Department of **Treasury and Finance**

Investment Lifecycle and High Value/High Risk Guidelines

Preparing Project Budgets for Business Cases

Technical guide

Draft

Victoria

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1. Background

Overview of the guide scope and its application in the Victorian Government planning process for preparing business cases

1.1 Context

This guide is a technical supplement to the Investment Lifecycle Guidelines series (2012). Users should refer to the Investment Lifecycle Guidelines as a basis for developing concepts and preparing business cases for which project budgets are required. The other technical supplements include the following:

- business case development for information and communications technology (ICT) projects;
- procurement strategy;
- governance;
- economic evaluation;
- project risk; and
- sustainability .

This document provides the user with information on how to develop robust cost and budget estimates that support sound investment decisions. It does this by addressing the following issues:

- financial planning of investments, linking capital costs in the project budget to whole-of-life costs for service delivery;
- how to accommodate risk and uncertainty in project budgeting and delivery; and
- project governance and sign-off requirements surrounding project budgets.

Particular emphasis is on stage 2 ‘Prove’ and the information required for the business case submission. It provides information to help users identify and achieve the optimum financial outcome over the whole life of the asset. In particular it helps projects develop the information they need for the project budget for a business case submission.

1.2 Purpose – developing and managing project budgets

This technical supplement, Guide for Preparing Project Budgets in Business Cases ('the guide') assists with establishing project budgets in a business case and managing the project budget during the delivery phase. It complements the supplementary guide on project risk management and its objectives are to:

- provide direction on developing capital project budgets in business cases;
- promote greater consistency, transparency and accountability in managing capital budgets;
- reinforce the obligation and principle that public officials manage projects to the lowest cost for the required performance, rather than to the maximum approved budget;
- put in place governance arrangements for managing project contingencies; and
- provide some direction on the public communication of capital costs.

The purpose of the guide is to support these objectives by providing standards on:

- developing a base cost estimate for a business case's proposed capital project;
- developing and costing project risks and contingencies;
- integrating base cost, project risk and contingency estimates to develop a project budget; and
- establishing governance and sign-off requirements that attest to the efficacy and veracity of a business case's project budget.

This guide is not prescriptive about **how** to develop cost estimates. It provides standards on the information required and quality requirements to be presented in a business case for decision-makers to consider. It outlines the linkages between the capital costs and whole-of-life costs that are needed as inputs to the business case and its economic appraisal to allow the selection of the best value for money option to deliver the benefits. It is recognised that the most appropriate methods and techniques to develop specific cost estimates may vary given the unique features of some projects; however, the standards in this guide must be met at a minimum. For example, the separate guidance on ICT projects identifies specific costing elements to be considered in developing the base cost estimate.

Where a project budget in a business case is prepared using a different method and/or techniques from those in this guide, the rationale and implications of the departure needs to be fully explained and justified in the business case.

Using an analogy, this guide is about 'the standards of cooking; not a recipe book'.

1.3 Scope of application

This guide applies in all cases where the Victorian Government requires a business case to be prepared. Currently, business cases are required for all projects costing $5 million or more in total estimated investment (TEI), including High Value/High Risk (HVHR)[1] projects. This applies to all projects and asset-related proposals seeking funding through the budget process, and for government business entities, for those prooposals that require the Treasurer's approval. This guide applies to all projects regardless of any preferred procurement option such as *Partnerships Victoria*, alliance contracting or any other procurement arrangement.

[1] HVHR projects have a TEI of $100 million or more, or have an identified high risk.

The concepts and principles of this guide can apply broadly to non-asset proposals; however, the primary focus is on capital asset proposals being considered by government.

1.4 Structure of this guide

This guide covers the following topics:

- **elements of a project budget** – an overview of thecomponents of a project budget as they should be presented in a business case prepared in accordance with Victorian Government policies and guidelines;
- **foundations for good project budgets** – an outline of the foundation points and the core elements to ensure a project budget can be developed for the business case (it is expected that all business cases presented to government for consideration satisfy these foundation points);
- **developing accurate base cost estimates** – a description of a base cost estimate and the expected standards to be applied to its preparation;
- **developing project risk estimates** – an overview of project risks; the different steps and techniques of project risk estimates; how to set the base risk allocation and contingency; and undertaking a sense (or reality) check on whether the estimates are appropriate;
- **establishing a project budget** – guidance on integrating the base cost estimate, project risk estimate and level of contingency to form the recommended project budget;
- **instruction templates for professional services** – suggested templates for engaging the professional services associated with developing the project budget for the business case; and
- **certification for project budget estimates** – sign-off templates for attesting to professional standard of estimation, integrity of process and fitness of project budgets.

> From 1972…
>
> 'We found that uniform guidance on cost estimating practices and procedures that would be the basis for formulating valid, consistent, and comparable estimates was lacking. In fact, evidence showed that each [agency] issued its own guidance for creating cost estimates and that the guidance ranged from a detailed estimating manual to a few general statements. In addition, we reported that cost estimators often ignored this guidance.'

Source: Comptroller General of the United States, Theory and Practice of Cost Estimating for Major Acquisitions, B-163058 (Washington, DC: 24 July 1972), and restated in the 2009 GAO Cost Estimating and Assessment Guide – Best Practice for Developing and Managing Capital Program Costs

1.5 Related guides and frameworks

This guide should be read in the context of other relevant documents:

- (the broader) Investment Lifecycle and High Value/High Risk Guidelines – Victoria (2012 and updates);
- National PPP Guides Volume 4: PSC Guidance;
- National Alliance Contracting Policy and Guidelines – Commonwealth Department of Infrastructure and Transport (2011);
- Australian Standard AS/NZS ISO-31000: 2009 Risk management – principles and guidelines;

- relevant departmental and agency project management methodologies;
- Project Management Institute's PMBOK, OGC Prince2 or other authoritative project management guidance; and
- Department of Infrastructure and Transport: Best Practice Cost Estimation Standard for Publicly Funded Road and Rail Construction (June 2008 and updates).

1.6 The need for an accurate project budget

The planned benefits of capital investment proposals need to be analysed, quantified and articulated in a business case, along with a thorough financial analysis of forecast capital costs, operational costs and risks.

Approving a business case project budget (as a forecast of actual outturn capital costs) requires a project owner to demonstrate that robust cost information has been used to develop the business case. This demonstration now includes specific sign-off and assurances provided as part of the business case submission to government.

An approved business case with a project budget that is subsequently found to have significantly underestimated the actual outturn capital cost raises doubt about the basis of the original investment decision. Further, a significant underestimation of the forecast outturn capital costs could displace future funding of alternative projects or services. This guide reinforces the need for the business case to be the core decision-making document and the need to fully understand the estimates provided.

Business cases need to reflect sound consideration of risks and the proposed treatment. Business cases should:

- identify major areas of uncertainty in the project;
- reflect this uncertainty in budget and schedule estimates; and
- demonstrate the structures, process and methods by which this uncertainty will be reduced or otherwise managed.

Departments should align risk management activity with AS/NZS 31000:2000 Risk Management – Principles and Guidelines.

This guide describes the process for developing risk-based cost estimates – one step in the management of risk over the investment lifecycle. The estimate represents an informed view of the financial risk at a point in time in the project/investment's lifecycle. Risk management is an ongoing activity, which must be managed throughout the life of the project to reduce or maintain the overall risk profile of the project.

2. Elements of a project budget

Overview of the elements of a project budget to be presented in a business case prepared in accordance with Victorian Government policies and guidelines

2.1 The headline elements of a project budget

The project budget should be prepared with the following headline elements (illustrated in Figure 1). These headline elements have various subcomponents, some of which are summarised below with more detail provided in sections 3, 4 and 5.

A risk-based project budget is a significant, but not final, step in managing risk across the investment/project lifecycle. The project budget aims to accurately identify the base cost estimate, while making provision for 'credible' risks over the delivery of the project. Risks may or may not materialise. The aim of ongoing risk management throughout the project is to minimise 'downside' events while maximising opportunities.

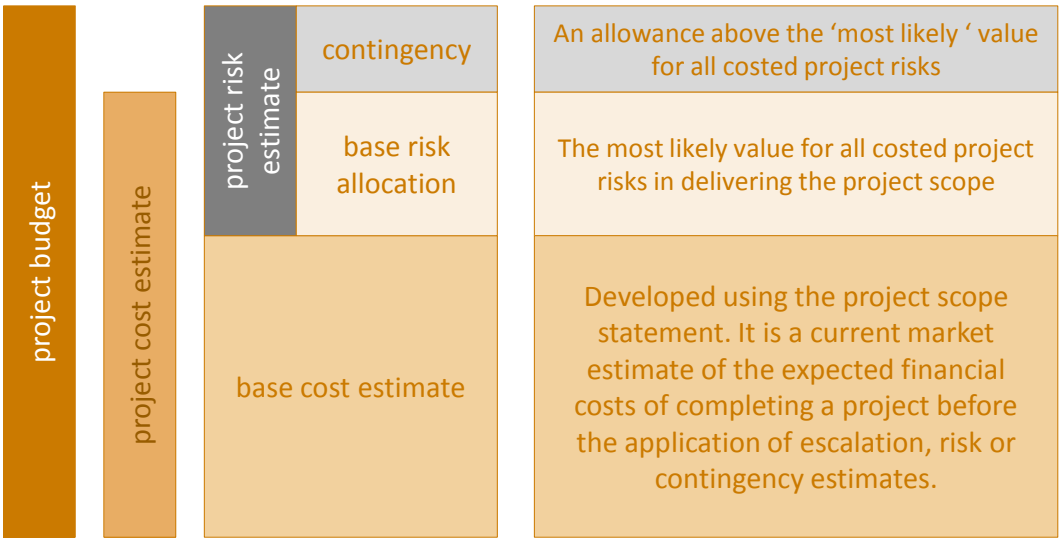


Figure 1 Headline elements of a project budget

2.1.1 Base cost estimate

The base cost estimate does not include any allowance for escalation,[2] risk or contingency.

The base cost estimate comprises the following cost elements:

[2] The base cost estimate is determined at a particular point in time, and allows the project cash flows to be forecasted by taking into consideration the project implementation timeline and schedule of works. While escalation is presented as part of the base risk allocation, it is not treated in the same way as the other risks included in the base risk allocation.

- **direct costs** – the estimated cost of labour, plant, materials and specialist subcontract work required to deliver the asset (based on calculated quantities derived from proposed design solutions and construction methodologies developed on industry best practice);
- **indirect costs** – the specific project costs necessary to support the direct costs of project delivery incurred by both the sponsor and the contractor(s); examples include site facilities, project insurances, professional fees, site management and supervision;

  The cost of agency staff applied to the project is not included in the estimate of the indirect costs because these costs are dealt with in the agency's ongoing base funding. However, there are cases where a large project sees the establishment of a special purpose statutary authority or the engagement of specialist capability for the project. In these cases it is appropriate to include the associated costs as indirect costs. At all times, double counting of staff and other costs needs to be eliminated.

- **contracting parties' fee** – this is an estimate of the contracting parties' profit margin and corporate overheads.

It is essential that the base cost estimate clearly articulates its boundaries and assumptions to inform the risk assessment discussed in chapter 5. Otherwise there is a high probability of overlap or omission.

'While it is clear that progress has been made in terms of implementing new acquisition reviews and reporting detailed baselines, there remain critical gaps in the material reported, particularly the quality of the underlying cost estimates needed to establish baselines.'

Actions Needed to Improve Transparency and Accountability, General Accounting Office, 13 April 2011

2.1.2 Project risks

There will always remain an element of uncertainty in the cost of a project up to the date of the final payment to the contractor. However, cost accuracy increases as uncertainty reduces over time; this has been described as a cone of uncertainty (see Figure 2).

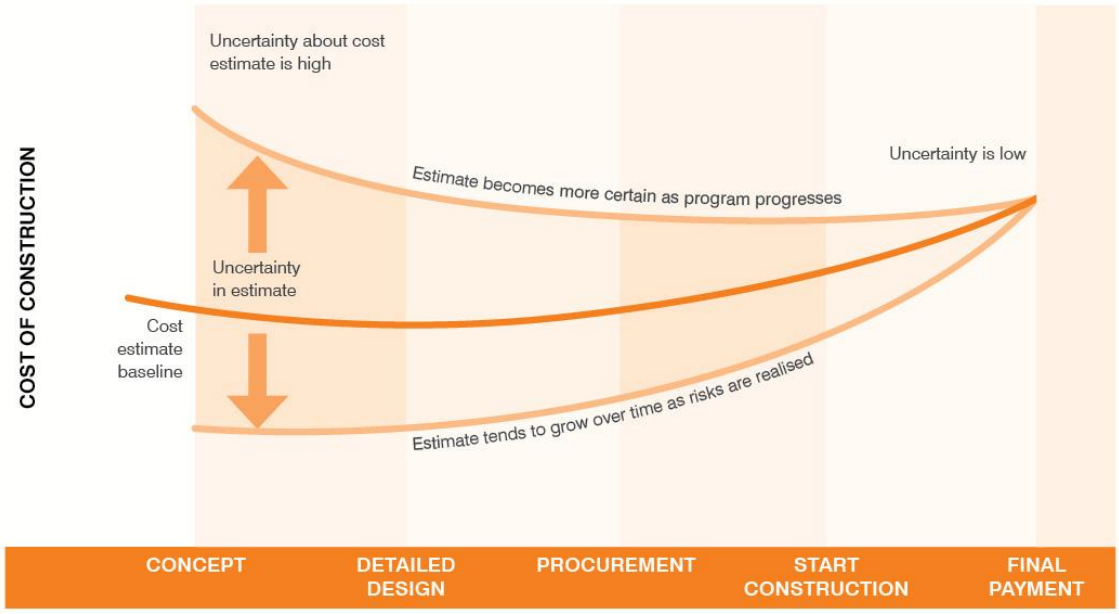
At each stage the key risks that should reduce or be mitigated include:

- detailed design – increased certainty over design requirements, specifications, ground conditions and site survey data;
- procurement – contractor pricing agreed (schedule of rates, lump sum, guaranteed maximum price etc.);
- construction phase – detailed design completed (construction drawings), detailed site inspections; and
- contract end – all variations agreed, all costs incurred, and presumably no claims outstanding.

This uncertainty needs to be managed over the life of the project, but it starts with an appropriate allowance being included within the project budget. This is achieved by including two elements within the project budget in addition to the base cost estimate:

1. the base risk allocation – an allowance for the 'most likely value' of the increase in cost above the base estimate to accommodate uncertainties in the project (unknown ground conditions, design detailing, contractor pricing); and
2. the contingency – an allowance above the 'most likely value' for all costed project risks.

The contingency should not be relied upon; the objective should be to deliver the project without recourse to this additional provision.



