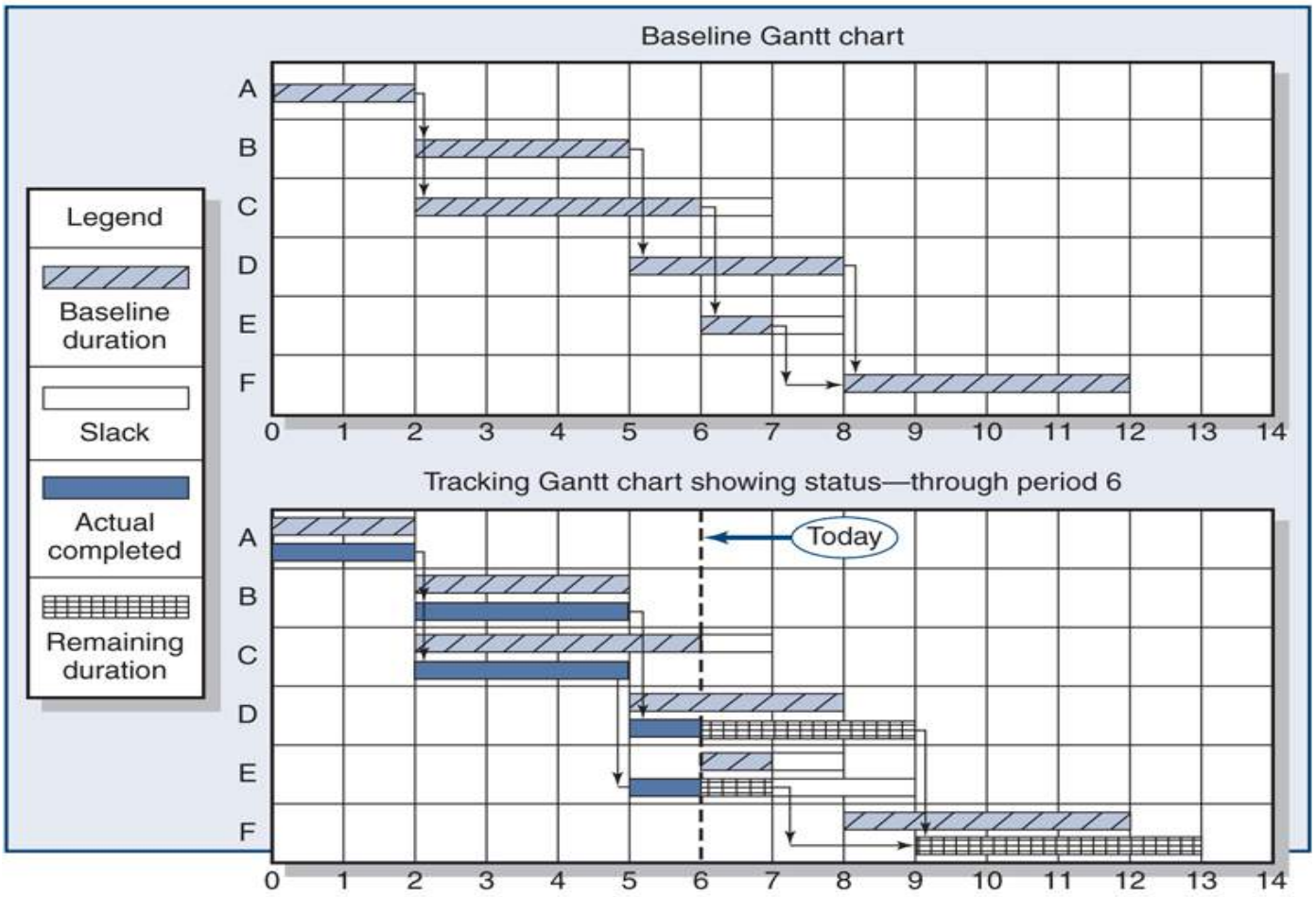
Project control

Control is the process of comparing actual performance against plan to identify deviations, evaluate courses of action and take appropriate corrective action

