Project Management

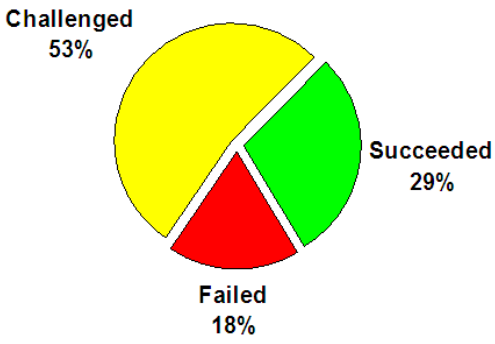
Rahul Premraj + Andreas Zeller

Read Chapters (a) Project Management, (b) Project Scheduling and (c) Risk Management from Pressman for this lecture.

CHAOS 2004

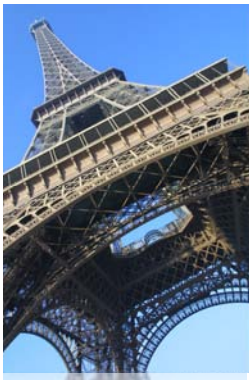
Survey Results

Resolution of Projects

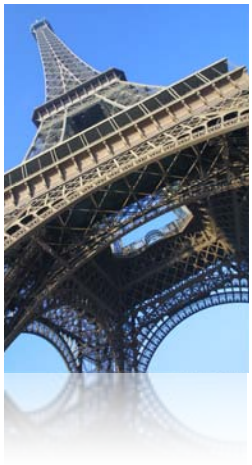


reliability of data questioned!

Software Projects vs. Engineering Projects



Engineering Projects



- Mechanical in nature.
- Structured, well-studied.
- Tremendous expertise and over >2000(?!?!) years of building experience!
- Standardized with lots of reuse.
- Estimation of products, personnel, time, and cost is easier.

Software Projects

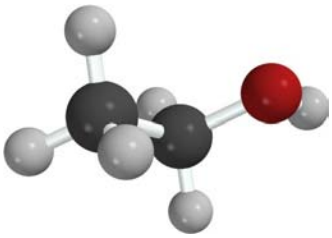
- Intangible
- Unpredictable
- Flexible
- Imagination & Creativity
- Practical
- Principles

Software vs. Engineering Projects

Other Differences

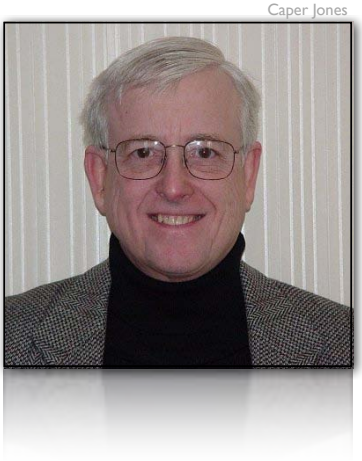
- Copying a system
  - Nearly the same for physical systems
  - Copying software is free (not good!)
- Problems solving
  - Same solution can be applied for physical systems.
  - Can be unique for software.
- Extensions
  - Small increments for physical systems.
  - Small increments for software systems can increase workload substantially.
- Unit of Work
  - Can measure hours of work spent working for physical systems.
  - For software development, this is tougher.

Software Development Craft or Science?



Software Project Management

Caper Jones

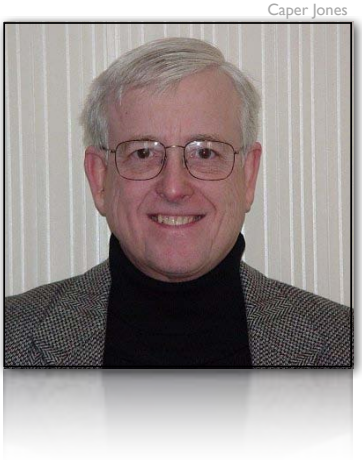


- Investigated 250 large projects.
- Unsuccessful projects showed weaknesses in:
  - Project Planning
  - Cost Estimation
  - Measurements
  - Milestone Tracking
  - Change Control
  - Quality Control

http://ii.metu.edu.tr/~is529/course_material/papers/Software%20Project%20Management%20Practices-Jones-2004.pdf (Read if interested)

Software Project Management

Caper Jones



...the most interesting aspect of these six problem areas is that all are associated with project management rather than with technical personnel.

http://ii.metu.edu.tr/~is529/course_material/papers/Software%20Project%20Management%20Practices-Jones-2004.pdf (Read if interested)

