CMSC 128

Introduction to Software Engineering
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jachermocilla@uplb.edu.ph

Software Project Planning

- Project planning marks the start of the project management process
- Estimation is the first activity in project planning
- When estimates are made, we look into the future and accept some degree of uncertainty
- Estimation is both science and art
  - Need not be conducted haphazardly

Software Project Planning

- What to estimate?
  - resources, cost, and schedule
- Factors affecting estimation
  - Project complexity
  - Project size
  - Structural uncertainty
  - Availability of historical data

Software Project Planning

- Objective
  - Provide a framework that enables the manager to make reasonable estimates of resources, cost, and schedule within a limited time frame at the beginning of the project.
  - Define best-case and worst-case scenarios so that outcomes can be bounded

Software Scope

- Function and performance allocated to software during system engineering must be assessed to establish a project scope
- Software scope describes function, performance, constraints, interfaces, and reliability
- Software scope must be unambiguous and understandable at management and technical levels

Obtaining Info for Scope

- Must communicate with customer
- First set of context-free questions
  - Who is behind the request for this work?
  - Who will use the solution?
  - What will be the economic benefit of a successful solution?
  - Is there another source for the solution?

Obtaining Info for Scope

- Second set of context-free questions
  - How would you characterize good output of the successful solution?
  - What problems will this solution address?
  - Can you show me the environment in which the solution will be used?
  - Are there special performance issues that will affect the way solution is approached?

Obtaining Info for Scope

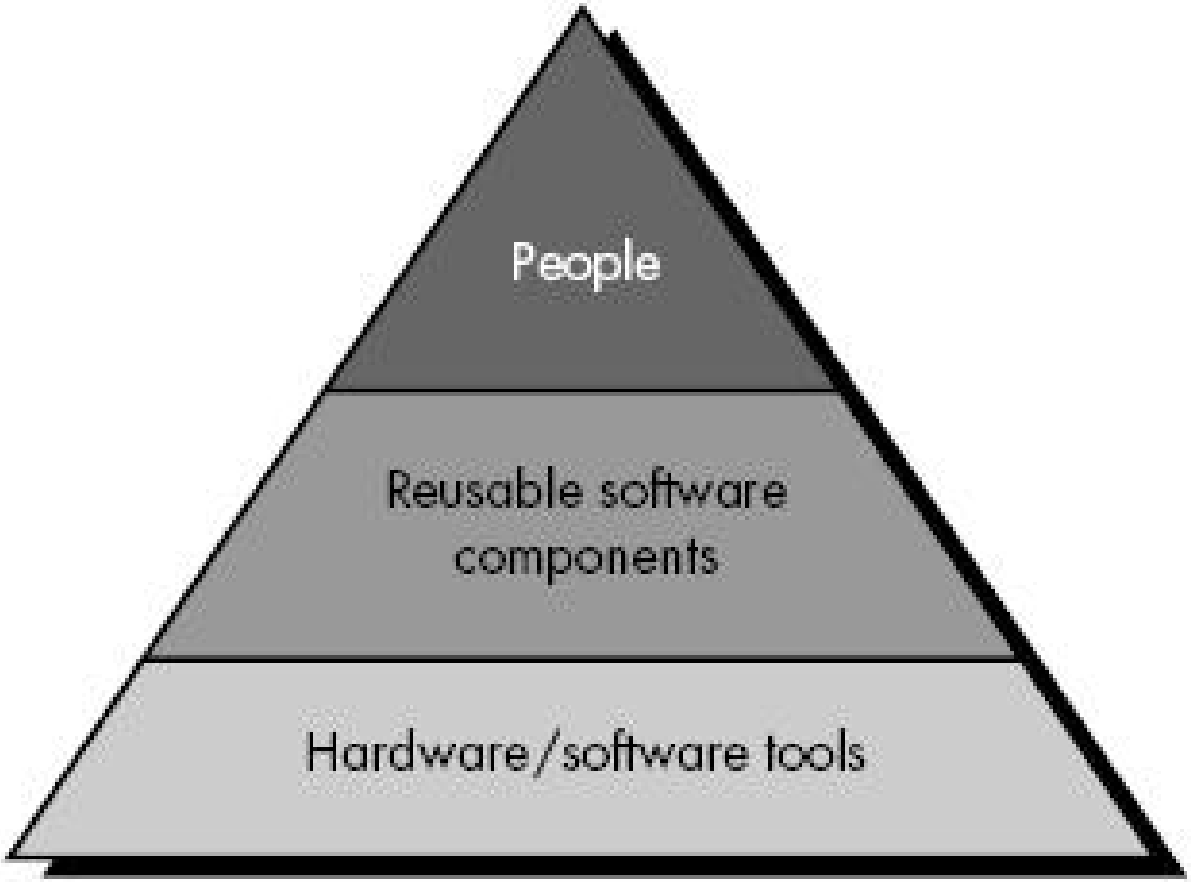
- Third set of context-free questions
  - Are your answers official?
  - Are my questions relevant to the problem that you have?
  - Am I asking too many questions?
  - Is there anyone else who can provide additional information?
  - Is there anything else that I should be asking you?