Project control steps

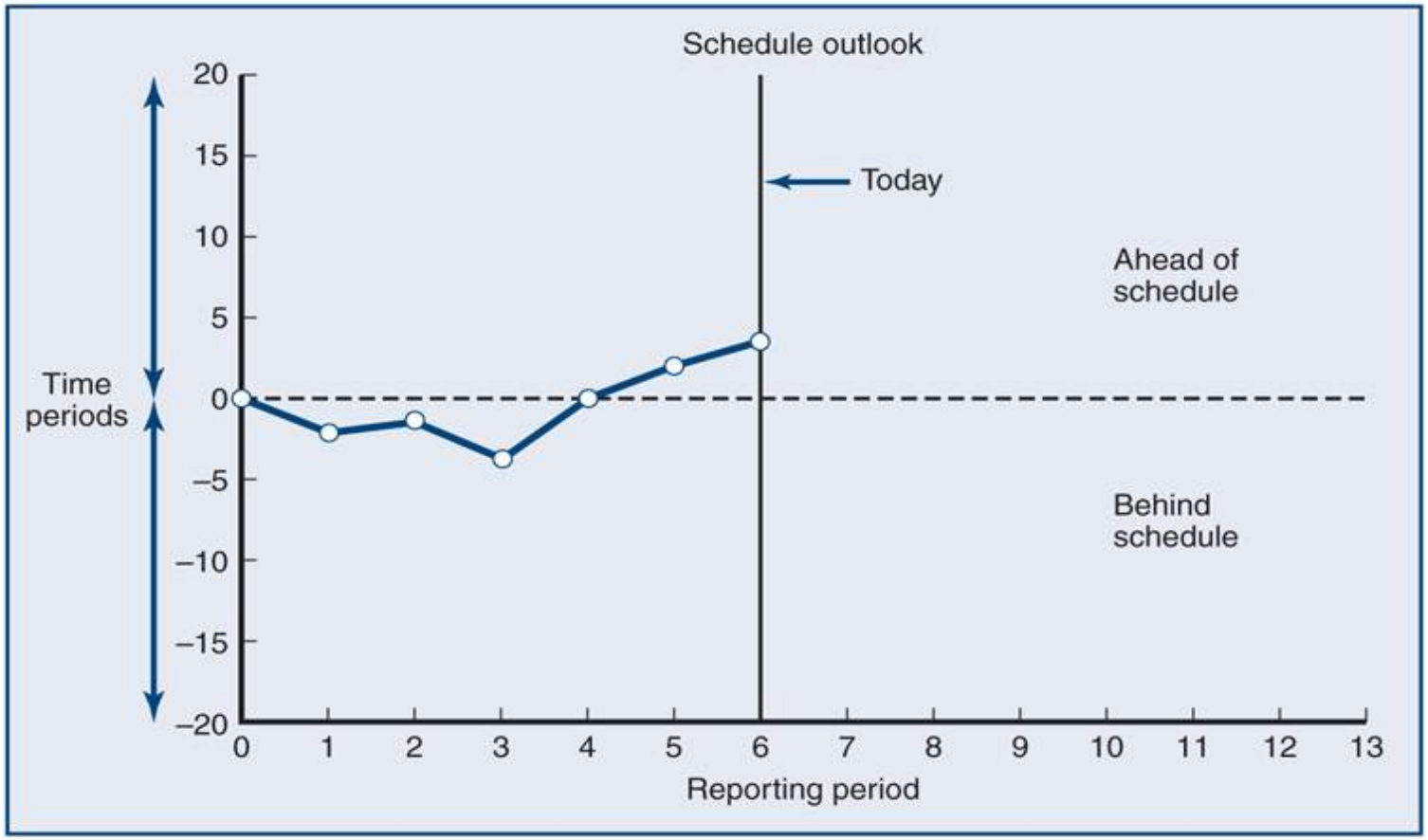
Baseline and tracking Gantt charts

Figure 13.1 BASELINE GANTT CHART



Project schedule control chart

Figure 13.2 PROJECT SCHEDULE CONTROL CHART



Disparity among monitoring systems

Time-phased baseline plan

- Corrects the failure of most monitoring systems to connect a project's actual performance to its schedule and forecast budget.
  - Systems that measure only cost variations do not identify resource and project cost problems associated with falling behind or progressing ahead of schedule.

Earned value cost/schedule system

- An integrated project management system based on the earned value concept that uses a time-phased budget baseline to compare actual and planned schedule and costs.

Earned Value (EV)

Earned value is a project management technique for measuring project performance and progress.