US Government Accountability Office

Figure 2 Cone of uncertainty

In developing the base cost estimate, it is necessary for the agency's cost estimator to make numerous assumptions about what will be delivered, and how and what circumstances will arise as the project is delivered. When assumptions are made, they often represent significant areas of uncertainty for the project time and cost estimates, which need to be recorded. The estimator, with the help of a business case development team, may further investigate the assumptions to eliminate or reduce the uncertainty, or moderate the risk impact.

Assumptions are normally captured as 'project risks'. The logic for determining an estimate of project risk is to better inform the sponsor on expected costs above that of the base cost estimate (i.e. a forecast of the 'actual outturn cost').

It is important to remember the process of identifying and estimating the cost of risks needs to connect to the ongoing management of risks and, in terms of accountability, to understand what risks have been provided for in the base risk allocation and contingency.

Escalation

When developing a project budget estimate assumptions must be made on the future price of goods and services. These prices change over time because of inflation, market conditions, peaks and troughs in demand and legislative impacts (e.g. carbon price). The impact of these future price changes need to be incorporated in the project cost estimate and cash flow.

Escalation is highly sensitive to predictions of market conditions, to both systemic changes and to the supply and demand of specific project inputs. Key historical indices or measures of cost movements used for future estimation of rates are available in industry publications and are produced by the Australian Bureau of Statistics. For example:

> Australian and New Zealand Standard Industrial Classification (ANZSIC) classes 4112 Residential Building Construction n.e.c. and 4113 Non-Residential Building Construction' – http://www.abs.gov.au/AUSSTATS/abs@.nsf/DSSbyCollectionid/63B1F55C25621179CA256ED200796D3E or tender price indices (TPIs) produced by cost management consultancies

These indices are based on observed historical data that is available for a range of specific components of the project, for example: concrete, cement and sand; petroleum and coal products; and steel. A cost estimator must use judgement to determine appropriate escalation factors (for the project-specific components) and the overall escalation (a single figure often used for presentation purposes). The specific risks and volatilities associated with your project need to be considered, such as sensitivity to steel price fluctuations, which might not follow TPI. Also the timeframe of cash flows needs to be considered in order to apply a TPI adjustment because these costs will be incurred over time and the cost base will therefore shift throughout the project duration. Care is needed when considering lead times and how these impact on cash flow because escalation compounds year-on-year and can become significant in future periods.

Cost estimators need skill, experience and wisdom to successfully use historical data to forecast future escalation, particularly in conditions of high volatility. In circumstances of volatility this needs to be brought to the fore in the presentation of the project budget so that management can better understand the assumptions underlying the budget.

For the purposes of this guide, escalation is to be included as a project risk in the base risk allocation. The calculation of the escalation allowance provides adequate assessment of forecast cost increases due to the rise and fall of project specific costs during project delivery.

The base cost estimate has the greatest impact on the accuracy of the project budget because it is the largest and most complex component and the foundation on which the base risk allocation and contingency are developed. Figure 3 illustrates the typical relative proportions seen in robust project budgets developed for the majority of government projects.

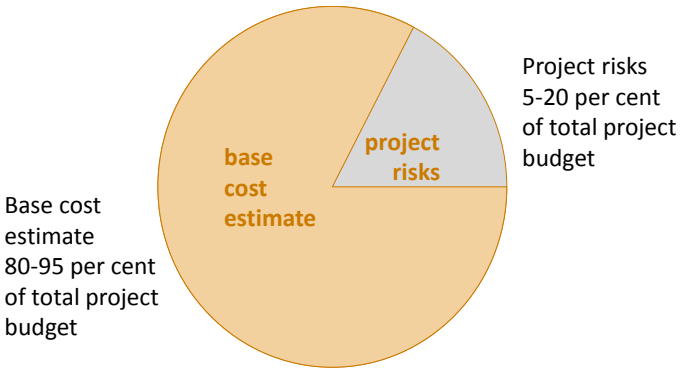


Figure 3 Typical cost proportions of a large capital project

2.2 Planning for financial success

The financial success of an investment can be defined as having two key components:

1. project delivery costs equal to, or less than, the budget; and
2. the lowest possible whole-of-life cost while meeting all specified investment outcomes.*

> * 'Investment outcomes' are those outcomes that sit at the core of the investment (e.g. patient care outcomes for a new health facility, teaching outcomes for a new school or transport outcomes for a new piece of transport infrastructure). It should be noted that the project for construction of any new asset or installation of a new ICT solution is simply part of the measures required to achieve this outcome and investment success does not depend solely on this phase.

These measures of success can be difficult to achieve, evidenced by the fact that projects regularly exceed budgets or operate less effectively than required. Meeting these conditions requires a robust financial planning process feeding into effective project management that actively maximises opportunities and minimises risks.

Successful financial planning requires the following:

- an understanding of the relationship between expenditure on development (construction, installation of new ICT system, etc) and expenditure on the operation of the asset;
- use of robust estimating techniques; and
- a robust risk management strategy that can identify, cost and accommodate uncertainty without exceeding the budget.

Note that this document aims to change the way in which project budgets have historically been developed. In some cases it will require project teams to challenge many commonly held opinions about or approaches to financial performance (see Table 1).

Historic thinking	Principle
Lowest capital cost is best	Sometimes the lowest capital cost can result in an asset that is very expensive to operate, or inefficiently delivers its performance outcomes. The optimum solution finds an effective balance between initial capital and whole-of-life costs.
Projects with high levels of uncertainty will always tend to go over budget	Uncertainty can always be accommodated when estimating a project. When it is known that a project has high levels of uncertainty then greater emphasis should be placed on the risk management and more detailed allowances for risk and contingency should be made.
Risk management involves allowing 10 per cent for things that go wrong	Provision for risk and uncertainty should be proportionate to the risk. Poor planning is not an excuse for large risks remaining in a project. As a project develops, the uncertainty should reduce and therefore risk allowances and contingencies should also reduce.
Sustainability is a financial burden on a project	Sustainability is the process of using natural, human and financial capital in the most efficient way possible. Avoidance of waste is central to this. Many (not all) sustainability objectives can result in cost-reductive outcomes – but these must be assessed over the whole life of the asset and not just consider the capital cost.

Table 1 Historic approaches to project budgets

2.3 The need for a whole-of-life approach

When developing business cases is important to focus on both the capital cost for the project and the whole-of-life costs for the asset in service. The costs to develop the new asset (or embed a new ICT program) are only a small part of the story. In fact, the cost of operating a new asset over, say, a 30-year life would normally far exceed the initial capital investment. For this reason it is critical that proposals forecast and plan for an efficient and low-cost operational life of the asset.

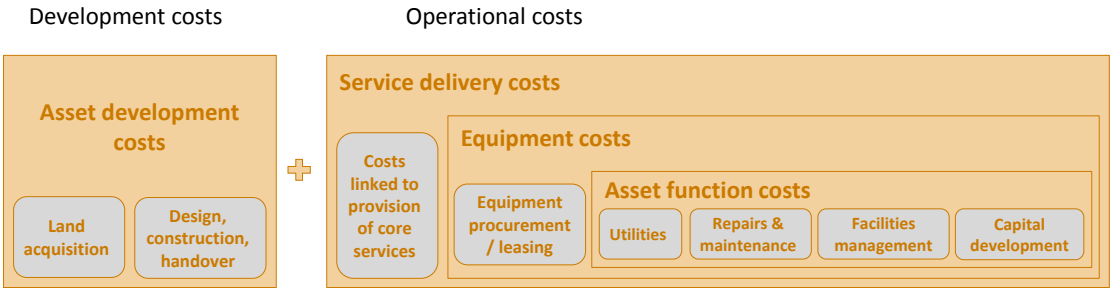


Figure 4 Total investment cost components

Figure 4 illustrates the nature of the costs that need to be considered. Inadequate effort in identifying and calculating operational costs during the investment decision making and early design phases can have a significant impact later on. While it is not always necessary to cost all of these elements in detail for the business case, it is important that the relationship between capital costs and potential increases or decreases in the costs at the operational phase is clearly defined.

The guidance recognises the importance of managing projects to budget, reinforcing the need to scope the project correctly at the outset (and in some cases reduce the scope) such that operational costs are affordable and cost effective.

2.4 'Poor project planning' risks are not project risks!

Risk in the context of 'project risks' refers to possible events in project delivery/construction, associated regulatory planning approvals and so on with outcomes that can be substantially dimensioned at the time the business case is developed. However, there are other (often very substantial) risks arising from poor or insufficient project planning – for example, business cases not completed in accordance with guidelines and featuring poor and/or incomplete analysis of the investment rationale and the proposed capital works. It is expected that business cases will involve a sufficient level of planning to produce defensible and robust estimates (that avoid poor project planning risks).

Financial impacts arising from the risk of 'poor project planning and analysis' represent an avoidable risk.

A capital project, irrespective of the quality or detail of its technical scoping, cannot be satisfactorily delivered as an investment if it is not directly linked to the business case service objectives in an efficient, effective and economical manner.

Poor project planning, and hence substandard cost estimating, cannot be remedied by a risk assessment . This is discussed further in section 5.1 (developing project risk estimates).

> '[In relation to] cost estimating – there was a lack of …capability to provide adequate cost estimates and inability… to evaluate the validity of the cost data.'

The Australian National Audit Office – General Report No.17 2010-11, Assurance Report 2009–10 Major Projects Report

2.5 Delivering to budget

The project budget is the amount approved based on the business case for delivering (constructing or installing) the asset. It is comprised of the base estimate, a risk allowance and a contingency.

The objective is for all projects to be delivered within budget (and to time and quality standards). This means that all projects must:

1. be built on clear project objectives with defined performance outcomes that should avoid unnecessary changes in scope, scale and definition; and
2. accommodate risk and uncertainty using robust risk management techniques that are appropriate to the complexity, nature and scale of the project and the procurement method.

This guidance provides information on how to achieve these outcomes.

3. Foundations for good project budgets

An outline of the foundation points and the need-to-haves that ensure a good project budget can be developed for the business case; it is expected that all business cases presented to government for consideration satisfy these foundation points

3.1 Better business cases and better project budgets

The Victorian Department of Treasury and Finance (DTF) provides advice to the government on implementing its asset investment program. This includes ensuring that effective management practices and processes are in place and operate optimally, including investment project performance. The aim is to ensure individual projects achieve their goals, deliver service benefits and that value-for-money outcomes are achieved. To make such evaluations and provide quality recommendations to government, reliable cost information and standards are required to ensure this baseline information is provided in the full business case.

The business case is the primary document that DTF and government use as the basis for:

- investing in the right things
  - ensuring projects respond to a real and priority community service need;
  - articulate the service need and expected benefits; and
  - effective ranking against competing priorities articulated in other business cases
- the quality of the implementation plans
  - understanding the time, quality and cost constraints for a project to deliver value-for-money outcomes from an investment; and
  - determining the optimal management plan and procurement strategy
- evaluating outcomes
  - the business case is primary source document by which success is defined and assessed in terms of meeting the service need and whether benefits are/were delivered.

DTF has developed this guide to establish a consistent framework so government decision making about allocating public funds is based on good-quality costing information. Poor cost estimates can lead to erroneous judgements of value for money and the relative merits of competing proposals (i.e. the 'opportunity cost of capital' criterion), and thereby undermine the decision-making process for achieving good public outcomes.

At all times, the project progress and the actual costs during project delivery should be traceable back to the project scope statement and ultimately to the service benefits of the business case.These relationship elements are illustrated in Figure 5.

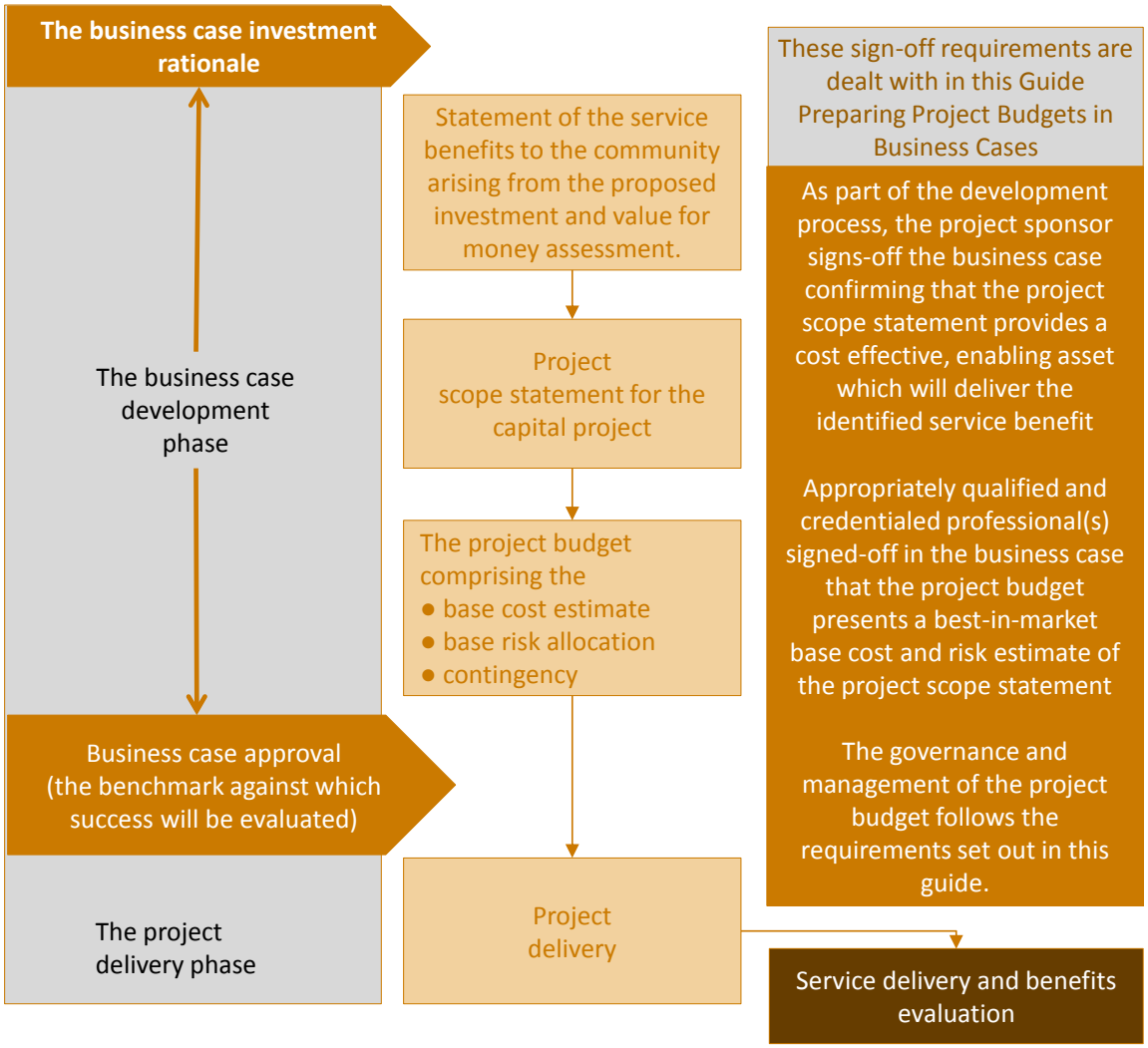


Figure 5 Interdependencies of key planning and management activities

3.2 Preparing to develop a project budget

It is essential to appropriately resource the project team in developing the business case and associated project budget. Reliable project budget estimates are dependent on experienced, capable, professional leadership with appropriate resources and time to investigate and prepare the estimates. Agencies preparing business cases must ensure appropriate time and resources are provided to support a quality outcome.

