Software Development Project Management

Software Development Process?
1) Announce availability.
2) Order the T-shirts for the Development team.
3) Write the code.
4) Write the manual.
5) Hire a Product Manager.
6) Spec the software (Writing the specs after the code helps to ensure that the software meets the specifications).
7) Ship.
8) Test (the customers are a big help here).
9) Identify bugs as potential enhancements.
10) Announce the upgrade program.

Cynical Views or Reality?
- Projects progress quickly until they are 90% complete. Then they remain at 90% complete forever.
- When things are going well, something will go wrong. When things just can't get worse, they will. When things appear to be going better, you have overlooked something.
- If project content is allowed to change freely, the rate of change will exceed the rate of progress.
- Project teams detest progress reporting because it manifests their lack of progress.

Software Project Elements
- All technical and managerial activities required to deliver the deliverables to the client.
- A software project has a specific duration, consumes resources and produces work products.
- Management categories to complete a software project:
  - Tasks, Activities, Functions

Software Project Management Plan (SPMP)
- The controlling document for a software project.
- Specifies the technical and managerial approaches to develop the software product.
- Companion document to SRS: Changes in either may imply changes in the other document.
- SPMP may be part of project agreement.

Project Agreement
- Document written for a client that defines:
  - Scope, duration, cost and deliverables for the project.
  - Exact items, quantities, delivery dates, delivery location.
  - Can be a contract, a statement of work (SOW), a business plan, or a project charter.
  - Client: Individual or organization that specifies the requirements and accepts the project deliverables.
  - Deliverables:
    - Software
    - Documents
    - Demonstrations of function
    - Demonstration of nonfunctional requirements
    - Demonstrations of subsystems
### Terms

**Work product**: Something that needs to be done or get created in the project:
- Applies to activities as well as tangible products

### Phases in the Unified Process

- **Inception**: Vision, requirements
- **Elaboration**: Design
- **Construction**: Coding, testing
- **Transition**: Delivery, testing

### Work-Products by Phase

#### Inception phase
- Business case/justification
- Problem statement
- Requirements Specification
- Use cases
- Risk analyses
- Priorities
- Acceptance plan

#### Design phase
- System architecture
- Various diagrams (class, sequence,...)
- Documentation plan
- Identify third-party components
- Configuration management plan
- Testing plan
- Maintenance plan

#### Construction phase
- Product source code
- Test code
- Documentation
  - Internal
  - User

#### Transition phase
- The software
- Installation instructions
- User manual
- Customer support
Additional Work-Products

- **Management “products”**
  - Design and development processes
  - Resource plan
  - Schedule, milestones
  - Release plan
  - Quality assurance plan
  - Risk management plan

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Work-product Traceability Diagram

- Shows impacts of one work product on another

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Work-Product Traceability Diagram (partial)

- Use Cases
- Object Model
- Coding Guidelines
- Acceptance Criteria
- Test Cases
- Source Code
- Final Product

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Project Management Terms (not universal)

- **Tasks**: Small units of work
- **Activities**: Major work units
- **Milestones**: When activities are completed
- **Functions**: Pervasive, ongoing management functions

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Tasks: Small units of work

- **Smallest** unit of management accountability
  - Atomic unit of planning and tracking
  - Finite duration, need resources, produce tangible result (documents, code)
- **Specification of a task**: Work package
  - Name, description of work to be done
  - **Preconditions** for starting, duration, required resources
  - Work product to be produced, acceptance criteria for it
  - Risk involved
- **Completion criteria**
  - Includes the acceptance criteria for the work products (deliverables) produced by the task.

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Activities: Major Units of Work

- Culminates in major project milestones:
  - Internal checkpoint should not be externally visible
  - Scheduled event used to measure progress
- Milestone often produces baseline:
  - Formally reviewed work product
  - Under change control (change requires formal procedures)
- Activities may be grouped into larger activities:
  - Establishes hierarchical structure for project (phase, step, ...)
  - Allows separation of concerns
- Precedence relations often exist among activities (PERT Chart)
Examples of Activities

- Major Activities:
  - Planning
  - Requirements Elicitation
  - Requirements Analysis
  - System Design
  - Object Design
  - Implementation
  - System Testing
  - Delivery

- Activities during requirements analysis:
  - Define scenarios
  - Define Use Case model
  - Define object model
  - Define dynamic model
  - Design User Interface

Activities during requirements analysis:
- Refine scenarios
- Define Use Case model
- Define object model
- Define dynamic model
- Design User Interface

Organizational Diagrams

- Work breakdown structure (WBS): Shows hierarchy of work products
- PERT chart: Shows the order in which activities must be done (a partial order)
- Gantt Chart or Schedule: Shows scheduling of work products as a function of time

Creating Work Packages

- Work Breakdown Structure (WBS)
  - Break up project into activities (phases, steps) and tasks.
  - The work breakdown structure does not show the interdependence of the tasks

Work Breakdown Structure (WBS) Diagram

WBS Tradeoffs

- Work breakdown structure influences cost and schedule
- Determination of work breakdown structure may be incremental and iterative
PERT Chart

- “Program Evaluation and Review Technique”
- U.S. Navy, 1957

To Build a PERT chart

- List all the tasks.
- For each task:
  - List the tasks that must (immediately) precede that task
  - Remove implied dependencies (called the "transitive reduction" of the graph)

Task durations and dependencies

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<th>Duration (days)</th>
<th>Dependencies</th>
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<td></td>
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<td>T9</td>
</tr>
<tr>
<td>T12</td>
<td>10</td>
<td>T11</td>
</tr>
</tbody>
</table>

Tasks in Building a House:
What are likely required orders?

