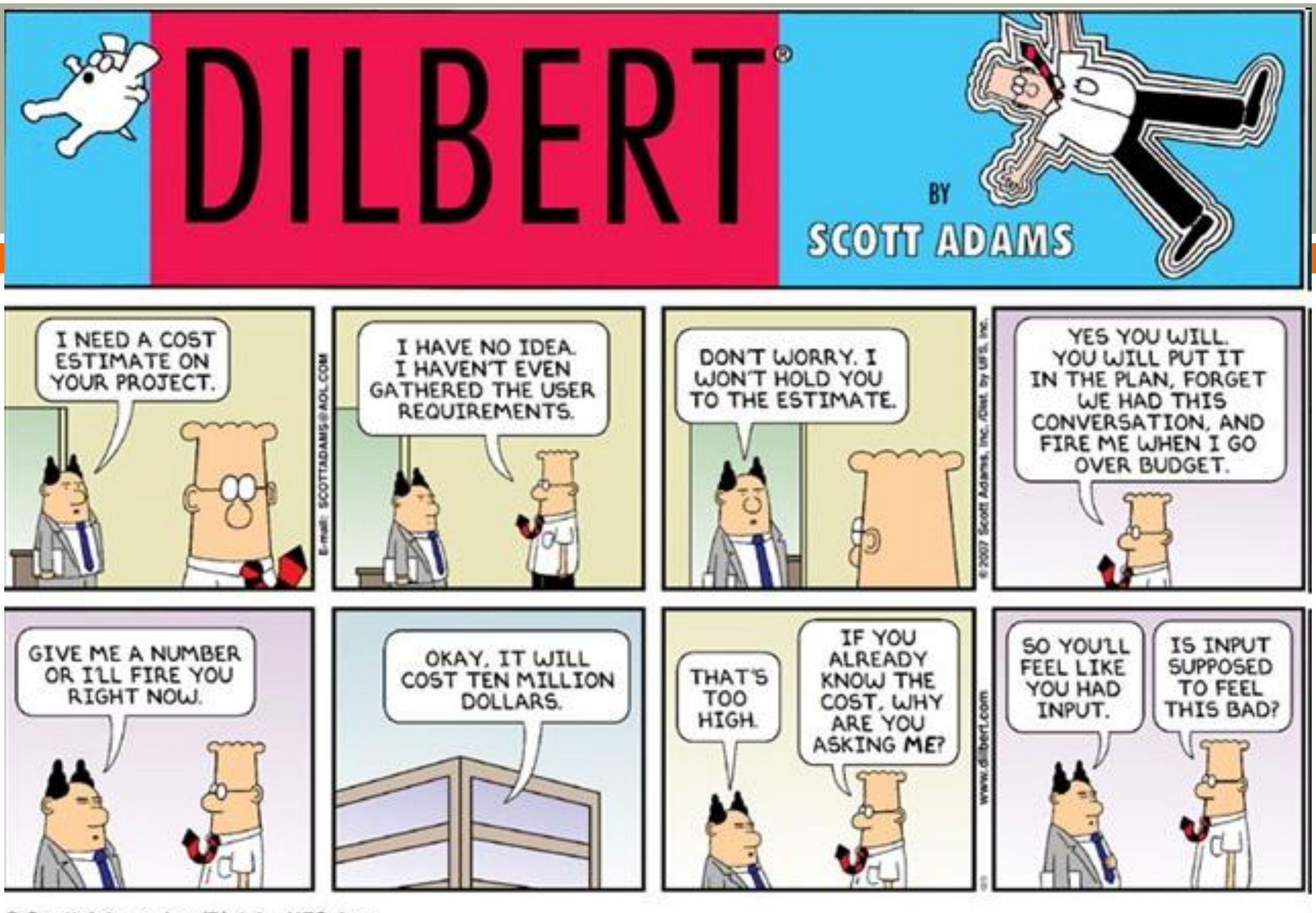
Software Estimation

SWEN 256 – Software Process & Project Management


DILBERT®
BY SCOTT ADAMS
I NEED A COST ESTIMATE ON YOUR PROJECT.
I HAVE NO IDEA. I HAVEN'T EVEN GATHERED THE USER REQUIREMENTS.
DON'T WORRY. I WON'T HOLD YOU TO THE ESTIMATE.
YES YOU WILL. YOU WILL PUT IT IN THE PLAN, FORGET WE HAD THIS CONVERSATION, AND FIRE ME WHEN I GO OVER BUDGET.
GIVE ME A NUMBER OR I'LL FIRE YOU RIGHT NOW.
OKAY. IT WILL COST TEN MILLION DOLLARS.
THAT'S TOO HIGH.
IF YOU ALREADY KNOW THE COST, WHY ARE YOU ASKING ME?
SO YOU'LL FEEL LIKE YOU HAD INPUT.
IS INPUT SUPPOSED TO FEEL THIS BAD?
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- “Predictions are hard, especially about the future”