Essential features of any EVM implementation include

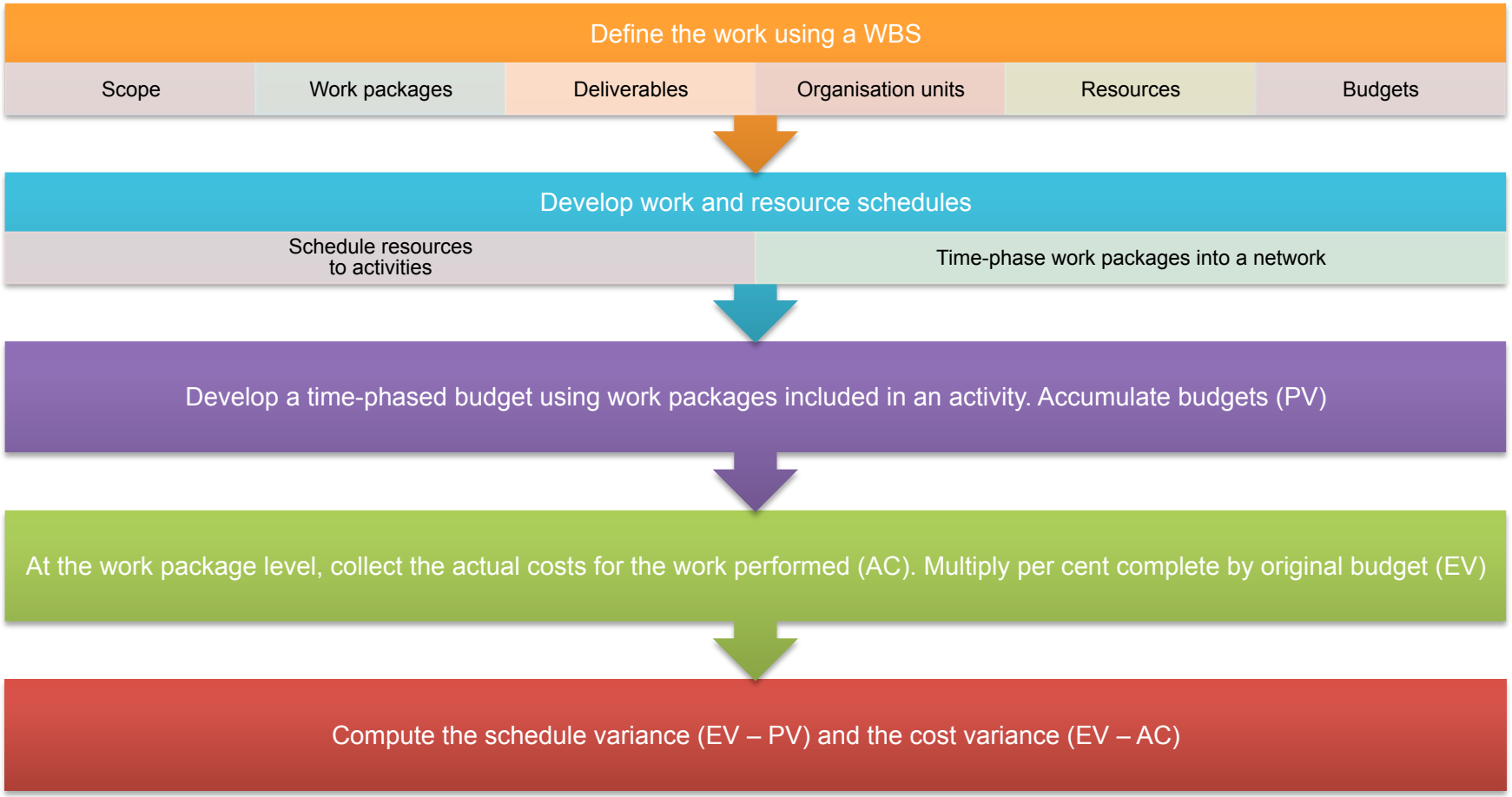
- a project plan that identifies work to be accomplished;
- a valuation of planned work, called Planned Value (PV) or Budgeted Cost of Work Scheduled (BCWS);
- pre-defined “earning rules” (also called metrics) to quantify the accomplishment of work, called Earned Value (EV) or Budgeted Cost of Work Performed (BCWP).

In Australia EVM has been codified as standards AS 4817-2003 and AS 4817-2006.

