

Quality assurance of concept selection, as well as management documentation and cost estimates for the selected project option

Cost estimation

Based on a draft prepared under the leadership of Metier AS,

Version 1.0, dated 11 March 2008

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1. Introduction

1.1. PURPOSE

The purpose of this guide to cost estimation is to make the cost estimation process for major government projects predictable, reliable and efficient in all project phases. The guide primarily deals with the estimation of investment costs, but also addresses various aspects of life-cycle costs and life-cycle benefits. The guide sets out requirements for cost estimation at a general level. It is assumed that government agencies and/or projects have their own tailored quality systems for cost estimation at a detailed level.

1.2 DEFINITION

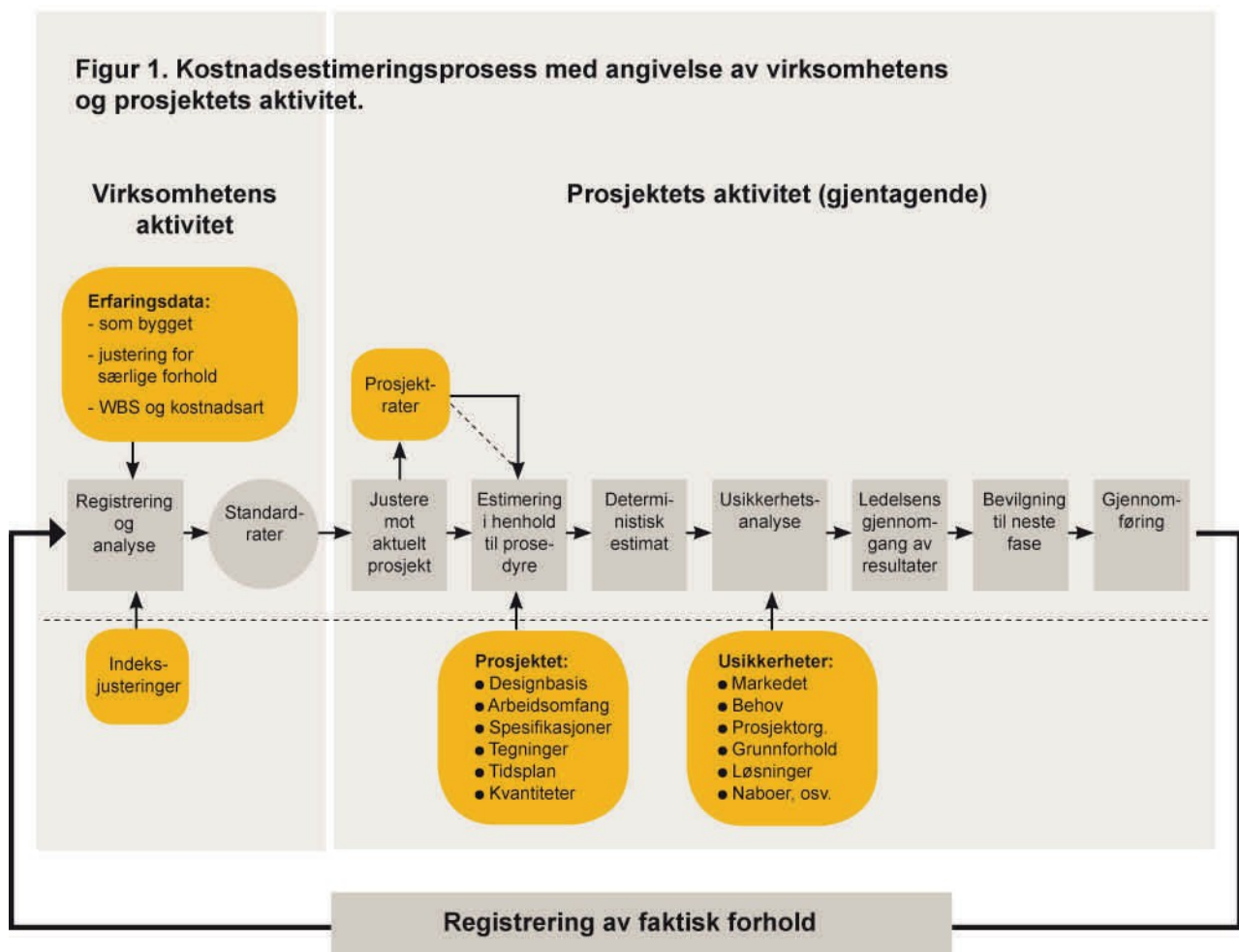
Key terms are defined in Guide No. 2 in this series, 'Common Terminology KS2', and Guide No. 3 'Common Terminology KS1', Ministry of Finance (the versions in force at any given time).