- Install roofing
- Install interior electrical
- Buy materials
- Excavate
- Build outside wall
- Install interior plumbing
- Install exterior siding
- Paint interior
- Install flooring
- Lay foundation
- Obtain permits
- Install exterior electrical
- Install exterior doors and fixtures
- Paint exterior
- Survey land
- Install interior doors and fixtures
- Install wallboard
- Install exterior plumbing

Task network with Milestones (ovals)
PERT -> Gantt

- As we saw, PERT enforces certain precedence constraints.

- Other kinds of constraints:
  - Staff assignment (task -> person) and loading constrains number of activities that can go on concurrently.
  - Resource availability further constrains time at which various activities can happen.

- The Gantt chart (or schedule) shows a particular scheduling of the tasks, subject to all of the constraints.

Real-life Gantt Chart

(source: http://www.kidasa.com/information/examples/aerospace/aerospace2.html)

Henry L. Gantt (1861-1919)

(http://accel-team.com/scientific/scientific_04.html)

- well-known pioneer in the early days of scientific management
- remembered for his humanizing influence on management, emphasizing the conditions that have favorable psychological effects on the worker
- "The Gantt chart for which he will be remembered, is a visual display chart used for scheduling, which is based on time, rather than quantity, volume or weight."

Critical Path

- A "critical path" on a PERT chart is one in which the sum of durations of the tasks on the path equals the shortest overall project-completion time.

- The critical path is shaded on the preceding diagram.

- PERT is also called CPM (Critical Path Method)

What is the Critical Path in Building your House, given the number of days required as shown?

- Install roofing (4)
- Install interior electrical (2)
- Buy materials (5)
- Excavate (7)
- Build outside wall (5)
- Install interior plumbing (4)
- Install exterior siding (3)
- Paint interior (2)
- Install flooring (2)
- Lay foundation (2)
- Obtain permits (24)
- Install exterior electrical (3)
- Install exterior doors and fixtures (2)
- Paint exterior (1)
- Survey land (1)
- Install interior doors and fixtures (2)
- Install wallboard (2)
- Install exterior plumbing (1)
Exercise

List as many ways you can for shortening the critical path in a set of tasks.

Staff Loading & Resources

Staff loading and resource constraints are two aspects of scheduling not represented directly on PERT charts.

Generally they have the effect of providing added sequencing, and therefore lengthening overall project time.

Staff Loading & Resources

Staff loading refers to:
- Some tasks can be assigned only to certain staff members, based on specialized skills.
- A given staff member can only do so much at a time.
- Staff members differ in their productivity on a given task.

How Do Constraints Differ from Precedence Relationships?

Precedence relationships specify a particular sequencing between two tasks.

Constraints don’t specify a particular sequence, but only that two tasks can’t be done simultaneously.

How Do Constraints Differ from Precedence Relationships?

Resource constraints refers to certain resources being needed for certain tasks, but being limited in the number of tasks they can support concurrently.

Resources include:
- Machines, workstations, storage units
- Rooms, offices
Tools

- Microsoft Project
  - Handles WBS
  - Handles PERT to Gantt
  - Does not handle resources
  - Sort of handles staff loading, except that a single staff member can be overloaded.

Tracking How Well are We Doing

Earned-Value Tracking Method/Chart

- One way to track how close to “done” the project is:
  - As key parts of a product are completed, the product “earns value”.

- Express earned value in % of total value or $ (= % x budgeted amount for task)

- Some variations allow partial credit, others don’t.

Earned Value vs. Time

- Earned value vs. Time
  - Earned value
  - Target: project complete
  - Task completed

- Earned value vs. Time
  - Earned value
  - Project complete
  - Task completed
Use of Earned Value Diagram

- Based on project Gantt chart, create a profile plan of earned value
- Track actual earned value against plan
- Use discrepancies to make projections about delivery dates, cost, etc.

Project Ahead of Schedule

Project Behind Schedule

Earned Value with sub-tasks in $ (% x budget)

Example Gantt Chart with Earned Value Overlay


Implication of Slippage

- Slippage in earned value may imply slippage in delivery date,
  especially if the slipped task is on the critical path.
Slip Chart

slip = delivery date minus previously announced delivery date

smaller slips are better

Word for Windows 1.0 Slip

Slip vs. Lead

- slip = delivery date minus previously announced delivery date
- lead = previously announced delivery date minus date on which new delivery announced

Example of Lead

- lead = previously announced delivery date minus date on which new delivery announced

Example:

- Original delivery date = day 200
- On day 195 announce new delivery date: day 300: moderate lead
- Small leads are bad (but small slips are good)

Slip-Lead Chart (plots slips vs. leads)

- Unhealthy region (large slips, small leads)
- Healthy region (large leads, small slips)

Word for Windows 1.0 Slip/Lead