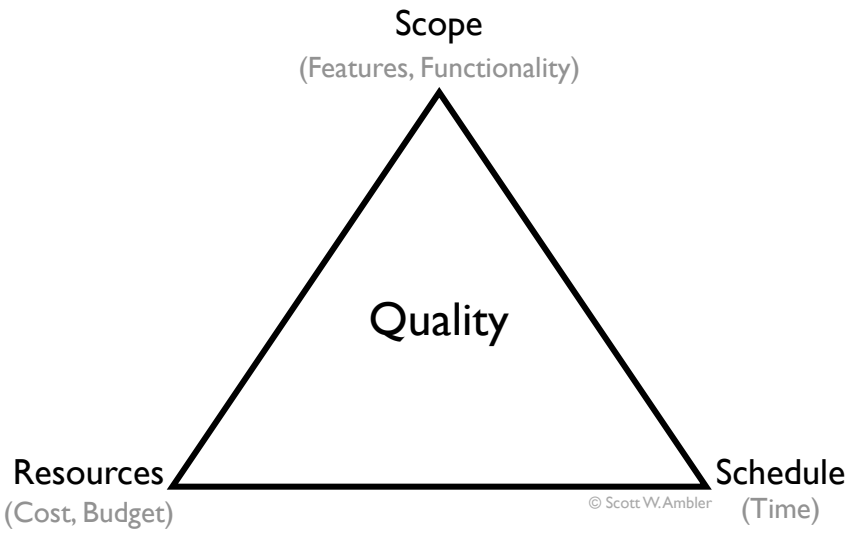
Laws of Project Management

- No major project is ever installed on time, within budget and with the same staff.
- Projects progress quickly until 90% complete; then they remain at 90% complete forever.
- One advantage of fuzzy project objectives is they let you avoid estimating costs.
- When things are going well, something will go wrong.
  When things just can't get worse, they will.
  When things seem to be improving – you've overlooked something.
- If project content is allowed to change freely, the rate of change will exceed the rate of progress.

Laws of Project Management

- No system is ever completely debugged.
  Attempts to debug a system inevitably introduce new bugs that are even harder to find.
- A carelessly planned project will take three times longer to complete than expected: A carefully planned project will take only twice as long.
- Project teams detest progress reporting because it vividly manifests their lack of progress.

The Iron Triangle

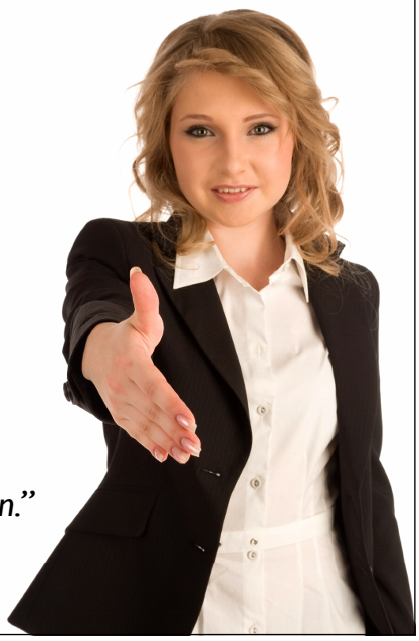


http://www.ambysoft.com/essays/brokenTriangle.html
http://en.wikipedia.org/wiki/Project_triangle
This triangle reflects the fact that the three properties of a project are interrelated, and it is not possible to optimize all three –
one will always suffer. In other words you have three options:
Design something quickly and to a high standard, but then it will not be cheap.
Design something quickly and cheaply, but it will not be of high quality.
Design something with high quality and cheaply, but it will take a long time.

A project manager's roles:

- Planning
- Staffing
- Execution
- Tracking
- and more...

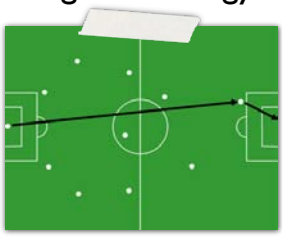
"plan the work and work the plan."



Management Functions

Planning

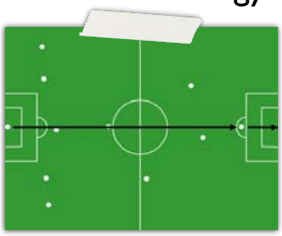
English Strategy



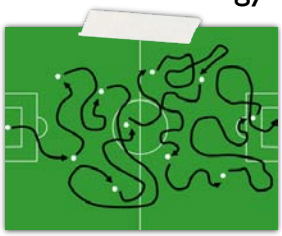
- What objectives are to be achieved?
- How and when resources are to be required?
- Flow of information, people and product across the organization.

Something off-track

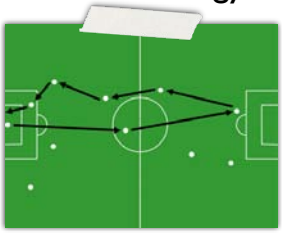
German Strategy



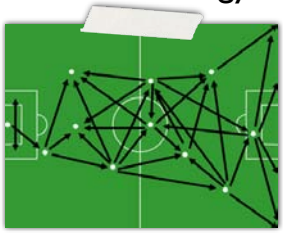
Brazilian Strategy



Swiss Strategy



French Strategy



Management Functions

Organizing

- Assigning responsibility for a task to people.
- Necessary at all scales of operation.
- Effective organization depends upon goals of the company and effective planning.

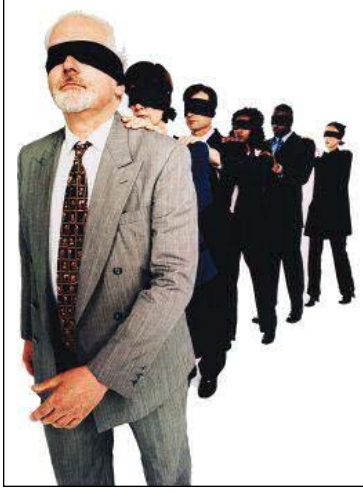
Management Functions

Staffing

- Deals with hiring personnel suitable to fit in the organizational structure.
- Identifying requirements for such personnel.
- Recruiting
- Compensating, developing and promoting.

Management Functions

Directing



- Leading subordinates.
- Guide subordinates understand and identify with the organization structure and the goals of the enterprise.
- Setting examples.
- Training for new comers.

