Manual

Project Cost Estimating Manual (PCEM)

December 2021 (v1.1)

Queensland Government

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Feedback

Please send your feedback regarding this document to: tmr.techdocs@tmr.qld.gov.au

Foreword

This Eighth Edition of the *Project Cost Estimating Manual* incorporates changes introduced to Department of Transport and Main Roads estimating processes and related policies. It also includes system changes introduced through the department's Portfolio, Program, Project and Contract Management System (3PCM) and feedback received from stakeholders such as the department's regional estimating champions and external service providers for improvements to its content and layout.

The updates to the Cost Estimation and Contingency Management Guidance Documents issued by the Australian Government have also heavily influenced the contents of this manual.

Departmental restructuring changes and the update of the *Federal Government's Best Practice Cost Estimation Standard for Publicly Funded Road and Rail Construction Guide* have also heavily influenced the contents of this manual.

The Department of Transport and Main Roads continues to pursue its commitment to the production of accurate project cost estimates. This edition has an increased emphasis on all-of-department contribution through the incorporation of other divisions such as TransLink, Maritime Assets and Infrastructure and Queensland Rail.

The manual acknowledges the importance of accurately communicating the circumstances and level of confidence recipients can have in any estimate. To achieve this the manual includes concepts to describe the delivery process for estimates as values ranging between pessimistic, to a most-likely cost. It is critical that attention be directed to both pessimistic and most likely estimate values as these inform the approved project funding.

Compliance with this manual is mandatory for all cost estimates prepared for the Department of Transport and Main Roads infrastructure projects included in the QTRIP with an exception to asset maintenance projects (such as Road Maintenance Performance Contracts) and the projects in the Maintenance, Preservation and Environment (MPE) and Road Operations (RO) Elements, as published in the Queensland Road System Performance Plan (QRSPP).

Estimators, project managers, engineers, technical officers and external service providers must follow these procedures when preparing cost estimates at any point in the project cycle.

Regional / district directors are accountable for the accuracy of project estimates.

Revision register

Rev #	Edition	Amended by	Date
1	Draft Release	PCEM management team	July 2002
2	First Edition	PCEM management team	Feb 2004
3	First Edition Ver. 1.1	PCEM management team	April 2004
4	Second Edition	PCEM management team	Dec 2004
5	Third Edition	PCEM management team	Dec 2007
6	Fourth Edition	PCEM management team	July 2009
7	Fifth Edition	PCEM management team	May 2012
8	Sixth Edition	PCEM management team	Sep 2015
9	Seventh Edition	PCEM management team	June 2017
10	Eighth Edition	PCEM management team	December 2021
11	Eighth Edition Ver. 1.1	PCEM management team	22 December 2021

Manual management plan

Purpose of the update

The departments' guidelines and manuals are routinely updated to ensure they align with the most up to date processes and policies of the state and federal governments.

This manual is managed through the following roles:

Role	Position / person
Manual Customer	General Manager – Portfolio Investment and Programming
Manual Sponsor	Executive Director – Program Development and Performance
Manual Manager	Director (Program Management Improvement) - PMI
PMD Representation	Director (Delivery Risk)
Manual Review Team Members	Manager (Estimating and Risk Evaluation) – PMI Principal Advisor (Estimating and Risk Evaluation) – PMI Senior Advisor (Estimating and Risk Evaluation) – PMI Regional / District Estimating Champions

Amendment and review strategy

Transport and Main Roads welcomes feedback about this manual. Please send feedback via tmr.techdocs@tmr.qld.gov.au, for the attention of the manual manager, who will acknowledge all feedback, suggested changes and improvement requests.

The manual owner and review team are responsible for ensuring the manual is updated to meet the department's needs. To this end the manual manager, in collaboration with the manual review team will:

- review feedback and comments
- monitor the context / environment the manual operates within, and
- recommend appropriate action to the manual sponsor.

Manual availability

The PCEM is available in PDF format on the Transport and Main Roads website www.tmr.qld.gov.au.

Printing this document

All downloaded and printed copies of this document are uncontrolled. The source website should be routinely checked for updated versions. The PDF version of this document will be printed as intended when the duplex (double sided) option is selected.

Contents

Tables

Figures

Acronyms

Acronym	Expansion
3PCM	Portfolio, Programming, Project and Contract Management System
APDV	Approved Project Delivery Value
BCR	Benefit Cost Ratio
BIM	Building Information Modelling
BI Publisher	Business Intelligence Publisher
CBA	Cost Benefit Analysis
CBS	Cost Breakdown Structure
CapEX	Capital Expenditure
DES	Department of Environment and Science
DITRDC	Department of Infrastructure, Transport, Regional Development and Communications
EPPM	Enterprise Project Portfolio Management
DVR	Digital Video Record
EFCT	Estimate For Comparison with Tenders
IMD	Infrastructure Management and Delivery Division
ISCA	Infrastructure Sustainability Council of Australia
ITS	Intelligent Transport Systems
MIC	Minor Infrastructure Contract
MOU	Memorandum of Understanding
MPE	Maintenance, Preservation and Environment
MRS	Transport and Main Roads Specification (Measurement)
MRTS	Transport and Main Roads Technical Specification
MSQ	Marine Services Queensland
NPA	National Partnership Agreement
NPV	Net Present Value
NTT	Notices To Tender
OBIEE	Oracle Business Intelligence Enterprise Edition Analytics Tool
OpEX	Operating Expenditure
OPPM	Oracle Primavera Portfolio Management
PAD	Property Acquisitions and Disposals

Acronym	Expansion
PAF	Project Assessment Framework
PAI	Principal Arranged Insurance
PCAR	Program Controls Analysis and Reporting
PCB	Project Cost Breakdown
PCECC	Project Cost Estimating Control Checklist
PCEM	Project Cost Estimating Manual
PIP	Portfolio Investment and Programming
PLSL	Portable Long Service Leave
PMF	Program Management Framework
PMI	Program Management Improvement
PPR	Project Proposal Report
PUP	Public Utilities and Plant
QR	Queensland Rail
QRSPP	Queensland Road System Performance Plan
RCP	Risk Context Profile
RFI	Requests For Information
S1D	Design Preliminary Design
S2D	Design Detailed Design
TIP	Transport Infrastructure Portfolio

1 Introduction

1.1 Purpose and application

The purpose of this manual is to provide guidance on rules and standards for the preparation of cost estimates in support of all transport infrastructure projects developed in accordance with the policies of the Department of Transport and Main Roads (department).

