**CH03 Planning and Managing the Project**

- Tracking Progress
- Project Personnel
- Effort Estimation
- Risk Management
- The Project Plan
- Process Models and Project Management

**Tracking Progress**

- Questions from our customers
  - Do you understand my problem and my needs?
  - Can you design a system that will solve my problem or satisfy my needs?
  - How long will it take you to develop such a system?
  - How much will it cost to have you develop such a system?
- Require a well-thought-out project schedule

**Project Schedule**

- PHASE 1
  - ACTIVITY 1.1
  - ACTIVITY 1.2
  - ACTIVITY 1.3
- PHASE 2
  - ACTIVITY 2.1
  - ACTIVITY 2.2
  - ACTIVITY 3.3
- PHASE n
  - ACTIVITY n.1
  - ACTIVITY n.2
  - ACTIVITY n.3

**Activity and Milestone**

- Activity is a part of the project that takes place over a period of time.
- Milestone is the completion of an activity -- a particular point in time.
- Describe each activity
  - precursor
  - duration
  - due date
  - endpoint

**Activity Graph**

- START
- Request permit
- Surveying
- Excavation
- Buy materials
- Lay foundation
- Build outside wall
- Install exterior plumbing
- Install exterior electrical
- Install exterior siding
- Paint exterior
- Install exterior doors and fixtures
- Install roofing
- Install floor
- Install interior plumbing
- Install interior electrical
- Install wallboard
- Paint interior
- Install interior doors and fixtures
- Finish

**Activity Graph with Duration**

- START
- Request permit
- Surveying
- Excavation
- Buy materials
- Lay foundation
- Build outside wall
- Install exterior plumbing
- Install exterior electrical
- Install exterior siding
- Paint exterior
- Install exterior doors and fixtures
- Install roofing
- Install floor
- Install interior plumbing
- Install interior electrical
- Install wallboard
- Paint interior
- Install interior doors and fixtures
- Finish
Estimating Completion

- Critical Path Method (CPM) analyzes the paths among the milestones.
  - Shows the minimum amount of time it will take to complete the project.
  - Reveals those activities that are most critical to completing the project on time.
- Trace through each path from start to finish, adding up the time.
- Critical path is the longest path.

Real time, Available time, Slack time

- **Real time** for an activity is the estimated amount of time required for the activity to be completed.
- **Available time** is the amount of time available in the schedule for the activity’s completion.
- **Slack time** = available time - real time
- Slack time = latest start time - earliest start time
- e.g. surveying

Tools to Track Progress: Gantt chart

<table>
<thead>
<tr>
<th>ACTIVITY NUMBER</th>
<th>DESCRIPTION</th>
<th>JAN</th>
<th>FEB</th>
<th>MAR</th>
<th>APR</th>
<th>MAY</th>
<th>JUN</th>
<th>JUL</th>
<th>AUG</th>
<th>SEP</th>
<th>OCT</th>
<th>NOV</th>
<th>DEC</th>
</tr>
</thead>
<tbody>
<tr>
<td>WBS 1.0 SYSTEM PLANNING</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1 Review specification</td>
<td>Specification approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.2 Review budget</td>
<td>Budget approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.3 Review schedule</td>
<td>Schedule approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.4 Develop plan</td>
<td>Plan approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WBS 2.0 SYSTEM DESIGN</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1 Top-level design</td>
<td>Design approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.2 Prototyping</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.3 User interface</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.4 Detailed design</td>
<td>Design approved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Project Personnel

- To determine the project schedule and estimate the associated effort and costs, we need to know:
  - how many people will be working on the project,
  - what tasks they will perform, and
  - what abilities and experience they must have.
- Who does what, and how the staff can be organized.

Staff Roles and Characteristics

- ability to perform the work
- interest in the work
- experience with similar applications, tools, languages, techniques, and development environment
- training
- ability to communicate and to share responsibility with others
- management skills

Work Styles

<table>
<thead>
<tr>
<th>INTUITIVE</th>
<th>INTROVERT:</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTROVERT:</td>
<td>Asks others</td>
</tr>
<tr>
<td>INTROVERT:</td>
<td>Acknowledges feelings</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EXTROVERT:</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXTROVERT:</td>
</tr>
<tr>
<td>EXTROVERT:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RATIONAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>RATIONAL</td>
</tr>
<tr>
<td>RATIONAL</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RATIONAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>RATIONAL</td>
</tr>
<tr>
<td>RATIONAL</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>INTUITIVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTUITIVE</td>
</tr>
<tr>
<td>INTUITIVE</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>INTROVERT:</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTROVERT:</td>
</tr>
<tr>
<td>INTROVERT:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EXTROVERT:</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXTROVERT:</td>
</tr>
<tr>
<td>EXTROVERT:</td>
</tr>
</tbody>
</table>
Communications