2. Requirements for cost estimation

2.1 THE ESTIMATION PROCESS

Figure 1 illustrates a sound cost estimation process. In principle, this estimation process will be repeated at each stage of a project's development as the project gradually becomes better defined.

Organisations that do not have established standard cost rates can remedy this by using data from comparable projects where the cost figures have the level of detail and precision required for the relevant project phase.



The uncertainty analysis must take into account the quality of the cost data used in the deterministic estimate, preferably through stochastic simulation.

2.2 COST ESTIMATION EXPERTISE

Cost estimation should be led by a person (the estimator) with specific training in cost estimation. At the very least, the estimator must have completed a course in basic estimation techniques, possess sound industry experience and have significant experience of delivering the types of projects being estimated.

2.3 OVERALL SCOPE AND KEY ASSUMPTIONS

The cost estimate must represent the full investment costs for the financier, including both direct and indirect costs. Key assumptions and any limitations must be clearly stated in the documentation.

2.4 LIFETIME CONSIDERATIONS

Lifetime costs are determined early in the project. The project management shall, throughout the project – and

particularly in the early stages – carry out adequate life-cycle assessments to ensure that sub-optimisation is avoided.

Lifetime costs should be stated as present value or as annual costs. Annual costs in this context are the lifetime cost spread over the service life as an annuity. One should also be mindful of aspects from a cost-benefit perspective, where maintaining an acceptable level of benefit may affect the investment and lifetime costs.

2.5 ESTIMATE CLASSES AND ESTIMATION METHODOLOGY

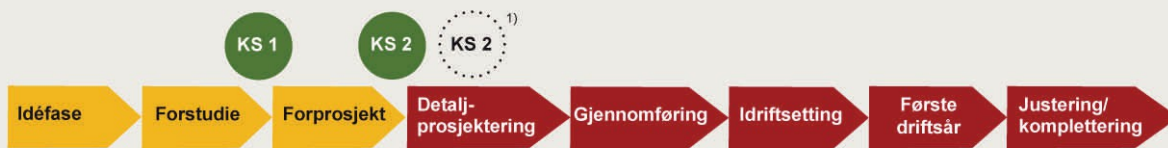
Table 1 shows how the accuracy of the cost estimate is tailored to the decision to be made in the various project phases and how the accuracy of the estimate correlates with how well the project is defined (degree of definition).

Figure 2 shows the phase breakdown in government projects. For KS 1, Class 4 estimates will be relevant, as the degree of project definition is at this level. For KS 2, the degree of project definition will be at Class 3 level.

Tabell 1. Tilpasning av nøyaktigheten på kostnadsestimatet i forhold til beslutningen som skal fattes. (Kilde: Generic Cost Estimate Classification Matrix fra AACE, Inc.)

Estimatklasse	Definisjonsgrad	Bruksområde	Metodikk	Forventet nøyaktighet	Ressurser for å lage estimatet
	Hvor godt prosjektet er beskrevet og avgrenset (definert). Uttrykt i % av full definisjon.	Typisk formål for estimatet.	Typisk estimeringsmetodikk.	Typisk +/- spenn relativt til det mest nøyaktige 1.	Typisk ressursforbruk relativt til det med minst ressursforbruk.
Klasse 5	0 % til 2 %	Screening eller mulighetsstudie	Stokastisk eller skjønn	4 til 20	1
Klasse 4	1% til 15 %	Konseptstudie eller mulighetsstudie	Overveiende stokastisk	3 til 12	2 til 4
Klasse 3	10 % til 40 %	Budsjett, godkjenning eller styring	Blandet, men overveiende stokastisk	2 til 6	3 til 10
Klasse 2	30 % til 70 %	Styring eller tilbud/anbud	Overveiende deterministisk	1 til 3	5 til 20
Klasse 1	50 % til 100 %	Kontroll estimat eller tilbud/anbud	Deterministisk	1	10 til 100

Figur 2. Faseinndeling i statlige prosjekter. (Kilde: rammeavtalen pr. juni 2005)