Reliable cost estimate information is used for:

- Prioritisation of 'candidate investments' to be accepted as a project (for example strategic or proposal estimates)
- rationalisation of a project's business case - for example Cost Benefit Analysis (CBA)
- justification for design cost approval for both concept and development phase cost estimates
- comparison of tenders
- estimation of variations and alternative project completion options, and
- ongoing cost control during the project's phases (concept, development, implementation and finalisation phases).

Costs are accumulated during all phases of a project from strategic planning to finalisation and all must be accounted for.

Some significant costs that may not be directly related to construction include land acquisition, relocation of Public Utility Plant (PUP) and environmental offsets.

Project cost management, of which project cost estimating is a part of, is to be applied in the context of the relevant governing framework / guide based on the project funding source and complexity. It is highly recommended and advised that readers understand those methodologies and processes before reading this document.

Together these documents provide the comprehensive foundation needed for conducting or managing estimating services within the department.

1.2 How to use the manual

This manual is developed as a reference guide for departmental employees, external contractors and consultants, local government councils, and other stakeholder organisations who are engaged in, or working on departmental infrastructure projects.

All paper versions of this manual are uncontrolled, and notifications will not be issued for any updates to this manual.

The current published version is available via the Transport and Main Roads website www.tmr.qld.gov.au.

1.3 Manual structure

This manual is structured to provide increasing levels of detail as the reader progresses.

The manual provides an up-front overview of the transport infrastructure delivery estimating functions used and applied at Transport and Main Roads including policy, principles and processes.

The manual then progresses to cover estimating functions and roles, standards, staging, risk and contingency, and an overview of commonly used tools applied to perform estimating functions.

The manual topics include the recommended strategies necessary to produce varying levels of project estimates to appropriately suit and service desired end-purpose goals and objectives.

It also provides an overview and additional considerations required for estimating of non-road infrastructure projects in Section 11.

1.4 Relationship to other systems

This manual has been structured as a reference on project cost estimating for project managers and estimators, within the context of the Program Management Framework (PMF), Queensland Transport and Roads Investment Program (QTRIP), Project Assessment Framework (PAF) process, national projects and OnQ project management methodology.

The department's various manuals and guides are intended to be complementary. However, where a conflict occurs the manual with the most recent or latest publication date takes precedence.

Note: *Any such conflict should be reported to the manual owner through the feedback process so that any necessary corrective actions can be taken*.

2 Estimating policy, strategies and standards

2.1 Policy statement

The *Infrastructure Cost Estimating Policy* (Estimating Policy) requires all cost estimates for the department's infrastructure projects to be completed as per the *Project Cost Estimating Manual* (PCEM).

This policy aims to provide guidance and reference to the appropriate standards that will maintain the levels of consistency, accuracy and high level of confidence required for transport infrastructure project cost estimates. This includes all state and nationally funded projects including road and rail, black spot and bridge renewal programs.

The department is committed to producing accurate and realistic project cost estimates for its infrastructure projects, and has therefore created an estimating policy which is founded on the following five key principles in order to achieve these objectives:

- Estimates are created in accordance with the requirements of the department's QTRIP Governance Principles, Project Assessment Framework (PAF) for Major Projects, the department's OnQ project Management Methodology, Work Breakdown Structure (WBS) and Transport and Main Roads Specifications (MRS).
- All projects (excluding asset maintenance projects such as Road Maintenance Performance Contracts and the projects in the Maintenance, Preservation and Environment (MPE) and Road Operations (RO) Elements, as published in the Queensland Road System Performance Plan (QRSPP) will require, 'unlikely' to be exceeded at 90% confidence level estimates to provide confidence in project priority, affordability and strategic fit, and a 'most likely' estimate with a 50% likelihood of not being exceeded for budget setting purposes. (Refer *Transport and Main Roads' Infrastructure Cost Estimating Policy* 'Key Principle 2').
- Estimates are to be presented using the prescribed estimate document format, (classifying into capital (CapEx) and operating (OpEx) expenditure, prior to submission for budgetary approvals, as per the department's *Infrastructure Asset Accounting Policy*.
- Estimates are subject to review and approval processes, and which are based on consistent, clear lines of responsibility and accountability, and to ensure that uniform costing standards and controls are applied to any budget information or documentation that is to be released.
- Estimate performance will be re-assessed and reviewed at all funding approval points. This is to ensure that the incurred actual project costs are neither significantly over and above the originally estimated total project cost, nor significantly under the estimated cost at any given stage of the project life cycle.

The aforementioned estimating policy is published and available (internally) on the Portfolio Investment and Programming (PIP) SharePoint site.

2.2 Applicability

The content of this manual is scalable and allows for project managers, sponsors and customers to jointly pre-determine the level of estimating rigor and documentation required.

Individual divisions, regions and district directors are responsible for the effective application of the estimating manual to develop realistic estimates and ensure their staff, possess the necessary skills and training to undertake estimating activities.

Consultants and contractors who are developing estimates for departmental projects are also required to comply with the requirements of this manual.