- Two people: 1 line of communication
- Three people: 3 lines of communication
- Four people: 6 lines of communication
- Five people: 10 lines of communication
- \( n \) people: \( n(n-1)/2 \) lines of communication

Meetings (complaints)

- The purpose of the meeting is unclear.
- The attendees are unprepared.
- Essential people are absent or late.
- The conversation veers away from its purpose.
- Participants argue, dominate the conversation, or do not participate.
- Decisions made at the meeting are never enacted afterward.

Project Team Organization

- Team members are organized in ways that enhance the swift completion of quality products.
- Choice of an appropriate structure depends:
  - the backgrounds and work styles of the team members
  - the number of people on the team
  - the management styles of the customers and developers

Chief Programmer team

```
Chief programmer
    ↓
Assistant chief programmer
    ↓
Senior programmers
    ↓
Librarian
    ↓
Junior programmers
    ↓
Administration
    ↓
Test team
```

Egoless Approach

- Holds everyone equally responsible.
- Criticism is made of the product or the result, not the people.
- All team members vote on a decision.

Comparison of Organizational Structures

- Highly Structured
  - High certainty
  - Repetition
  - Large projects
- Loosely Structured
  - Uncertainty
  - New Techniques or technology
  - Small projects
  - Creative
Effort Estimation:

How much the project COST

• Several types of costs: facilities, staff, and methods and tools.
• Facilities: 100 square feet of dedicated floor space, 30 square feet of table space, floor-to-ceiling enclosure, free from phone calls and uninvited visitors --- for each person to work effectively.
• Staff: the biggest component of cost is effort, how many staff-days
• Tools: tools and training cost.

Estimation techniques:

• Expert Judgement
• Algorithmic Methods
• Machine-learning Methods
• Finding the Model for Your Situation

Expert Judgement

• Ask an Expert
• Analogies and educated guess
• Asking three predictions:
  ➔ pessimistic one (x)
  ➔ optimistic one (y)
  ➔ Most likely guess (z)
• Normalized by (x + 4y + z)/6

Expert Judgement: Delphi technique

• Ask each individual predictions secretly
• Calculate average estimate
• Present the estimate to the group
• Allow them to revise

Algorithmic Methods

• Express the relationship between the effort and the factors that influence it.
• $E = 5.25 \ S^{0.91}$
  ➔ $S$ is size in lines of code
• $E = 5.5 + 0.73 \ S^{1.16}$ (by Bailey)
• Size Estimation problem
  ➔ Estimates required before size information is available.

COCOMO 2.0

• Estimates size in terms of high-level objects, such as,
  • number of server data tables,
  • number of client data tables,
  • number of screens,
  • number of reports
  • percentage of screens and reports reused from previous projects
Productivity Factors
- Customer interface complexity
- User participation in requirements definition
- Customer-originated program design changes
- Customer experience with the application area
- Overall personnel experience

Productivity Factors (continue)
- Use of Structured Programming
- Use of design and code inspections
- Use of top-down development
- Overall complexity of code
- Complexity of program flow
- Overall constraints on program’s design

Machine-learning Methods
- Learn from the past projects
- Predict the future cost
- Neural Network approach
  → training the network with data from past projects
  → network values are adjusted to reflect past experience
  → training methods, such as back-propagation
  → use the network to produce an effort estimate

Neural Network e.g.

Input layer
Intermediate layers
Output layer

Problem complexity
Novelty of application
Use of design tools
Team size
Effort

Case-based Reasoning (CBR)
- Build case history of past projects
- Using CBR system
  → User identifies a new problem as a case
  → it retrieves similar cases from a repository of historical information
  → it reuses knowledge from previous cases
  → it suggests a solution for the new case
- How to characterizing cases and determining similarity

Finding the Model for Your Situation
- Which model is the best?
- Depending on your situation
- In general based on comparison data, Bailey-Basili model performs better than others.
Different reports of effort distribution //

Planning

Testing

Coding

Other

Brooks

Yourdon

Risk Management

- A risk is an unwanted event that has negative consequences.
- Risk management involves understanding and controlling the risks.
- Generic Risk: common to all software projects
- Project specific Risk: particular vulnerabilities of the given project.

