Work Breakdown Structure (WBS)

Emanuele Della Valle
http://emanueledellavalle.org
Credits

- This slides are largely based on Prof. John Musser class notes on “Principles of Software Project Management”
- Original slides are available at http://www.projectreference.com/
- Reuse and republish permission was granted
Agenda

- **Today**
  - Review Classes 5 and 6
  - Work Breakdown Structures (WBS)

- **Next Class**
  - Estimation
Classes 5 and 6 Review

- Phases in details
  - Know the 7 phases
  - Understand the steps in each phase
  - Know the primary goals, characteristics and issues of each

- Lifecycles
  - Know a representative sample
  - Waterfall and variation, 1-2 iterative ones
  - Learn a bit about XP and other Agile methods
  - Matching Lifecycles to Project

- Planning (introduction)
  - Primary Planning Steps
  - Documents
Introduction to session 7, 8, and 9

Estimation

- Predictions are hard, especially about the future
  - Yogi Berra*

- 2 Types: Lucky or Lousy?

Introduction to session 7, 8, and 9
Planning, Estimating, Scheduling

- What’s the difference?
- Plan: Identify activities. No specific start and end dates.
- Estimating: Determining the size & duration of activities.
- Schedule: Adds specific start and end dates, relationships, and resources.
Introduction to session 7, 8, and 9

Project Planning: A 12 Step Program

1. Set goal and scope
2. Select lifecycle
3. Set team form
4. Start team selection
5. Determine risks
6. Create WBS
7. Identify tasks
8. Estimate size
9. Estimate effort
10. Identify task dependencies
11. Assign resources
12. Schedule work
Introduction to session 7, 8, and 9

How To Schedule

1. Identify “what” needs to be done
   • Work Breakdown Structure (WBS)

2. Identify “how much” (the size)
   • Size estimation techniques

3. Identify the dependency between tasks
   • Dependency graph, network diagram

4. Estimate total duration of the work to be done
   • The actual schedule
Introduction to session 7, 8, and 9

WBS & Estimation

- How did you feel when I asked
  - “How long will your project take?”
- Not an easy answer to give right?
- At least not if I were a real customer on a real project
- How can you manage that issue?
You need to decompose your project into manageable chunks

ALL projects need this step

Divide & Conquer

Two main causes of project failure
  • Forgetting something critical
  • Ballpark estimates become targets

How does partitioning help this?
A Project: functions, activities, tasks

- Function
  - Management activity
  - Often spanning the life of the project, such as:
    - Project Management
    - Risk Management
    - Change Management

- Activity
  - An element of work with expected duration, cost, resources
  - Can be subdivided into other activities or tasks

- Task
  - Lowest level of work on the project
  - Typically not shown on preliminary WBS (too granular)
  - Smallest unit of work in the real schedule
Work Breakdown Structure: WBS

- Hierarchical list of project’s work activities

- 2 Formats
  - Outline (indented format)
  - Graphical Tree (Organizational Chart)

- Uses a decimal numbering system
  - Ex: 3.1.5

- Includes
  - Development, Mgmt., and project support tasks

- Shows “is contained in” relationships

- Does not show dependencies or durations
Contract vs. Project WBS

- Contract WBS (CWBS)
  - First 2 or 3 levels
  - High-level tracking

- Project WBS (PWBS)
  - Defined by PM and team members
  - Tasks tied to deliverables
  - Lowest level tracking
A Full WBS Structure

- Up to six levels (3-6 usually) such as
  - Managerial levels
    - 1: Total Program
    - 2: Project
    - 3: Task
  - Technical levels
    - 4: Subtask
    - 5: Work Package
    - 6: Level of Effort

- Upper 3 can be used by customer for reporting (if part of RFP)
- Different level can be applied to different uses
  - Ex:
    - Level 1: authorizations
    - Level 2: budgets
    - Level 3: schedules
WBS

