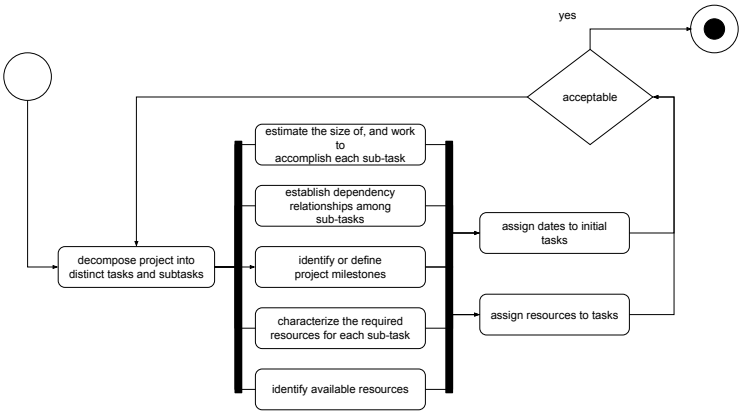
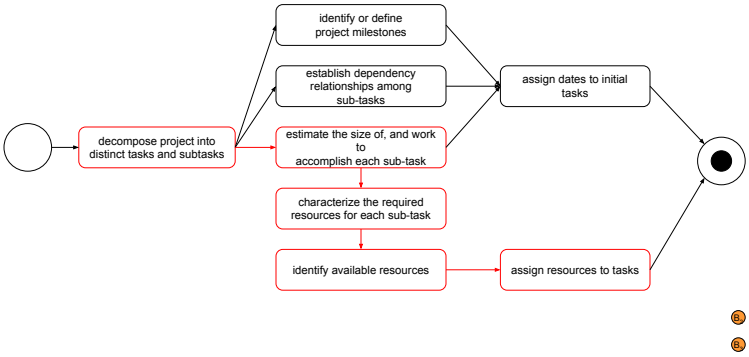
Scheduling and Monitoring

- Project Scheduling
  - task dependency (PERT) analysis/charts
  - staffing levels (PNR curves)
  - time lines (Gantt Charts)
- Project Status Tracking
  - Milestones
  - Earned Value Analysis
  - Scrum points and velocity
- Causes of Slippage and Failure

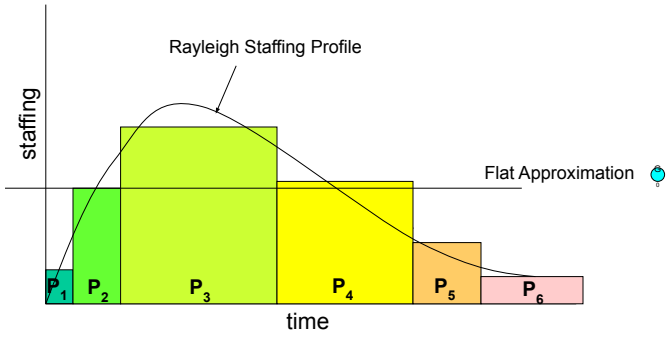
Project Scheduling



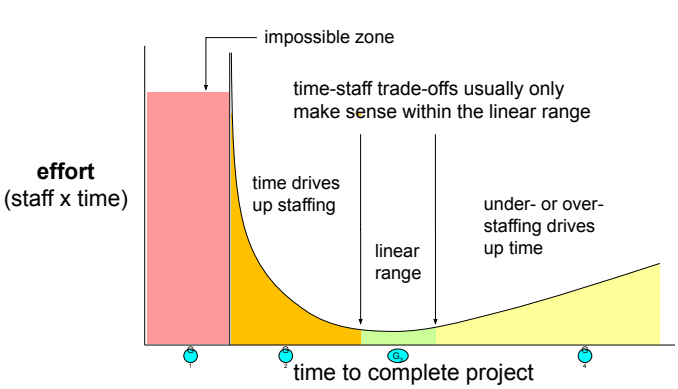
Dependencies (PERT charts)



Rayleigh Staffing Profile Curve

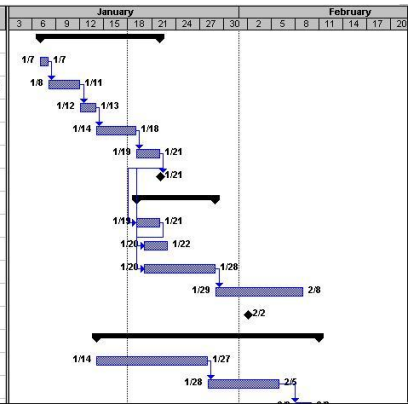


PNR Effort/Time Curve
(there is an optimal size and time)

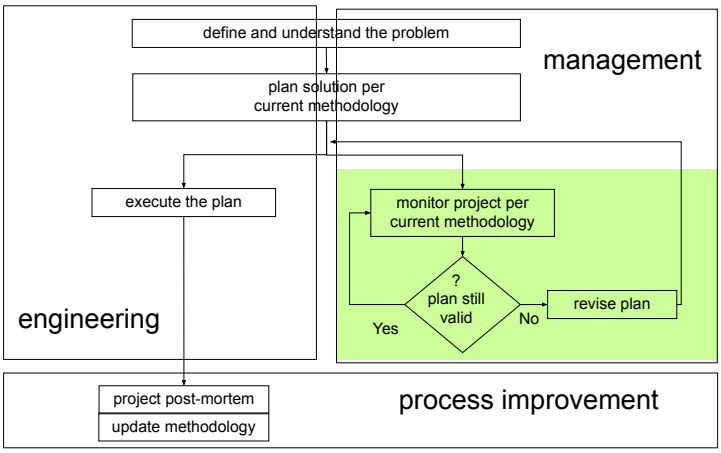


Timelines (Gantt charts)