Management Functions

Controlling

- Measuring and correcting activities to ensure that goals are met.

Four Ps of Project Management

People

Product

Process

Project

Four Ps of Project Management

People

Product

Process

Project

People

The most important ingredient that was successful on this project was having smart people... very little else matters in my opinion.

In a study published by the IEEE, the engineering vice presidents of three major technology companies were asked the most important contributor to a successful software project. They answered in the following way …

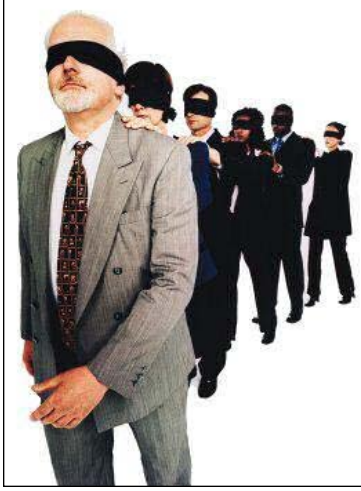
People

Stakeholders

- Senior managers
- Project managers
- Practitioners
- Customers
- End-users

People

Team Leaders

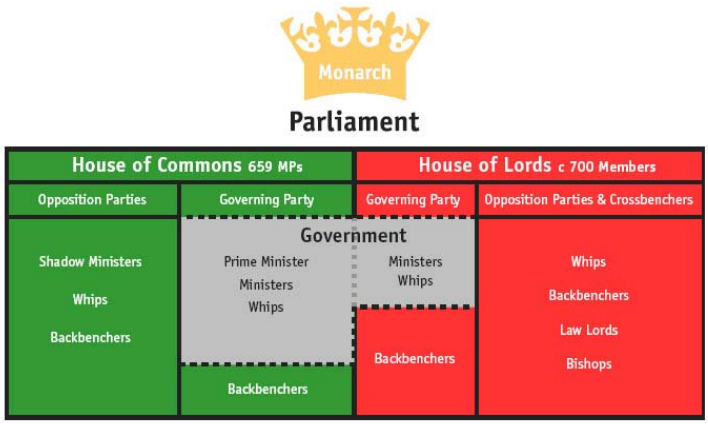


... individuals just fall into a project manager role and become accidental project managers.

- Motivation
- Organization
- Ideas or innovation

People

Organizational Structure

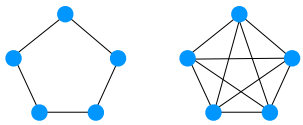


People

Communication & Coordination

Team

Decentralised-Control Team Structure



Summary

Decision Making

The process of specifying a problem/opportunity, identifying alternatives, evaluating them, and selecting from among the alternatives.

Conflict Management

Exists when two or more people have incompatible goals and one or both believe that the behavior of the other prevents their own goal attainment.

Four Ps of Project Management

People

Product

Process

Project

Product

Define the Scope of the Project

- Context: How does the software fit into a larger system, product, or business context, and what constraints are posed?
- Information objectives: What are the inputs and outputs of the system?
- Function and performance: What functions are to be performed to transform the inputs to outputs?

Kitchen Sink Syndrome

http://en.wikipedia.org/wiki/Kitchen_sink_syndrome

Scope creep (also called focus creep, requirement creep, feature creep, function creep) in project management refers to uncontrolled changes in a project's scope. This phenomenon can occur when the scope of a project is not properly defined, documented, or controlled. It is generally considered a negative occurrence that is to be avoided.

Product

Divide & Conquer

Four Ps of Project Management

People

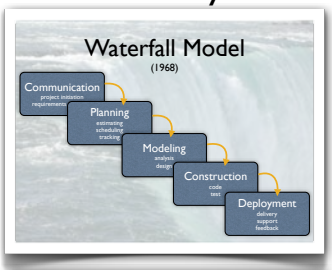
Product

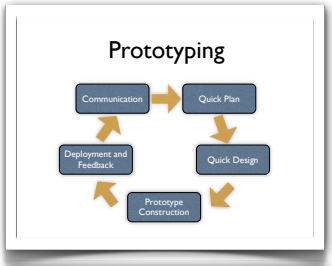
Process

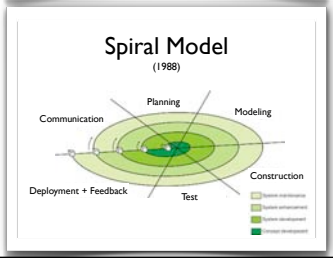
Project

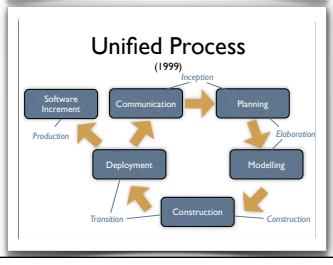
Process

Many Processes to choose from!









Process

What to keep in mind while choosing the process?

- customers who requested the product and the end-users.
- the product's characteristics.
- the project environment in which the software is developed.

Four Ps of Project Management

People

Product

Process

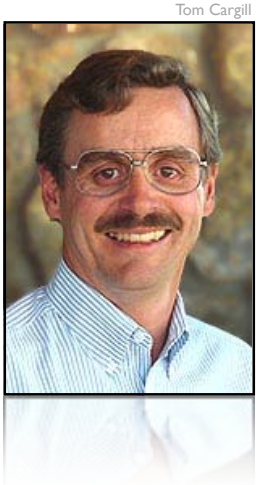
Project

Signs of Failure

- Development team doesn't understand customer's needs.
- Product scope is poorly defined (Kitchen Sink Syndrome).
- Poorly managed changes.
- Chosen technology changes.
- Business needs change.
- Unrealistic deadlines.
- Inexperienced team.
- Poor management.