Setting a culture of cost awareness, strong leadership and accountability are all necessary to establish a good project budget and manage it during project delivery. Strong leadership working with an appropriate governance framework will support a sound investment process. A governance framework should reinforce the principle that the public sector should manage projects to the lowest cost for the required performance and not to the full project budget.

Table 2 summarises the foundation points to be satisfied prior to developing a project budget. It underpins the preparatory work and thinking to develop a project budget that is suitable for presentation in the business case. Where a business case does not satisfy the substance or intent of a foundation point, it is expected that this would be highlighted in the business case, with the potential implications and rationale discussed.

Foundation points – pre-budget development	Description
1. Clear identification of the service benefits to be delivered	The service benefits for the proposed investment should be clearly articulated (including measures of quantity, quality and timing) in the business case. (Refer to the business case guidance in the Investment Lifecycle Guidelines.)
2. Demonstrable links between the service benefits and the proposed capital assets enabling that service delivery	The business case needs to provide a convincing case that the proposed capital project will deliver the identified service benefits in an efficient, effective and economical manner; and that this capital asset option is more beneficial than a non-capital asset alternative.
3. A clear **project scope statement** of the capital works in terms of: • core objectives of functionality, utility and performance levels; and • specifications of design and input elements	A project scope statement is a prerequisite for developing a robust project budget estimate. The scope statement comprises the core objectives of: • functional and performance requirements; • the physical scope (e.g. construction inputs); and • services to be provided by the project delivery team. In articulating the physical scope, the business case needs to assume certain design and input factors. Moreover, the impacts of stakeholder engagement and change management need to be included.
4. A well-thought-out concept/design that addresses the project scope statement in an efficient, effective and economical manner	Accuracy in cost estimates is dependent upon the level of investigation and design (for example, sufficient research and investigations of site conditions and design to achieve efficiency in operational costs). Note that, particularly for building and construction projects, experienced estimators should be able to 'price' project elements using benchmark cost data. A high level construction timetable will be needed to inform escalation.
5. A good understanding of current and future market conditions	An understanding of current and future market conditions and likely impact during the tendering and project delivery phases is necessary. The sponsor should understand the market's capacity and interest for the project and the supply chain outlook (including market depth and capacity). This will impact on procurement method and associated risk allocation.
6. A clear understanding of the project risk profile and the upside and downside risks	A clear and mature understanding of the project risk profile including the correlation between risks and the compounding effects on budget and time. It should be based on input from capable, experienced practitioners and is required to determine appropriate risk estimations. Good project budgets avoid both over- and under-estimations of risks, and do not factor in (optic risk) premiums to ensure the appearance of 'on-budget' success.
7. Availability of valid benchmarking data from similar projects	Access to relevant, accurate and up-to-date benchmarking data, as well as historical information, will support the development of project budgets that can pass informed scrutiny and challenge. This may be sourced from the client's own project program and from other state and national agencies.

Table 2 Summary of foundation points pre-project budget development

Experience suggests there is need for a number of analytical, planning and thinking activities to be undertaken to develop a good-quality business case.

Truncating the timeline or the number of activities will lead to a suboptimal outcome. Expediency is damaging to good project planning.

In short, short cuts are disastrous.

3.3 Developing a project budget

There is considerable literature on cost-estimating practices, with a number of accepted estimating principles. However, much of this material is focussed on the construction of capital assets, rather than the whole-of-life context of the investment.

This guide focuses on understanding the overall cost estimate as a basis for decision making and assisting in subsequent budget management. This provides government with greater assurance that project budgets are well developed, understood, managed and targeted to their objectives.

In developing project budgets, the agency needs to be aware of the main elements making up the project budget and their relativities. Project analysis should not focus on high-attention elements like risks at the exclusion of the more substantial elements like direct and indirect costs. Departments should ensure they do not 'load up' the estimate of project risks to cover the potential impacts of poor and/or truncated planning. Where necessary there should be an indication of the level of confidence in the estimate and an appropriate adjustment to the contingency.

Table 3 summarises the foundation points that underpin the development activities of a project budget that is suitable for presenting a business case, and fulfil the requirements the Investment Lifecycle Guidelines. Where a business case does not satisfy the substance or intent of a foundation point, it is expected that this would be highlighted in the business case with the potential impacts and rationale discussed.

Foundation points – during development	Description
1. The project budget recommended in the business case is representative of a challenging but achievable outcome for an experienced and capable project team	The project budget must be developed with the mindset that it will enable project delivery through good planning and the application of hard and smart work by an experienced and capable team. All cost elements should be traceable to the specific elements in the project scope statement, which in turn has a traceable link directly to the efficient delivery of service benefits identified in the business case. Government decision-makers need confidence that the project budget is not inclusive of costs that inappropriately reduces the 'optic risk' of a budget over-run. Conversely the project budget should be realistic and not overly impacted by 'optimism bias'.
2. A robust estimating procedure	Documenting, implementing and conforming to a comprehensive estimating procedure that is industry best practice. This will provide a good basis for establishing a best-in-market project budget along with its assumptions.
3. A structure and presentation format of the base cost estimate that promotes understanding by decision-makers	An appropriate work breakdown structure and terminology should be used consistent with this guide, and applied consistently to promote understanding by decision-makers. A work breakdown structure ensures that no parts of the estimate are omitted or double counted, and allows for comparisons to similar programs and systems. The documentation should be easy to use and comprehensive to inform the reader's understanding of the assumptions and its strengths and weaknesses.

Foundation points – during development	Description
4. Project risks are modelled on the basis that responsibility is assigned to the best and most capable party	Identifying and quantifying project risks must proceed on the basis that all necessary and prudent investigations (e.g. geotechnical, regulatory planning) have been done. Moreover, the risk modelling must be on the basis that the party best positioned to manage the risk will take responsibility for that risk. The government decision-makers need confidence that the project risks are not modelled with premiums loaded in 'just to be sure'.
5. Senior management attention to the preparation and detail of the estimate	Sufficient senior management attention to the quality of inputs and the approach to preparing estimates to ensure adherence to procedures and processes. Important aspects to consider are: • using experienced and sufficient resources to perform the work required to ensure the reliability of estimates; • undertaking necessary analysis and assessment to determine an appropriate base risk allocation and contingency allowance; • using benchmarking and cost databases effectively to validate cost estimates; • timely provision of information; and • reporting how the estimate is prepared including assumptions, qualifications and exclusions.
6. Appropriate independent review and sign-off	There should be a process of independent review by appropriately experienced personnel in order to determine that the cost estimate: • captures all the relevant scope of the project scope statement; • reflects, as best as possible at the business case stage, good practice design solutions, construction methodology, constraints, program scheduling etc.; • the cost estimation process is prepared following best practice; and • is reasonably based on professional judgement and experience and there is confidence that it can be achieved through good planning and application of hard and smart work. (The cost estimation process should be subject to an approval process based on consistent, clear lines of responsibility and accountability to ensure costing standards apply to any budget information. **The importance of independent review and sign off increases commensurate with the scale and complexity of the project**.)
7. Appropriate change management for cost estimates	Appropriate reporting, management and approval of changes to cost estimates, as they are being developed, should be in place to enable effective communication and accountability.
8. Good-quality documentation that evidences the project budget estimate	The project budget estimate documented in the business case needs to clearly articulate and validate the project scope statement, state the key parameters, assumptions and constraints of the estimate, and provide a statement of the reliability/reproducibility of the budget estimate. A business case must provide a level of confidence to decision-makers that their decision, based on investment benefit:cost ratio, value for money and 'opportunity cost of capital' considerations, is not invalidated by a poor budget estimate. The planning, investigation, design development and risk identification/quantification necessary at this stage must be of a level to give this confidence.
9. Process and system reviews for continuous improvement	Regular process and system reviews conducted during the budget development, as well as project learnings from other similar projects should be shared to increase corporate knowledge, and encourage and facilitate continuous improvement.

Table 3 Summary of foundation points to be satisfied during the project budget development

3.4 Culture, incentives and governance

While the governance of project budgets during delivery is addressed briefly, the development and implementation of a governance framework is out of scope for this guide (users should refer to the separate technical guide on project governance). However, the following discussion is provided to inform the distinction made in the guide between base risk allocation and contingency and their management (refer to section 6.3).

Any governance framework that is effective must give the government confidence that the project can be successfully delivered as planned and for the lowest cost.

HM Treasury in the United Kingdom (UK) in its Infrastructure Cost Review report states that outturn costs rise because the processes of budget preparation, approval and management do not provide effective incentives to minimise the outturn cost. In particular, insufficient consideration is given to the assessment, placement and management of the project's contingency. There was a finding that many large infrastructure projects tend to be managed within a quoted budget, rather than aiming at lowest cost. If the budget includes contingencies this tends to be viewed as 'available' budget and should be spent.

The report identifies that successful projects tend to share common characteristics such as:

- strong governance and culture to reduce costs, clear roles and responsibilities including role separation between the sponsor, funder and the delivery agency;
- working to the principle that public officials should manage projects to the lowest cost for the required performance, and not to full project budget expenditure or maximum allowable affordability; and
- effectively allocating and controlling the project contingency by the funder rather than the project delivery office.

> 'Within the … [capital works programme enabling the 2012 Summer Olympics hosted by London] there is a very clear delineation of accountability for cost control and the management of contingency budgets. All contingency is clearly identified as either 'project' or 'program' and either 'in scope' (available to the project) or out of scope (funder's contingency is not viewed, as is often the case, as available budget). A strong governance structure is built around the process for allocating contingency which, combined with effective incentivisation at all levels, has instilled a culture of cost awareness and accountability. The achievement of cost and risk reductions at the delivery level frees contingency for reassignment within the programme, subject to justification and approval. Success in part has been driven by the clarity of decision making and commitment to ensuring that the sponsor was set up as an effective and properly empowered sponsor organisation.'

Source: Infrastructure Cost Review, Technical Report HM Treasury, UK, December 2010

Recent audit reports from the United States[3] and UK[4] suggest there are significant opportunities for government improvement in setting realistic project baselines, managing

[3] How much will this program really cost? Cost Estimating and Assessment Guide: Best Practices for Developing and Managing Capital Program Costs (GAO-09-3SP), 2 March 2009

[4] Infrastructure Cost Review, HM DTF/ Infrastructure UK, December 2010

risk and reducing the excessively high costs of constructing infrastructure. In the UK alone, this estimated saving is £20 to £30 billion over the next decade.

4. Developing base cost estimates

Description of a base cost estimate for a project (mainly focused on a building or construction project) and the expected standards to be applied to its preparation (refer also to separate business case guidance for ICT projects)

The base cost estimate represents the largest proportion of costs and has the greatest impact on project budget accuracy. It is the largest and most complex component and the foundation on which risk and contingency are determined. Recently it has been somewhat neglected, with the focus shifting to risk estimation software. The consequence is that base cost estimates have often lacked the methodology and accuracy needed to produce the precise and reliable project budgets essential for business case decision making.

However, accurate base cost estimates are achievable if a disciplined and rigorous approach is taken to their preparation using specialist knowledge.

4.1 Essential ingredients for an accurate base cost estimate

The accuracy of the base cost estimate will increase to acceptable standards if these four elements are employed in a systematic and integrated manner.

1: Clearly defined project scope

2: Competent and experienced estimators using relevant benchmark cost data and who are prepared to certify their work

3: A recognised and rigorous approach to estimating

4: A robust and insightful peer review process

These four elements are discussed in detail below.

A base cost estimate founded on a poorly defined scope is no more than an ill-informed guess.

4.2 Clearly defined project scope

A well-defined project scope statement is the critical contributor to an accurate base cost estimate. An accurate estimate relies on the project being clearly defined. This doesn't mean that extensive design information is required, just that the project fundamentals around design, approach, risks, site conditions and so on should be captured.

The project scope statement should include:

- a detailed description of the scope of the capital works (including drawings, specifications and calculations);
- construction methods;
- program dates;
- project performance objectives;
- project risks that may be encountered;

- all necessary and prudent investigations to complete the project definition;
- the proposed method of delivery (design and construct, alliance, public–private partnership, etc.); and
- a description of those works (otherwise associated with the project) specifically excluded or not in scope.

A number of recognised classifications are available that describe the level of project definition maturity needed to achieve differing levels of accuracy of base cost estimates. Agencies should have regard to those classifications to achieve an acceptable standard of business case for consideration by government, including the following requirements.

a) The project definition in the project scope statement should be developed to at least a level of 10–20 per cent of complete definition.[5]
   - The agency will typically need the project definition to be within this range to develop the required base cost estimate for the business case. The greater the agency knowledge, experience and track record in delivering the project type, the more acceptable it is to work to a project definition at the lower range of development.
   - For similar reasons it can be expected that low-risk projects could tolerate a lower level of project definition than high-risk projects due to their heterogeneous nature (see section 5.1).

b) The project scope statement should enable the base cost estimate to be prepared to within a ±5 per cent level of reliability.
   - This is based on the principle that the cost estimator is costing the project scope statement rather than predicting what the actual outturn project cost may be.
   - This expected level of accuracy should be capable of repetition by another independent and competent cost estimator, producing a base cost estimate from the same project scope statement and the same 'assumption book' (i.e. a register of key assumptions like timings, methodology etc.).
   - In this situation it would be expected that the two estimates would be within ±5 per cent of each other. If this cannot be achieved, then additional review may be required to confirm the project scope statement, the assumptions book and/or the methodology used.

During business case development, there may be specific scope items for which full details are not available. For example, the business case recommends the inclusion of artwork for the exterior of a new significant public building, which will be commissioned following an open competition. While the requirement is known, the cost and nature of the requirement cannot be fully detailed for the business case. In this case, the agency should propose (and highlight as a provisional sum) an upper cost limit in the base cost estimate for decision-makers to consider. Decision-makers may make such funding single purpose and savings not available for re-allocation to other project works or issues.