Chart Format Example

- Retail Web Site
  - 1.0: Project Management
  - 2.0: Requirements Gathering
  - 3.0: Design and Analysis
  - 4.0: Site Software Development
  - 5.0: Testing and Production
    - 4.1: HTML Design and Creation
    - 4.2: Backend Software
    - 4.3: Graphics and Interface
    - 4.4: Content Creation
      - 4.2.1: Database Implementation
      - 4.2.2: Middleware Development
      - 4.2.3: Security Subsystems
      - 4.2.4: Catalog Engine
      - 4.2.5: Transaction Processing
Retail Web Site
1.0 Project Management
2.0 Requirements Gathering
3.0 Analysis & Design
4.0 Site Software Development
   4.1 HTML Design and Creation
   4.2 Backend Software
      4.2.1 Database Implementation
      4.2.2 Middleware Development
      4.2.3 Security Subsystems
      4.2.4 Catalog Engine
      4.2.5 Transaction Processing
   4.3 Graphics and Interface
   4.4 Content Creation
5.0 Testing and Production
WBS Types

- Process WBS
  - a.k.a Activity-oriented
  - Ex: Requirements, Analysis, Design, Testing
  - Typically used by PM

- Product WBS
  - a.k.a. Entity-oriented
  - Ex: Financial engine, Interface system, DB
  - Typically used by engineering manager

- Hybrid WBS: both above
  - This is not unusual
  - Ex: Lifecycle phases at high level with component or feature-specifics within phases
  - Rationale: processes produce products
WBS

Product WBS Example
WBS
Process WBS Example

Level 0 - Entire Project

Intranet Project

Level 1

Concept
Web Site Design
Web Site Development
Roll Out
Support

Level 2

Evaluate Current Systems
Define Requirements
Define Specific Functionality
Define Risks & Risk Management Approach
Develop Project Plan
Brief Web Development Team

Level 3

Define User Requirements
Define Content Requirements
Define System Requirements
Define Server Owner Requirements
Outline WBS with Gantt Chart
WBS

WBS by PMI Process Groups

<table>
<thead>
<tr>
<th>Task Name</th>
<th>Gantt Chart</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initiating</td>
<td></td>
</tr>
<tr>
<td>Select project manager</td>
<td></td>
</tr>
<tr>
<td>Form project team</td>
<td></td>
</tr>
<tr>
<td>Develop project charter</td>
<td></td>
</tr>
<tr>
<td>Planning</td>
<td></td>
</tr>
<tr>
<td>Develop scope statement</td>
<td></td>
</tr>
<tr>
<td>Create WBS</td>
<td></td>
</tr>
<tr>
<td>Develop and refine other plans</td>
<td></td>
</tr>
<tr>
<td>Executing</td>
<td></td>
</tr>
<tr>
<td>Concept</td>
<td></td>
</tr>
<tr>
<td>Web Site Design</td>
<td></td>
</tr>
<tr>
<td>Web Site Development</td>
<td></td>
</tr>
<tr>
<td>Roll Out</td>
<td></td>
</tr>
<tr>
<td>Support</td>
<td></td>
</tr>
<tr>
<td>Controlling</td>
<td></td>
</tr>
<tr>
<td>Closing</td>
<td></td>
</tr>
</tbody>
</table>

Microsoft Project

[Image of Gantt chart showing project timeline and tasks]
Less Frequently Used Alternatives

- **Organizational WBS**
  - Research, Product Design, Engineering, Operations
  - Can be useful for highly cross-functional projects

- **Geographical WBS**
  - Can be useful with distributed teams
  - NYC team, San Jose team, Off-shore team
WBS

Work Packages

- Generic term for discrete tasks with definable end results
- Typically the “leaves” on the tree
- The “one-to-two” rule
  - Often at: 1 or 2 persons for 1 or 2 weeks
- Basis for monitoring and reporting progress
  - Can be tied to budget items (charge numbers)
  - Resources (personnel) assigned
- Ideally shorter rather than longer
  - Longer makes in-progress estimates needed
  - These are more subjective than “done”
  - 2-3 weeks maximum for software projects
  - 1 day minimum (occasionally a half day)
  - Not so small as to micro-manage
Wrap Up (so far)

