Chapter 5: Software effort estimation

NET481: Project Management

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Topics to be covered

- Difficulties of Estimation
- Where are estimates done?
- Problems of over- and under- estimate
- Estimation techniques

What makes a successful project?

Delivering:

- agreed functionality
- on time
- at the agreed cost
- with the required quality

Stages:

1. set targets

2. Attempt to achieve targets

BUT what if the targets are not achievable?

What makes a successful project?

- Targets are set for a project and the project manager tries to meet them

- A project manager has to produce:
  - An estimate of the effort.
  - An estimate of the activity durations.
  - An estimate of
  - effort affects → Cost
  - An estimate of
  - activity durations affects → The delivery time

Some problems with estimating

- Nature of software.
  - Complexity and invisibility of software.
  - Subjective nature of much of estimating
  - Over-estimating small tasks and
  - Under-estimating large ones.
  - Political pressures
  - Different objectives of people in an organization
  - Managers may wish to reduce estimated costs in order to win support for acceptance of a project proposal

Some problems with estimating

- Changing technologies
  - Technology is rapidly changing, making the experience of previous project estimates difficult to use in new ones.
  - Projects differ
  - Experience on one project may not be applicable to another

Where are estimates done?

Estimates are carried out at different stages of a software project for a variety of reasons.

- **Feasibility study**
  - Estimates here conforms that the benefits of the potential system will justify the costs
  - **Strategic planning**
  - Project portfolio management will involve:
    - Estimating benefits and costs of new applications (projects) to allocate priorities.
    - Such estimates may also influence the scale of development staff recruitment

Where are estimates done?

- **System specification**
  - Design shows how user requirements will be fulfilled.
  - Estimating The efforts needed to implement different design proposals.
  - Estimates at the design stage will also confirm that the feasibility study is still valid

Where are estimates done?

- **Evaluation of suppliers proposals**
  - A manager could consider putting development to tender
  - Potential contractors would examine the system specifications and produce estimates (their bid).
  - The manager can still produce his own estimates why?
    - To question a bid that for instance that seems too low which could be an indication of a bad understanding of the system specifications.
    - Or to compare the bids to in-house development

Where are estimates done?

- **Project planning**
  - As the planning and implementation of the project becomes more detailed
    - More estimates of smaller work components will be made
      - These will confirm earlier broad estimates
      - And support more detailed planning (e.g. staff allocation)

Over- and under- estimating

- An over-estimate is likely to cause project to take longer than it would otherwise

- This can be explained by the application of two laws:
  - **Parkinson's Law:** 'Work expands to fill the time available'
    - Thus, e.g. for an easy task over estimating the duration required to complete it will cause some staff to work less hard to fill the time.
  - **Brook's Law:** putting more people on a late job makes it later
    - So overestimating the effort required to perform a task (activity) means more staff assigned to it than needed

Over- and under- estimating

- Underestimating a project: Can cause the project to not be delivered on time or cost
- but still could be delivered faster than a more generous estimate
- On the other side the danger of underestimating a project is the effect on the quality
- **Zeroth law of reliability**: if a system doesn't have to be reliable it can meet any other objective

Basis for successful estimating

A. The need for historical data.

- Most estimating methods need information about past projects

- Care has to be considered when applying past performance

to new projects because of possible differences in factors such as:

  - Different programming languages
  - Different experience of staff
  - Different terminology

There are international Data Base containing data about thousands of projects that can be used as reference

Basis for successful estimating

B. Measuring work.

- The time and cost to implement software depends on:
  - The developer's capability and experience
  - The technology that will be used

- The usual practice is to start by expressing work size independently of the effort, using measures such as:

(

a)

S

LOC OR KLOC: Source lines of code or thousands of lines of code

(b) Alternative size measure is Function Points (FP)

A taxonomy of estimating methods

- Bottom-up - activity based, analytical
- Parametric or algorithmic models e.g. function points
- Expert opinion - just guessing?
- Analogy - case-based, comparative
- Parkinson and ‘price to win’

Bottom-up versus top-down

- Bottom-up
  - use when no past project data
  - identify all tasks that have to be done – so quite time-consuming
  - use when you have no data about similar past projects
- Top-down
  - produce overall estimate based on project cost drivers
  - based on past project data
  - divide overall estimate between jobs to be done

Bottom-up estimating

1. Break project into smaller and smaller components
2. Stop when you get to what one person can do in one/two weeks
3. Estimate costs for the lowest level activities
4. At each higher level calculate estimate by adding estimates for lower levels

Top-down Estimation

- It is associated with parametric or algorithmic models.
- A formula for a parametric model:
  - Effort = (System Size) * (Productivity Rate)
  - The model of forecasting the SW development effort has two components
  - System size is a method of assessing the amount of work
  - Productivity rate is a method of assessing the rate of work at which the task can be done

Top-down Estimation

- Example:

System Size = 3 KLOC.