Project

Tom Cargill



The first 90% of the code accounts for the first 90% of the development time.

The remaining 10% of the code accounts for the other 90% of the development time.

Project

Common Sense Approach

- Start on the right foot.
- Maintain momentum.
- Track progress.
- Make smart decisions.
- Conduct a postmortem analysis.

Project

W5HH Principle

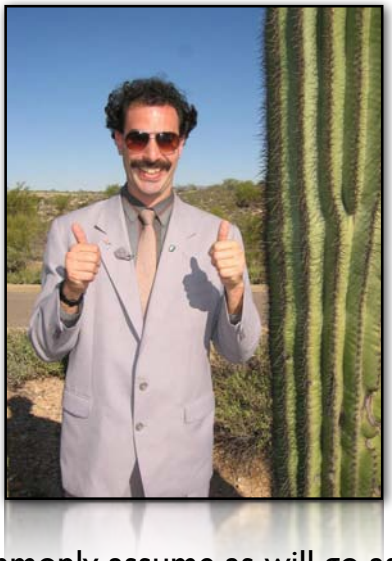
Barry Boehm

- Why is the software being built?
- What will be done?
- When will it be done?
- Who is responsible for a function?
- Where are they organizationally located?
- How will the job be done technically and managerially?
- How much of each resource is needed?

Project Scheduling

Project Scheduling

Software project scheduling is an activity that distributes estimated efforts across the planned software duration by allocating the effort to specific software engineering tasks.



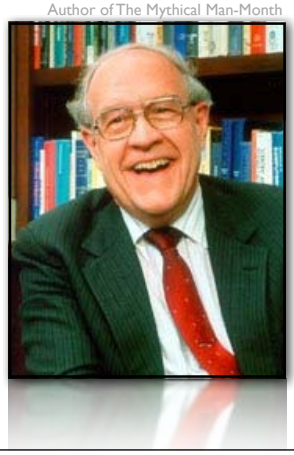
People commonly assume as will go as planned – Each task will take as long as it ought to take.

Project Scheduling

- Unrealistic deadline set by someone outside the development group and forced on managers and practitioners within the group.
- Underestimation of effort and resources.
- Failure to notice that project is falling behind schedule.

Project Scheduling

Fred Brooks
Author of The Mythical Man-Month



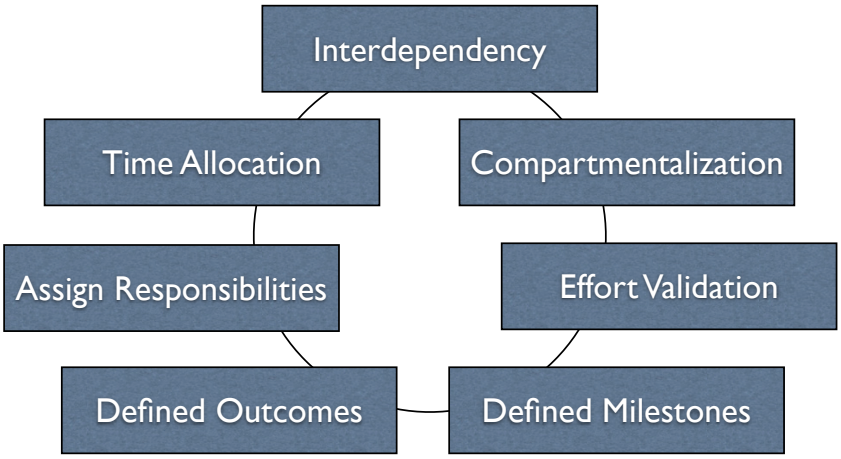
Q: How software projects fall behind schedule?

A: One day at a time.

Project Scheduling

Hurricanes (e.g., natural disasters, strikes, etc.) don't affect projects much... but termites (e.g., keyboard not working, tyre puncture) do.

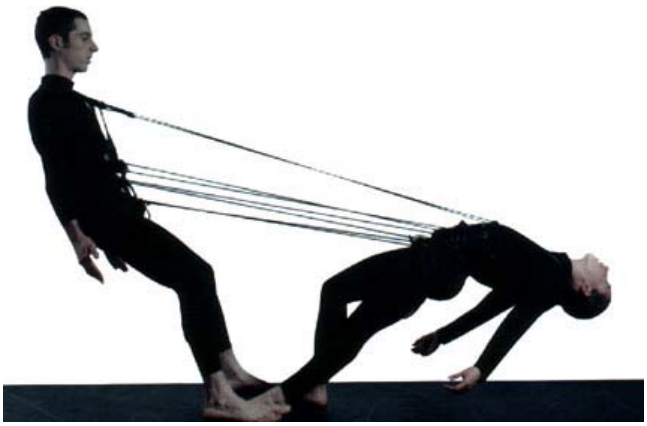
Principles of Project Scheduling



Compartmentalization

See Pressman 24.2.1: The project must be compartmentalized into manageable activities

Interdependency



One must determine the dependendies between tasks

Time Allocation

Every task needs an allocation of work units (such as person-days)