[5] While, as noted earlier, there are various classifications of estimates based on a percentage of project definition, there is a dearth of guidance on how to interpret that percentage and it remains a matter of judgement for the agency. However, in all cases the maturity of the project scope statement must enable preparation of a base cost estimate within a ±5 per cent level of reliability.

An ill-defined project scope statement will result in significant uncertainty and misunderstanding, which will result in significant differences in expectations at contract award. This will lead to unpredictable increases in costs and/or poor outcomes.

4.3 Competent, experienced estimators prepared to certify their work

The base cost estimate should be founded on a project scope statement that is 10–20 per cent of complete definition.[6]

This lack of full definition represents a challenge to producing an accurate base cost estimate. It will necessitate estimators who are experienced in their field and able to exercise sound judgement and knowledge to bridge both the inevitable information gaps and ensure effective integration of the base cost estimate with the project risk assessment.

Notwithstanding this lack of full definition, it is clear that experienced estimators are capable of producing highly accurate estimates as evidenced by lump-sum design and contract tenders (which include both base cost estimates and project risk estimates) where the design is often only at the 20–30 per cent level of definition.

Describing and defining an appropriate standard of experience for estimators is not simple since it involves the need for tacit knowledge, judgement and experience that will be project specific and not conducive to a simple specification. Therefore the track record and industry reputation of the individual estimator and their company can be of greater importance.

Skills and capability for base cost estimating

Estimating the base cost is complex and, when done properly, it requires a high level of professional skill and judgement. Essentially two types of engagements may be undertaken:

Developing the base cost estimate

- The base cost estimate is prepared by senior experienced cost estimators who have a track record of successful estimation practice. They are required to understand and have relevant experience for the project they are engaged on. They need to be recognised by peers as showing wisdom and knowledge of the current market and future trends.

Reviewing the base cost estimate developed

- Peer/independent reviews of the base cost estimate should be carried out by personnel with appropriate estimating and estimating management experience. Generally a minimum of five years' estimating experience in the specific sector would be expected, and preferably additional specific industry experience in other sectors.

In addition to the prerequisite skills and experience, it is expected that the estimator should be prepared to certify the quality of their estimate, expressly acknowledging the adverse

[6] It should be noted that 10–20 per cent of design definition does not necessary equate to 10–20 per cent of design effort. The focus in this guide is on design definition that enables a ±5 per cent level of reliability for the base cost estimate. For example, additional effort may need to be expended on high-risk design elements in comparison with low-risk design elements that may be as costly, or even more costly, in construction terms.

consequences for government should the resultant base cost estimate not address the levels of accuracy expected for business cases. A suggested template for estimator sign-off is provided in Appendix B.

4.4 A robust estimating methodology

To provide the accuracy expected of base cost estimates adopt a robust estimating methodology that is consistent with an industry-recognised structure. The estimating methodology should entail a hybrid of 'first principles' and 'unit rates' approaches[7] for estimating the direct costs, indirect costs (including design fees) and owner's costs.

As a guide this hybrid could be a 50:50 ratio of first principles:unit rates, recognising that this ratio will be project specific and will vary accordingly. More effort using a 'first principles' approach would be expected for the high-value and/or high-risk elements and 'unit rates' for the low-value and/or low-risk items. **Using simple rules of thumb, such as '5 per cent allowance for owner's costs', will not provide sufficient accuracy.**

The method by which the estimate is produced must be appropriate both for the type and the design development phase of a project. In early design it is unusual to try to break costs down to 'first principles'; instead, it is more normal to have unit rates drawn from similar benchmark project types.

> For example, the estimate for a new building might initially be based on a $\$/m^2$ of gross internal floor area. As the design develops this might then be disaggregated into elemental costs (single-figure estimates for each building element), and then finally broken down further to describe the costs (unit rates) for each part of that element or sub-element. At each stage the level of detail in the cost plan should be proportional to the level of design information available. For civil engineering projects it is common to separately identify costs for labour, plant and materials because each is often sourced in large quantities or for long durations.

A clear, consistent, transparent format for both the presentation and underlying structure of the base cost estimate is necessary to facilitate a constructive and independent interrogation, and benchmarking to comparable projects, by both the peer reviewer and the senior responsible owner (SRO). The summary presentation of the base cost estimate should follow the format outlined in Appendix A.

4.5 Insightful and meaningful reviews

Ensure that insightful and meaningful reviews are undertaken by both peers and senior management, every base cost estimate requires rigorous reviews. These reviews should occur at two levels.

1. **Peer review by another estimator**. This involves a 'line by line' review by an alternative estimator other than the original estimator. This may be someone with necessary qualifications and experience from within the same agency or a professional cost estimation service provider. The peer review should result in a ±5 per cent level of variation from the original estimate. Some areas that this review might focus on include:

[7] Costing items in first principles involves breaking the unit cost such as $\$/m^2$ into labour, plant and materials.

- computational checking – to ensure all calculations are correct and subtotals are carried through to the grand total;
- thorough and correct measurement – to ensure items are not omitted;
- assumptions – where design information is scarce, the estimator may be required to make assumptions about the design – these should be clearly set out;
- inclusions and exclusions – ensuring the estimate clearly defines what it includes and excludes (e.g. land costs, professional fees, subcontract design, artwork); and
- correct TPIs – ensuring the project estimate is set at the correct point in time.

2. **Review by the SRO**. While preparing the base cost estimate requires specialist and experienced skills, it is also necessary that the agency reviews the base cost estimate from a business perspective to ensure that estimate reflects the proposed capital asset in terms of the project scope statement, whole-of-life considerations and service benefits. This review ensures the SRO is familiar with the base cost estimate and comfortable that it represents the best-in-market pricing, and is defensible.

> 'Avoid over specification, the application of unnecessary high standards or specifications and usage of bespoke or "gold plated" solutions when off the shelf design is sufficient. Encourage more outcome based specifications and a greater consideration of value for money, delivering cost certainty and programme certainty.'

HM Treasury Infrastructure UK – Infrastructure Cost Review, Main Report, December 2010

Departures from the outline of these steps, which may arise from departmental project experience and/or specific project characteristics, should be explained and justified in terms of best-for-the-State outcomes and the likely impact on the confidence level of the project budget.

5. Developing project risk estimates

Overview of project risks, and discussion of the different steps/phases and techniques of project risk estimates, how to set the base risk allocation and contingency, and undertaking a sense (or reality) check on whether the estimates are appropriate

5.1 Thinking about project risks

Not all capital projects are the same. Procuring infrastructure is very different to building projects, differences that significantly impact on the size and nature of project risks.

Buildings:

Building projects have many repeatable structural elements that 'have been done before' and can be easily benchmarked on cost. Extensive use of artificial or manufactured materials lends to predictability. Moreover, buildings are typically constructed from the ground up, involving minimal interface with the natural environment, adding further predictability.

Infrastructure:

Infrastructure projects are largely heterogeneous, generally with critical elements that are structurally different and frequently involve the 'not been done many times before' factor. The extensive use of naturally occurring materials, the extensive interface with other network assets, the (often unpredictable) natural environment, high exposure to volatile costs of labour, hydrocarbons, etc. tends to lead to a relatively higher risk profile.

Empirical evidence suggests that cost overruns and delays are often a feature of these projects. Cost overruns and benefits shortfalls of 50 per cent are relatively common; cost overruns over 100 per cent are not uncommon. In one study of major projects in 20 countries, nine out of 10 projects had cost overruns.

A common misconception is that the idiosyncratic nature of infrastructure means that project risks often crystallise and that this is just an unfortunate downside. Often infrastructure projects are attributed to the cause of 'nation building' and this in some way justifies this downside, the long-term benefits dwarfing the cost and time overruns.

Unfortunately, these views about infrastructure can be seen as a licence for poor planning in **all** capital projects. The reality is that all projects involve risk; large infrastructure projects have a poor reputation for coping with risk, often resulting in time and cost overruns. However, this is not an inevitable result of investing in civil and process infrastructure (or buildings for that matter).

There needs to be a distinction drawn between project risks and poor project planning risks:

Project risks are the risks associated with implementing the project, for example, a contaminated site, regulatory planning failure to grant a right of way or materials defect. These are the residual risks that projects are exposed to and that need to be managed, either by:

- transferring them to another party better able to manage and price the risk; or
- retaining the risk, which implies active management by the agency to reduce or preferably remove the risk by taking treatment/control actions.

A well-managed project, and one that has been through an appropriately robust and rigorous business case and procurement process, could be expected to have project risks costed in the range of 5–20 per cent of the project budget.

Risk identification evolves over the course of project development, as further project knowledge is gained. Wherever possible identified risks should be mitigated by taking steps in the design or through project management initiatives. Assessing risks should therefore focus on 'residual' risks – those that cannot be mitigated fully at any given stage.

Poor project planning risks most often crystallise on projects when the DTF Investment Lifecycle Guidelines have not been applied properly. These risks are most often associated with flawed and truncated project planning, and typically see significant scope changes and other surprises during the tender process and/or post-contract award. Poor project planning risks can be catastrophic, resulting in extensive delays and significant cost overruns. (Well-documented examples include the Sydney Opera House: delivered 10 years later than originally planned at a cost overrun of 1,400 per cent.)

A risk professional should assist in moving beyond 'group think' outcomes and provide a project risk estimate that is neither optimistic nor pessimistic. Good planning requires full transparency; agencies must be able to demonstrate the work done in developing the project budget in the business case (see section 5.2).

Optimism bias: This describes the tendency for base costs and risks to be systematically underestimated during the business case development phase. This results in project budgets based on optimism rather than on a rational weighting of gains, losses and the considered likelihood that adverse hazard events may impact on the project.

Note: It is unacceptable to use artificially inflated benefits and/or deflated costs as a way of maximising the chance of a business case attracting funding support.

Pessimism bias: There is also another alternative scenario, especially when a project, arising from an urgent and compelling public interest need, has been pre-announced and committed to before finalisation of a comprehensive business case. In this case it is easy for an agency to overestimate the costs, risks and time required.

Note: It is unacceptable to artificially overestimate costs, risks and time as a way of maximising the chance of the project being delivered on budget and on time.

Cautionary note: While these biases are a recognised 'psychological phenomenon' in project management literature, they do not excuse poor estimating. It is the responsibility of the agency and its advisers to recognise the potential for bias and ensure that project budgets are not adversely affected.

It is poor practice for risk to be either ignored or dealt with in an arbitrary way, for example, having a corporate practice of simply adding a 10 per cent 'contingency' onto the base cost estimate to create the project budget. Rather, best practice is that all significant project risks are identified, usually though workshops based on the input of capable and experienced practitioners, and then each is dimensioned in terms of likelihood and potential consequence.

5.1.1 Uncertainty

A further level of analysis to risk identification is the concept of uncertainty. Uncertainty is the level of confidence that can be put on the identification and cost estimation of the potential risk consequence. The following categories of events are a useful guide to the concepts of risk and uncertainty.

- The *known knowns*: If potential risk events can be quantified (i.e. in terms of their likelihood and the potential consequence), they are addressed in the base risk allocation and contingency. The known knowns are normally referred to as the project risks. The greater (lesser) the confidence of estimating likelihood and potential consequence, the more (less) likely that these estimates of the known risks will be correct.
- The *known unknowns* are known hazard events with a wide range of significantly different possible outcomes. These potential hazards can be identified, but there is no basis upon which to estimate the likelihood of the event occurring and/or the consequence if it does occur. In capital projects, such *known unknowns* commonly relate to events that can be identified (e.g. adverse ground conditions), but there is little available information (e.g. site investigations) on which to quantify either the chance that the event might happen or the impact on the costs of the project if it did. These events are so uncertain that they can not be quantified with the confidence that would classify them as project risks.[8]

  Further investigation on these events may provide the information required to increase the confidence on the estimates of probability and impact to allow these events to be classified as risks. Often this is not only desirable but necessary to undertake this work to satisfy the foundation points for budget development.[9]

  Often the difference between *known knowns* and *known unknowns* is the amount of research/investigation undertaken. Unless work is undertaken to dimension *known unknowns* to the standard of risk analysis outlined in section 5.3, they should not be included in the project budget.
- The *unknown unknowns* are risks that cannot be reasonably identified and so are not included in the risk estimates. There is no allowance or provision for these in the project budget and if these types of events crystallise then the agency must apply for supplementary funding through the normal budget processes of government. These events are also known as uncertainty.

[8] To ensure clarity, 'project risks' are hazards that can be quantified (i.e. the *known knowns*). Hazards that can't be quantified or perhaps even identified are true uncertainties (i.e. the *known unknowns* and the *unknown unknowns*) do not attract a funding provision in project budgets and should such events crystallise then the agency must apply for supplementary funding through the normal budget processes of government.

[9] The inclusion of *known unknowns* as project risks (the *known knowns*) is not appropriate. The level of accuracy is low, and therefore the inclusion would unreasonably skew or inflate the total project risk estimate. In a tendering stage, where bidders are prepared to competitively price and take on the management of project risks, costing *known unknowns* is more akin to taking a gamble on the price, and would attract price premiums and/or have unattractive consequences during project delivery.

Good planning is about reducing the level of uncertainty – it can never be eliminated. Where the extent of uncertainty significantly reduces the ability to accurately price a proposal, thought should be given to building in options that allow for informed decisions to be taken when uncertainties are resolved. For example, this could involve further research, pilot studies, staged development or termination options.

Example of a known unknown – extent of ground contamination

An agency has conducted research of land and historical records and identified that the site of a future construction project was used to manufacture lead batteries in the early part of the 1900s. The agency followed up on this documentary discovery by engaging the specialist services of an environmental engineering firm. This 'technical risk expert' undertook bore samples and generally investigated how underground conditions may have impacted on the movement of any soil contamination to the present day.

After receiving the investigation report, the agency's project risk analysis team concluded that identified soil contamination would cost $2.5 million to remediate. However, once site excavations are well advanced, there are two likely scenarios:

- there is no additional contamination; and
- there is additional contamination if suspected water table flows eventuated. The expected cost of remediation arising from the second scenario is an additional $1.2 million.

In this case, it would be appropriate for the agency to include $2.5 million for remediation in the base cost estimate, and identify a project risk of $1.2 million, which the funding authority may place in the base risk allocation or in the contingency. (On the other hand, if the risk analysis is that there is a 50-50 chance of the water table issue occurring, then this would suggest $0.6 million in the base risk allocation and perhaps an additional $0.6 million in the contingency.)

Further, there may be a possibility that cannot be quantified with any reasonable confidence that a geological fault exists, down which the contamination has been able to infiltrate to a deeper level. Remediation would cost more if this were the case. If fault lines were known to exist in the local area then this uncertainty may be a real issue for the project and it would be appropriate to undertake further site investigation, such as seismic surveying, in order to gather the information that would eliminate this uncertainty and either render the event as a cost or a risk estimate.