Productivity Rate = 40 days per KLOC.

Effort = (System Size) * (Productivity Rate)

Effort = 3* 40 =120 Days.

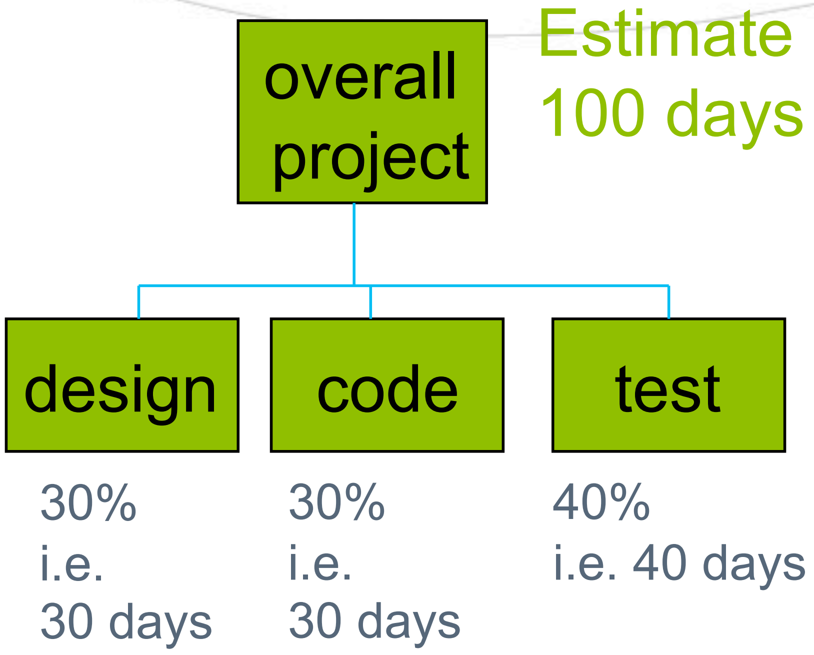
System Size is a size driver.

Productivity Rate is a productivity driver.

Top-down Estimation

- Other parametric models:
  - **Function points** is concerned more with task sizes.
  - **COCOMO** is concerned more with productivity rate.

Top-down estimates



- Produce overall estimate using effort driver(s)
- distribute proportions of overall estimate to components

Estimation by Analogy

- It is also called case-based reasoning.
- For a new project the estimator identifies the previous completed projects that have similar characteristics to it.
- The new project is referred to as the target project or target case
- The completed projects are referred to as the source projects or source case
- The effort recorded for the matching source case is used as the base estimate for the target project
- The estimator calculates an estimate for the new project by adjusting the (base estimate) based on the differences that exist between the two projects

Estimation by Analogy

- There are software tools that automate this process by selecting the nearest project cases to the new project.
- Some software tools perform that by measuring the
  - Euclidean distance between cases (projects).
  - The Euclidean distance is calculated as follows:

distance= square-root of ((target_parameter$_1$-source_parameter$_1$)^2 ….
+ (target_parameter$_n$ -source_parameter$_n$)^2)

Estimation by Analogy Example

- Assume that cases are matched on the basis of two parameters, the number of inputs and the number of outputs.
- The new project (target case) requires 7 inputs and 15 output
- You are looking into two past cases (source cases) to find a better analogy with the target project:
  - Project A: has 8 inputs and 17 outputs.
  - Project B: has 5 inputs and 10 outputs.

Which is a more closer match for the new project A or project B?

Answer

- Distance between new project and project A:
  - Square-root of ((7-8) 2 + (15-17) 2)= 2.24
  - Distance between new project and project B:
  - Square-root of ((7-5) 2 + (15-10) 2)= 5.39

Project A is a better match because it has less distance than project B to the new project