- List of Activities, not Things
- List of items can come from many sources
  - SOW, Proposal, brainstorming, stakeholders, team
- Describe activities using “bullet language”
  - Meaningful but terse labels
- All WBS paths do not have to go to the same level
- Do not plan more detail than you can manage
PM must map activities to chosen lifecycle

Each lifecycle has different sets of activities

Integral process activities occur for all
  • Planning, configuration, testing

Operations and maintenance phases are not normally in plan (considered post-project)

Some models are “straightened” for WBS
  • Spiral and other iterative models
  • Linear sequence several times

Deliverables of tasks vary by chosen lifecycle
WBS Techniques

- Top-Down
- Bottom-Up
- Analogy
- Brainstorming
  - Post-its on a wall
- Rolling Wave
  - 1st pass: go 1-3 levels deep
  - Gather more requirements or data
  - Add more detail later
WBS - Techniques

Top-down

- Start at highest level
- Systematically develop increasing level of detail

Best if
- The problem is well understood
- Technology and methodology are not new
- This is similar to an earlier project or problem

But is also applied in majority of situations

Advantages
- Quick
- Can be done when only part of the requirements is understood

Disadvantages
- May lack important details specific to the project that have never occurred in earlier projects
WBS -Techniques

Bottom-up

- Start at lowest level tasks
- Aggregate into summaries and higher levels
- Disadvantages
  - Time consuming
  - Needs more requirements complete
- Advantages
  - Detailed
WBS - Techniques

Analogy

- Base WBS upon that of a “similar” project
- Use a template
- Analogy also can be estimation basis

Advantages
  - Based on past actual experience

Disadvantages
  - Needs comparable project
WBS -Techniques

Brainstorming

- Approach
  - Generate all activities you can think of that need to be done
  - Group them into categories

- Both Top-down and Brainstorming can be used on the same WBS

- Remember to get the people who will be doing the work involved (buy-in matters!)

- Advantages
  - Detailed
  - Buy-in

- Disadvantages
  - Time consuming
WBS -Techniques

Rolling Wave

- 1st pass: go 1-3 levels deep
- Gather more requirements or data
- Add more detail later

Advantages
- Quick
- Works with poorly understood requirements
- Mitigates the risk of forgetting important items
- Detailed

Disadvantages
- Time consuming
WBS

WBS are Basis of Many Things

- Network scheduling
- Costing
- Risk analysis
- Organizational structure
- Control
- Measurement
WBS Guidelines Part 1

- Should be easy to understand
- Some companies have corporate standards for these schemes
- Some top-level items, like Project Mgmt. are in WBS for each project
  - Others vary by project
- What often hurts most is what’s missing
- Break down until you can generate accurate time & cost estimates
- Ensure each element corresponds to a deliverable
WBS Guidelines Part 2

- **How detailed should it be?**
  - Not as detailed as the final MS-Project plan
  - Each level should have no more than 7 items
  - It can evolve over time

- **What tool should you use?**
  - Excel, Word, Project
  - Org chart diagramming tool (Visio, etc)
  - Specialized commercial apps

- Re-use a “template” if you have one
Put yourself at work :-)

- Divide in groups (3-5 people)
- Develop a WBS for a software project that aims at delivering an online music store (e.g., iTunes)
- Choose one of the following approaches and stick to it
  - Top-Down
  - Bottom-Up
  - Brainstorming
- Use outline format
- You have 30 minutes
- We will discuss your WBS together
Homework – 2: WBS

- Create a WBS for your project
  - Please think this through. You’re the PM now!

- Guidelines
  - Do it at managerial level (see slide 14)
    - 4-7 nodes at 1st level
    - 2-5 nodes at 2nd level (per each node at 1st level)
    - You can go deeper at your discretion
    - Include project management tasks
  - As we covered in class, you can use either a process, product or hybrid approach
    - For most of your projects I suspect the process approach would work best at managerial level.
  - Follow the standard hierarchical numbering scheme for WBS structures
  - Use outline format
Homework – 2: WBS

Submission

- Use the tool you prefer between Notepad/Word/Excel
- Add homework-2 to the appropriate folder in the dropbox folder of your project
Optional Readings

- McConnell: 8 “Estimation”