

Agenda

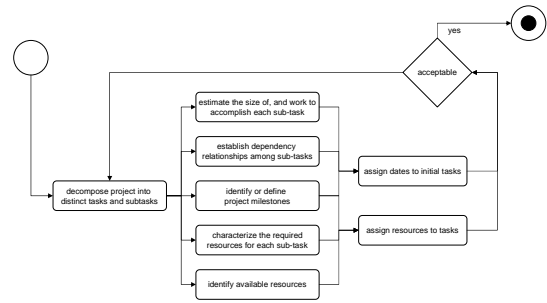
- Project Scheduling
 - work breakdown and task definition
 - task dependency (PERT) analysis
 - milestones and Earned Value Analysis
 - resource and staffing dependencies
 - time lines (Gantt Charts)
 - staffing levels (PNR curves)
- Project Status Tracking
 - Using EVA to measure progress
- Automated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

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Project Scheduling



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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

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Task Dependencies

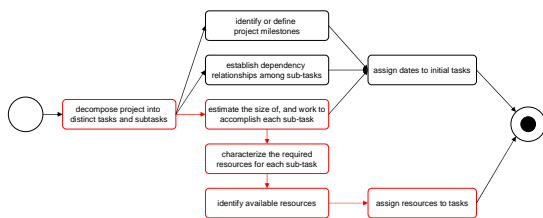
- input/output relationships between tasks
 - may be strict
 - e.g. system test starts after component integration
 - may allow overlap
 - e.g. design can start one month after architecture
- process-mandated pre-requisites
 - support training must precede beta shipment
- these dictate the order of scheduling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

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Dependencies (PERT charts)



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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

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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

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The Scheduling Process

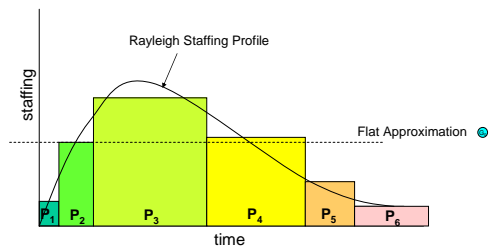
- order the tasks based on dependencies
- define the pool of available resources
- assign appropriate resources to each task
 - there will probably be resource conflicts
 - these will create additional dependencies
- start each task as soon as possible
 - as soon as all dependencies are satisfied
 -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

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Rayleigh Staffing Profile Curve

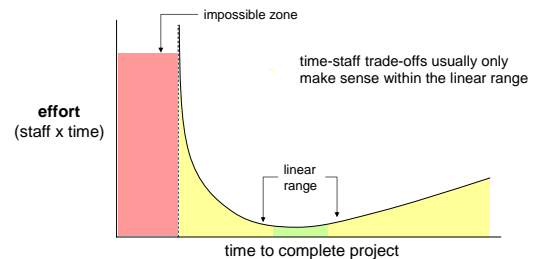


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PNR Effort/Time Curve

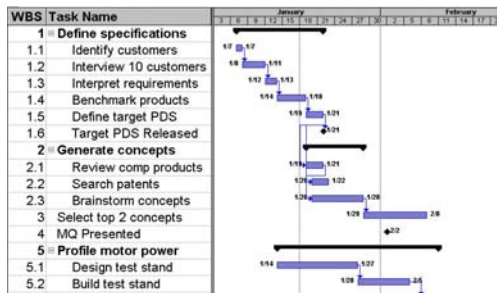


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Timelines (Gantt charts)

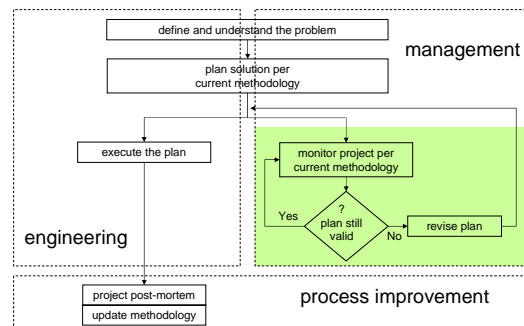


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Project Management 1A



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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

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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 $\frac{3}{4}$ was easy.

All the hard stuff is in the last $\frac{1}{4}$!

Q: How does a project get to be a year late?

A: One day at a time.

Fred Brooks, *The Mythical Man-Month*

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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

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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 ... $\frac{1}{4}$ earned at start, $\frac{3}{4}$ 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

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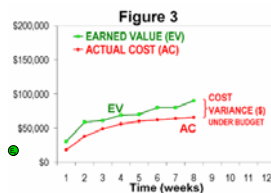
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Tracking with Earned Value

Comparing Earned Value with Planned value enables us to determine ...

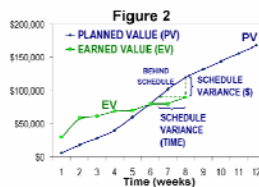
- what fraction of the project is complete
- whether or not the work is on schedule.



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Comparing Earned Value with Actual Cost enables us to

- determine whether or not we are within budget (on the work completed so-far).
- estimate the cost to completion, based on the performance so-far.

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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

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For Next Lecture

- McConnell, section 28.4, 34.8
 - general thoughts on measurement & improvement
- Spolsky: Stealth Process Improvement
- Wikipedia
 - Best Practices Benchmarking
 - Process Improvement
 - Capability Maturity Models
 - Six Sigma
 - ISO9000
 - Software Metrics
- Kaner – Software Engineering Metrics
 - 12pp, good analysis of problems w/software metrics

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Supplementary Slides

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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

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