If no known fault lines exist in the locality and the geological structure made it extremely unlikely for such geological structures to exist then it may not be worthwhile going to the expense of the survey. The event would remain as an uncertainty, or a known unknown if identified and an unknown unknown if not identified. Either way it is not expected that such events should be costed provided that the appropriate level of investigation has been carried out in accordance with these guidelines.

5.2 Principles of project risk estimation

Through this guide agencies are encouraged to adopt risk analysis processes that are robust and defensible, including the use of a broad reference of similar and exemplary projects that verify the risk analysis as reasonable (i.e. the sense check).

The process for project risk estimation should be based on the following principles:

- identifying and quantifying project risks follows best practice, including
  - using appropriate investigation to understand and treat or control risk;
  - employing project management capability commensurate with the challenges of the project; and
  - allocating risks to the party best able to manage the risk (and therefore price it);
- the estimate discloses all material assumptions and does not 'double count';
- the estimate is a robust figure within which the project can be delivered through good planning and effort involving active and capable management (a robust estimate is not one that delivers a project inside of its estimate simply because the estimate is pitched high);
- value for money for the State is a critical criterion, with the State seeking the lowest whole-of-life cost for the required performance of the infrastructure, noting that the inclusion of flexibility may represent value for money;
- good planning and discipline is maintained to minimise optimism and pessimism bias in determining the project risk estimation; and
- departures from this guide are explained and justified in terms of best for the State outcomes.

5.3 Undertaking a risk analysis

Consideration of risk is heavily reliant on good judgement and experience. The 'tools' are a means of facilitating the thinking process, concisely capturing that judgement and making appropriate decisions. The important part is the quality of thinking and deliberation that goes into considering risk. Best practice risk analysis has substance over form. Following the process on its own does not produce robust risk estimates. Agencies should ensure they engage well-qualified and experienced professionals capable of providing the depth of input required to prepare risk estimates that do have substance.

The following box identifies the skills that would be expected from such professionals.

Skills and capability for leading risk analysis

Risk analysis is complex and, done properly, it requires a high level of professional skill and judgement. Essentially two types of skills are required:

- process skills that include workshop facilitation, interpretation and coordination of assumptions, financial modelling and interpretation of analytical results; and
- technical skills – highly trained professionals experienced in the technical disciplines required to deliver the project (e.g. design and construction capability) such as architects, engineers and cost estimators.

Delivering a risk analysis requires both skills from formal learning and considerable professional judgement, which can only be acquired by experience.

Risk estimation is by its very nature uncertain. Budget approvals require a level of confidence that risk estimates are developed to a professional standard. Analogous to the legal test applied to claims of negligence, the standard expected is that of a skilled person exercising and professing to have that specialist skill.

Consideration of the skills and experience required to fulfil these roles is set out in section 7.2.

Development of project, and more specifically, project procurement objectives and undertaking a market analysis are important considerations in risk analysis. This ensures the

risk analysis deliberations are guided by a set of principles relevant to the project. These guiding principles should be based on the following questions:

- What are the main objectives that we are after?
- What is our tolerance for deviation from these objectives?
- How does that help us set a limit on materiality? (i.e. how big should a risk be before it's worth considering?)
- What is the time horizon for considering risk?
- What are the risk issues generic to this area?
- What risk events are precedents for this type of project?
- What controls can we take for granted in such a project? (i.e. all contracts have a number of clauses intended to protect both parties from certain risk events).

The process of risk analysis is a large subject that can be organised in different ways. Best practice risk analysis will proceed through the following steps:

1. identifying project risks;
2. quantification of project risks;
3. analysis of project risks to develop risk management strategies;
4. verifying the risk estimates; and
5. presentation of the risk analysis work.

Figure 6 demonstrates how these steps fit into a typical risk analysis process for a project.

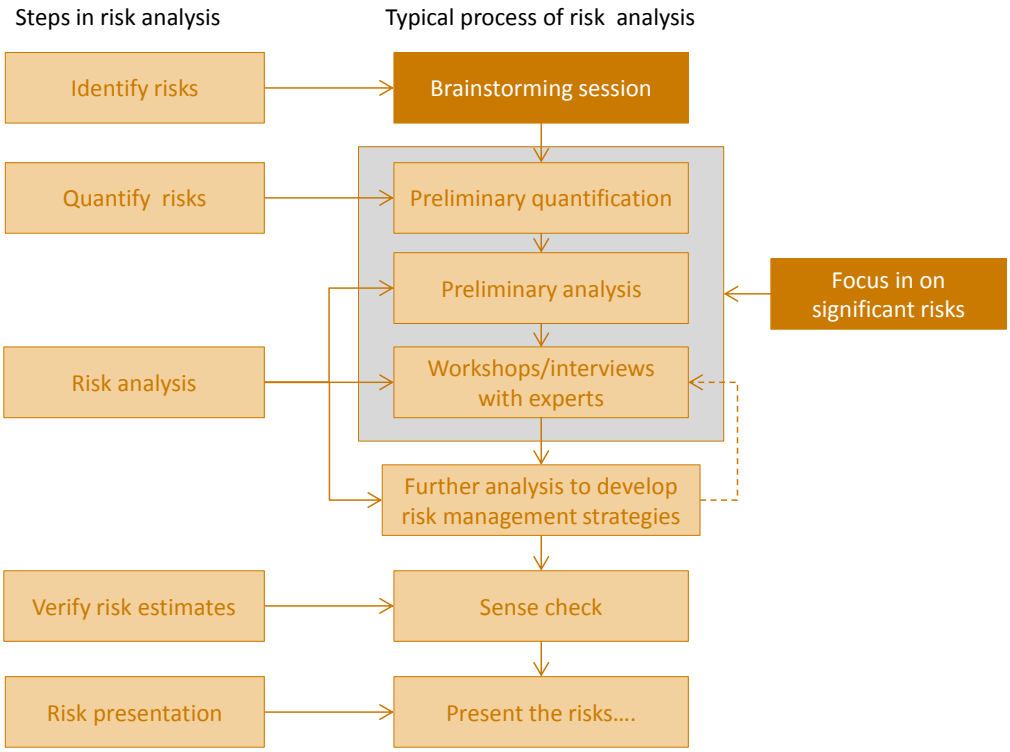


Figure 6 The phases in a typical risk analysis

Figure 6 is included as an example of a best practice standard for estimating risks generally suitable for medium-sized projects. For simpler projects it may not be necessary to use formal

workshops and interviews. For more complex projects it may be necessary to undertake multiple workshops and establish independent analysis of project components or high-risk events. At the stage that the risk analysis is being undertaken, the base cost estimate should already be in existence and is used as the basis for doing risk analysis.

5.4 Sizing project risks

The outcome from adopting the processes in steps 1–3 (outlined in Figure 6) is a robust risk register that has risk events identified.[10] The risks should be ranked relative to each other, using qualitative risk analysis tools, and risk management controls considered (including their likely impact on the qualitative ranking of the risks). This provides the essential foundation on which the quantitative estimates in step 4 can then be established.

It is critical that estimates are prepared on the basis of best practice risk management. Best practice risk management allocates risks to the party best able to manage the risk (and therefore price it at the lowest cost to the project). Provided this principle is rigorously adopted agencies will have a solid foundation to avoid either optimism or pessimism bias. This principle applies irrespective of the procurement strategy adopted for the project.

Best practice risk management allocates risks to the party best able to manage the risk (and therefore price it at the lowest cost to the project).

Depending on the complexity of the project, different analytical tools may be appropriate to quantify and analyse the risks (steps 2 and 3). The agency should ensure that the right analytical tools are used, commensurate with the complexity and riskiness of the project.

A selection of the different risk estimation techniques are described in Table 4.

Technique	When to use
Simple scenario analysis (or expected value technique)	Small projects, often repeatable, that are well understood and relatively simple to implement. The risks can be readily identified/analysed using limited time and resources. (Simple scenario analysis (or the expected value technique) involves considering different possible scenarios, estimating the likely effect they will have on the project and the probability they have of occurring. The level of exposure on a particular risk is given by the effect the scenario has on the project, multiplied by the probability of its occurrence.)
MERA (multiple estimating using risk analysis)	Small to medium-sized projects where risk is a feature but relatively well understood and not very material to the project budget. (MERA analysis is the extension of the simple scenario analysis technique to consider multiple different possible scenarios, estimating the likely effect these will have on the project and the probability that they have of occurring. The level of exposure on a particular risk is given by the sum of the combined effect each scenario has on the project, multiplied by the probability of its occurrence.)
Sensitivity and scenario analysis	Typically used to test underlying assumptions and in particular where simple and MERA analysis is used. The test involves changing the underlying assumptions and analysing the sensitivity of total risk estimates to that change. Sensitivity and scenario analysis can also be combined with stochastic simulation, although less often because simulation automatically builds in sensitivity and multiple scenario considerations.

[10] Note that a risk register does not identify risk outcomes (e.g. the cost overrun associated with the discovery of poor ground conditions), rather it is a list of risk events (e.g. 'poor ground conditions').

Technique	When to use
Stochastic simulation techniques like Monte Carlo or Latin Hypercube	Medium to large-sized projects for which the risk analysis is important. Suitably qualified expertise and reviewers must be used to conduct and verify the use of such techniques.

Table 4 Examples of risk estimation techniques

Determining risk estimates is best based on a combination of professional judgement and previous project data (where available and proven to represent best practice). The result should be presented as a range of outcomes, clearly stating the sensitivity of the estimates to the underlying assumptions and the level of confidence the agency places on the estimates.

Risk identification and cost estimation are more uncertain in the earliest stages of a project, which is also when decisions of greatest impact are often made. An agency and its expert advisers should operate as a single team to avoid any institutional shortcomings of incomplete commitment and inconsistent decisions when it comes to estimating risks and contingency. The need for judgement should not be used as an excuse for failing to give adequate consideration to a formal analysis of project risk.

Risk estimation is essentially about compiling realistic forecasts and answers to questions that start with 'what if?'

Clearly one size doesn't fit all. However, for the majority of public sector projects that are well investigated and analysed in the business case, at the point of commitment (when the government considers approval) agencies should be able to estimate project budgets that include an estimate of project risks in the indicative range of 5–20 per cent. It may be higher for some projects. Generally:

- Business-as-usual or routine projects (low risk, low value), such as school buildings and simple road and health projects that can draw on corporate history, should have a project risk estimate (base risk allocation and contingency) of 5–10 per cent of the total project budget.
- More complex building projects that are not regularly undertaken by agencies, or larger infrastructure projects regularly undertaken, are more likely to include project risk at the higher end of the range of, say, 15–20 per cent.
- Idiosyncratic or one-off projects that are high risk due to unique engineering or other high risk factors may need the agency to move outside of this indicative range and include a project risk estimate over 20 per cent (e.g. Victoria's Synchrotron).

The difference between a project risk estimate of, say, 25 per cent versus 15 per cent might simply be further investigation and research (i.e. greater planning). Notwithstanding the extent of planning undertaken, a higher project risk estimate may be appropriate to cover a genuinely high-value and high-risk project. The above ranges are indicative, but agencies should use them as a guide to inform the level of effort that is expected to go into the planning. This work must be documented to demonstrate that the base risk allocation genuinely covers project risk and that planning risk has been largely eliminated.

Cautionary note

It is bad practice and contrary to the public interest to 'load up' the project risk estimate to compensate for absent or poor project planning. This may have the undesirable effect of producing padded budgets that maximise the 'optics' of successfully delivering a project to the business case's project budget.

Agencies need to apply a realistic view on risks. Australian construction and design companies are among the most successful in the world and promote a reputation of excellence. They typically have a long history of delivering complex and high-risk projects with good financial outcomes. Therefore, agencies should ensure they do not over-identify and over-inflate the uniqueness and/or the challenges of delivering a project. An informed and experienced view needs to be taken of the industry's capability and expertise to manage project risks.

5.5 Setting the base risk allocation and contingency

5.5.1 The base risk allocation

The base risk allocation is a critical cost component that, combined with the base cost estimate, is the most likely cost outcome to government in delivering the project. This project cost estimate includes:

- risks transferred to another party[11] (e.g. contractor) at a price to government that reflects the effectiveness and efficiency (value for money) that is expected in transferring the risks; and
- risks retained by government that likewise reflect the most likely outturn cost to government of managing these risks.

'Most likely' implies a statistical average of weighted probabilities and impacts. Ostensibly this single figure estimate represents the most probable outcome for the project considering all the risks and their respective weighted likelihoods of occurring and impacts (and potentially range of impacts). However, it remains a judgement – one that should be informed by appropriate analysis and experience.

The business case will need to provide the basis for the proposed base risk allocation in the make up of the project budget.

5.5.2 The contingency

'Success', from a project costing point of view, is to deliver the full scope within the project cost estimate (i.e. the base cost estimate + base risk allocation). However, there are circumstances where this does not occur as risks that were unlikely to occur materialise. In these situations, the project cost estimate will be exceeded. To proactively recognise these situations, project budgets include a contingency above the base risk allocation.

[11] Note that insurable project risks (i.e. project risks for which the cost impact can be transferred to an insurer at a cost acceptable to the agency and government) are to be accounted for in the base cost estimate in the form of insurance costs. Transferring risk under insurance contract effectively exchanges what otherwise would be a risk estimate (with all the variability of actual outcome versus estimate entailed), with a fixed cost (i.e. the premium).

Contingency caters for:

- the volatility of the project's risks as demonstrated by the spread of likely cost outcomes determined through the risk analysis steps;
- any significant risks that fall outside of the norm, and are significant reasons for the project being volatile; and
- the sensitivity of the project to underlying risk assumptions, such as correlations between risks and/or secondary risk impacts.

A high-risk project with a volatile cost profile (e.g. a large spread of potential outcomes as measured using statistical tools) may justify a contingency recommendation that lines up with a 90 per cent confidence limit, if this technique is used.

In these circumstances the contingency may be significant and, together with the base risk allocation, may be greater than the 10–25 per cent expected for the majority of government projects. In contrast, for a 'business as usual', low-risk project with low volatility and high certainty in its base cost estimate, the base risk allocation and contingency may be in the range of 0–10 per cent of the recommended project budget.

5.5.3 Recommending the base risk allocation and contingency amounts

In presenting recommendations for the base risk allocation and contingency amounts in the project budget, the agency will need to employ judgement and a test that involves the notion of likelihood. Agencies are required to provide sufficient justification in the business case for both recommended amounts.

The justification must include a rationale for the contingency that provides an appropriate upper limit for the total project budget 'beyond the most likely value for all risks' (i.e. the base risk allocation). This upper limit must provide a realistic estimate that the project cost is unlikely to exceed (and not an easy target).