Effort Validation

As time allocation occurs, we must make sure that no more than the allocated number of people have been scheduled at any given time

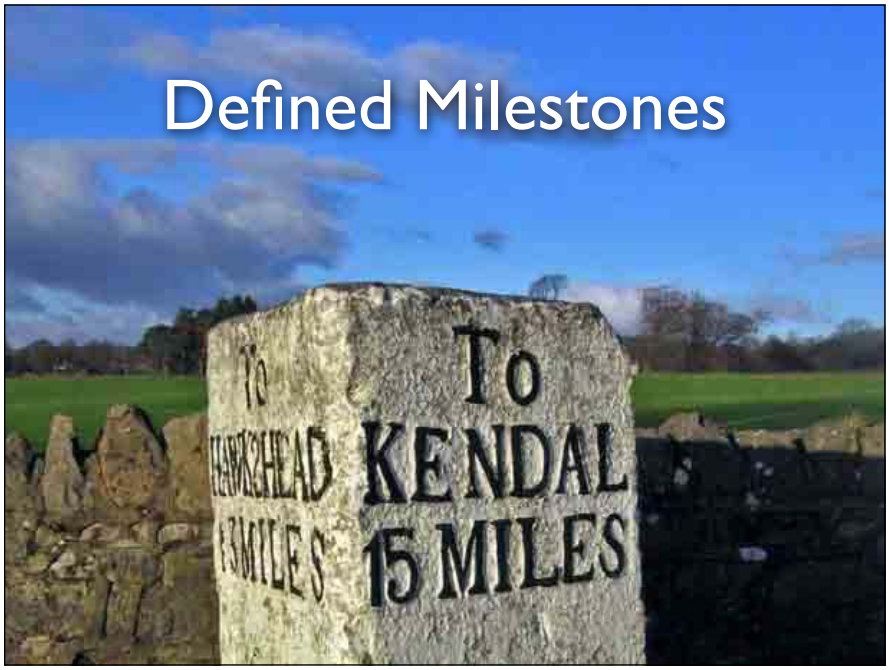
Assign Responsibilities

Every task should be given to a specific task member (with backup plans)

Defined Outcomes

Every scheduled task should have a defined outcome – also called a *deliverable* (such as a document)

Defined Milestones



Every task should have a *milestone.* A milestone is reached when a deliverable has been reviewed for quality and has been approved.

Scheduling Tools

Compartmentalization

Work Breakdown

- Breakdown the goal of the project into several smaller, manageable goals.
- Repeat process until each goal is well understood.
- Plan for each goal individually – resource allocation, assignment, scheduling, etc.

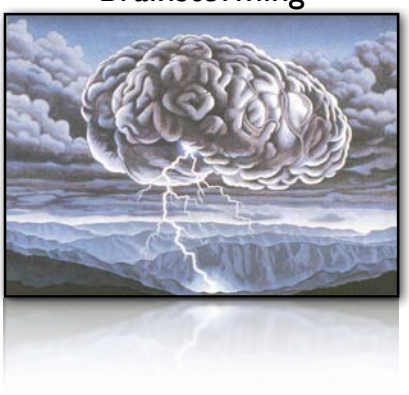
The 100% Rule...states that the WBS includes 100% of the work defined by the project scope and captures all deliverables – internal, external, interim – in terms of the work to be completed, including project management.

Work Breakdown

How to build one?

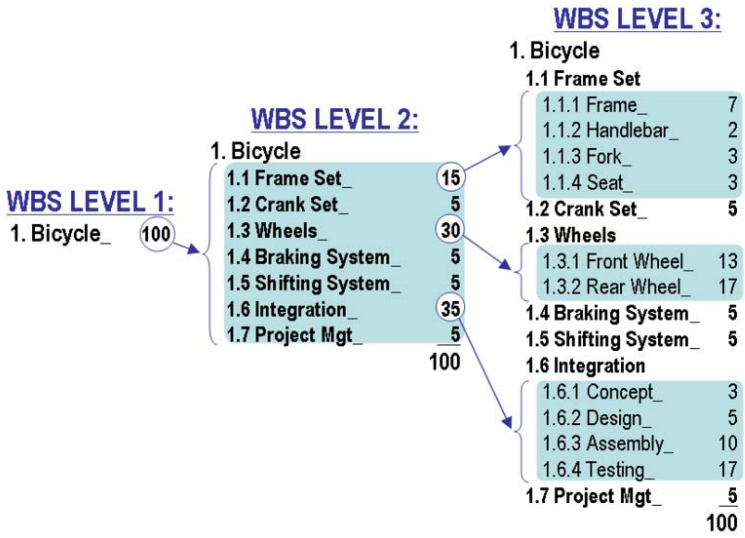
Top-down Approach

Brainstorming

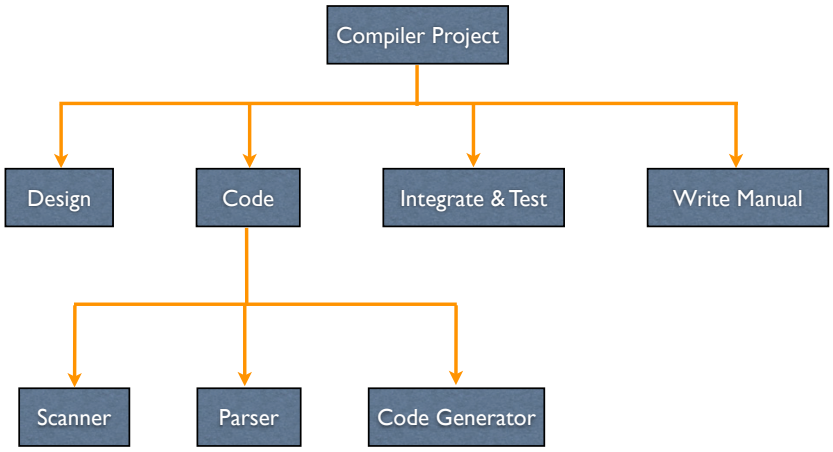


Top-down approach: Start at the highest, top level activities and systematically develop increasing levels of detail for all activities.
Brainstorming: Generate all activities you can think of that will have to be done and then group them into categories.