Common terms in EV systems

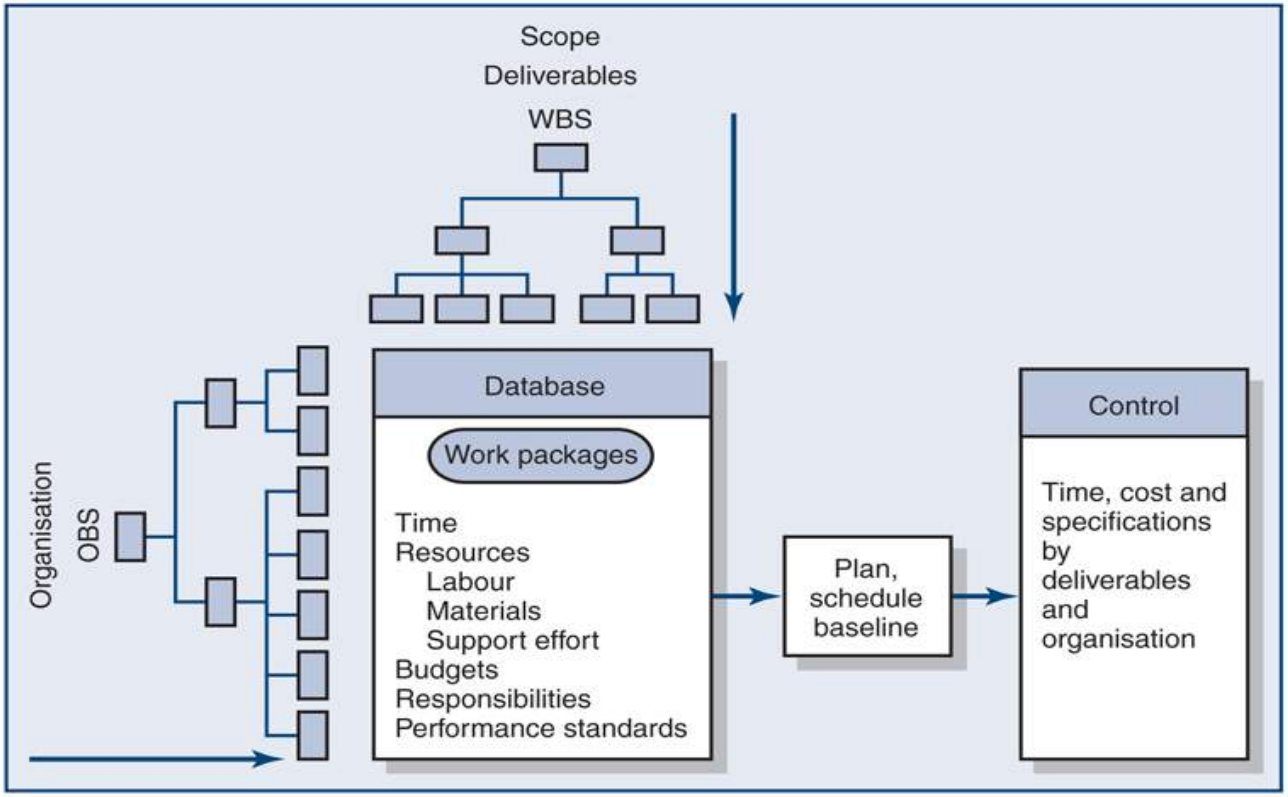
TABLE 13.1	Glossary of terms
EV	Earned value for a task is simply the per cent complete times its original budget. Stated differently, EV is the per cent of the original budget that has been earned by actual work completed. (The older acronym for this value was BCWP—budgeted cost of the work performed.)
PV	The planned time-phased baseline of the value of the work scheduled. An approved cost estimate of the resources scheduled in a time-phased cumulative baseline (BCWS—budgeted cost of the work scheduled).
AC	Actual cost of the work completed. The sum of the costs incurred in accomplishing work. (ACWP—actual cost of the work performed.)
CV	Cost variance is the difference between the earned value and the actual costs for the work completed to date where CV = EV – AC.
SV	Schedule variance is the difference between the earned value and the baseline line to date where SV = EV – PV.
BAC	Budgeted cost at completion. The total budgeted cost of the baseline or project cost accounts.
EAC	Estimated cost at completion.
ETC	Estimated cost to complete remaining work.
VAC	Cost variance at completion. VAC indicates expected actual overrun or underrun cost at completion.

