Estimation

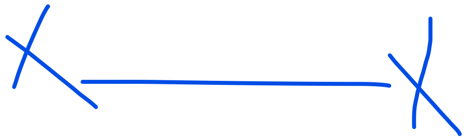
Adapted from John Musser

Estimation

- “Predictions are hard, especially about the future”, Yogi Berra
- 2 Types: Lucky or Lousy?

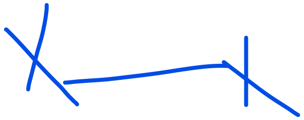
Planning, Estimating, Scheduling

- 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.



Project Planning: A 12 Step Program

- Set goal and scope
- Select lifecycle
- Set org./team form
- Start team selection
- Determine risks
- Create WBS
- Identify tasks
- Estimate size
- Estimate effort
- Identify task dependencies
- Assign resources
- Schedule work



How To Schedule

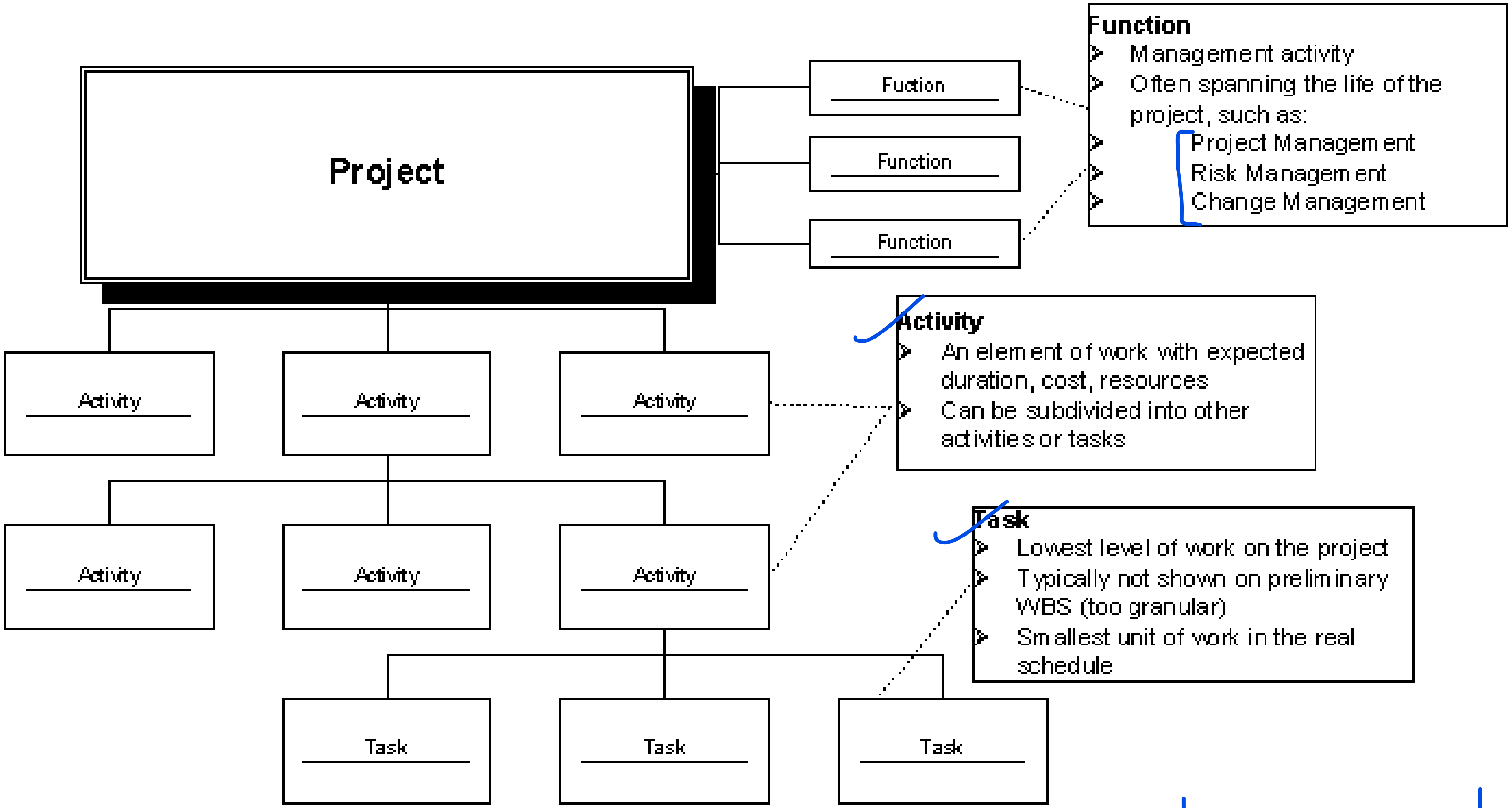
- 1. Identify "what" needs to be done
  - Work Breakdown Structure (WBS)
- 2. Identify "how much" (the size)
  - Size estimation techniques
- 3. Identify the dependency between tasks
  - Dependency graph, network diagram
- 4. Estimate total duration of the work to be done
  - The actual schedule

Partitioning Your Project

- 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?