Work Breakdown



Work Breakdown



Work Breakdown

Advantages

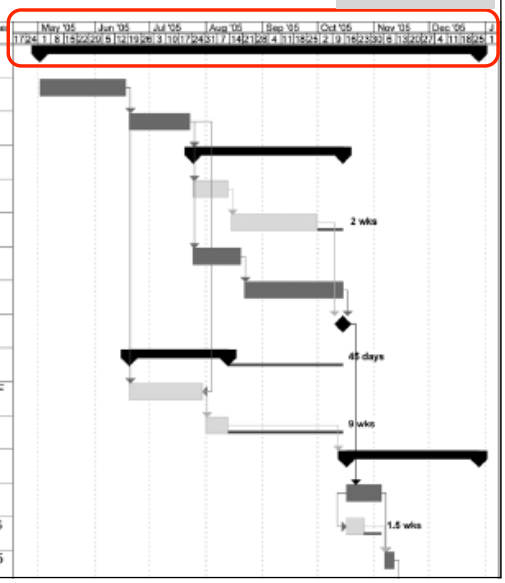
- Serves as basis for project scheduling, resource allocation and budgeting.
- Structured approach.
- Minimizes omissions.
- Right level of detail.
- Good communication tool.

Gantt Chart

Task List

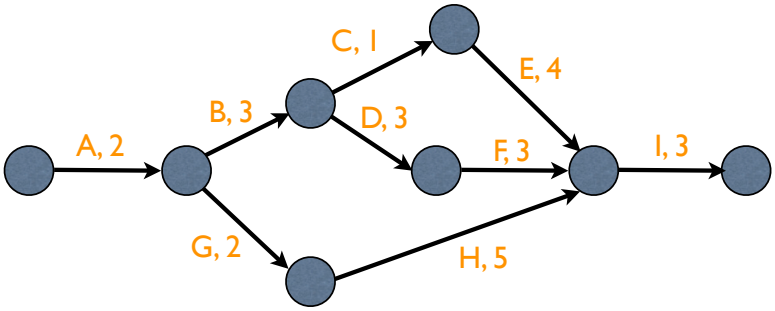
Duration

ID		Duration	Predece
1	**Software Project**	**172.5 days**	
2	Requirements	7 wks	
3	Design	5 wks	2
4	**Programming**	**60 days**	3
5	Unit Tests for Feature A	3 wks	3
6	Program Feature A	7 wks	5
7	Unit Tests for Feature B	4 wks	3
8	Program Feature B	8 wks	7
9	Feature-Complete Build	0 days	6,8
10	**Test Preparation**	**40 days**	
11	Build Test Plans	6 wks	2,3FF
12	Review, Correct Test Plans	2 wks	11
13	**Test Execution**	**52.5 days**	12
14	Execute Test Plan A	3 wks	9
15	Execute Test Plan B	1.5 wks	14SS
16	Fix Defects	1 wk	14,15



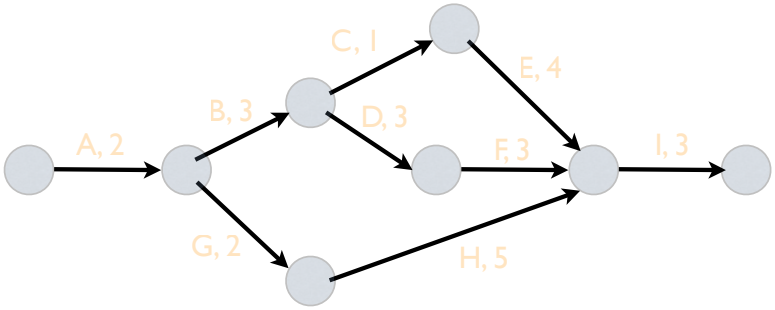
helps you schedule, budget and allocate resource

