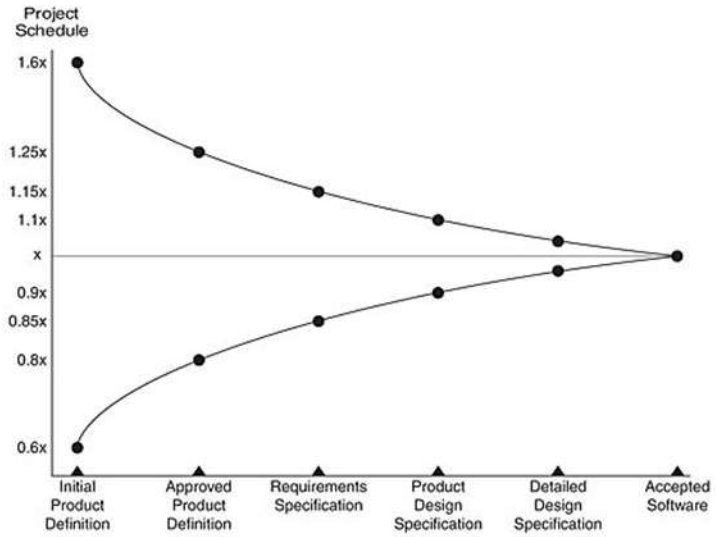
COMP319 Cost Estimation

Cost estimation is a commonly a difficult tasks in software engineering, this is due to a number of factors, for example there not being enough knowledge about what will be involved with completing the project as it evolves with time.

Barry Boem's cone of uncertainty in software estimation.

Barry Boem when working on the software industry did some interesting research in which he analysed the estimates people produced for software with the actual figures achieved. With his figures estimates were divided by the actual final project time and this figure f/a was plotted against phases in the projects life. So the figures on the right hand side are estimates calculated very late in the projects time line and figures further to the left were earlier estimates. He did this for a lot of projects. His results looked like Figure 1. Note f/a = 1 is a perfect estimate f/a<1 is an underestimate of time and f/a > 1 is an overestimate of time.



Note that the range of f/a was wide for the being of the project and narrowed down as the project progressed, this is not surprising as early on in the project's life less is known about what will be involved in the development. Notice after the design specification is completed the estimation is a lot easier. We can use the graph as follows.

If we make an estimate but at the initial project definition phase of 10 weeks, we could use the graph to estimate that we would expect of range of uncertainty from by 10/0.6 = 17 weeks to

10/1.6 = 6 weeks (approximate). This is useful for risk planning to get an idea of the range of possible outcomes.

EQF Estimation Quality Factor

Estimation quality factor is a technique used to determine the quality of your estimation.

High estimation factors means a very accurate estimate with little deviation from the actual delivery time of the project. So an EQF of greater than 10 means that on average the estimates will be less than 10% different the actual project.

Low EQF could be the result of a wide range of factors including:

Poor estimation skills

Lack of knowledge about the project when the estimation was done

Pressure from others to produce for example a low estimate (pressure from management)

Estimation Bias

Estimation bias as measured for a number of estimates shows if the estimator in general over or under estimates. So if the estimator has an estimation bias of 0, this means that they over estimate the same amount of time that they under estimate.

If measuring the bias of F/A a positive bias indicates that the estimator is generally overestimating.

Reasons for over-estimation

The project manager is worries that the project will overrun and therefore wants to have a lot of time allocated to the project.

There is a financial benefit to putting in the high estimate, for example the company might know there has been allocated a lot of money to this project so it pays to keep it going longer.

Reasons for under-estimation
Lack of experience of project manager leads to too much optimism.
Pressure from management to keep estimates low.

The effects of over and under estimation

Over-estimation leads to waste and over-resourcing of projects, it might also lead to high costs estimations which could lead the business to lose trade.

Under estimations generally lead to more over-runs causing the businesses to lose reputation and possible money in the form of contract penalty clauses.

The Rise and Fall of the Chaos Report (J. Laurenz Eveleens and Chris Verhoef)

This report found the following problems with the Chaos report.

The Standish report classified project outcomes in the following categories:

Type 1: project success. The project is completed on time and on budget, offering all features and functions as initially specified.

Type 2: project challenged. The project is completed and operational but over budget and over the time estimate, and offers fewer features and functions than originally specified.

Type 3: project impaired. The project is cancelled at some point during the development cycle.

The first problem with this classification is that it is incomplete, For instance, a project that's within budget and time but that has less functionality doesn't fit any category, this was pointed out in a Chaos review paper by Robert Glass and Magne Jørgensen.

The other more serious issue is looking at what the Chaos report was measuring, in summary projects classified as successes has a forecast/actual ratio>=1 for time (no overrun) and a forecast/actual ratio<=1 for functionality (functionality complete)

However these ratios depend on two variables the actual project value and the forecast value, so unless an organisation can either overestimate or get the forecast time correct, the project will overrun based on an incorrect forecast (not because of a failure to deliver). This problem of project forecasting was examined by Barry Boem and described by a concept which he referred to as his cone of uncertainty.

This report looked at 3 different organisations and found the following interesting points.

The first organisation they looked at has a very high accuracy of forecast yet only managed (according to the Chaos criteria) to managed a 59% success rate.

The second organisation they looked at admitted they used the Standish criteria to determine if a project was a success, this led them to increase the forecast time for their projects (to achieve a greater success rate), many projects ran within budget and within time, yet the accuracy of the forecasting for this organisation was less than the first organisation, due to the bias introduced by the Chaos reports targets.
This lead to the over-resourcing of projects and inefficiencies with the organisation not working at full capacity.

The also looked at a third organisation which despite having a good performance in terms of forecasting, (small deviation from the actual), has an institutional bias in producing low forecasts for time. This led to them having a low success rate according to Chaos criteria based on this bias, even though they were actually very good performers in terms of their own internal quality measures.

So the criticisms are that the raw f/a ratio is a poor judge of project success and organisations following that criteria will often bias their forecasting to achieve apparent project success.