A purely statistical representation of risk (using stochastic tools) is insufficient evidence to justify either the contingency or the base risk allocation. While such tools may provide supporting analysis for setting the estimates they must also be supported by a rigorous and in-depth rationale, including the capability of the project delivery team, the 'sense check' and sign off by management.

5.6 Verifying the estimates (the sense check)

The sense check is introduced to the process to assist agencies in overcoming optimism and pessimism biases and to increase confidence that the base cost estimate, base risk allocation and contingency are appropriate. The steps to establish the estimates can be seen as an insider's view of the project, which is valid when based on sound professional skills and judgements. Nevertheless it can, both knowingly and unknowingly, be compromised by an understanding that ultimately the project office will be judged by their performance in delivering the project against the estimate.

Whereas the insider view is the conventional and intuitive approach to planning projects and estimating costs and risks, the outsider view takes an independent view of the project and compares it to similar projects already completed in an exemplary manner. A relevant

comparison to a number of similar projects (e.g. on type of project, procurement strategy, the complexity and geographic location) is good practice.

The outsider view is less likely to re-employ the same analytical techniques on the project; therefore, the outside view is more likely to avoid the effects of bias on the project. The aim is to provide a knowledgeable and realistic benchmark or sense check on whether the estimates are reasonable and truly represent the most likely outcome for the project.

Agencies can present the sense check as evidence that the costs, risks and contingencies are fair and reasonable. Evidence must be provided in the business case supporting the rationale for the base estimate, base risk allocation and contingency.

6. Establishing a project budget

Guidance on integrating the base cost estimate and project risk estimate (including the level of contingency) to form the recommended project budget

6.1 Establishing a project budget

A project budget, consistent with the work outlined in sections 4 and 5, needs to be determined and recommended by the agency as part of its business case. At this stage, an agency should have invested appropriate time and resources in defining the project scope, estimating the costs and analysing the risks to produce high-quality advice to inform government decision making.

The management decision taken by the agency in determining the project budget is critical.

A business case should not be submitted to government for a decision if there has not been a high-quality and transparent process to determine a project budget that is rigorously calculated and defensible.

To establish the project budget,[12] and produce a single figure, the base cost estimate, base risk allocation and the contingency are added (see Appendix A for the presentation template of the project budget's main summary line items).

Illustrative example

Without providing the justification required in the business case to support the recommended amounts for the base risk allocation and contingency, the following illustrates the headline figures for a medium risk infrastructure project. Additional details are provided in Appendix A.

Base cost estimate	$300m
Base risk allocation	$33m
Project cost estimate	$333m
Contingency	$21m
Project budget	**$354m**

Successful project delivery sees:

[12] Projects are funded by government using nominal dollars, and therefore the project budget and cash flows need to be presented in nominal dollars.

- the full project scope delivered as intended within the cost envelope of the base cost estimate and base risk allocation;
- the lowest outturn cost for the required performance; and
- no or little call made on the contingency.

The aim is to deliver value for money for the State. Over and underestimated project budgets both place financial strain on the overall government budget. This can constrain or compromise government's ability to deliver its full program of service priorities and is therefore not in the public interest.

Figure 7 illustrates the relationship between the cost estimates arising from sections 4 and 5 to arrive at the project budget in the business case.

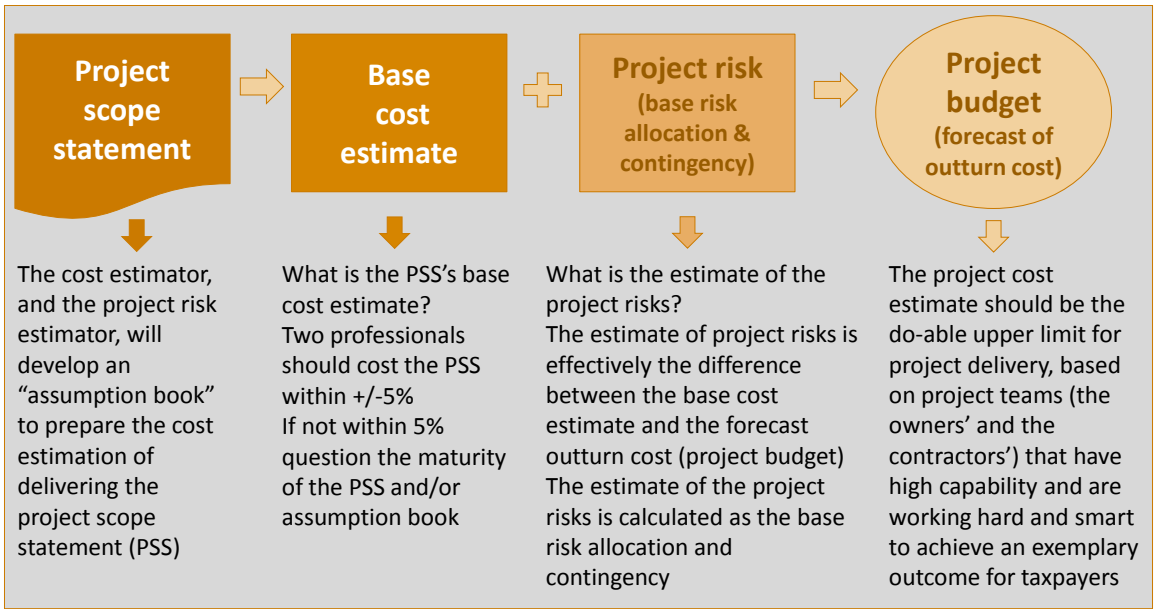


Figure 7 The relationship between base cost estimate, project risks and project budgets

6.2 The mechanics of developing the project budget

A business case needs to recommend the preferred procurement strategy (and contracting model) for the capital project. The recommendation should be based on the procurement strategy that delivers the best overall outcome for the State considering a number of factors (which are normally interrelated) such as:

- delivering the lowest whole-of-life cost for the required performance standards, including effective management of the project's base costs and risks;
- managing ongoing stakeholder requirements and issues during the project delivery phase; and
- the prevailing market conditions.

Figure 8 illustrates a common process used by agencies to develop project budgets. The initial project budget is based on a 'design and then construct' or 'construct only' strategy. Once the project budget is developed ('Project budget 1'), the best procurement strategy is determined. Then it is necessary to refine the project budget ('Final project budget') in light of the procurement strategy. The expectation is that an alternative procurement strategy, to that of 'construct only', is selected because this will best manage the base costs and project

risks for the required objectives, and thereby provides a more attractive and predictable outcome for the State. Hence, the final project budget should be equal to or less than that initially estimated.

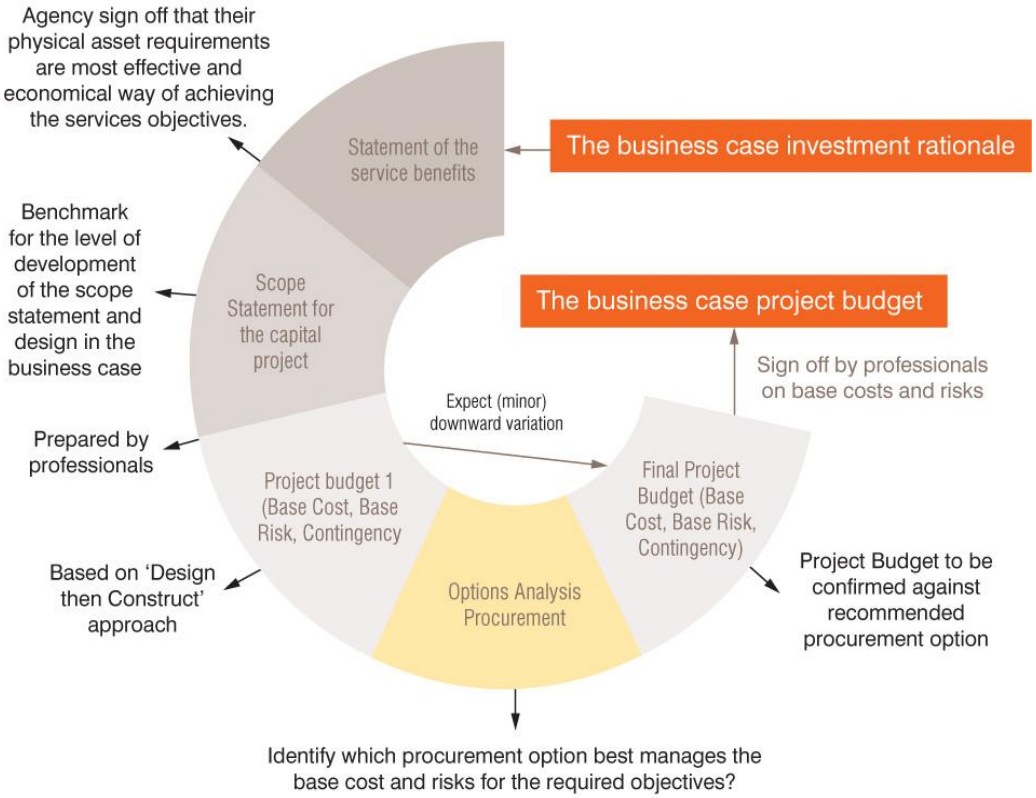


Figure 8 The mechanics of developing the final project budget

It is worth noting here that the project budget for the business case is the sum of all estimated costs for the successful delivery of the capital project. This means that the project budget will have components that will be allocated to different parties:

- **The agency's project delivery office**: The project budget will normally include cost estimates for site acquisition, contractors and/or professional services that will be managed and paid for directly by the agency. In addition, the agency may retain certain risks it is best placed to manage and this will be reflected in the base risk allocation as funding available directly to the agency as, and when, appropriate.
- **The main project contractor**: The construction contract will be awarded to the successful tender, and the project budget components of the base cost estimate and that of the transferred risks in the base risk allocation, will effectively equate to the contract price.
- **The CEO/Minister/Treasurer**: The contingency is managed by a party not having direct responsibility for project delivery (such as the agency's project delivery office). Approval for expenditure against the contingency may be from the Minister/Treasurer for a government-approved business case and in other cases by the agency's CEO or board.

Figure 9 illustrates the management and application of the project budget to different parties.

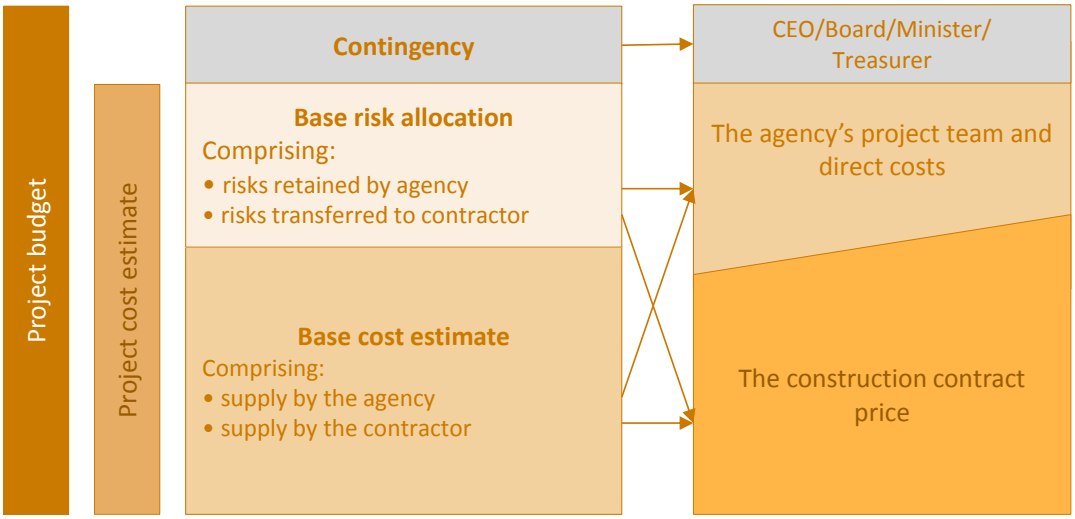


Figure 9 Managing various components of the project budget

6.3 Governance and management of project budgets

6.3.1 Budget disclosure

As outlined in this guide project budget estimates are likely to vary quite significantly, particularly in the development phase. Any public disclosure of estimate should therefore be carefully considered and minimised – if anything, only identified as a 'ball park estimate'. As displayed in Figure 2 the final estimate will not be known until the project is complete.

Also, following funding approval, project budgets can be commercially sensitive. Government policy requires that all major capital projects are the subject of an open tender process where the contractor's price is competitively determined. Effectively, a major part of the project budget in a business case represents the government's reserve price. When publicly disclosed, potential bidders are informed of an anchor price and of the government's view on project affordability.

Accordingly, **where project budgets are judged to be particularly commercially sensitive** and their disclosure before or during a tender process may compromise the State in obtaining best-in-market prices, a different process is recommended:

- The process of developing project budgets for business cases, and other project costings, are to be dealt with as commercial-in-confidence.
- If a business case is approved, and the project proceeds to tender, the project budget remains commercial-in-confidence.
  - Budget papers, annual reports and other public documentation may include the project budget in the aggregate of a portfolio's capital works program.
  - The project budget will not be disclosed in any media releases or public information bulletins prior to awarding of tender contracts.
  - To ensure transparency and address public interest, individual project budgets will continue to be communicated to the Auditor-General (as part of the review of the Estimated Financial Statements for the Victorian general government sector).
- Once the tender has closed and the successful proponent is awarded the contract, information on the accepted tender and the business case project budget is publicly communicated by the agency.

6.3.2 Budget control

Following approval of a business case the project cost estimate is sectioned into a cash flow schedule, which is managed by the agency and its project office. However, the contingency amount must be held outside of the control of the project office:

3. For all projects, but particularly higher value, more complex projects, internal control mechanisms should be in place to ensure the project team does not have automatic access to, or control of, project contingency.
    - For example, access to contingency may require approval of the CEO and/or the Minister (depending on the complexity of the project).
4. In some cases government may determine that access to contingency will be subject to the Treasurer's approval.
    - For example, some HVHR projects may be considered extremely sensitive and awareness of emerging risks important for fiscal monitoring.

Contingency and risk allocation approval processes and tolerances should be detailed in project governance documents.

If additional funding is required beyond the approved project budget, the responsible Minister will make an appropriate submission to the government for funding.

6.3.3 Accountability

As the project proceeds to completion some variation might be expected against the project cost estimate and the contingency may be used. Departments should be aware that they will be accountable for the rigour of the project cost estimate and the project budget against outcome, and the appropriate use of contingency. The decision-making process for using contingency should include an audit trail.

6.4 Project delivery by a public–private partnership

Where a project is assessed as suitable for PPP delivery in the procurement options analysis, the agency will need to commence development of the Public Sector Comparator (PSC) once the PPP option is confirmed by government. Detailed guidance on the development of the PSC can be found in the national PPP guidelines.