Project Elements

- 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

Estimations

- Very difficult to do, but needed often
- Created, used or refined during
  - Strategic planning
  - Feasibility study and/or SOW
  - Proposals
  - Vendor and sub-contractor evaluation
  - Project planning (iteratively)

statement of work

- Basic process
  - Estimate the **size** of the product
  - Estimate the **effort** (man-months)
  - Estimate the **schedule**
  - NOTE: Not all of these steps are always explicitly performed

SES

Estimations

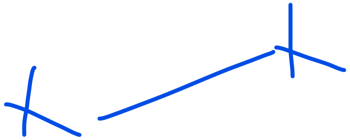
- Remember, an “exact estimate” is an oxymoron
- Estimate how long will it take you to get home from class tonight
  - On what basis did you do that?
  - Experience right?
  - Likely as an “average” probability
  - For most software projects there is no such ‘average’
- Most software estimations are off by 25-100%

Estimation

- Target vs. Committed Dates
  - Target: Proposed by business or marketing
  - Do not commit to this too soon!
  - Committed: Team agrees to this
  - After you’ve developed a schedule

Estimation

- **Size:**
  - – Small projects (10-99 FPs), variance of 7% from post-requirements estimates
  - – Medium (100-999 FPs), 22% variance
  - – Large (1000-9999 FPs) 38% variance
  - – Very large (> 10K FPs) 51% variance



Estimation Methodologies

- Top-down
- Bottom-up
- Analogy
- Expert Judgment
- Priced to Win
- Parametric or Algorithmic Method
  - Using formulas and equations

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Top-down Estimation

1

- 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

2

Bottom-up Estimation

- ✓ Create WBS
- Add from the bottom-up
- Advantages
  - ✓ Works well if activities well understood
- Disadvantages
  - ✓ Specific activities not always known
  - ✓ More time consuming

3

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
  - Systematic
- Can use a weighted-average of opinions

4

Estimation by Analogy

- Use past project
  - Must be sufficiently similar (technology, type, organization)
  - Find comparable attributes (ex: # of inputs/outputs)
  - Can create a function
- 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

4 Priced to Win

- Just follow other estimates
- Save on doing full estimate
- Needs information on other estimates (or prices)
- Purchaser must closely watch trade-offs
- Priced to lose?

b

Algorithmic Measures

- ✓ Lines of Code (LOC)
- ✓ Function points
- ✓ Feature points or object points
- Other possible
  - Number of bubbles on a DFD
  - Number of of ERD entities
  - Number of processes on a structure chart
- ✓ LOC and function points most common
  - (of the algorithmic approaches)
- [Majority of projects use none of the above]

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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)

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Function Points

- Software size s/b 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

Function Point Process

- 1. Count # of biz functions per category
  - Categories: outputs, inputs, db inquiries, files or data structures, and interfaces 5
- 2. Establish Complexity Factor for each and apply
  - Simple, Average, Complex
  - Set a weighting multiplier for each (0->15)
  - This results in the "unadjusted function-point total" UFP
- 3. Compute an "influence multiplier" and apply
  - It ranges from 0.65 to 1.35; is based on 14 factors
- 4. Results in "function point total"
  - This can be used in comparative estimates

Wideband Delphi

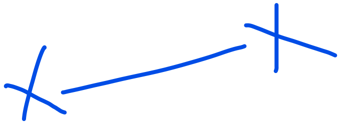
- Group consensus approach
- Rand corp. used orig. Delphi approach to predict future technologies
- Present experts with a problem and response form
- Conduct group discussion, collect anonymous opinions, then feedback
- Conduct another discussion & iterate until consensus
- Advantages
  - Easy, inexpensive, 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

Parametric Method Issues

- Remember: most projects you'll run into don't use these
- Which is 'normal', so don't be surprised
  - Or come-in to new job and say "Hey, let's use COCOMO"
- These are more effective on large projects
  - Where a past historical base exists
- Primary issue for most projects are
  - ✓ Lack of similar projects
    - Thus lack of comparable data
- Catch-22: how to get started

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



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’ now)

Effort Estimation

- McConnell shows schedule tables for conversion of size to effort
- As with parametric size estimation, these techniques perform better with historical data
- Again, not seen in 'average' projects
- Often the size and effort estimation steps are combined (not that this is recommended, but is what often is done)
- "Commitment-Based" Scheduling is what is often done
  - Ask developer to 'commit' to an estimate (his or her own)

COCOMO

- COnstructive COst MOdel
- Allows for the type of application, size, and "Cost Drivers"
- Outputs in Person Months PM
- Cost drivers using High/Med/Low & include
  - Motivation
  - Ability of team
  - Application experience
- 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

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

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.

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)