Resources

- After defining the scope, resources must be estimated
- Each resource is characterized by
  - Description
  - Statement of availability
  - Chronological time that the resource will be required
  - Duration of time that the resource will be applied

Resources

FIGURE 5.2
Project resources



Resources

- Human Resources
  - Skills required are identified
  - Both organizational(ex. manager) and specialty(ex. DBA) positions are specified
- Reusable Resources
  - Off-the-shelf components
  - Full-experience components
  - Partial-experience components
  - New components

Resources

- Environmental Resources
  - Supports the project: both hardware and software
  - Software Engineering Environment
  - Development Environment

Estimation

- Options to obtain reliable estimates
  - Delay estimation until late in the project
  - Base estimates on similar projects that have already been completed
  - Use decomposition techniques
  - Use one or more empirical models for software cost and effort estimation

Decomposition

- Can use problem or process decomposition
- Understand the scope and generate an estimate of 'size'

Software Sizing

- Factors affecting project estimates
  - Estimate of the size of product
  - Ability to translate size estimate into effort, time, and cost
  - Degree to which project plan reflects the ability of the team
  - Stability of requirements and SEE
- In project planning, size refers to the quantifiable outcome of the software project (LOC or FP)

Software Sizing

- Approaches
  - 'Fuzzy-logic' sizing
  - Function point Sizing
  - Standard component sizing
    - Some software have 'standard components'
      - Modules, reports, screens, etc
  - Change sizing
    - When using existing software that must be modified
    - Estimates the number and type of modifications(adding, deleting, reuse, etc.)

Problem-based Estimation

- Use of LOC and FP in estimation
  - *Estimation variable* that is used to 'size' each element of software
  - *Baseline metrics* collected from past projects and used together with estimation variables to develop cost and effort projections
- Planner begins with bounded statement of software scope, then decompose software into problem functions that can each be estimated individually using LOC or FP

Problem-based Estimation

- Baseline productivity metrics (LOC/pm or FP/pm) are applied to the estimation variable and cost or effort for the function is derived
- In using LOC as estimation variable, decomposition is essential to obtain more accurate estimates
- In using FP as estimation variable, countable information domain and complexity adjustment values are used

Problem-based Estimation

- When estimating (based on historical data or intuition), specify optimistic, pessimistic, and most likely size
- Three point value or expected value is computed
  - EV = (opt + 4*most_likely + pess)/6

Process-based Estimation

- Identify framework activities and tasks for the selected process then estimate the effort required for each
  - Unit of effort is person-month, the amount of work that a person can do in one month
- Decompose software into problem functions
- Meld the product and the process

Empirical Models

- Use empirically derived formulas to predict *effort* as a function of LOC or FP
- General structure
  - Effort = A + B x (estimation var)^{C} , where A, B, and C are empirically derived constants
- Examples
  - Walston-Felix, E=5.2 x KLOC$^{0.91}$
  - Bailey-Basili, E=5.5 x 0.73 x KLOC$^{1.16}$

COCOMO

- COnstructive COst MOdel, by Boehm
- Hierarchy of models
  - Model 1 - basic
    - Effort(and cost) as function of size (LOC)
  - Model 2 - intermediate
    - Same as Model 1 but includes 'cost drivers'
  - Model 3 – advanced
    - Same as Model 2 but includes assessment of cost drivers impact on each step

COCOMO

- Three classes of software projects
  - Organic
    - Relatively small, small teams, less rigid requirements
  - Semi-detached
    - Intermediate in size and complexity
    - Teams with mixed experience
  - Embedded
    - Tight constraints

COCOMO

- Basic
  - $E=a*KLOC^b$, $D=c*E^d$
- Semi-detached
  - $E=a*KLOC^b$ x Effort_Adjustment_Factor

Software Equation

- $E=[LOC \times B^{0.333}/P]^3 \times (1/t^4)$
  - E – effort
  - T – duration in years
  - B – special skills factor, min=0.16, max=0.39
  - P – productivity parameter

Make or Buy?

- Guidelines
  - Develop specification of function and performance
  - Estimate internal cost to develop and delivery date
  - Select three or four candidates applications
  - Select reusable components
  - Develop comparison matrix
  - Evaluate
  - Contact other users for opinion

Summary

- Planner must estimate time, effort, and resources (hardware, people, resource)
- Estimation techniques: decomposition and empircal
- Automated tools can be used
- Estimates derived from one technique must be revonciled with other techniques

Reference

- Roger S. Pressman.Software Engineering: A Practitioner's Approach, 4th Ed.McGraw-Hill,1997. Chapter 5