WBS	Task Name
1	**Define specifications**
1.1	Identify customers
1.2	Interview 10 customers
1.3	Interpret requirements
1.4	Benchmark products
1.5	Define target PDS
1.6	Target PDS Released
2	**Generate concepts**
2.1	Review comp products
2.2	Search patents
2.3	Brainstorm concepts
3	Select top 2 concepts
4	MQ Presented
5	**Profile motor power**
5.1	Design test stand
5.2	Build test stand



Project Management 1A



Project Status Tracking

- [stand-up] what is each person doing
  - what tasks are they have recently finished
  - what tasks they expect to complete next
  - what obstacles they are encountering
- [management] how is project progressing
  - are resources allocated according to plan
  - is progress proceeding according to plan
  - does anyone need help
  - does the plan need to be revised
    - changes in problem, resources, approach

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

A 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
  - **specific**, **measurable**, **achievable**, **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 2

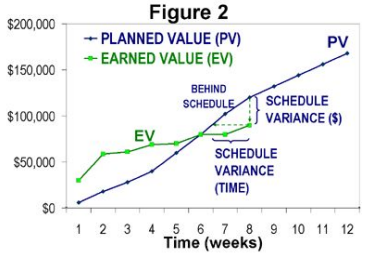
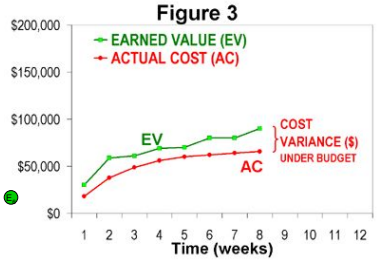


Figure 3



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.

SCRUM Points

- relatively easy to estimate
  - developer-convenient unit: “best-case days”
  - a measure of work, not a delivery date
  - less misleading and arbitrary than “dollars”
  - small task estimation is easy and accurate
- excellent progress tracking
  - small tasks enable fine-grained tracking
  - a more linear measure of progress
- well correlated to product progress
  - only accepted features earn points

Sprint Velocity

- self-calibrating measure that includes:
  - productivity, overhead, bugs, competing priorities
- uncertainty is recognized and quantified
  - consistency of recent velocity measurements
  - convergence of backlog grooming/estimates
- enables better projections of completion
  - replaces optimistic promises with extrapolations
- enables better management
  - guides choice of what to accept in next sprint
  - highlights backlog, productivity, distractions
  - makes product owner a partner in development

Team Exercise

- Consider your P1-4 plans and results:
  - tasks not recognized or under-estimated
  - tasks that slipped, didn’t meet expectations
- Consider your project management:
  - did you know what everyone was doing?
  - were problems promptly recognized?
  - how prompt and effective was response?
- In retrospect:
  - how well chosen were project milestones?
  - what else should have been called out?
  - what worked, what would you do differently?

Common Causes of Slippage

- poor or unstable requirements
- unrealistic schedules (poor estimates)
- “Scope Creep” (new input, lose focus)
- unanticipated construction problems
- unanticipated quality problems
- unanticipated integration problems
- external dependency issues
- unplanned distractions

Why Projects Fail

Rank	Challenged	Failure
1	Lack of user input	Incomplete requirements
2	Incomplete requirements/specs	Lack of user involvement
3	Changing requirements/specs	Lack of resources
4	Lack of executive support	Unrealistic expectations
5	Technological incompetence	Lack of executive support
6	Lack of resources	Changing requirements/specs
7	Unrealistic expectations	Lack of Planning
8	Unclear objectives	Didn’t need it any longer
9	Unrealistic time frames	Lack of IT management
10	New technology	Technological illiteracy

Requirements 30% **Planning 25%** **Management 20%** **Technological 7%**

Was uns nicht umbringt macht uns nur stärker.

Friedrich Wilhelm Nietzsche
Also Sprach Zarathustra

Final Exam

- When: Wed 12/16, 2-5PM
- Scope: learning objectives since mid-term (a few may spill over into first half)
- Length: 12 multi-part questions, +1 XC
- Format: same as midterm
- Difficulty: similar to midterm
  - mostly list, define, describe, justify, examples
  - a few "apply to this situation" questions

Feel free to email me with questions that arise while you are reviewing for final

Supplementary Slides

The Traditional Model

- generate a huge list of requirements
- development commits to a long schedule
- the requirements continue to change
- development hit with other emergencies
- work is not completed on schedule
- everybody is surprised
- destructive finger-pointing ensues

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

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

scheduling

- start with
  - list of tasks required to complete project
    - broken down into fairly small sub-tasks
  - input/output dependencies among the tasks
  - time and resource estimates for each task
  - list of constraints on each resource
- produce
  - a correctly ordered task timeline
  - reasonable task assignments
  - a list of measurable milestones

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