Planning IV: Resource & Schedule Estimating

Outline
- Review of PSP Levels
- Overview
- Resource planning
- Estimating development and task time
- Combining multiple estimates
- Multiple regression
- Schedule estimating
- Earned value tracking
- Estimating accuracy
- Homework #5

Overview (cf. Humphrey, 1995, p. 145)
- This chapter covers:
  - How to make plans for small programs
  - How to combine these into larger consolidated plans
- Schedule planning includes:
  - Resource loading
  - Resource utilization
  - Earned value tracking
  - ...

Review of PSP Levels (Humphrey, 1995, p. 11)
- PSP0: Current process
  - Time recording
  - Defect recording
  - Defect type standard
- PSP1: Size estimating
  - Task planning
  - Schedule planning
  - Coding standard
  - Size measurement
  - Process improvement proposal (PIP)
- PSP2: Planning
  - Cyclic development
  - Quality Mgt
  - Planning
  - Baseline
  - PSP0.1: Coding standard
  - PSP1.1: Task planning
  - PSP2.1: Design templates
- PSP3: Cycle development

- Customer Need
  - Product Size & Estimation
  - Product Requirements
  - Product Release
- Management
  - Resources Available
  - Resources Needed
  - Resource Utilization
- Schedule
  - Multiple Resources
  - Schedule Status
  - Tracking Reports

- In the PSP, the resource is your time.
- Productivity
  - Hours required / unit of work
  - Each job has many unique conditions and factors which affect productivity
    - See "cement" example, p. 148.
  - Estimate productivity by calculating the average and range from prior jobs (homework assignments)

NOTE: Real life is not as linear as this framework suggests.
Estimating Task Time

The SW development task is a special instance of general tasks for which time estimates must be made.

- See Fig. 6.3, p. 156, and general task-estimation steps.
- For SW development we prefer to base our estimates on historical data.
- We have three types of historical data which may be used:
  - A: Estimated object LOC & total actual development hours
  - B: Actual object LOC & total actual development hours
  - C: Actual total new/changed LOC & total actual development hours

Development Time Planning Process

Walk through example on p. 153-155

See how regression parameters are calculated and used.

Combining Multiple Estimates

Assume 4 estimates: a, b, c, d.

The estimated hours and standard deviations are:

- $H_a, H_b, H_c,$ and $H_d$
- $s_a, s_b, s_c,$ and $s_d$

When estimates are independent (e.g. come from separate databases) and unbiased (not all from the same project, under same manager, etc.):

- $H_t = \sum H_i$
- $s_{t} = \sqrt{\sum s_i^2}$
- $H_{upper} = H_t + s_t$
- $H_{lower} = H_t - s_t$

Must use more involved calculation for the prediction interval when estimates to be combined are not statistically independent.

Use formulas on p. 160-162

Multiple Regression

The problem:

- We don’t have detailed enough data.
- e.g. We have total hours, new LOC, reused LOC, & modified LOC, but not hours by each of these LOC categories.

The solution:

- Multiple regression estimates the relative contributions.

Example regression equation:

- $\text{Hours}_i = \beta_0 + \beta_1 \text{New}_i + \beta_2 \text{Reuse}_i + \beta_3 \text{Modified}_i$
Multiple Regression (cont.)

- Gauss’s method is used to solve the simultaneous equations (cf. p. 560-564 for an example).
- The resulting equation is:
  - \[ \text{Hours} = 6.71 + 0.0784 \times 650 + 0.0150 \times 3000 + 0.2461 \times 155 = 141 \]
  - \( b_0 = 6.71 \) hours overhead
  - \( b_1 = 0.0784 \) hrs to develop a new LOC (12.76 LOC / hr)
  - \( b_2 = 0.0150 \) hrs to reuse a LOC (66.48 LOC / hr)
  - \( b_3 = 0.2461 \) hrs to modify a LOC (4.06 LOC / hr)
- The prediction interval calculation and formulas are shown on p. 166-168.
- Caution: Use regression with care. Don’t apply formula outside database limits.

Schedule Estimating: Overview

- Even with good estimates, if you make incorrect assumptions about daily / weekly available time, schedules can be seriously in error.
- Only time available for direct work can be used to set a schedule.
- Many other activities demand your time: vacation, sick, mail, committees, etc.
- Over time you should gather data on how you use your time, only then can you make good schedules.
  - Planning using this “unplanned time cushion” gives you some “slack” and room for adjustment for “crunch” times in your schedule.
  - Typically only 50-75% of time can be spent on direct work.

Schedule Estimating: The PSP

- The procedure is documented by:
  - Fig 6.4: PSP Schedule Planning Diagram
  - Table 6.11 & 12: Schedule Planning Template & Example
  - Table 6.13 & 14: Task Planning Template & Example
- NOTE:
  - This is presented in a very TOP-DOWN approach, as opposed to a BOTTOM-UP approach which is commonly used in activity-based planning (cf. MGT 882).
  - Look at and talk about Fig. 6.4, p. 171
  - Walk through step-by-step sequence, & forms
  - Discuss relationship of this method to project networks, activity-based planning, etc.
    - Show equivalent network for Humphrey’s task plan
    - Demonstrate project management software.

Earned Value: Definition

- “Earned value (EV) is a way to evaluate project progress. It establishes a relative value for every task and credits that value when [the task is complete].”
- EV allows progress to be tracked on different types of activities, and even when planned sequencing is changed, or tasks are added or deleted.
- EV = Percent based on proportion of total project.

Earned Value (cont.)

- EV is credited only when a task is completed.
  - No partial credit is given.
  - If tasks are large enough that intermediate tracking is desired, break them down and assign EV’s to all subtasks.
- Question: What are some examples of small and large ISD/SE tasks?
- Set checkpoints based on total project size.
  - Over 2-3 weeks, 10 checks is too much
    - Humphrey:
      - > 1 per week, < 1 per day
      - 2-4 per week

EV Tracking Example

- Walk through:
  - Tables 6.15 & 16 - Task & Schedule Plans
  - Tables 6.17 & 18 - Actual
  - Table 6.19 - Adjusted schedule (additional task added to original schedule)
- Finished on time even with all the changes.
EV Conclusions

- Get management help for problems and alert them to changes.
- EV & motivation
  - It is hard to maintain motivation when working on activities which have no EV.
  - Therefore, promptly put new activities into your plan, and
  - Promptly drop activities.
  - Remember, you are in charge, and the plan is there to help you.

Estimating Accuracy
(cf. Humphrey, 1995, p. 196-204)

- Estimation is difficult.
- Over- and under-estimation should balance out.
- Error\% = 100 * (Actual - Estimated) / Estimated
- Note student and class results in Fig’s 6.6-13 on p. 197-201.
  - Over- and under-estimation
  - Improvement for some
  - Bad estimate after good ones.
- DON’T OVERCOMPENSATE
- Learning time depends on each person

Estimating Accuracy (cont.)

- Small estimates
  - Small tasks have lots of variation.
  - To improve estimation, try to understand as many causes as possible.
  - Do this with consistent planning, using historical data, and planning in detail.
- Composite estimates
  - Composites are more reliable
  - Estimates are difficult when using evolving process data

Overcompensation
- Don’t estimate to “average” - you’ll always be off
- Don’t adjust your intuition
- Get feedback from colleagues

Reasonableness
- Is the estimate reasonable?
- Strange \( \beta \) weights can be caused by:
  - Closely-clustered historical data
  - Estimating above and below the historical data range
  - Including outliers

Homework #5
- Program 5A
  - Integration via Simpson’s rule
  - See p. 765-767, and Assignment Kit #5