2.3 Estimating rationale

Estimating is an integral part of a system of interdependent core inputs of scope, time, risk, cost and quality.

The department's estimating rationale is that cost estimating must be exercised in the broader context of the project and program management framework to provide assurance that estimate values are continually dependable.

This manual recognises that projects are inherently uncertain and, that irrespective of the stage of a project, that there will be incomplete or sometimes unavailable project scope information on which to base the project estimate.

The manual aims to establish a set of defined project parameters and includes strategies and procedures on how to undertake the departmental risk management process, and to allocate contingencies as well as convey meaningful information concerning the reliability of the figures provided.

Estimate reliability will progressively improve throughout the project life cycle as a result of the systematic review and associated approval processes as outlined within the following performance standards.

2.4 Performance standards and measurement

Historically for most projects, the base estimate increases as the project moves through various phases. This can cause some disruption to the overall funding process and also potentially result in budget shortfalls, whilst also causing delays to the commencement of other priority projects in the program.

The overall performance of estimates can only be duly assessed at project finalisation stage. The variation of estimates at each phase, as a percentage of the total project cost, is expected to fall within the ranges shown in Table 2.4.

This table is also represented diagrammatically as a cone of accuracy in the Figure 2.4(a) to Figure 2.4(c) (extracted from the federal *Best Practice Cost Estimation Standard for Publicly Funded Road and Rail Construction*, May 2011).

The expectation is that individual project estimates, prepared progressively from business case forward to have a 90% confidence factor (P90) of not being exceeded at completion.

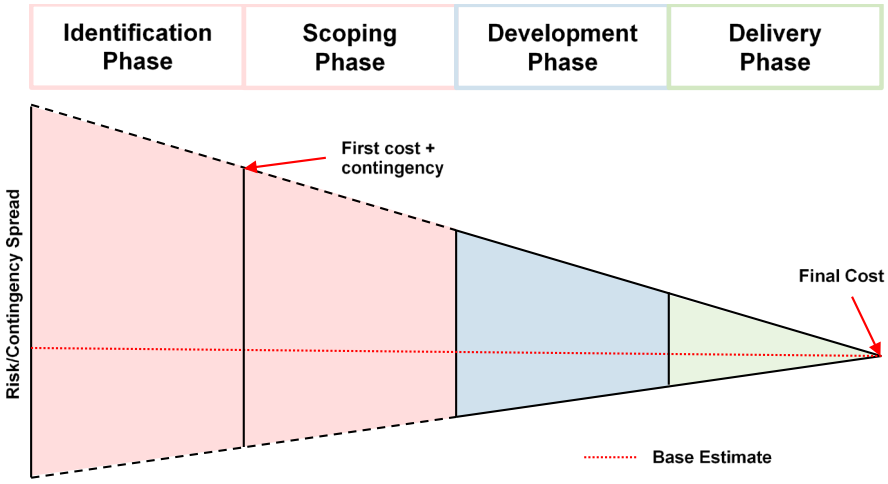
Table 2.4 - Cost estimate performance standard (measured in finalisation phase)

Project phase	Cost estimate document	Percentage variance of completed project cost	
		Lower	Upper
Concept	Business case	-15%	+20%
Development	Stage 1 design	-10%	+15%
Development	Stage 2 design	-5%	+10%
Implementation	Construction	-2.5%	+5%

Since pre-project or strategic estimates are usually developed from project scopes that were not well defined or with minimum information, greater care needs to be exercised in publishing such estimate figures.

The percentage ranges for these types of estimates are indicative only and must be viewed against the context of the background information upon which they are developed.

Figure 2.4(a) - The ideal project cost history



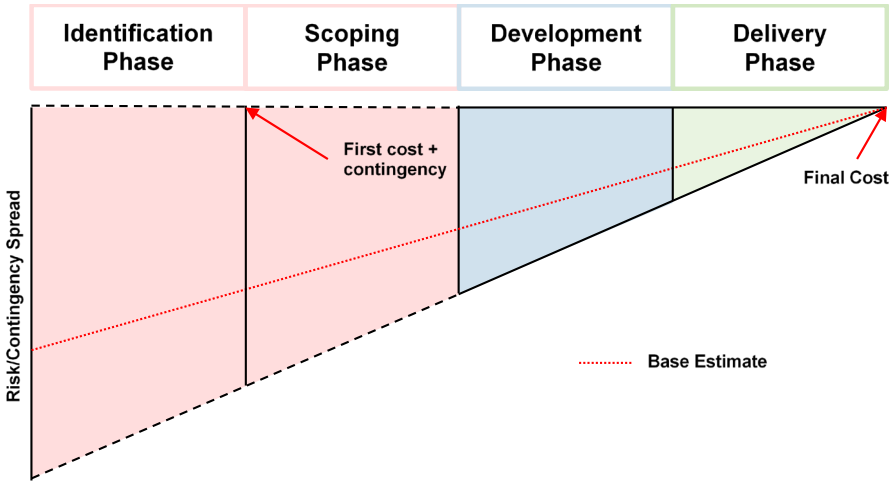
An **'ideal'** project where the **final cost is the first cost excluding contingency**
= a project where the net cost of anticipated risk and contingent items was nil and there were no net cost changes

An 'ideal' project, shown in Figure 2.4(a), is where the final cost is equal to the first cost, excluding contingencies.

An 'acceptable project, Figure 2.4(b), is where the 'final cost' includes, but does not exceed these original contingency estimates. However, not all projects proceed in this way.

