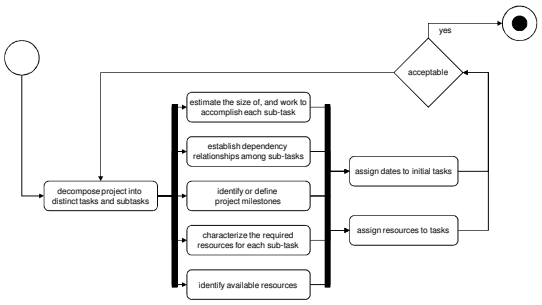
Agenda

- Project Scheduling
  - work breakdown and task definition
  - task dependency (PERT) analysis
  - milestones and Earned Value Analysis
  - resource and staffing dependencies
  - time lines (Gantt Charts)
  - staffing levels (PNR curves)
- Project Status Tracking
  - Using EVA to measure progress
- Automated Scheduling tools

Project Scheduling



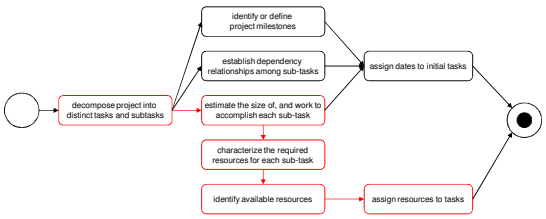
Work Breakdown

- hierarchical decomposition of work
  - independent sub-tasks that sum to the whole
  - can be based on either tasks or goals
  - both process- and problem-centric
- sub-tasks are fundamental unit of work
  - the granularity of work estimation
  - the granularity of assignment & scheduling
  - the granularity of task inter-dependencies
  - the basis for progress tracking
- granularity will evolve with the project

Task Dependencies

- input/output relationships between tasks
  - may be strict
    - e.g. system test starts after component integration
  - may allow overlap
    - e.g. design can start one month after architecture
- process-mandated pre-requisites
  - support training must precede beta shipment
- these dictate the order of scheduling
  - they also determine the (longest) critical path

Dependencies (PERT charts)



Establish Project Milestones

- Specific and Measurable
  - an objectively ascertainable moment
  - avoid subjective assessments
- Relevant measures of project progress
  - goals achieved, work completed
  - not merely hours of work done
- Timely (relatively closely spaced)
  - enable fine-grained progress tracking
  - accurate assessment of work state and rate

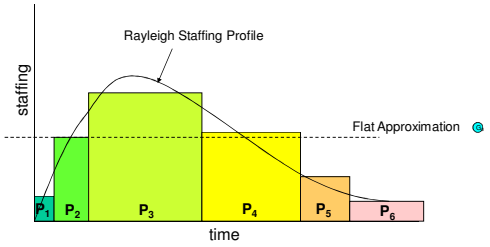
Staffing and Resources

- task resource needs must be described
- projects require people
  - classes of people with specific skills
  - specific people with unique skills
    - these people tend to have many commitments
- other non-sharable resources
  - special laboratories (e.g. usability)
  - special equipment (e.g. a system emulator)
- some of these may be critical resources

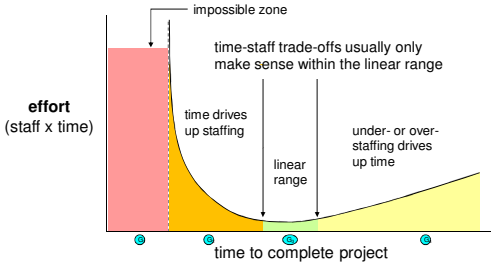
The Scheduling Process

- order the tasks based on dependencies
- define the pool of available resources
- assign appropriate resources to each task
  - there will probably be resource conflicts
  - these will create additional dependencies
- start each task as soon as possible
  - as soon as all dependencies are satisfied
  - completion time based on estimate and staffing
  - this can be done backwards (from due date)
- display results as a Gantt chart