Developing an integrated cost / schedule system



Project management information system overview

Figure 13.3 PROJECT MANAGEMENT INFORMATION SYSTEM OVERVIEW



Development of project baselines

Purposes of a baseline (Planned Value, PV)

- An anchor point for measuring performance
  - A planned cost and expected schedule against which actual cost and schedule are measured
  - A basis for cash flows and awarding progress payments
  - A summation of time-phased budgets (cost accounts as summed work packages) along a project timeline

What costs are included in baselines?

- Labour, equipment, materials, project direct overhead costs (DOC)

Development of project baselines

continued

Rules for placing costs in baselines

- Costs are placed exactly as they are expected to be ‘earned’ in order to track them to their point of origin.
- Per cent complete rule
  - Costs are periodically assigned to a baseline as units of work are completed over the duration of a work package.

Methods of variance analysis

Comparing earned value with the expected schedule value

Comparing earned value with the actual costs

Assessing the status of a project

Required 3 data elements

- Budgeted cost of the work scheduled (PV)
- Budgeted cost of the work completed (EV)
- Actual cost of the work completed (AC)

Calculate schedule and cost variances

- A positive variance indicates a desirable condition,
- A negative variance suggests problems or changes that have taken place

Methods of variance analysis

Cost variance (CV)

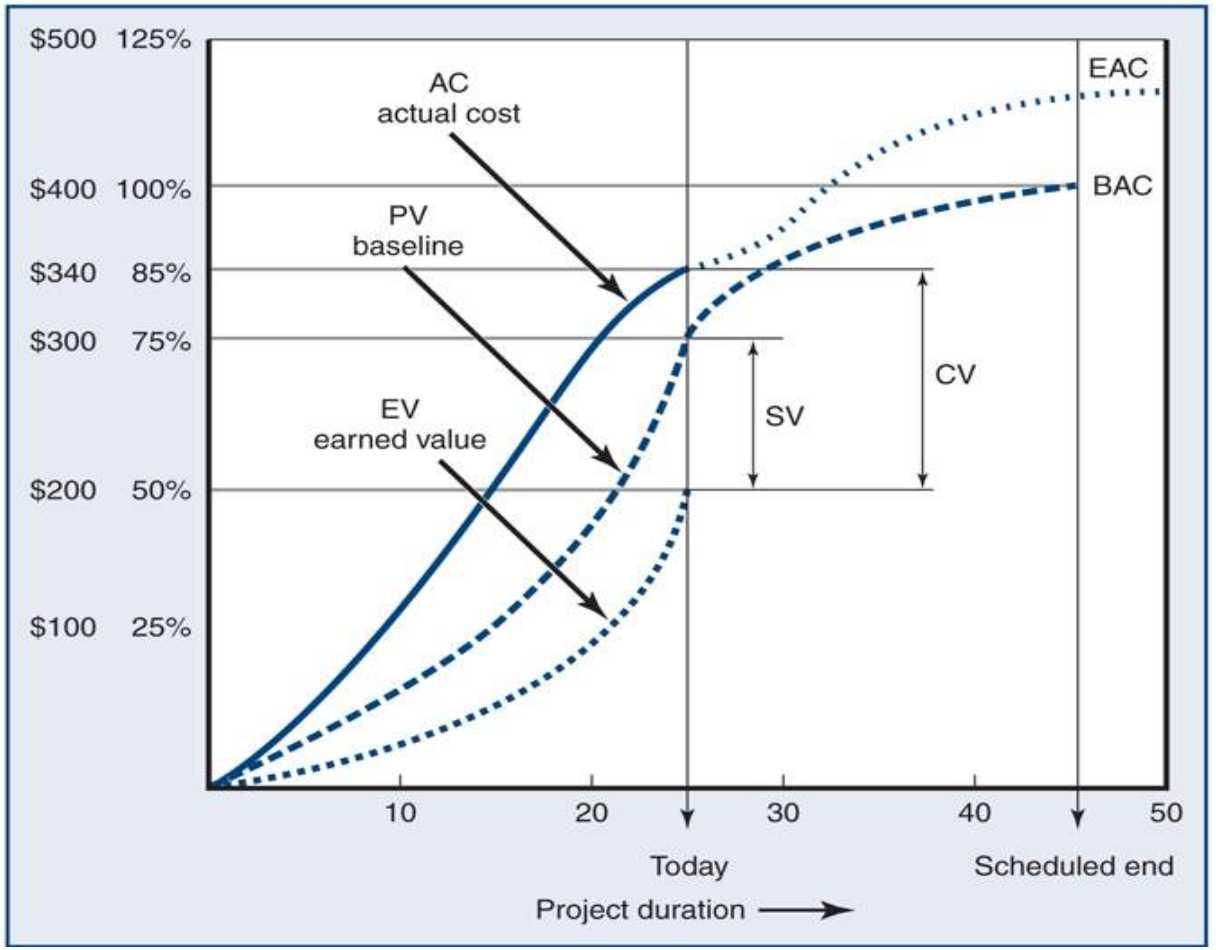
- Indicates if the work accomplished using labour and materials costs more or less than was planned at any point in the project