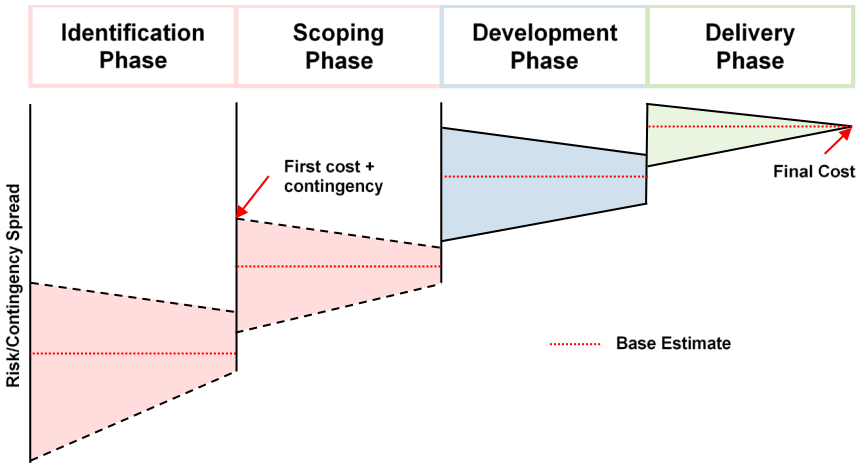
Figure 2.4(c) shows an 'unacceptable' cost history where the base estimates and contingencies are being continually revised upwards.

Figure 2.4(b) - An acceptable project cost history



An **'acceptable'** project where the **final cost doesn't exceed the first cost excluding contingency**
= a project where all the risks and contingent items occurred or where net changes were absorbed within the risk and contingency allowance

Figure 2.4(c) - An unacceptable project cost history



A project where the **final cost is well above the first cost excluding contingency**
= *a project where there was either or a combination of:*
- *extra risks eventuated above those anticipated*
- *extra cost changes occurred plus all the anticipated risks eventuated*
- *excessive cost changes occurred even though risks were less costly than anticipated*

Cost estimates change over time, and for a variety of reasons, not all of which are desirable. Adjustments to estimates are usually caused by changes to scope, assumptions, pricing adjustments, contingencies, escalations and so on.

Performance against these standards shall be reviewed in the finalisation phase of the project.

As these standards are lag indicators, regions and districts of the department may wish to adopt other measures to indicate whether their estimates are under control at any particular time. Variance from previous stage estimates may be one such measure.

The estimating performance of the regions and districts will be continuously reviewed to assess and determine estimate consistency, accuracy and possible identified training needs.

These findings will be reported internally to the General Manager (Portfolio Investment and Programming), General Manager (Program Delivery and Operations), and to the appropriate Regional or District Director.

These measures are detailed in the current QTRIP Governance Principles.

2.5 Estimating practices

The following estimating practices are used in the department for supporting the estimating processes referred to in Section 4.1.

2.5.1 Practices for developing base estimate

The project scope is a significant factor in the reliability of any cost estimate. As such, the estimator should endeavour to clearly identify the scope of works before commencing the estimate.

All works for transport infrastructure projects must be categorised based on asset class defined in the department's *Transport Infrastructure Asset Management Policy*. All transport infrastructure asset classes are covered by this policy including; roads, road structures, busways, light rail systems, active transport infrastructure and maritime infrastructure.

A Work Breakdown Structure (WBS) is to be prepared with the project manager and then quantities, costs and/or rates assigned to each relevant item. This will deliver a Base Estimate that includes Contractor and Principal costs.

Estimators should ensure that costs are included for all activities during the life of the project, down to at least Level 3 of the standard project WBS.

For projects which are not covered under OnQ, the procedures prescribed by the funding source or process (for example, nationally funded projects, PAF projects) are to be followed.

For non-road projects, the appropriate WBS and factors should be used for that particular infrastructure type – refer to Section 11 for more details.

Where historical unit rates are used (see Section 9.1), they must be based on the rates of projects which are similar in nature, and the rates should also be adequately factored to establish their currency, relevance or appropriateness for use within the project estimate, including other considerations such as:

- age of the rates
- changes to prevailing market conditions
- departmental requirements
- on-and-off site overheads and profit
- variations in constructability, methodology and project delivery method, and
- location and updated site conditions and so on.

Estimators should ensure that CapEx/OpEx classification is considered for all estimates in collaboration with the relevant project manager to ensure compliance with the policy requirement. The CapEX/OpEX classification should be considered at the strategic level of the estimating process and be continued on throughout the entire project life cycle.

Each estimate shall be presented using the standard estimate structure format and have an estimate report that incorporates the scope definition and assumptions on which the estimate has been based.

Estimates are to be presented in outturn dollars as described in Section 3.1 which is an estimate of what the total cost of the project would turn out to be at completion.

Projects that are funded under the Australian Government funding and state-funded major projects must use the Project Cost Breakdown (PCB) template when submitting a Project Proposal Report, to forecast costs and to collect internal project benchmarking information. The PCB Template can be found in the PIP SharePoint and relevant website of the department.

Projects seeking Australian Government funding approval up to $7.5M with total estimated costs not exceeding $25M must use the Small Road Proposal Report Template to submit cost proposal information. Refer to Project Proposal Report Template provided in *Notes on Administration for Land Transport Infrastructure Projects 2019-2024* for more information.

Estimates must be updated and captured in the 3PCM system at every gating approval. Such estimates also require undergoing an electronic approval process. The estimating lessons learnt are to be captured in the learnings register for subsequent use in the project manager's completion report and to facilitate subsequent benchmarking.

2.5.2 Practices connected with risk assessment

In all instances the project manager is responsible for developing a high confidence-level estimate for the project, ensuring the overall completeness and robustness of the estimate in accordance with the project estimate structure outlined in Figure 3.1(a).

As the base estimate is being developed, a risk register should also be developed with risks associated with the project. It is important to consider all the risks that are raised at the risk workshops in the risk register. Such discussions may trigger additional ideas and options leading to strategies that will minimise risks and/or create opportunities.