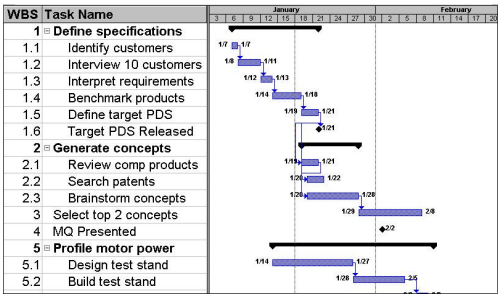
Rayleigh Staffing Profile Curve



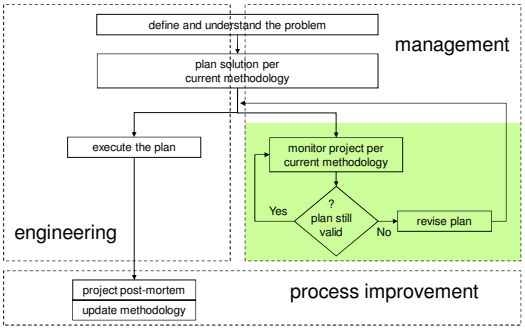
PNR Effort/Time Curve (there is an optimal size and time)



Timelines (Gantt charts)



Project Management 1A



Project Status Tracking

- what is each person doing
  - what tasks are they currently working on
  - when will each of these tasks be completed
  - have they encountered any problems
- how is project progressing
  - are resources allocated according to plan
  - is progress proceeding according to plan
  - does someone need a little help
  - does the plan need to be revised
    - changes in problem, resources, approach

A Typical Status Discussion

mgr: *Where are we on the app-server?*
engr: I'm about 80% done.
mgr: *You've been 80% done for six weeks!*
engr: The first ¾ was easy.
All the hard stuff is in the last ¼!

Q: How does a project get to be a year late?
A: One day at a time.

Fred Brooks, The Mythical Man-Month

Quantifying Progress

- task completions are obvious milestones
  - they are **specific**, **measurable**, **relevant**
- they may be poor measures of progress
  - not usually evenly spaced measures of work
  - may be too large for fine grained tracking
- we need a different kind of measure
  - to enable fine grained (e.g. daily) tracking
  - to enable meaningful schedule tracking
  - to enable meaningful budget tracking

Earned Value Analysis

- construction size and effort estimates
  - yield an expected cost for each sub-task
  - this is the budgeted value of that sub-task
- the Earned Value of an effort
  - is the value of all the tasks **completed** so far
    - or … ¼ earned at start, ¾ earned at completion
    - or … partial value for progress (e.g. tests passed)
- Tracking Earned Value enables us to
  - assess project completion and speed
  - meaningfully assess cost-performance

Tracking with Earned Value

Comparing Earned Value with Planned value enables us to determine …

(a) what fraction of the project is complete

(b) whether or not the work is on schedule.

Figure 3

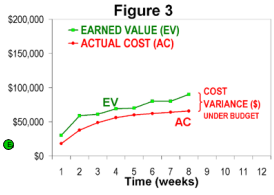
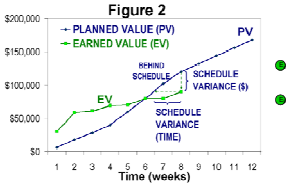


Figure 2



Comparing Earned Value with Actual Cost enables us to

(a) determine whether or not we are within budget (on the work completed so-far).

(b) estimate the cost to completion, based on the performance so-far.

The Need for Automation

- schedules are revised continuously
  - tweaking to get a schedule that works
  - changes to tasks and estimates
  - changes in available resources
  - updates to reflect actual progress
- automation is essential
  - task descriptions maintained in a database
  - automatic schedule generation
  - planned vs. actual comparisons

Scheduling Tools

- define project
  - describe all tasks, sub-tasks and milestones
  - describe all resources
  - describe all dependencies and constraints
- automatically produce schedules
  - which meet all specified constraints
  - this is very difficult to do by hand
- enter task and resource status information
  - generate reports on progress and problems

For Next Lecture

- McConnell, chapter 6, section 34.4
  - class design, programming **into** your language
- Spolsky: What are specs
  - the starting point for your design
- Gabriel/Steele: Objects have(n't) failed
  - promises and disappointments of the OO revolution
- Selected class patterns
  - a few front-ending and instantiation tricks
- UML class, package and object diagrams