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
**Review of PSP Levels** *(Humphrey, 1995, p. 11)*

- **Baseline**
  - Current process
  - Time recording
  - Defect recording
  - Defect type standard

- **Planning**
  - Task planning
  - Schedule planning

- **Quality Mgt**
  - Size estimating
  - Test report

- **Cyclic**
  - Code reviews
  - Design reviews

- **PSP0**
  - Design templates

- **PSP1**
  - Task planning
  - Schedule planning

- **PSP1.1**
  - Task planning
  - Schedule planning

- **PSP2**
  - Design templates

- **PSP2.1**
  - Design templates

- **PSP3**
  - Cyclic development

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**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
  - ...

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*AU INSY 560, Winter 1997, Dan Turk*
Review of the PSP Project Planning Framework
(cf. Humphrey, 1995, p. 146)

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


- **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)
Estimating Task Time

(cf. Humphrey, 1995, p. 145)

- 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 (Humphrey, 1995, p. 149)

<table>
<thead>
<tr>
<th>LOC Size Estimate</th>
<th>Obtained historical data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Are there sufficient data for a regression calculation?</td>
</tr>
<tr>
<td></td>
<td>Do the regression calculation on actual object LOC and actual hours</td>
</tr>
<tr>
<td></td>
<td>Calculate the time required</td>
</tr>
<tr>
<td></td>
<td>Calculate the prediction interval</td>
</tr>
<tr>
<td></td>
<td>Time Estimate</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Estimating Choice C</th>
<th>Calculate the productivity in actual new &amp; changed LOC per hour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Calculate the shortest and longest likely times</td>
</tr>
<tr>
<td></td>
<td>Time Estimate</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Estimating Choice B</th>
<th>Calculate the time required</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Calculate the prediction interval</td>
</tr>
<tr>
<td></td>
<td>Time Estimate</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Estimating Choice A</th>
<th>Calculate the time required</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Calculate the prediction interval</td>
</tr>
<tr>
<td></td>
<td>Time Estimate</td>
</tr>
</tbody>
</table>

Walk through diagram and steps, p. 149-153.
Development Time Planning  

Example \hspace{1em} (Humphrey, 1995, p. 149)

- Walk through example on p. 153-155
- See how regression parameters are calculated and used.

Combining Multiple Estimates \hspace{1em} (cf. Humphrey, 1995, p. 158-163)

- Assume 4 estimates: a, b, c, d.
- The estimated hours and standard deviations are:
  - $H_a$, $H_b$, $H_c$, $H_d$ and $\sigma_a$, $\sigma_b$, $\sigma_c$, $\sigma_d$
- When estimates are independent (e.g. come from separate databases) and unbiased (not all from same project, under same manager, etc.):
  - $H_t = \text{total hourly time} = \Sigma H_i$
  - $\sigma_t = \text{total standard deviation} = \sqrt{\Sigma \sigma_i}$
  - $H_{\text{upper}} = H_t + \sigma_t$
  - $H_{\text{lower}} = H_t - \sigma_t$

- 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 (cf. Humphrey, 1995, p. 162-166)

- 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:
  - \[ \text{Hours}_t = \beta_0 + \beta_1 \text{New}_k + \beta_2 \text{Reuse}_k + \beta_3 \text{Modified}_k \]
Multiple Regression (cont.)
(c.f. Humphrey, 1995, p. 162-168)

- Gauss’s method is used to solve the simultaneous equations (cf. p. 560-564 for an example).
- The resulting equation is:
  - Hours = 6.71 + 0.0784*650 + 0.0150*3000 + 0.2461*155
    = 141
  - \( \beta_0 = 6.71 \) hours overhead
  - \( \beta_1 = 0.0784 \) hrs to develop a new LOC (12.76 LOC / hr)
  - \( \beta_2 = 0.0150 \) hrs to reuse a LOC (66.48 LOC / hr)
  - \( \beta_3 = 0.2461 \) 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
(c.f. Humphrey, 1995, p. 168-170)

- 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
Schedule Planning Procedure
(cf. Humphrey, 1995, p. 170-180)

- 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 sub-tasks.

- 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

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**EV Tracking Example**
(cf. Humphrey, 1995, p. 182-195)

- 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.
- \( \text{Error\%} = 100 \times (\text{Act} - \text{Est}) / \text{Est} \)
- 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

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**Estimating Accuracy (cont.)**


- **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 β 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. 755-757, and Assignment Kit #5