The estimator must develop a compliant risk register for all transport infrastructure projects. To seek Australian Government funding, the estimate is submitted in the appropriate federal format.

Note: Where strategic estimates or planning estimates are prepared, they should not be expressed as having any form of confidence level (that is, not to be expressed as 'P'. Therefore, such estimates should not be published.

The department recommends the following risk evaluation approach (project type definitions are given in Section 2.6.5.2) for developing cost estimates:

- **Major Projects (which refer to PAF framework)**, a quantitative approach must be used for risk assessment and probabilistic methods for risk evaluation. This approach models individual risks, to provide greater levels of certainty and confidence about the likelihood and impact they will have.
- **OnQ Type 1 and Type 2 (large) projects** are expected to undergo a quantitative approach to risk assessment and probabilistic methods for risk evaluation.
- **OnQ Type 3 projects** will generally undergo a qualitative approach for risk assessment. However, the actual costs of the project at completion still should meet the criteria of 90% likelihood of not being greater than the estimate.
- For projects that are funded by the Australian Government with a total anticipated Outturn P90 cost (including contingency) exceeding $25M the probabilistic risk evaluation process must be used. For projects with a total anticipated Outturn P90 cost (including contingency) under $25M may use a deterministic methodology, however the Australian Government recommends using a probabilistic cost estimation method where possible (refer to notes on Administration for Land Transport Infrastructure Projects 2019-2024 for more information).

Traditionally a P90 estimate is prepared using a quantitative approach which employs probabilistic tools, techniques, templates and specialist such as @Risk for risk evaluation. For nationally funded projects, the Australian Government requires submission of the supporting @Risk files such as probability distributions, simulation details, Tornado diagrams, and summary statistics at 5% intervals from 5% to 95% for review purposes.

Where a qualitative approach can be used, the estimator draws upon ‘softer’ skills such as previous experience, stakeholder engagement, problem solving and a common-sense review by appropriate personnel.

This process is heavily reliant on the project team’s experience and aims to develop a project budget that is unlikely to be exceeded but is not excessively conservative.

2.5.3 Practices connected with contingency development

The department requires an appropriate contingency to be developed based on the risks associated with the project. This is particularly important in the early project stages where project information is unavailable. To achieve the appropriate level of confidence for all these project types, the estimator should reflect on the following factors:

- The estimate has had a peer review by a suitably experienced and qualified person.
- The TMR Risk Management Framework has been used to identify, analyse, mitigate, record, assess and apportion the risk value, when estimating the cost of risk and contingency.
- The overall value of risk apportioned to the project must also reflect the extent of completed design development, survey and geotechnical data, and
- The project's objectives and the scope, including the projects physical configuration and extent, are clearly documented and acceptable to the customer. The Australian Government requires contingency management of funds between P50 and P90 values.

2.5.4 Practices connected with cashflow and escalation

Project cashflow should be presented with all cost estimates prepared for QTRIP projects. The estimated cashflow for each financial year should 'align' with the approved budget distribution over the duration of the project. The program of works may be used to generate cashflows.

The Cashflow sheet in 3PCM solution provides the opportunity for estimators to build project cashflow and to apply corresponding escalation rates to yearly cashflow. Alternatively, estimators can use the Estimation Calculator given in Annexure H of this manual.

To convert the estimate to outturn costs, the estimator must apply escalation rates to the cashflow. The department releases annual updates to the escalation rates informed by the Australian Government.

The project forecast needs to best represent the expenditure flow for the anticipated delivery of the project and the cashflow associated with the project needs regular reviewing and updating throughout the project delivery process.

2.6 Related policies, standards and frameworks

The key operational policies in the department relating to compliance of investment programs are itemised below with descriptions given in the ensuing sections:

- Transport and Main Road's Infrastructure Asset Accounting Policy and Guidance
- Transport Infrastructure Portfolio
- Portfolio Management Framework
- OnQ Project Management Framework
- Project Assessment Framework (PAF) for major projects
- Queensland Transport and Roads Investment Program (QTRIP)- including the QTRIP Savings Management Policy
- Integrating, portfolio, program and OnQ frameworks with QTRIP

- Portfolio, Program, Project and Contract Management (3PCM) system, and
- Project and Contract management process in the 3PCM system.

This manual also references other key departmental policies, standards and frameworks including:

- *Network Optimisation Framework*
- *Cycling Infrastructure Policy*
- *Managed Motorways Policy*
- *Road Safety Policy*
- *Accessibility Policy*
- *Sustainability Assessment,* and
- *Transport Infrastructure Asset Management Policy*.

The department supports Queensland Government priorities and objectives and develops these into investment strategies that are based on the state's strategic transport needs.

Identifying and funding the highest priority works and managing them through an efficient transport portfolio of work is critical to realising the benefit outcomes that each project is designed to deliver to the community.

The *QTRIP Savings Management Policy* ensures transparency in the identification and management of project savings.

Portfolio, program and project management processes all rely on sound strategic estimates, project cost estimates and cost control measures, to ensure decision integrity in relation to conformance with government priorities, project justification and authorisations, and operation of transport infrastructure programming.

2.6.1 Transport and Main Roads Infrastructure asset accounting policy and guidance

Cost estimate items for each QTRIP project requires classifying into capital (CapEx) and operating (OpEx) expenditure, before being presented for budgetary approvals, as per the Transport and Main Roads *Infrastructure Asset Accounting Policy*. Queensland Treasury defines the CapEx and OpEx costs in the Non-Current Asset Policies for Queensland Public Sector.

Capital expenditure (CapEx) is defined as valid costs related to an asset (for example, road infrastructure construction) which are, therefore, capitalised. These costs incurred in enhancements or upgrades or condition improvements to an asset or component, which improve the asset beyond its current standard of performance or capacity or life.

Operating expenditure (OpEx) is defined as maintaining the Transport and Main Roads asset in a serviceable and safe state within its original function, without improvements, upgrades or life extension. This includes repairs to damage or wear and tear that would have prevented the asset reaching its current planned useful life.

In addition:

- all expenditure incurred prior to business case approval must be recorded as OpEx
- all expenditure on project finalisation activities must be recorded as OpEx, and

- all expenditure on third party assets such as Public Utility Plant (PUP) and local government assets must be recorded as OpEx.

Further information can be obtained from the *Cost Classification for Transport Infrastructure Projects – September 2020 Guideline*.

2.6.2 Transport infrastructure portfolio

For projects managers who need to ensure project governance arrangements are adopted, it is important they understand whether their project is within the scope of the Transport Infrastructure Portfolio (TIP) and TIP governance arrangements.

The department's Transport Infrastructure Portfolio (TIP) contains thousands of projects and candidate investments over ten years, with investments ranging from very small (less than $1M) to the very large (greater than $1 billion) as diverse as road, rail, air and sea. The scope of the TIP is investment in:

- transport planning and policy studies with significant cost and asset implications
- maintenance, preservation and operation of the existing transport infrastructure assets
- new transport infrastructure assets
- initiatives relevant to the management of existing and future transport corridors, including managed motorways and transport corridor acquisitions.

2.6.3 Portfolio management framework

The department manages most of its projects within programs of work. Each project is required to identify its estimated total project cost and the estimated next stage costs to the program manager for approval, funding and inclusion in their program.

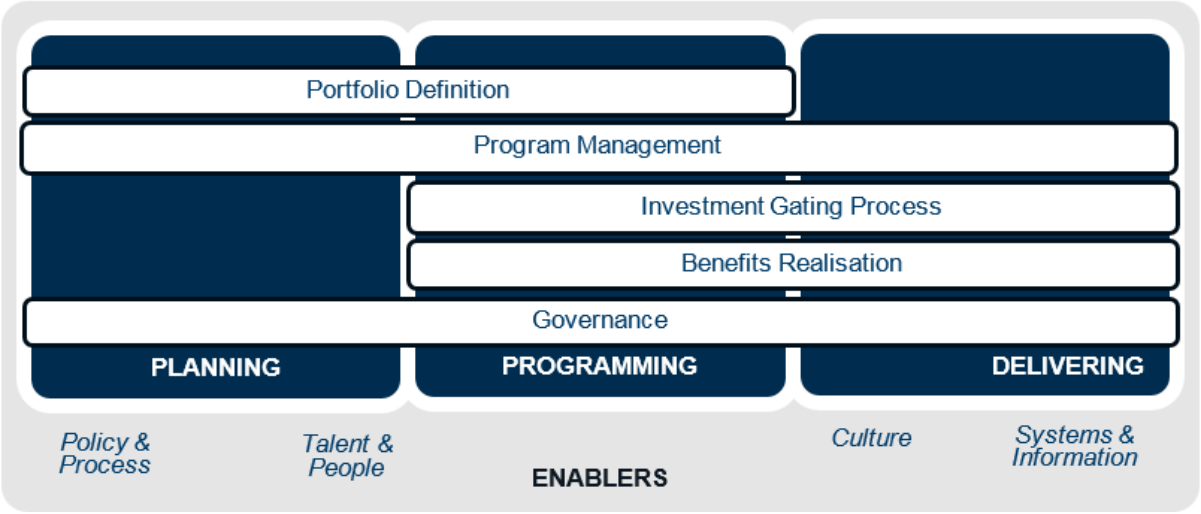
The department's approach to transport infrastructure investment is supported by a robust portfolio management framework that draws together 'best management practice thinking', and department tried and tested processes.

The framework can be distilled to five components:

- portfolio definition
- program management
- investment gating process
- benefits realisation, and
- governance.

These span the pillars of planning, programming and delivery, and are supported by enablers including policy and processes, talent and people, culture and systems, and information.

Figure 2.6.3 - Portfolio management framework



2.6.4 OnQ project management framework

Successful project management is characterised by good planning, effective scoping and resourcing, realistic expectations of outcomes and strong management support.

The higher the level of complexity within projects, the higher the need becomes to have rigour applied through the adoption and use of effective project management methodologies.

OnQ is the project management framework used and maintained by the department to direct and guide effective project management practice.

The framework has a methodology that consists of five sequential phases:

- strategic
- concept
- development
- implementation, and
- finalisation.

OnQ provides structured guidance concerning processes and documents used to progress a project from concept to finalisation, considering the project's complexity and inherent project risk profile.

This concept phase includes project proposal, options analysis and business case stages.

2.6.4.1 OnQ and estimating

Estimates will be developed throughout the life cycle of a project (from concept through to finalisation) in support of management needs.

Pre-project and strategic estimates are to be in current dollar values and dated accordingly. Projects contesting to enter the QTRIP are required to have estimates in outturn dollars showing the base cost, as well as pessimistic and most likely values.

The confidence that estimators have in the estimate values are to be portrayed by a confidence index rating (refer Section 7.4.2) which captures in broad terms the project's scope, maturity, data available and time provided / available to produce the estimate.

Estimate documents and stages align with the project phases as shown in Table 2.6.4.2(b). It should be noted that many other estimates are also generated during project delivery process.

Whilst only those estimates on which approvals are generally based have been shown, it can also be noted that project and estimate stages align, except that there is an additional estimate stage 'Procurement' within the project development phase, and at the end of the development phase, at Stage 2 Design (S2D).

The estimated total project cost must be updated whenever a project advances to the approval stage.