Defining and Quantifying the Risk

- Risk impart: the loss associated with a risk
- Risk probability: the likelihood for the risk to occur
- Risk exposure = risk impart * risk probability

Risk Reduction

- Risk control: a set of actions taken to reduce or eliminate a risk
- Justify the action:
  - Risk leverage = (Risk exposure before reduction - risk exposure after reduction) / (cost of risk reduction)
- Record your decisions in a risk management plan.

Risk Management Activities

- Risk assessment
- Risk analysis
- Risk prioritization
- Risk control
- Risk reduction
- Risk management planning
- Risk resolution

“Top Ten List” of Risk Items

- 1. Personnel shortfalls
- 2. Unrealistic schedules and budgets
- 3. Developing the wrong software functions
- 4. Developing the wrong user interface
- 5. Gold plating (cost overrun)
“Top Ten List” of Risk Items (more)

• 6. Continuing stream of requirements changes
• 7. Shortfalls in externally (other groups or co.) performed tasks
• 8. Shortfalls in externally furnished components
• 9. Real-time performance shortfalls
• 10. Straining computer science capabilities

The Project Plan

• We write a document called a project plan to
  ➔ communicate risk analysis and management,
  ➔ project cost estimates,
  ➔ schedule, and
  ➔ organization
• to our customers and our own group

Items for good project plan

• project scope
• project schedule
• project team organization
• technical description of the proposed system
• project standards, procedures, and proposed techniques and tools
• quality assurance plan

More Items for good project plan

➔ configuration management plan
➔ documentation plan
➔ data management plan
➔ resource management plan
➔ test plan
➔ training plan
➔ security plan
➔ risk management plan
➔ maintenance plan

Process Models and Project Management

• managing at building quality products on time and within budget
• tailor the project management techniques to
  ➔ particular characteristics of the resources needed,
  ➔ the chosen process, and
  ➔ the people assigned.

Enrollment Management

• Case study: Digital Alpha AXP project
• Vision enrollment (Business Goals, Project objectives):
  ➔ establish and shared common goals
• Commitment delegation (Trust, Accountability)
  ➔ result was measurable and identified with a particular owner
  ➔ who is held accountable for delivery.
Enrollment Management (more)
- Inspection and support (Review, Encouragement)
  → inspect to make sure that delivery would be on time, identify risk
  → supportive feedback and make changes to help move the project forward
- Acknowledgement and learning (Personal, Public)
  → acknowledgement progress both personally and publicly
  → recorded what had been learned and how things could be improved

One-page Master plan
- see the “big picture”
- have a global picture of
  → what to do,
  → and when
  → and how to do it
- regular operation inspections

One-page report: itemizing key points
- schedule
- milestones
- critical-path events in the past month
- activities along the critical path in the next month
- issues and dependencies resolved
- issues and dependencies not resolved (with ownership and due dates)

Recognition of job well done
- engineers are usually motivated more by recognition than by financial gain
- announcing progress in public and managers show appreciation

Flexible and focused management
- resulting in meeting schedule,
- producing exceptional product,
- meeting performance goals.

Accountability Modeling
- U.S. Air Force and Lockheed Martin (F-16 software case study)
- More than four Million lines of code, a quarter of which met real-time deadlines in flight.
- Integrated product development team:
  → combining individuals from different functional groups into an interdisciplinary work unit,
  → empowered with separate channels of accountability
Team and Stakeholder

- **Team**: any collection of people responsible for producing a given (desired) result
- **Stakeholder**: anyone affected by that result or the way in which the result is achieved.
- **Accounting**: a report of what you have done, are doing, or plan to do
- **Consequences**: with the goal of doing only what makes sense for both the team and the stakeholders

Accountable

- including a weekly team status review
- each **personal action item** had explicit closure criteria and was tracked to completion
- activity map showing progress on each activity in the overall context of the project
- earned value: a scheme for comparing activities and their contribution to the overall progress of the project

Accounting hand-off from one team to others

- coordination among different teams: use software to track the hand-off from one team to another
- Accountability model coupled with hand-off model
  - provide mechanism for communication and coordination
  - encourage risk management
  - integrated progress reporting with problem solving

Accountability model applied

- to the design of management systems,
- to team operation procedures,
- replacing independent behaviors with interdependence,
- emphasizing: “being good rather than looking good” !!!

Anchoring Milestones

- Win-Win Spiral Model
  (US. Department of Defense’s STARTS program case study)
  - reduces from $140 to $57 per delivered line of code,
  - quality improved from 3 to 0.035 fault per thousand delivered lines of code.