  Yogi Berra

- Two Types of estimates: Lucky or Lousy

Basic Estimation Process

- Created, used or refined during
  - Strategic planning
  - Feasibility study and/or SOW
  - Proposals
  - Vendor and sub-contractor evaluation
  - Project planning (iteratively)
- Basic process
  1) Estimate the **size** of the product
  2) Estimate the **effort** (man-months)
  3) Estimate the **schedule**
  - NOTE: Not all of these steps are always explicitly performed

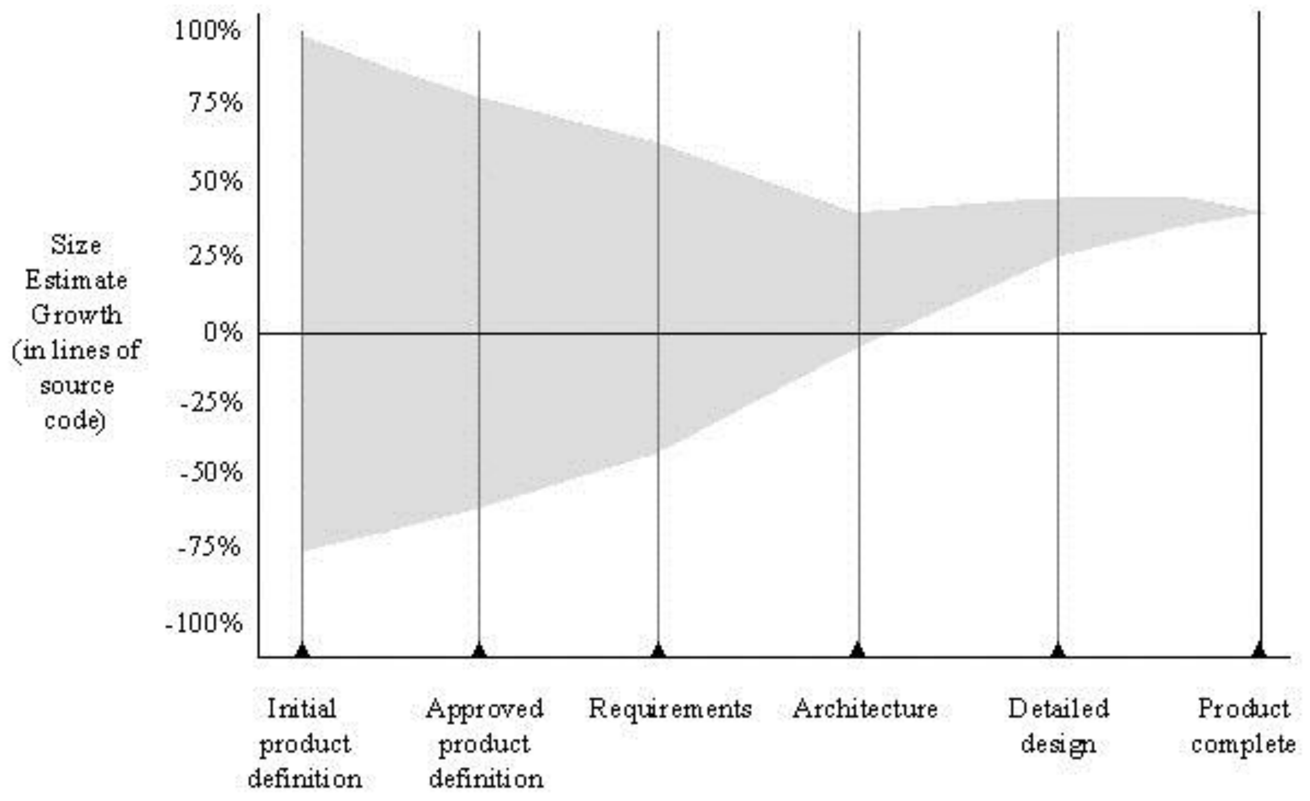
Estimations

- Remember, an “exact estimate” is an oxymoron
- Estimate how long will it take you to get home from class today-
  - On what basis did you do that?
  - Experience right?
  - Likely as an “average” probability
  - For most software projects there is no such ‘average’