7. Instruction templates for professional services

Provides various templates for engaging the professional services associated with developing the project budget for the business case

7.1 Instruction templates for base cost estimation

There are two main types of engagements:

1. developing the base cost estimate; and
2. reviewing the base cost estimate that has been developed.

The following suggested instructions are provided for agencies seeking to engage these services, either externally or internally.

7.1.1 Developing the base cost estimate

The importance of an accurate project budget has been highlighted in section 4, which also explained how the accuracy will be increased by using competent and experienced cost estimators. A template of instructions that agencies could consider for engaging such professional services is given below. The first provides a template for engaging the professional services associated with developing the project budget for the business case.

Brief – senior cost estimate advisory services

Role context

While roles titled 'estimator' exist at various levels in project development, management and advisory organisations, the particular role defined below is at the executive level as a key member of a project team for $50m to multibillion multidisciplinary projects. Typically the role requires high-level functional capability and the capacity to understand the uncertain nature of costs and key risks of large-scale projects throughout the project's lifecycle. The position should report to the project director.

Role accountabilities

- Producing accurate and reliable base cost estimates based on well-developed scopes of work;
- Ensuring that project budgets factor in project risk associated with uncertainty, incomplete information and the complex interrelationships between project variables;
- Applying a robust estimating methodology recognised within the industry that adopts sound value management techniques and change management processes;
- Creating and maintaining a competent and efficient estimation team appropriate for project requirements;
- Ensuring the accuracy and quality of decisions made within the estimation team such as those related to construction sequencing and productivity;
- Ensuring necessary accuracy and reliability of data and information on which estimates are based including the quality of benchmarking and analyses undertaken;

Brief – senior cost estimate advisory services (cont.)

Role accountabilities (cont.)

- Effectively integrating the output of the estimation team (procurement, quantity surveying) and across the bid team (design, constructability, risk) to achieve the most accurate and reliable overall result;
- Collaborating and communicating effectively across all functions of the bid team;
- Identifying risks and opportunities and responding for best overall outcome;
- Systematically implementing rigorous estimate reviews; and
- Documenting the underlying assumptions as articulated above.

Background, skills and competencies

- Background in quantity surveying, estimation, project engineering, contracts and procurement with a proven track record at a senior technical or project management level;
- In excess of 15 years' project experience, preferably as a senior estimator with a broad background in providing accurate and achievable cost plans, first principle estimates and value management advice for large infrastructure projects, for example, involving PPPs and alliances;
- Ability to lead teams to produce accurate project cost estimates and budgets from concept to definitive information;
- Thorough knowledge of current estimating strategies and techniques;
- Conceptual and integrative thinking capacity related to complex systems and operating environments and ability to accurately infer or visualise a whole project in all aspects (e.g. scope, program, constraints and stakeholders) with incomplete information;
- Relevant tertiary engineering or construction-related qualifications are desirable but not essential;
- Proven ability to lead, communicate with and influence people to achieve complex and challenging objectives;
- Commercial acumen necessary for accurate cost estimates on multimillion/billion dollar projects; and
- Rigorous and thorough in approach including ability to apply a high level of attention to detail.

7.1.2 Reviewing the base cost estimate

The importance of insightful and meaningful reviews has been explained in section 3. The nature and extent of the review must be appropriate to the project profile. This can range from a basic peer review for simple, lower value, lower risk projects, ranging up to independent external review by experienced professional estimators for more complex, higher value, higher risk projects. A template that agencies could consider for engaging such professional services is given below.

Reviewing the base cost estimate

Some of the review assessments that agencies should consider addressing include whether:

- the project scope statement has been described and quantified in an industry recognised, methodical way, conforming to an agreed work breakdown structure specific to the sector;
- the standard of works conforms to technical, design and construction requirements in legislation, industry and other standards, codes and recognised manuals (compatibility with existing and adjacent infrastructure is relevant as is consideration of modern engineering equivalents and technologies; compliance with strategic asset management plans and total management plans are likely to be highly relevant);
- the base cost estimate aligns with the project scope statement and enables the requirements of the statement of service benefits;
- the base cost estimate is consistent with standard of works and the conditions prevailing in the market for engineering, engineering supplies and construction;
- the base cost estimate reflects the construction methodology, staging, productivities, site or working constraints, etc.;
- the unit rates used in the base cost estimate are market competitive and are supported by a logical build up with relevant productivity and wastage factors;
- the base cost estimate excludes allowances for risk, contingencies and escalation, and is free of calculation errors and double counting;
- the base cost estimate presentation conforms to the required format;
- sanity checks confirm that the estimate conforms to known benchmarks achieved from prior best practice projects;
- the assumptions, exclusions, qualifications and any limitations of the estimate are appropriately documented and accompany the estimate;
- any material changes from previous approvals or reviews of base cost estimate are clearly explained addressing the 'why' as well as the 'what'; and
- departures from the guide are identified and justified.

7.2 Instruction templates for project risks[13]

Identifying and quantifying risks is a specialist task that requires a multidisciplinary approach. The skills necessary to develop a robust base risk allocation and contingency in accordance with this guide require a combination of professional qualifications and experience. Typically this means agencies need to supplement project team resources with external professional services. That said, agencies should not think that this task can be delegated entirely to consultants. Ultimately, the agency itself must play a central role in establishing the base risk allocation and contingency.

Effective engagement with professional services requires a clear scope of work and active management of advisers by agencies. Agencies should prepare a brief on the objectives, scope and timing of the capital investment, including an assessment of its value and importance to the agency, its key stakeholders and its complexity.

[13] The *Partnership Victoria* Public Sector Comparator Supplementary Technical Note provides an appropriate reference for undertaking risk analysis and quantification. While it was developed for *Partnerships Victoria* projects the approach to risk and the techniques described for quantifying risk are equally applicable to all capital investment projects. The methodologies described (simple and advanced valuation techniques) are a useful point of reference for establishing the instruction template and scope of work for project risks.

To get the best out of professional advisers, agencies should actively engage and develop collaborative working relationships. This is particularly the case when it comes to risk analysis. Agencies must expect to spend considerable time briefing advisers on their requirements and working with them to identify and quantify risks. Expecting a professional adviser to deliver on a scope of work with minimal or no communications on the issues will invariably not deliver an appropriate or acceptable project budget estimate.

At a high level the scope of professional risk services is to:

- identify risks;
- evaluate risks;
- cost the treatment/control of risk response;
- develop mitigation strategies including optimal risk allocation (between the State and contracted parties);
- assess residual risks;
- plan the response to residual risks;
- prepare and recommend a base risk allocation estimate;
- prepare and recommend contingency; and
- document and communicate to the wider project team the strategy and plans for managing the project risks.

Broadly speaking there are likely to be three roles that agencies can seek to engage professional services on (it should be noted that one firm or individual may be qualified to provide all these services):

1. **Project risk** and **control services**: coordinate and facilitate the risk process, including workshops, and apply best practice risk management standards. These services are relatively well established in the market, including:
   - qualitative risk analysis in line with risk standards;
   - quantitative risk analysis that depending on the complexity of the project and the nature of the risks (includes risk modelling using various stochastic software packages); and
   - verifying the risk estimates (undertaking a sense check)

(Risk facilitation is a skilled role that is usually carried out by a professional that has a deep background in capital investment and a track record in facilitating workshops and applying best practice risk management standards.)

2. **Risk quantification and modelling services:** specialist modelling capability is engaged for complex projects with many significant and interdependent risks. This requires professional skills in coordinating risk assumptions and combining these in a risk quantification model. Often this work is combined with the project risk and control services as both involve coordination and interpretation of risk assumptions provided by technical experts.

(*These services are integral to planning the project, such as architects, engineers, quantity surveyors and demand forecasters. Technical qualification to undertake these roles is a given.)*

The following instruction templates can be used for engaging these professional services (which may be sourced from both internal and external professionals).

Project risk and control services

As a guide, agencies should consider engaging professional services to:

- coordinate and facilitate the risk analysis process including workshops, and apply best practice risk management standards;
- define and agree with the agency's project team the overall strategy for the risk review including the level of risk analysis and the quantification tools to be used (establish a base line by defining the context and basis for the risk analysis and risk management plans);
- define and agree with the agency's project team the methodology for establishing a robust base risk allocation including the justification and reference projects that will be used as a sense check;
- form a risk management team by identifying and assigning those who will act as technical risk experts to identify risks and provide estimation of probability and impact;
- introduce the risk analysis plan and manage progress throughout the process;
- identify as exhaustively as possible all significant project risks and uncertainty associated with the project; ascertain the cause of the risk (hazard event) and assess how the risks are related to other risks (correlated); classify the risks according to a risk categorisation framework; consider each risk identified and record in a risk register
    - the cause of the risk by identifying the hazard event (not the outcome), such as poor ground conditions (not cost overrun);
    - trigger events that give rise to the risk occurring;
    - the timing and frequency of the risk occurring;
    - the range of possible outcomes in terms of cost, time and impact on the investment (project and/or future performance of the asset);
    - management response or control actions to mitigate the impact of particular risks;
    - residual risks after the control response; and
    - the range of possible outcomes post control action in terms of cost, time and impact on the investment (project and/or future performance of the asset).
- identify the risk analyst responsible for further analysis and quantification of the risk;
- prepare a risk management strategy including the robust case for the risk allocation; and
- quantify the combined impact of all risks quantified to establish the recommended base risk allocation and contingency.

The level of quantification and consequently risk modelling that is required will depend on the complexity of the project and the nature of the risks. A highly complex project that is high risk will typically require more complex risk quantification and modelling than a relatively low risk project. The level of sophistication in risk quantification is discussed in section 4.3 including an outline of some of the techniques available. The scope of work should reflect the complexity of the project and the level of risk.

The following can be used as an instruction template for engaging these professional services.

Risk quantification and modelling services

The professional services will vary from a simple to a complex project risk profile, as a guide.

Simple risk quantification

- Develop an analysis that appropriately quantifies the base risk allocation based on the assumptions provided by the risk experts.
- Critically analyse the risk assumptions provided by the risk experts and identify any interdependencies and correlations. As part of this analysis identify and eliminate any double counting, optimism and pessimism bias.
- Carry out a sensitivity analysis to determine which assumptions and variables are most and least sensitive to changes impacting on the base risk allocation.
- Analyse the results of the analyses and recommend an appropriate base risk allocation and contingency for the project.

Advanced risk quantification

- Develop an advanced probability analysis using stochastic tools and software that appropriately quantifies the base risk allocation based on the assumptions provided by the risk experts. The output from this analysis is a statistical distribution.
- Critically analyse the risk assumptions provided by the risk experts and identify any interdependencies and correlations and factor these into the risk quantification. As part of this analysis identify and eliminate any double counting, optimism and pessimism bias.
- Carry out a sensitivity analysis to determine which assumptions and variables are most and least sensitive to changes impacting on the base risk allocation.
- Analyse the results on the modelling and recommend an appropriate base risk allocation and contingency for the project.

3. **Risk estimation services:** usually a component of the scope of work for technical advisers. The requirement for these experts is to take on the role of risk expert in their discipline. The following can be used as an instruction template for engaging these professional risk services from technical advisers.

Risk estimation services

Agencies can consider the following guide for these professional services technical experts.

Simple risk quantification

- Apply the standards of your professional technical discipline to quantify the risks in accordance with the project's risk strategy.
- Work cooperatively with the project risk and control services provider and the other technical experts to identify, quantify and establish risk characteristics (including interdependencies between risks known as correlation).
- Assess the likelihood (probability) and impact (consequence) of each risk (the risk assumptions).
- Provide the risk assumptions to the project risk and control services provider in a format that is in accordance with the project risk strategy.
- Identify which risks justify more detailed analysis, evaluation and quantification, and for these risks carry out a more detailed analysis as instructed by the agency.
- For each risk decide on what are the main options for avoiding, reducing, transferring or containing risks (mitigation strategy).

8. Certification of project budget estimates

Outlines the requirements for certification both by the SRO and the professional services engaged with developing the project budget for the business case

8.1 Addressing key interdependencies in the business case

The guide puts in place the following requirements.

1. The project scope statement is provided as part of a business case and the agency's SRO provides a specific sign-off attesting that:

   — it describes a fit-for-purpose asset that enables delivery of the identified service benefit (from the statement of the service benefits);
   — it defines the physical scope, utility and functional requirements of the capital project in an efficient, effective and economical manner; and
   — departures from the Guide for Determining Project Budgets in Business Cases are identified explained and justified in terms of best-for-the-State outcomes.

2. The base cost estimate, including assumptions used in its preparation, is explained and provided as part of the business case. A specific sign-off is required from an appropriately qualified and credentialed professional that:

   — its calculation presents a best-in-market cost estimate of the project scope statement;
   — the estimate does not include allowances for escalation and risk; and
   — departures from the Guide for Determining Project Budgets in Business Cases are identified explained and justified in terms of best-for-the-State outcomes.

3. The project risk estimate (i.e. the base risk allocation and contingency) is explained, including the methodology used for the calculation, and provided as part of the business case. A specific sign-off is required from an appropriately qualified and credentialed professional that:

   — identifying and quantifying project risks follow best practice and are predicated on capable management commensurate with the challenges of the project;
   — the estimates disclose all material assumptions and does not include 'double counting'; and
   — departures from the Guide for Determining Project Budgets in Business Cases are identified explained and justified in terms of best-for-the-State outcomes.

8.2 Sign-off by SRO for the statements of service and scope

The agency's SRO (or project sponsor) is required to provide in the business case a sign-off stating that the project scope statement provides for a cost-effective enabling asset for delivering the identified service benefits that underpin the business case's investment

rationale (i.e. the statement of the service benefits). The sign-off can be provided at the front of the business case's appendix documenting the project budget.

The wording of the sign-off may need to be tailored to suit the specific project; however, it should meet the intent of the following template.

The statements of service and scope

Agency sign-off on the statements of the service benefits and project scope statement

I attest that:

- the project scope statement defines a fit-for-purpose capital asset that is directly linked to, and enables delivery of the identified business case service objectives (i.e. the statement of the service benefits) in an efficient, effective and economical manner;
- the project scope statement is sufficiently mature to allow development of a project budget to the standard required by the guide;
- all material inputs, including the 'assumption book', that evidences the development of a high-quality project budget are reported in this appendix of the business case;
- the project budget has been reviewed from a holistic perspective to ensure it does reflect the proposed capital asset in terms of the project scope statement and service objectives, and, as SRO, I am familiar and comfortable with the base cost estimate as representing the best-in-market pricing for the application of best practice project delivery;
- the project budget recommended in the business case is of high quality suitable for government decision making, and has been developed to the lowest cost for the required performance; and
- departures from the guide are identified, explained and justified in terms of best for the State outcomes.