2.6.4.2 OnQ project types

The OnQ framework classifies projects into three types to standardise the management of various projects depending on the project complexity and risk as detailed in the Table 2.6.4.2(a).

It considers familiarity with the project (how often the department delivers this type of project), whether the scope is simple and apparent, how sensitive the project is to external influences, the funding levels required and so on.

Table 2.6.4.2(a) - Project types

Type 1 project	Complex / high or extreme risk transport infrastructure projects, requiring higher levels of investigation, rigor and control.
Type 2 project	Straight forward / medium risk transport infrastructure projects, requiring moderate levels of investigation, rigor and control.
Type 3 project	Simple / low risk transport infrastructure projects, requiring lower levels of investigation, rigor and control.

Other project types commonly used in the department are:

Major projects – Complex / high or extreme risk transport infrastructure projects greater than $100M. These projects are required to comply with the Project Assessment Framework (PAF).

Queensland Road System Performance Plan (QRSPP) projects – smaller-scale works on the state-controlled road network covering Maintenance, Preservation and Environment (MPE), Road Operations (RO) and investment groups have simplified for these projects. Similarly, the Australian Government has exemptions for maintenance projects under the *National Land Transport Act* 2014. The cost code structure for QRSPP projects are simplified to either CapEx or OpEx category.

Table 2.6.4.2(b) – Estimate requirements in different phases of various project types

OnQ				PAF		Federal		CapEX / OpEX
Phase	Estimate		Estimate Type	Phase	Estimate Type	Phase	Estimate Type	
	Type 1 & 2	Type 3						
Strategic planning / pre-project	Strategic planning					Identification phase	Indicative total project P50 & P90 as out-turned and non-outturned costs, for project approval process.	OpEX
Concept phase	Project proposal			Strategic Assessment of Service Requirements (SASR)		Scoping phase	Detailed project P50 & P90 as out-turned and non-outturned costs, for project approval process. Actual costs for previous phases.	OpEX
	Options analysis (P50 and P90>$50M only)			Preliminary evaluation	P50 & P90			OpEX
	Business case	Business case /Type 3 scope identification	P50 and P90	Business case	P50 & P90			OpEX
Development phase	Stage 2 design		P75 for >$25M (for APV)	Supply strategy development / source suppliers	P75 (for APV)	Development phase	Detailed P50 & P90 as out-turned and non-outturned costs, for project approval process. Actual costs for previous phases.	CapEX /OpEX
Implementation phase	Construction activities		Regular updates to cost estimates, forecasts and contract variations	Establish service capability / deliver service	Regular updates to cost estimates, forecasts and contract variations	Delivery phase	Actual costs for previous phases (if undertaken), an estimate for the Delivery phase in PPR as a part of the overall cost, and for post procurement / cost schedule update.	CapEX /OpEX
Finalisation phase	Handover, review and close out		Actual costs and residual property related costs	Endorsement of project closing	Actual costs and residual property related costs	Post completion phase	Actual costs and residual property related costs + post completion report with Project Cost Breakdown Template.	OpEX

2.6.5 Project Assessment Framework (PAF) - major projects

Project Assessment Framework (PAF) is used across the Queensland Government to ensure a common, rigorous approach to assessing projects at critical stages in their lifecycle, from the initial assessment of the service required, through to delivery. The PAF's application is not limited to infrastructure projects or public private partnership (PPP) projects. PAF is a whole-of-government project assessment process that establishes a common approach to assessing projects at critical stages in their lifecycle. Its aim is to maximise the benefits returned to government from project investments.

The PAF requirements are applicable for projects with a value over $100M and/or projects that have a high level of risk and complexity. The Project Evaluation unit within PIP assists project owners to implement PAF requirements and is available to manage the documentation, financial / commercial and economic requirements of the PAF for project owners.

The use of investment gating has been mandated within the department for the Transport Infrastructure Portfolio (TIP) to guide decision-making across the life cycle of complex and high risk projects.

Project managers are required to ensure the gating process provides independent guidance and assurance that a project is attractive, achievable and affordable in delivering its perceived or desired performance benefits and aligned with the department's strategic objectives.

It also provides assurance at each stage of the life cycle that the project is on target to meet specified deliverables and realise intended outcomes and benefits.

The department aims to improve infrastructure investment governance using an investment prioritisation framework, which focuses on ensuring consistent delivery of programs aligned with strategic priorities, and clear responsibility and decision-making processes to enable investment choices. Refer the PAF in the department's webpage for more information.

2.6.5.1 Major project gating

The Major Project Gating process applies to projects with an estimated capital expenditure of $100M or more, or project with significant risk and/or complexity.

Project Owners should confirm governance arrangements for business cases for major projects with the department's Project Evaluation Unit within PIP for Queensland Treasury, Department of Infrastructure, Transport, Regional Development and Communications (DITRDC), and for Infrastructure Australia (for projects with total project cost above $250M).