Schedule variance (SV)

- Presents an overall assessment in dollar terms of the progress of all work packages in the project scheduled to date

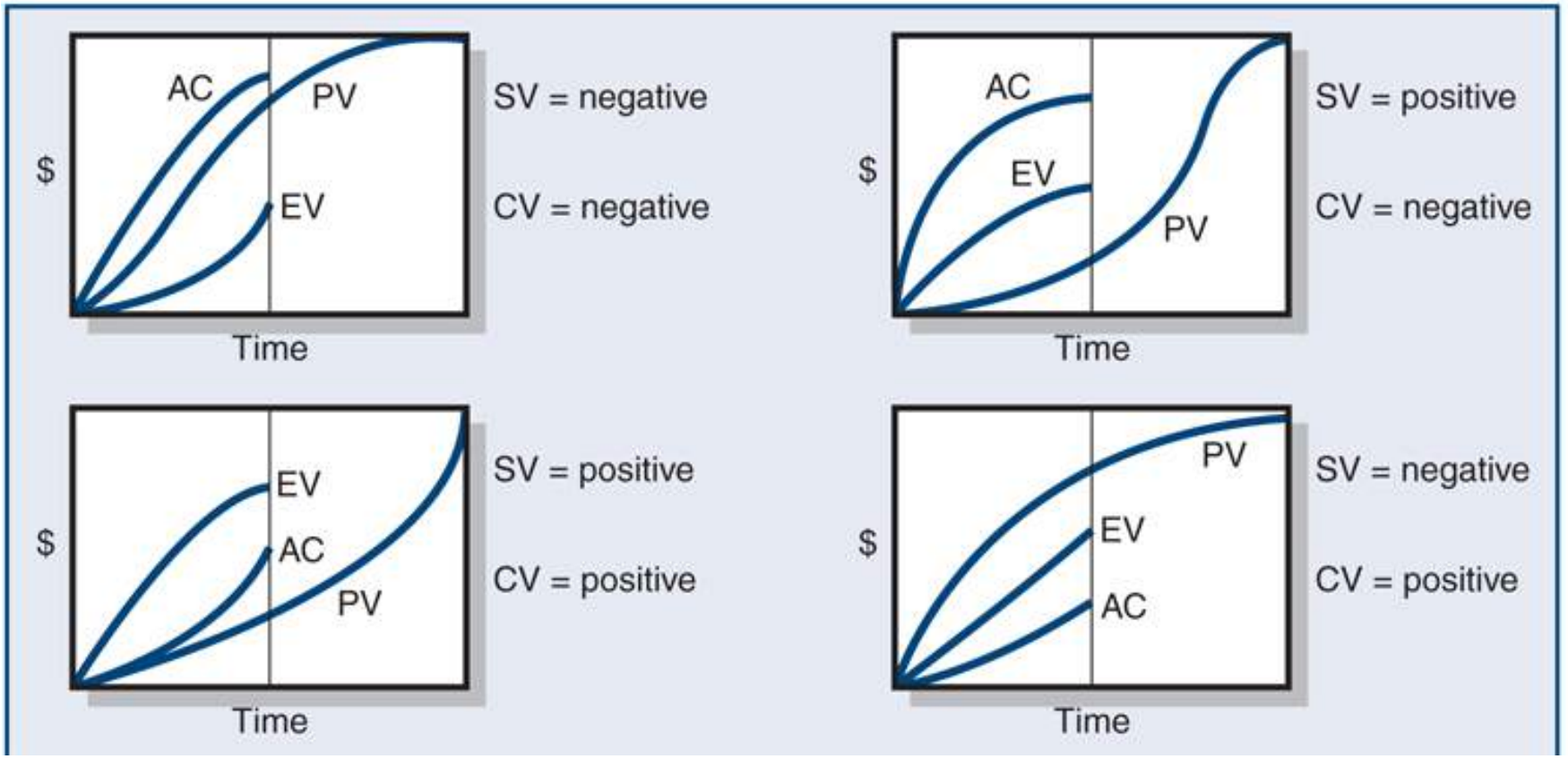
Cost / schedule graph

Figure 13.4 COST/SCHEDULE GRAPH



Earned-value review

Figure 13.5 EV REVIEW EXERCISE



Performance indexes

Cost performance index (CPI)

- Measures the cost efficiency of work accomplished to date
- CPI = EV/AC

Scheduling performance index (SPI)

- Measures scheduling efficiency
- SPI = EV/PV

Per cent complete indexes

- Indicates how much of the work accomplished is represented bythe total budgeted (BAC) and actual (AC) dollars to date
- PCIB = EV/BAC
- PCIC = AC/EAC

Interpretation of indexes

TABLE 13.3 Interpretation of indexes

Index	Cost (CPI)	Schedule (SPI)
1.00	Under cost	Ahead of schedule
= 1.00	On cost	On schedule
< 1.00	Over cost	Behind schedule

Additional earned value rules

Rules applied to short-duration activities and/or small-cost activities

- 0/100 per cent rule
  - Assumes 100 per cent of budget credit is earned at once and only when the work is completed
- 50/50 rule
  - Allows for 50 per cent of the value of the work package budget to be earned when it is started and 50 per cent to be earned when the package is completed
- Per cent complete with weighted monitoring gates
  - Uses subjective estimated per cent complete in combination with hard, tangible monitoring points

Forecasting final project cost

Methods used to revise estimates of future project costs

- EAC_{re}
  - Allows experts in the field to change original baseline durations and costs because new information tells them the original estimates are not accurate
- EAC_f
  - Uses actual costs-to-date plus an efficiency index to project final costs in large projects where the original budget is unreliable

Forecasting model: EAC_f

The equation for this forecasting model:

$$EAC_f = ETC + AC$$

$$EAC = \frac{\text{Work remaining}}{CPI} = \frac{BAC - EV}{EV/AC}$$

where EAC_f = estimated total cost at completion.