<Name>

Senior Responsible Owner

Signature:

Date:

8.3 Sign-off for base cost estimate

To assist the SRO sign their attestation, the base cost estimator needs to certify the quality of their estimate and expressly acknowledge the adverse consequences for government should they produce a base cost estimate that does not meet the levels of accuracy expected for business cases.

The wording of the certificate may need to be tailored to suit the specific project; however, it should meet the intent of the template included in Appendix B, which can be in the form of a letter to the agency's SRO.

8.4 Sign-off for project risk

The agency and its advisers collectively involved in preparing the base risk allocation and contingency are expected to sign off that they have prepared robust estimates based on a rigorous and thorough process in accordance with this guide.

8.4.1 Project risk services

Overarching sign-off is required in the business case from the agency and its advisers that:

- All significant risks have been identified and analysed.
- The base risk allocation represents a robust and reasonable 'most likely' estimate of all project risks.
- The contingency represents a robust and reasonable estimate (and not an easy target) of the upper limit for the total project budget 'beyond the most likely value for all project risks'.
- The overall impact of risks has been assessed using recognised tools that have included sensitivity and scenario testing (as appropriate).
- The base risk allocation and contingency have been sense checked against an appropriate range of benchmark risks and projects and this demonstrates that they are robust estimates.
- The process adopted is in accordance with this guide.

The sign-off should be against an outline of the risk profile of the project and a justification for the decision to select the base risk allocation and contingency quanta in the context of the risk profile. This should also include a description of the sensitivity of the base risk allocation to the input data, the range of risk estimates analysed, and the level of confidence in the accuracy of the figures stated.

Deliberately, the guide is not prescriptive on the tools and therefore the statistical language that agencies and advisers adopt. Therefore, the sign-off should be a meaningful statement and expression of the work that has gone into preparing the base risk allocation. Agencies should ensure that the sign-offs are appropriately drafted to reflect the level of professional skill that has been applied to the process aggregating as appropriate to the services provided.

The second template in Appendix B, which should be in the form of a letter to the agency's SRO, can be adapted by the agency as appropriate.

8.4.2 Technical risk services

Specific sign-off is required from each technical expert on the underlying assumptions that go into the risk analysis, including for each identified risk that:

- the qualitative analysis of probability and impact is reasonable and based on professional judgement and experience; and
- the detailed and quantified evaluation of likelihood, consequence, timing, expected value and dependencies are reasonable and based on professional judgement and experience.

The third template in Appendix B, which should be in the form of a letter to the agency's SRO, can be adapted by the agency as appropriate to address the specific services provided.

9. Glossary

Term	Definition	Comment Statement of Service Benefit
Statement of service benefit	The rationale in the business case that defines the service need and outlines the service delivery improvements and the expected outcomes to be achieved from the proposed investment.	This statement describes the service benefits that the capital project will enable. It can be articulated in a strategic assessment, an investment logic map, an investment concept brief, or other such similar document.
Project scope statement	A foundation document for the project budget. It is directly aligned to achieving the benefits set out in the statement of service benefit. It defines the content, scope, utility and business requirements of the capital project.	The scope statement needs to be of sufficient quality and detail (see the companion guideline) to enable determination of the project budget, and should be provided as an appendix of the business case. A work breakdown structure or functional brief are examples of a project scope statement.
Base cost estimate	Based on the project scope statement, the current best-in-market estimate of the expected financial costs of delivering the project. This does not include any estimates for escalation, risk or contingency.	A base cost estimate comprises costs for design, margins, project management, consultants, site preparation, building materials, labour, and use of plant and equipment. It is prepared by a suitably qualified professional, and should be provided in an appendix of the business case. Escalation is a separate activity undertaken 'outside' of the base estimation process. See escalation definition below.
Project risk[14]	Variability in future project delivery outcomes for which a likelihood and impact of occurrence can be estimated. Variability arises from events which are known hazards or are readily observable in practice or from experience. A reasonable estimate of the range of variation in actual outcomes can be quantified or derived from calculation. The total allocation for Project Risk provided in a Business Case project budget is the Base Risk Allocation plus the Contingency.	The estimations for all project risks (inherent and contingent) are usually determined through risk workshops involving experienced and capable officials and, as appropriate, consultants. Estimates need to be prepared by a qualified professional and provided as an appendix of the business case. (Risks can result in either a positive or negative impact.) Caution must be exercised to ensure that project risks are neither over- nor under- estimated; and are benchmarked to actual events and contemporary risk management responses.
Base risk allocation	A financial calculation and judgement of the most likely or probable total financial impact of all costed project risks after the application of risk management practices.	The base risk allocation should include the allowance for escalation. (See escalation definition below.) Note: Unique items, such as land purchase costs, can be separately identified and costed. They should be presented as an item in the base cost estimate, and if necessary, in the base risk allocation.

Term	Definition	Comment Statement of Service Benefit
Escalation	The anticipated variation in project costs over time as a result of factors such as inflation, market conditions, supply constraints, timeframes etc.	The escalation factors (or rates) are sensitive to market conditions and are included in the base risk allocation. The base cost estimate is determined at a particular point in time, and this allows the project cash flows to be forecast by taking into consideration the project implementation timeline and schedule of works. An allowance for escalation is calculated by applying the escalation factor(s) to the cashflow.
"Most likely"	This implies a statistical average of weighted probabilities and impacts. Ostensibly the representation of a single figure estimate represents the most probable outcome for the project considering all the risks and their respective weighted likelihoods of occurring and impacts (and potentially range of impacts). However, it remains a judgement, one that should be based on informed analysis and experience.	There are a number of techniques to cost risk. This guide deliberately avoids the terminology of probabilistic estimating (e.g. P10, P50, P90) and specifically does not define the use of term 'most likely value'. It is expected that agency practices will determine their preferred approach to costing risks, and that the costs proposed follow a methodology that is defensible and robust.
Contingency	A provision for costed project risks in excess of the base risk allocation. This provides a reasonable financial allowance in the event that risks greater than the "most likely" risk impact materialise during project delivery.	This provision is best managed externally to the agency's project team.
Project Cost Estimate	The sum of the base estimate and base risk allocation.	This amount is normally the 'budget' that is managed by the agency's project office.
Project Budget	Comprises the base cost estimate, base risk allocation and a contingency. It addresses all delivery aspects of the approved project.	This amount is approved as part of the business case decision.
Project Definition	The project definition includes: • a detailed description of the scope of the capital works (including drawings, specifications, calculations etc) • construction methods • program dates • project performance objectives • project risks that may be encountered • all necessary and prudent investigations to complete the project definition • the method of delivery; and • a description of those works (otherwise associated with the project) specifically excluded or not in scope.	The project definition in the project scope statement should be developed to at least a level of 10-20% of complete definition.

Appendix A: Presentation of the project budget

Table 1: Headline project cost element summary

Base cost estimate	$XXXm	(Table 2)
Base risk allocation	$XXm	(Table 3)
Project cost estimate	$XXXm	
Contingency	$XXm	(Table 3)
Project budget	$XXXm	

Table 2: Base cost estimate

BASE COST ESTIMATE Effective date of BCE: dd/mm/yy Estimated date of commencement of construction: dd/mm/yy.				
1	**Direct Costs**			
	1.1	Materials		
	1.2	Labour		
	1.3	Plant Hire		
	Sub Total			$
2	**Indirect Costs**			
	2.1	Recurring overheads		
		2.2.1	Site facilities	
		2.2.2	Plant & Equipment - site maintenance	
		2.2.3	Project management costs	
		2.2.4	Commercial	
		2.2.5	QA and Safety	
	2.2	Non recurring overheads		
		2.3.1	Establishment and mobilisation	
		2.3.2	Disestablishment and demobilisation	
		2.3.3	Project Insurances	
		2.3.3	Professional fees- design, legal, financial etc	
	Sub total			$
3	**Owners Cost**			
	3.1	Contracted professional staff		
	3.2	Investigations		
	3.3	Land costs & resumptions		
	3.4	Authority fees		
	3.5	Owner supplied plant and equipment		
	Sub Total			
4	**Contractors Fee**			
	4.1	Profit margin		
	4.2	Corporate overheads		
	Sub Total			$
5	**Provisional Sums**			
	5.1			
	Sub total			$
TOTAL OF BASE COST ESTIMATE				**$**

Table 3: Project risks

6	**Base Risk Allocation**			
	6.1	Escalation	(Period between BCE and construction)	
	6.2	Project risk A		
	6.3	Project risk B		
	Sub total			$
7	**Contingency**			
	7.1			
	Sub total			$
Total of Project Risks				**$**

Appendix B: Templates for estimate certification

Base cost estimate services

Addressee: [Senior Responsible Owner]

Re: Sign-off for project base cost estimating services

We refer to the contract dated [ ] between [ ] and [ ], through which [ ] has been engaged to provide base cost estimating services (the 'contract'). This letter and the advice it refers to has been developed pursuant to the contract.

The report of our advice was developed in accordance with the Department of Treasury and Finance (DTF) guidance Determining Project Budgets in Business Cases Supplementary Technical Guide to the Investment Lifecycle Guidelines (the 'DTF guides'), which has been wholly and consistently applied in determining the base cost estimate for the project.

I acknowledge that the accuracy of this base cost estimate is critical to a sound assessment of the merits of the business case for the [XYZ] project and that an inaccurate base cost estimate may lead to flawed investment decisions with serious consequences for government.

I have prepared this base cost estimate in accordance with <name of technical> Standard and I certify that it represents the most likely 'best in market' assessment of the outturn costs of the project as described in project scope statement provided to me, and that it is accurate and reproducible within ±5 per cent (against another cost estimator working from the same project scope statement and assumption book).

Limitations

This letter and the report have been prepared in accordance with the contract.

Our analysis does not constitute an audit of either the risks or the assumptions provided by others including the technical risk experts. We have relied on the assumptions provided as appropriate and prepared in accordance with the DTF guide.

We have carried out our internal quality and management review on the base cost estimate and are satisfied as to the integrity and accuracy of the calculations. The base cost estimate has been prepared to conform to current practice in Australia and in particular with the DTF guide. We note that it is usually the case that some events and circumstances do not occur as expected or are not anticipated. Therefore, actual results will almost always differ from the forecasts.

This letter may only be relied upon by the State pursuant to the terms of the contract. This letter and the report cannot be relied upon by any third party for any purpose whatsoever. We disclaim all responsibility to any other party for any loss or liability that the other party may suffer or incur arising from or relating to or in any way connected with the contents of this letter.

The State should take into account the limitations of the scope of our work and other factors, commercial and others, which it should be aware of from sources other than our work.

Estimator (Partner or Principal)

<Company name>

Signature:

Date:

Project risk services

Addressee: [Senior Responsible Owner]
[Agency]

Project risk and control services (including risk quantification)

We refer to the contract dated [ ] between [ ] and [ ], through which [ ] has been engaged to provide project risk and control services including base risk allocation and sizing the contingency (the 'contract'). This letter and the advice it refers to has been developed pursuant to the contract.

We confirm that our professionals engaged to assist you have the requisite background in project risk and control services including risk quantification and associated financial modelling.

Base risk allocation and contingency

Our attached report risk analysis (the 'report') recommends an appropriate base risk allocation and contingency for the [ ] project (the 'project'). The report was developed in accordance with the Department of Treasury and Finance (DTF) Guide for Determining Project Budgets in Business Cases Supplementary Technical Guide to the Investment Lifecycle Guidelines (the 'DTF guides'), which has been wholly and consistently applied in determining the base risk allocation and sizing the contingency for the project.

The assumptions contained in the report were developed in conjunction with the agency and its advisers including technical risk experts. The advice and recommendations have been discussed with your nominated stakeholders.

The base risk allocation represents the most likely outcome for the project. The contingency represents the appropriate confidence limit, that is, it provides an appropriate upper limit for the total project budget 'beyond the most likely value for all risks' (i.e. the base risk allocation). This confidence limit provides a realistic estimate (and not an easy target) that the project cost is unlikely to exceed this amount based on information available at this time. We analysed the base risk allocation and contingency in accordance with the DTF guide as documented in our analysis in the report. Our view is that the base risk allocation and contingency recommended are appropriate for the project.

Limitations

This letter and the report have been prepared in accordance with the contract.

Our analysis does not constitute an audit of either the base cost estimates or the assumptions provided by others including the technical risk experts. We have relied on the assumptions provided as appropriate and prepared in accordance with the DTF guide.

We have carried out our internal quality and risk management review on the base risk allocation and contingency models (the 'risk model') and are satisfied as to the integrity and accuracy of the calculations. The risk model has been built to conform to current practice in Australia and in particular with the DTF guide. We note that it is usually the case that some events and circumstances do not occur as expected or are not anticipated. Therefore, actual results will almost always differ from the forecasts.

This letter may be relied upon by the State pursuant to the terms of the contract. This letter and the report cannot be relied upon by any third party for any purpose whatsoever. We disclaim all responsibility to any other party for any loss or liability that the other party may suffer or incur arising from or relating to, or in any way connected with, the contents of this letter.

The State should take into account the limitations of the scope of our work and other factors, commercial and others, which it should be aware of from sources other than our work

Estimator (Partner or Principal)
<Company name>

Signature:
Date:

For project risks services for technical experts

Addressee: [Senior Responsible Owner]
[Agency]

We refer to the contract dated [ ] between [ ] and [ ], through which [ ] has been engaged to provide technical risk expert services (the 'contract'). This letter and the advice it refers to has been developed pursuant to the contract.

We confirm that our professionals engaged to assist you have the requisite technical background and experience necessary to provide these services.

Our advice was developed in accordance with the Department of Treasury and Finance (DTF) Guide for Determining Project Budgets in Business Cases Supplementary Technical Guide to the Investment Lifecycle Guidelines (the 'DTF guides'), which has been wholly and consistently applied by us in contributing to determining the base risk allocation and sizing the contingency for the project.

Base risk allocation and contingency assumptions

In relation to the report risk analysis (the 'report') that recommends an appropriate base risk allocation for the [ ] project (the 'project'), we prepared the risk assumptions (the 'risk assumptions') identified in the report.

The risk assumptions were developed in accordance with the DTF guide. In our professional opinion the risk assumptions are appropriate for the purposes of estimating the base risk allocation and contingency.

Limitations

This letter and the risk assumptions have been prepared in accordance with the contract.

This letter may only be relied upon by the State and the project risk and control services provider engaged by the State pursuant to the terms of the contract. This letter and the risk assumptions cannot be relied upon by any other third party for any purpose. We disclaim all responsibility to any other party for any loss or liability that the other party may suffer or incur arising from or relating to or in any way connected with the contents of this letter.

The agency should take into account the limitations of the scope of our work and other factors, commercial and others, which it should be aware of from sources other than our work.

Technical expert (Partner or Principal)
<Company name>
Signature:
Date: