keynote

Project Estimating

A managers' guide to estimating principles and practice

INTRODUCTION

Predicting the effort and cost of an IT project is like predicting stock market movements, or next week's weather. It has been the subject of extensive research and a wide range of approaches and techniques are available. The grim reality though, is that there is no single approach that consistently generates accurate results in any situation.

KEY CHALLENGES

This note summarises the fundamental approaches to estimating, identifies the main problems/limitations, and suggests practical ways to improve the quality of estimates.

On an IT project there are 3 main areas to estimate:

- The cost of equipment, parts and materials
- The amount of effort and hence the labour costs
- The elapsed time needed

Of these, the cost of equipment, parts and materials is the easiest. As a broad generalisation, these elements are often less that half of the total project-cost. It is frequently possible to estimate equipment costs to within ±10% at an early stage, and average equipment costs show a small downward trend over time.

Estimating the effort needed is much more difficult with early estimates having spreads of ±50% or more. Several careful iterations around such estimates are usually needed to achieve useful results.

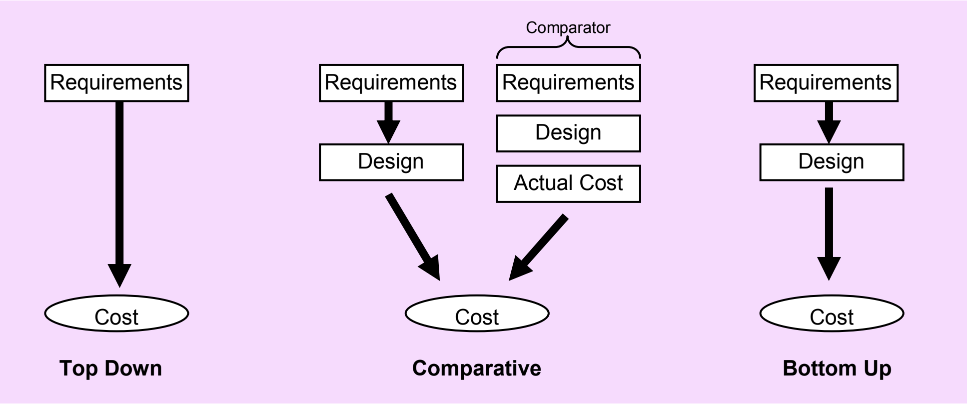
Elapsed time is determined by a combination of:

- Effort driven tasks whose duration depends on the number of people working (e.g software development, testing).
- Fixed duration tasks and interdependencies (equipment delivery times, document review periods).

Because of the dependency on effort estimates, this is likely to be the least accurate of the 3 areas estimated.

ESTIMATING METHODS

There are three main estimating approaches (see figure) which can be summarised as: top-down, bottom-up, and sideways (comparative).



Top Down

Top-down estimating takes a description of the needs/requirements (the ‘top’) and produces directly an estimate of the effort/material or cost to achieve the solution.

For example to estimate the cost of a new office building you might decide the floor area needed, based on the number/size of rooms wanted and multiply that by a construction cost per square metre to arrive at the estimated building cost.

This approach can sometime used to estimate the cost of IT projects if:

- The size and complexity of requirements can be described in a quantifiable way
- There is a recognised formula to translate requirements into effort or cost.

The most common technique is based on Function Points, a measure of the amount of functionality or complexity in a system requirement. A formula translates this into effort based on a number of driving parameters. Whilst the approach appears scientific, the formula is often empirical (i.e. without any (analytical basis) and the parameters require subjective judgements such as degree of complexity).

Once a total effort or cost estimate is obtained this can be partitioned using typical proportions. For a software development project typical proportions are Requirements 20%, Design 20%, Development 40%, Test 20%. If you do this remember everything is driven by the original estimate and partitioning is not improving that estimate.

Comparative (Sideways)

Comparative estimating involves taking requirements or design and comparing them with similar completed projects where the effort or cost is known. Comparisons can be with one or multiple reference projects to make them representative. This is what most people do when they estimate ‘by experience’.

To use this approach, the requirements or solution needs to be sufficiently well developed to select valid comparisons. Comparisons should be considered carefully for fit, based on criteria such as size, technology and business environment.

Specific differences between target and reference projects, such as size can be compensated for using scaling factors.

An extreme example of the comparative approach is to carry out a pilot project or task to provide the reference point. The pilot needs to be small enough to carry out early, and yet representative for estimating purposes, and there are obvious dangers in extrapolating from a single small pilot to a much larger project.

Bottom Up

Bottom up estimating involves taking the requirements, producing an initial design, identifying the work (and materials) needed to realise each component in the design (the ‘bottom’) then summing these up.

Using the previous example, to estimate the labour cost of the new office building, identify all the work components (build walls, paint walls, fit windows etc.) work out a cost for each one and sum them to get a total cost.

The design can be broken down to increasing levels of detail to improve confidence. There is no rule on how far to go; more effort is needed to develop a detailed design but this yields more information resulting in a more accurate estimate.

PROS AND CONS

Top-Down

The top-down technique is useful in the early stages of a project to provide indicative estimates, once requirements have been captured. It goes directly from requirement to solution, so estimates are quick to produce, little design work is needed and the formula based approach facilitates what-if analysis.

The technique can only be used however if a proven algorithm is available, is highly sensitive to the parameters used and gives no insight into the solution needed.

Comparative

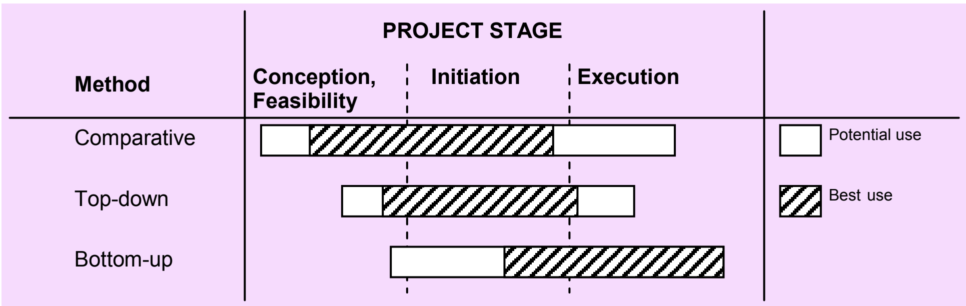
The comparative technique is easy to understand, being based on experience, is useful at any stage in a project and can cope with loosely defined/quantified requirements.

The main problems are finding suitable comparators (particularly for innovative projects) and getting access to comparative information, which may be commercially sensitive or simply not recorded.

Bottom-Up

The bottom-up technique can be applied in almost any situation, the basis of the estimate is clear and can be refined to clarify uncertainties or increase accuracy. The main disadvantages are that it requires the design to be available and it needs the most information and effort to produce.

The figure illustrates when the techniques are applicable during a project.



SOURCES OF ERROR

The main sources of error in estimating are summarised below.

Poor estimating technique

This includes choosing the wrong approach, choosing bad models or comparators, not applying the techniques with sufficient effort and care or practical failings such as arithmetical errors.

Omissions

If something is left out then it won't be estimated regardless of the technique used. There may be omissions in requirements, design or a failure to recognise the full scope of the work.

Changes

Changing the requirements or solution after the estimate has been made will introduce errors. Changes that increase the scope are the main concern but changes, which don't increase scope, can still increase effort and hence cost.

Risks

Risks are adverse events which have some probability of arising but aren't certain, and so are not taken into account in the estimate. If risks do occur they will increase the cost. In a highly innovative project with many risks then some are bound to occur.

CONTINGENCIES

Contingency provisions should be considered whenever estimates are produced. They should address each of the four areas above.

Contingency provisions should be explicit (not hidden) and the basis on which they are made recorded. Contingency provision for risks will need to consider the likelihood and impact of risks.

IMPROVING ESTIMATES

Using estimates from several sources can improve estimates and increase confidence or at least highlight the spread in estimates.

Multiple estimating approaches can be used, e.g. using the comparative approach in combination with either top-down or bottom-up approach.

Multiple inputs

Multiple contributors can improve estimates either by several people reviewing and improving a single estimate or specialists estimating their own areas and combining them.

3 point estimates

More than one estimate can be produced. The 3-point technique estimates the most likely, best-case and worst-case figures whilst the 3-solution technique estimates cheap-and-cheerful, middle of the road, and Rolls Royce solutions.

Commercial comparators

The cost of a bespoke solution may be compared with an available product or a quotation for a commercial developed solution.

PRACTICALITIES

Any estimate must be communicated in context, this includes:

- The reason for making it
- The scope of the work (inclusions and exclusions)
- The assumptions and their rationale
- The spread expected.

The table indicates how familiarity typically affects estimating spreads.

Situation	Certainty	Spread
We have done similar work before using the same people, processes, technology and environment	High	±0-15%
We have done similar work before but with different people, or processes, or technology, or environment	Medium	±15-50%
We know of other organisations elsewhere that have done similar work, but we have never done it ourselves	Low	±50-100%
We don't know anyone anywhere that has done this work, this way before	Very Low	>100%

Sources of problems

Common causes of estimating problems include:

- Off-the-cuff estimates made without thought
- Omissions, particularly when tackling new work
- Systematic errors particularly in a new environment or technology
- Over-confidence of individuals
- End point/target scheduling
- Pressure - from colleagues, managers or customers.

It is worth recognising the most estimating errors are under-estimates.

CONCLUSIONS

There are no certainties in estimating . Good estimates need a structured and thorough application of sound techniques, a large dose of experience and a recognition of the limitations inherent in the results. What is certain is the poor estimates almost invariably have an adverse impact on a project and the individuals involved.

MORE INFORMATION

For more information on the techniques described in this note please contact:

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