PERT Charts



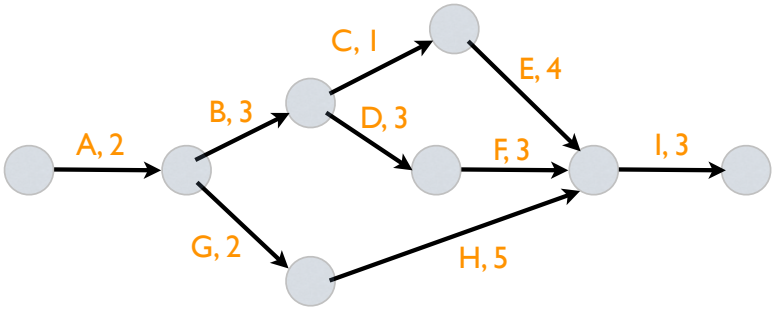
PERT Charts

Arrows indicate tasks



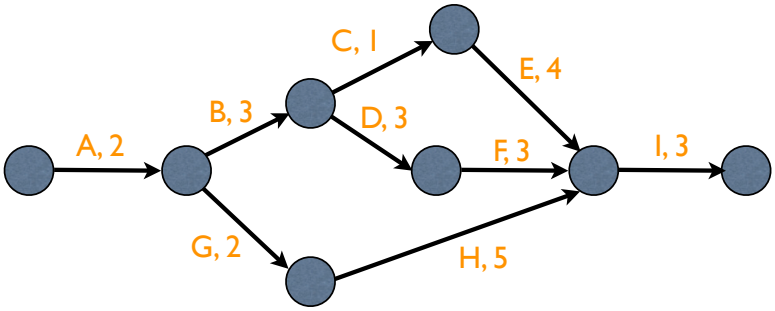
PERT Charts

Labels indicate task name and duration
(here, lets assume in days)



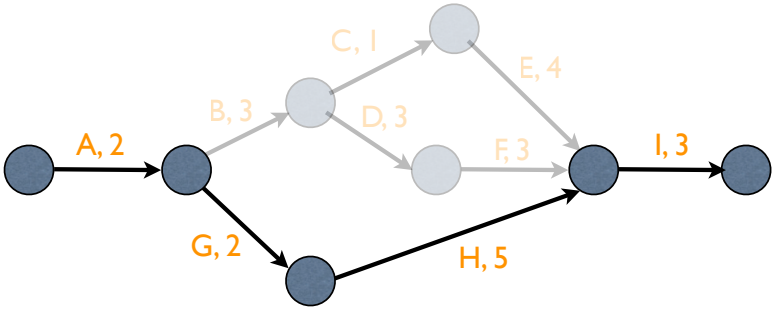
PERT Charts

Nodes indicate the start and end points of tasks.



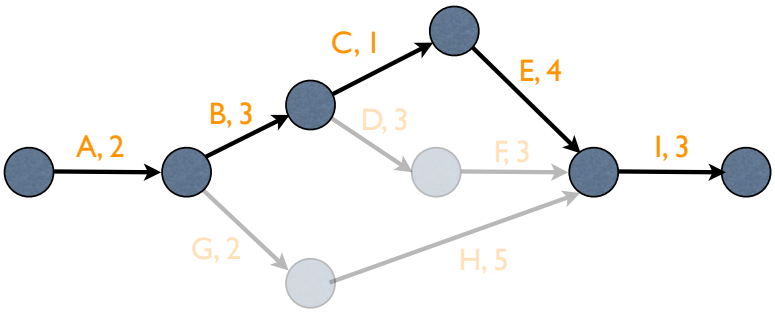
PERT Charts

There are several routes to reach from start to finish.
Time to complete: 12 days!



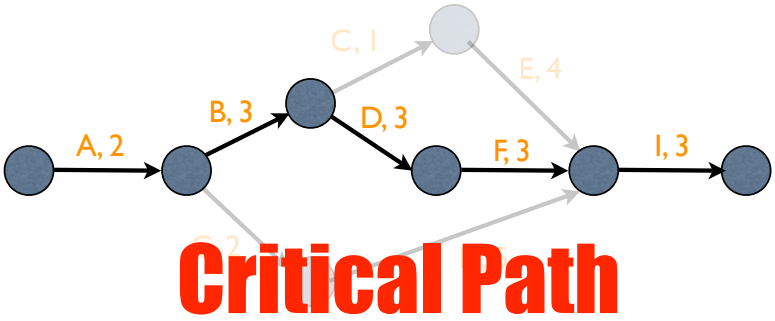
PERT Charts

There are several routes to reach from start to finish.
Time to complete: 13 days!



PERT Charts

There are several routes to reach from start to finish.
Time to complete: 14 days!



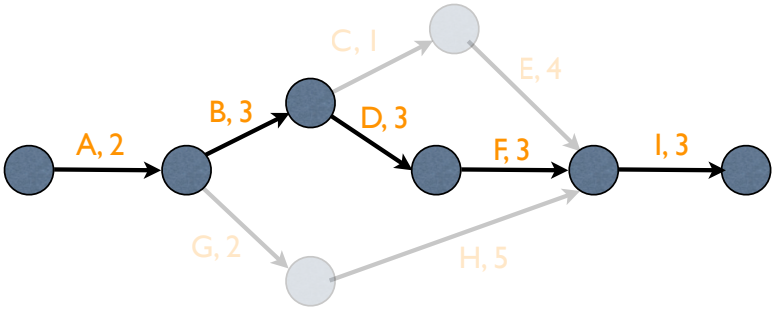
Critical Path

PERT Charts

- The pre-requisites and dependencies of tasks determine a *critical path:* the sequence of dependencies in the project.
- The critical path is the sequence of activities that takes the *longest time to complete*.
- Any delay to an activity in the critical path will cause delays to the overall project.
- Delays to activities not on the critical path ("float" or "slack") need not necessarily cause overall delays.