Estimation

- Target vs. Committed Dates
    - Target: Proposed by business or marketing
    - Do not commit to this too soon!
    - Committed dates: Team agrees to this

Cone of Uncertainty



Estimation Methodologies

- Expert Judgment
- Top-down
- Bottom-up
- Analogy
- Priced to Win (request for quote – RFQ)
- Parametric or Algorithmic Method
  - Using formulas and equations

Expert Judgment

- Use somebody who has recent experience on a similar project
- You get a “guesstimate”
- Accuracy depends on their ‘real’ expertise
- Comparable application(s) must be accurately chosen

Top-down Estimation

- Based on overall characteristics of project
  - Some of the others can be “types” of top-down (Analogy, Expert Judgment, and Algorithmic methods)
- Advantages
  - Easy to calculate
  - Effective early on (like initial cost estimates)
- Disadvantages
  - Some models are questionable or may not fit
  - Less accurate because it doesn’t look at details

Bottom-up Estimation

- Create WBS – Work Breakdown Structure, identify individual tasks to be done.
- Add from the bottom-up
- Advantages
  - Works well if activities well understood
- Disadvantages
  - Specific activities not always known
  - More time consuming

Estimation by Analogy

- Use past project
  - Must be sufficiently similar (technology, type, organization)
  - Find comparable attributes (ex: # of inputs/outputs)
- Advantages
  - Based on actual historical data
- Disadvantages
  - Difficulty 'matching' project types
  - Prior data may have been mis-measured
  - How to measure differences – no two exactly same

Algorithmic Measures

- Lines of Code (LOC)
- Function points
- Feature points or object points
- LOC and function points most common
  - (of the algorithmic approaches)
- Majority of projects use none of the above

Wideband Delphi

- Group consensus approach
- Rand Corp. used orig. Delphi approach in the 1940's to predict future technologies
- Present experts with a problem and response form
- Conduct group discussion, collect anonymous opinions, then feedback
- Conduct another discussion & iterate until consensus
- Advantages
  - Easy, inexpensive, utilizes expertise of several people
  - Does not require historical data
- Disadvantages
  - Difficult to repeat
  - May fail to reach consensus, reach wrong one, or all may have same bias

Code-based Estimates

- LOC Advantages
  - Commonly understood metric
  - Permits specific comparison
  - Actuals easily measured
- LOC Disadvantages
  - Difficult to estimate early in cycle
  - Counts vary by language
  - Many costs not considered (ex: requirements)
  - Programmers may be rewarded based on this
    - Can use: # defects/# LOC
  - Code generators produce excess code

LOC Estimate Issues

- How do you know how many in advance?
- What about different languages?
- What about programmer style?
- Stat: avg. programmer productivity: 3,000 LOC/yr
- Most algorithmic approaches are more effective after requirements (or have to be after)

Function Points

- Software size measured by number & complexity of functions it performs
- More methodical than LOC counts
- House analogy
  - House's Square Feet ~= Software LOC
  - # Bedrooms & Baths ~= Function points
  - Former is size only, latter is size & function
- Six basic steps

Code Reuse & Estimation

- Does not come for free
- Code types: New, Modified, Reused
- If code is more than 50% modified, it's "new"
- Reuse factors have wide range
  - Reused code takes 30% effort of new
  - Modified is 60% of new
- Integration effort with reused code almost as expensive as with new code

Estimation for Agile Development

- Each user scenario is considered separately
- The scenario is decomposed into a set of engineering tasks
- Each task is estimated separately
  - May use historical data, empirical model, or experience
  - Scenario volume can be estimated (LOC, FP, use-case count, etc.)
- Total scenario estimate computed
  - Sum estimates for each task
  - Translate volume estimate to effort using historical data
- The effort estimates for all scenarios in the increment are summed to get an increment estimate

Effort Estimation

- Now that you know the “size”, determine the “effort” needed to build it
- Various models: empirical, mathematical, subjective
- Expressed in units of duration
  - Man-months (or ‘staff-months’)

COCOMO

- Barry Boehm – 1980's
- **CO**nstructive **CO**st **MO**del
- Input – LOC, Output - Person Months
- Allows for the type of application, size, and "Cost Drivers"
- Cost drivers using High/Med/Low & include
  - Motivation, Ability of team, Application experience, etc.
- Biggest weakness?
  - Requires input of a product size estimate in LOC