ETC = estimated cost to complete remaining work.
AC = cumulative actual cost of work completed to date.
CPI = cumulative cost index to date.
BAC = total budget of the baseline.
EV = cumulative budgeted cost of work completed to date.

Monthly status report

Example

Project number: 163 **Project manager:** Connor Gage
Project priority now: 4
Status as of: April 1, 2007
Earned value figures:

PV	EV	AC	SV	CV	BAC
588,240	566,064	596,800	−22,176	−30,736	1,051,200
EAC	**VAC**	**EAC_f**	**CPI**	**PCIB**	**PCIC**
1,090,640	−39,440	1,107,469	.95	.538	.547

Project description: A computer-controlled conveyor belt that will move and position items on the belt with accuracy of less than one millimeter.
Status summary: The project is approximately 25 days behind schedule. The project has a cost variance of ($30,736).
Explanations: The schedule variance has moved from noncritical activities to those on the critical path. Integration first phase, scheduled to start 3/26, is now expected to start 4/19, which means it is approximately 25 days behind schedule. This delay is traced to the loss of the second design team which made it impossible to start utilities documentation on 2/27 as planned. This loss illustrates the effect of losing valuable resources on the project. The cost variance to date is largely due to a design change that cost $21,000.
Major changes since last report: The major change was loss of one design team to the project.
Total cost of approved design changes: $21,000. Most of this amount is attributed to the improved design of the serial I/O drivers.
Projected cost at completion: EAC_f is estimated to be $1,107,469. This represents an overrun of $56,269, given a CPI of .95. The CPI of .95 causes the forecast to be greater than the VAC −$39,440.
Risk watch: Nothing suggests the risk level of any segments has changed.

Other control issues

Scope creep

Baseline changes

Data acquisition costs and problems

Scope changes to a baseline

Figure 13.13 SCOPE CHANGES TO A BASELINE