¹⁾ Veg- og jernbanesektor

Estimation must be based on recognised estimation methods that are tailored to the sector and the specific problem. The following list shows examples of various estimation methods:

- **Analogue estimation** involves using the actual costs from previously completed, similar projects as the basis for estimating the cost of the project in question. Analogue estimation relies on expert judgement.
- **Resource-based estimation** involves setting unit rates for each resource in order to estimate the cost of the activity (for example, hourly rates for staff and bulk costs per cubic metre). Obtaining price information is a method of gathering such unit rate information.
- **Bottom-up estimation** involves estimating the costs of individual work packages or activities at the lowest level of detail. These detailed costs are totalled or rolled up to a higher level for reporting and monitoring.

- **Parameter estimation** is a technique that utilises a statistical relationship between historical data and other variables (for example, costs per square metre of building, costs per line of software code) to estimate the cost of an activity.

2.6 DOCUMENTATION OF EXPERIENCE DATA, TRANSPARENCY AND TRACEABILITY

Experience data from completed projects shall form the basis for estimating new projects. It is important that there are clear, transparent and unambiguous descriptions of the content of the individual items, so that there is full traceability between the estimator's assessments and the estimate.

Figure 3 illustrates examples of good and poor descriptions of experience data documentation.

Figur 3. Eksempel på god og dårlig beskrivelse av dokumentasjon av erfaringsdata

(Kilde: Society of Cost Estimating and Analysis (SECA))



2.7 CORRECTION FACTORS

Correction factors are factors intended to adapt the empirical figures to the circumstances of the new project. The most important are:

- Complexity
- Technological development
- Location factors
- Local conditions.

Example from the assessment of complexity in the Norwegian Public Roads Administration's cost database:

1. Topography: Nature of the terrain.

Proportion of cuttings, gradients, etc.:

- Very high: Steep slopes, steep terrain formations.
Particularly for bridges:
Foundations in deep water requiring divers.
- Normal: Generally undulating, gently sloping terrain formations.
- Very low: Flat, gentle formations, no foundations under water.

The Norwegian Public Roads Administration's complexity factors do not provide quantified correction factors. The factors are intended solely to provide a basis for characterising completed projects as a relevant basis for estimating new projects.

2.8 DOCUMENTATION OF UNCERTAINTY ASSESSMENTS

It is also important that there are clear and unambiguous descriptions of the assessment underlying the uncertainty range (P10, P90) for an item. Documenting this range in an unambiguous manner prevents it from being included twice or, conversely, omitted.

2.9 NEUTRAL ESTIMATES

The cost estimate must not contain systematically optimistic or pessimistic assessments. It is essential that the estimation process does not incorporate hidden reserves or marginalise items for unspecified costs which, based on experience, are required in the industry.

2.10 QUALITY ASSURANCE

The cost estimate must always be reviewed by someone who is independent of the project. This is to ensure that the estimate is based on sound empirical data and that sound, multidisciplinary judgement has been applied.

2.11 THE ROLE OF MANAGEMENT

Management is responsible for ensuring that there is a well-functioning estimation process within the organisation.

Each individual cost estimate must be formalised in a separate document approved by senior management.

3. Checklist for quality assurance of cost estimates

1. Does the cost estimate represent the full investment costs for the financier, including both direct and indirect costs?
2. Are all key assumptions and any limitations clearly documented?
3. Has the cost estimate been prepared on the basis of a documented estimation process within the organisation and the project?
4. Has the estimation been carried out by individuals with formal expertise in cost estimation?
5. Has the estimation been carried out by individuals with extensive experience of this type of project?
6. Does the organisation have documented and clear requirements for accuracy at the relevant decision point?
7. Is the level of accuracy of the cost estimate appropriate for the decision to be made in the various project phases?
8. Does the accuracy of the cost estimate depend on how well the project is defined (the level of definition)?
9. Is the estimate structured in a way that is standard within the industry?
10. Is the estimate based on relevant and documented empirical data that has been adjusted to take account of the project's context?
11. Are there clear, transparent and unambiguous descriptions of the content of the individual items, ensuring full traceability between the estimators' assessments and the final estimate?
12. If there have been different contributors to the individual items in the cost estimate, have the estimators shared a common understanding of the estimate's margin of safety against cost overruns?
13. Has the cost estimate been reviewed by a party independent of the project?
14. Has the cost estimate been formalised in the form of a separate document approved by management?