Estimation Issues

- Quality estimations needed early but information is limited
- Precise estimation data available at end but not needed
  - Or is it? What about the next project?
- Best estimates are based on past experience
- Politics of estimation:
  - You may anticipate a “cut” by upper management
- For many software projects there is little or none
  - Technologies change
  - Historical data unavailable
  - Wide variance in project experiences/types
  - Subjective nature of software estimation

Over and Under Estimation

- Over estimation issues
  - The project will not be funded
    - Conservative estimates guaranteeing 100% success may mean funding probability of zero.
  - Parkinson’s Law: Work expands to take the time allowed
  - Danger of feature and scope creep
  - Be aware of “double-padding”: team member + manager
- Under estimation issues
  - Quality issues (short changing key phases like testing)
  - Inability to meet deadlines
  - Morale and other team motivation issues
    - See “Death March” by Ed Yordan

Know Your Deadlines

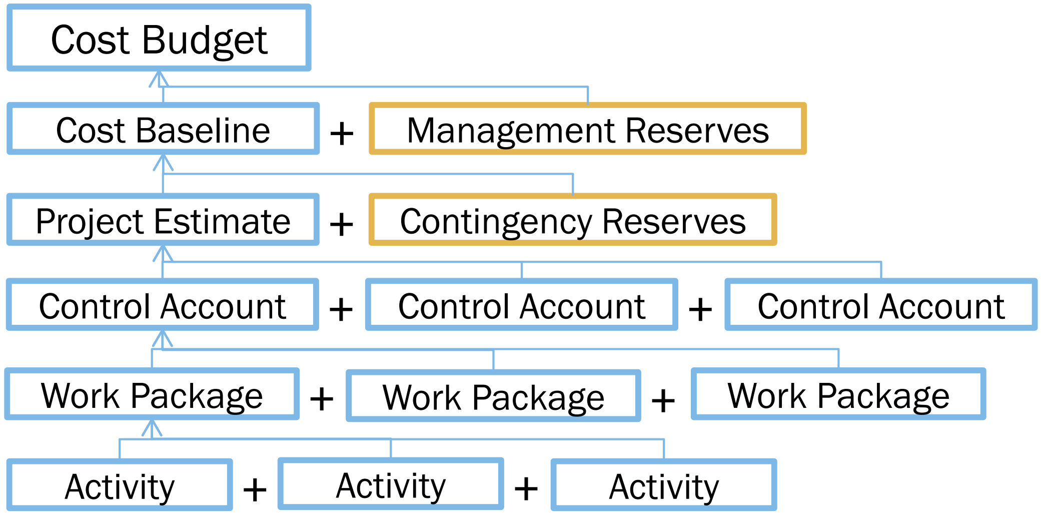
- Are they ‘Real Deadlines’?
  - Tied to an external event
  - Have to be met for project to be a success
  - Ex: end of financial year, contractual deadline, Y2K
- Or ‘Artificial Deadlines’?
  - Set by arbitrary authority
  - May have some flexibility (if pushed)

Estimation “Presentation”

- How you present the estimation can have **huge** impact
- Techniques
    - Plus-or-minus qualifiers
        - 6 months +/-1 month
    - Ranges
        - 6-8 months
    - Risk Quantification
        - +/- with added information
        - +1 month of new tools not working as expected
        - -2 weeks for less delay in hiring new developers
    - Cases
        - Best / Planned / Current / Worst cases
    - Coarse Dates
        - Q3 02
    - Confidence Factors
        - April 1 – 10% probability, July 1 – 50%, etc.

What Do You Do With Final Estimates

- For Time or Cost Estimates:
  - Aggregation into larger units (Work Packages, Control Accounts, etc.)
  - Perform Risk Analysis to calculate Contingency Reserves (Controlled by PM)
  - Add Management Reserves: Set aside to cover unforeseen risks or changes (Total company funds available – requires Change Control activities to access)



Estimation Guidelines

- Estimate iteratively!
  - Process of gradual refinement
  - Make your best estimates at each planning stage
  - Refine estimates and adjust plans iteratively
  - Plans and decisions can be refined in response
  - Balance: too many revisions vs. too few

Other Estimation Factors

- Account for resource experience or skill
  - Up to a point
  - Often needed more on the “low” end, such as for a new or junior person
- Allow for “non-project” time & common tasks
  - Meetings, phone calls, web surfing, sick days
- There are commercial ‘estimation tools’ available
  - They typically require configuration based on past data

Other Estimation Notes

- Remember: “manage expectations”
- Parkinson’s Law
  - “Work expands to fill the time available”
- The Student Syndrome
  - Procrastination until the last minute (cram)

Questions/Discussion