Production processes:
The soft science of project planning

Topics:
- Project planning
- Personal Software Process (PSP) framework

Terms that will be used in this lecture
Goal
Plan
Task

Quick introduction to PSP
Framework for codifying and improving one's own (personal) operational process
Based on ideas from CMM:
- Defines and then refines a process
- Developers estimate, precisely record, and later reflect upon resource requirements for process tasks
Does not prescribe technical methods
- E.g., my PSP might use Z/Statecharts to analyze requirements; yours might use UML

Example PSP
Sequence of three phases:
- Planning: Production/documentation of a plan
- Development: Analysis, design, implementation and testing of program
- Postmortem: Analysis of process data (e.g., estimated vs. actual time, number of defects, etc)
Planning involves estimation of time and resources required to do development
Involves data collection and assessment

The role of plans and assessment
Planning:
- is critical to the success of any complex process
- yet most of us are not very good at it
PSP exercises our planning skills, forcing us to:
- plan, even if our early plans are naive
- estimate costs of each step in plan
- collect cost and quality data during execution, and
- analyze this data to assess how well we planned the various phases and how to improve planning

Question
What are the qualities of a good project plan?
A case study in poor planning

New function for the OS/360 operating system:
- Engineering estimate: $175,000.00
- 6 months later, estimate revised to: $525,000.00
- But only the first figure had been budgeted
- Where does the rest of the money come from?

Turns out that $175K was close to the cost of implementation/unit testing, but:
- neglected costs of documentation, quality assurance, integration testing, etc

Another example

Consultant budgets 2 engineers @ 3 weeks to do requirements analysis for new project
The “plan”:
- justifies the time estimate by need to consult with users on location
- does not identify number of meetings required or what will be discussed at these meetings
- no indication that clients will be able to schedule users to attend these meetings

Is this really a plan?

What is planning?

Not a pseudonym for “just starting work on”
Largely a mental exercise:
- requires deep understanding of the nature of the processes being planned
- involves critical analysis and a healthy dose of skepticism

Produces an operational plan:
- specifies what to do and precisely how to do it
- both the what and the how are difficult to devise
- these are the skills you want to hone

Tasks

Operations that you “know how to do”:
- Well-defined inputs
- Well-defined outputs
- Well-defined method for “converting” the inputs to the outputs

Examples of task:
- Given a context free grammar, develop a recursive-descent parser that recognizes strings in that grammar

Question

What are some other examples of tasks from programming/software design?

What are some examples of tasks from other creative activities?
- Writing tasks?
- Painting tasks?

Complex tasks

Two sources of task complexity:
- lots of sub-tasks, which must be performed according to some protocol
  - involves creativity, but still routine, i.e., no magic!
  - Note: What an expert considers to be a task, a novice considers to be magic
  - some “subtasks” are lack a procedure
    - well-defined inputs and outputs, but ill-defined procedure
    - procedures are heuristic (may yield nothing, may not terminate)

To plan, you must decompose tasks to a sufficiently fine grain, so that you can:
- budget time and resources for the routine tasks
- identify and plan for the uncertainty arising from complex tasks
Software project planning...

Software development is flush with complex tasks
- These can be resource black holes
- Best methods for resourcing them are empirical, based on historical data
  - Mature method for doing this based on proxies
A more frustrating problem is to fail to plan for and resource the necessary, but routine tasks
- E.g., the OS/360 manager failing to budget for documentation and integration testing
- No magic here; he just forgot!

Question

How can we be sure that we haven’t missed anything?
What might be the source(s) of missing items or tasks?

Goals

Specify “what” is to be accomplished, but not how
Examples:
- Understand a client’s problem requirements
- Ensure the Mean-time-to-failure (MTTF) of a product is greater than two years
Planning heuristic:
- Identify the major goals of all stakeholders, and
- operationalize these goals into tasks
Benefit: Helps ensure you haven’t missed anything

Example

Goal: Understand problem requirements
Vague goal; provides no insight into how to operationalize it into a set of tasks
Can you decompose it into subgoals?
- these could be more amenable to operationalization

Sub-goals of “understanding”

Understanding a subject involves:
- Acquiring a “deep” apprehension of the details of the subject
- Organizing and relating these details into useful categories
Are these subgoals any more amenable to operationalization?
- First involves analysis, i.e., breaking apart concepts and ideas to learn “what is in them”
- Second involves synthesis, i.e., putting together concepts into a coherent whole
These need not be performed in isolation, but distinction is useful in planning

Operationalize the analysis subgoal

Goal: Acquire a clear and distinct mental model of the functionality the system you are to build must support
Problem: You are not a domain expert, so how might you come to acquire this knowledge?
- Consult documentation (budget time for this!)
- Schedule meetings between reqts engineers and clients
  - How many meetings will be necessary?
  - When is the first meeting?
  - What articles must you prepare for the meeting?
  - What data must you collect at the meeting?
Operationalize the synthesis subgoal

**Goal:** Record (codify) the knowledge acquired during analysis in a useful form
- E.g., requirements analysis culminates in a written document
What are the qualities of a good document?
- Coherent top-down structure
  - How will you identify this structure?
  - How will you check that the text conforms to it?
- Requires careful attention to style and editing
- Needs to have been reviewed by multiple readers
- Needs a good index

Turn these "qualities" into goals, then operationalize them into tasks

What is a plan?

**Precise operationalization of one or more goals**
Defines the work and how it will be carried out:
- Defines each major task
- Estimates time and resources required
- Provides framework for mgmt review and control

What else should it contain?

For you...

You need the following from your plan:
- Job sizing: How big is the job and how long do you expect it to take?
- Job structure: How will you do the work? What will you do first, second, and so on?
- Job status: How will you know where you are? Will you finish on time and are costs under control?
- Assessment: How good was the plan? Did you make any obvious errors? What mistakes could you avoid in the future?

For your customer

Your customer needs:
- What is the commitment? What will you deliver? When, and at what cost?
- Will the product be what they want? Will there be interim checkpoints on product performance/quality?
- Is there a way to monitor progress? What kind of warning can they expect of cost, schedule, or quality problems? Will changes in scope be clearly identifiable?
- Will they be able to evaluate the job? Can they separate planning problems from poor management? Is there a way to assess product quality during the job?