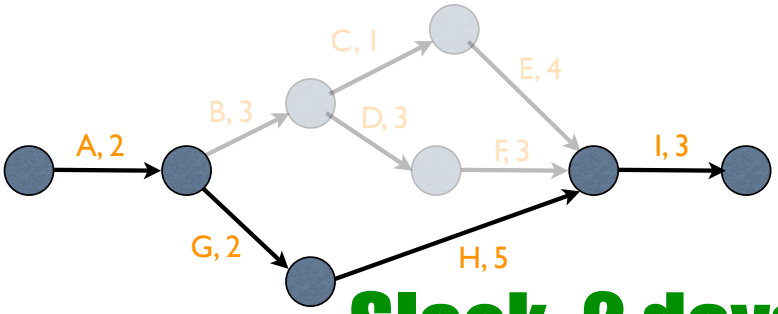
PERT Charts

There are several routes to reach from start to finish.
Time to complete: 14 days!



PERT Charts

There are several routes to reach from start to finish.
Time to complete: 12 days!



Slack: 2 days

PERT Charts

- Optimistic time (O): the minimum possible time required to accomplish a task, assuming everything proceeds better than is normally expected.
- Pessimistic time (P): the maximum possible time required to accomplish a task, assuming everything goes wrong (but excluding major catastrophes).
- Most likely time (M): the best estimate of the time required to accomplish a task, assuming everything proceeds as normal.

http://en.wikipedia.org/wiki/Program_Evaluation_and_Review_Technique
AND
http://www.egr.msu.edu/classes/ece480/goodman/ganttv1.pdf

PERT Charts

- Expected time (T_E): the best estimate of the time required to accomplish a task, assuming everything proceeds as normal.

$$T_E = (O + 4M + P) / 6$$

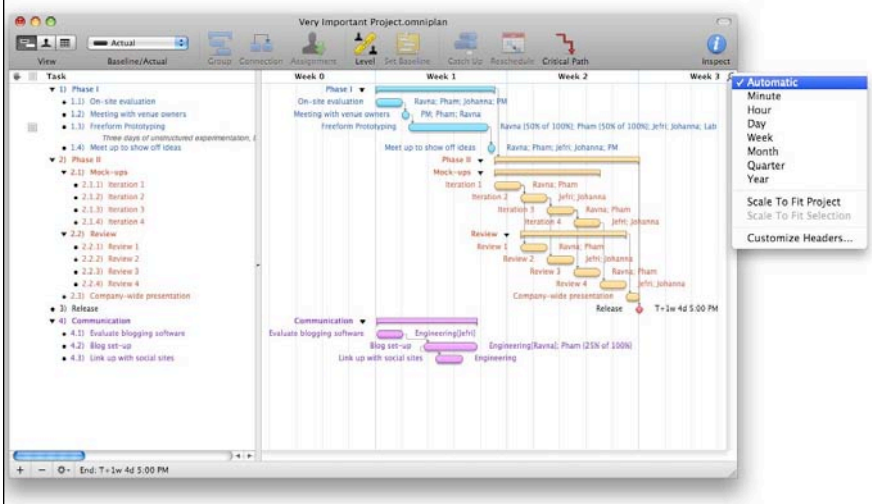
The assumption here is that the expected time is the average time the task would require if the task were repeated on a number of occasions over an extended period of time.

PERT Charts

PERT is useful because it provides the following information:

- Expected project completion time.
- Probability of completion before a specified date.
- The critical path activities that directly impact the completion time.
- The activities that have slack time and that can lend resources to critical path activities.
- Activity start and end dates.

Project Planning Tools



Risk Management

He who will not risk cannot win (John Paul Jones, 1791).

Types of Risks

- Project risks threaten the *project plan*.
  Causes project to slip and increase cost.
- Technical risks threaten the *quality* and *timeliness* of the project.
  Causes implementation to become difficult or impossible.
- Business risks threaten the *viability* of the project to be built.
  Causes project to be irrelevant or redundant.

Types of Risks

- Known risks are those that can be uncovered during careful evaluation of the project, and the business and technical environment
  (e.g. unrealistic delivery data, lack of documented requirements).
- Predictable risks can be extrapolated by past experience/projects
  (e.g. poor productivity or communication).
- Unpredictable risks are those that are difficult to identify
  (e.g. manager falls of a horse).

Risk Management

Types of Risks

- Generic risks
- Product-specific risks

Risk Items Checklist

(example)

- Product size
- Business impact
- Customer characteristics
- Development environment
- Technology to be built
- Staff size and experience

Risk Management

Similar story with software development!

Risk Table

Risk	Category	Probability	Impact	RMMM
Size estimate low	PS	20%	2	
Change in req.	PS	45%	3	
Lack of training	DE	15%	2	
Staff inexperienced	ST	40%	4	
Delivery deadline tightened	BU	60%	5	

Impact values:
1 - catastrophic
2 - critical
3 - marginal
4 - negligible

Note that RMMM stands for Risk Migitation, Monitoring & Management (slide 84)

Assessing Risk Impact

Risk Exposure (RE) = P x C

where P is the probability of the event to occur and C is the cost to the project if the risk occurs.

RMMM

Risk Migitation, Monitoring & Management

- Risk avoidance (prevention better than cure)
- Risk monitoring
- Risk management and contingency plans.

Project Control

Project Control

- Measuring and correcting activities to ensure that goals are met.
- Detect when any deviations from the plan are occurring.
- Minimize need for corrective action.

Four Ps of Project Management

People

Product

Process

Project

Software Project Management

...the most interesting aspect of these six problem areas is that all are associated with project management rather than with technical personnel.

Summary

Project Scheduling

Risk Management

He who will not risk cannot win (John Paul Jones, 1791).