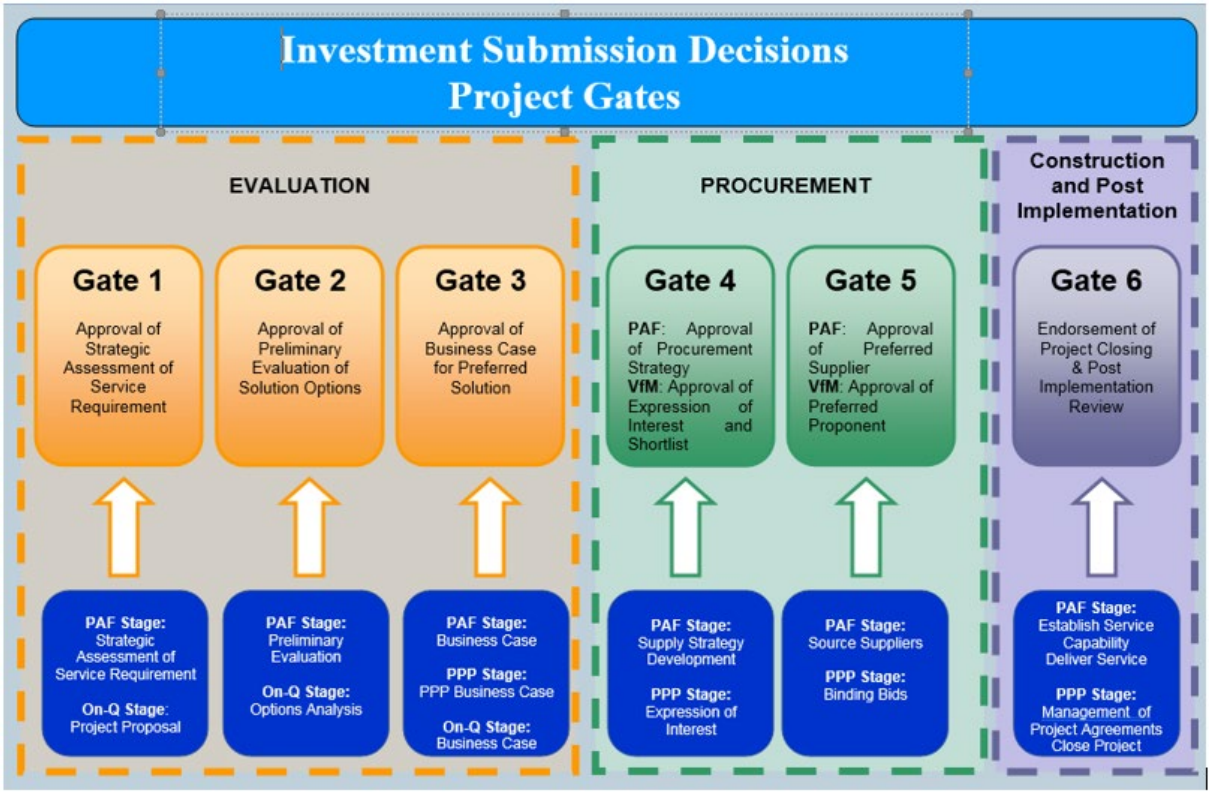
Initiatives falling within this category require preparation of gating submission, attaching a project deliverable PAF report relevant to the gating phase, for consideration and approval.

An independently conducted assurance review of the report, coordinated through PIP, is also used to guide for evaluation. The use of project gating informs decision making across the lifecycle of major projects.

Initiatives falling within this category will require preparation of a gating submission for consideration and approval and each appropriate gate.

The department's major project gating process outlined in Figure 2.6.8 aligns with PAF and incorporates elements of the Value for Money (VfM) Framework, and how Public Private Partnership is considered in line with the National Public Private Partnership Guidelines.

Figure 2.6.5.1 - Projects gating process model



2.6.5.2 Non-major project gating

OnQ Type 1 project gating process applies to projects with an estimated capital expenditure between $50M and less than $100M, or those of significant risk and/or complexity below this financial threshold. *Note: Project Owners should confirm governance arrangements for business cases for OnQ Type 1 projects with the department's Project Evaluation Unit in the PIP Division.*

Initiatives falling within this category require preparation of a gating submission including attachment of a project deliverable OnQ report, relevant to the gating phase (project proposal, options analysis or business case), for consideration and approval by the department. The OnQ Type 1 project gating ensures the best option (fit for purpose) is identified and increased confidence for the department that projects are consistently achieving OnQ minimum standards (by completing three gating reviews) prior to an investment decision.

The OnQ project deliverable is guided by an independent assurance review of the report, undertaken by PIP's Project Evaluation Unit.

The decision authority for post-Business Case for OnQ project deliverable for $50M to less than $100M capital expenditure projects remains with District Directors in PDO. Note additional requirements apply for projects with Australian Government funding.

Figure 2.6.8 shows the relationship between the estimating function, PMF and OnQ project management methodology. Further information can be obtained from the QTRIP Governance Principles document available (internally) on the PIP SharePoint page.

2.6.6 Queensland Transport and Roads Investment Program (QTRIP)

The department plans, manages and delivers Queensland's integrated transport infrastructure, and outlines the department's current and planned investments in transport and road infrastructure over the next four years for roads, railways, active transport, marine infrastructure and public transport solutions within the Queensland Transport and Roads Investment Program document (QTRIP).

All planned TIP investments for Years 1 to 4 in the department are to be published in QTRIP each year and managed through various program and project management systems (in some instances, some investments may be marked not for publication as a line item in QTRIP) in the department.

All state-funded investments are considered to be committed if funding is allocated in Years 1 and 2 of the QTRIP and are indicative if funding is allocated in Years 3 and 4 of the QTRIP.

All Australian Government projects with committed funding as per the Federal Budget outcomes, as outlined in the National Partnership Agreement (NPA) – Queensland Schedule. Three divisions in the department play major roles in development, management and delivery of QTRIP:

- Policy, Planning and Investment (PPI) Division – defines key strategies, policies and plans for an integrated transport system.
- Infrastructure Management and Delivery (IMD) Division - facilitates the safe delivery of transport infrastructure and operations of the state road network and includes RoadTek, department's commercial business arm, responsible for infrastructure delivery and maintenance, and
- TransLink Division - manages and regulates Queensland's integrated passenger transport infrastructure network across a range of state-wide service providers and government agencies.

Other state government authorities having influence include:

- Queensland Treasury – Project Assessment Framework
- Queensland Rail - a statutory authority responsible for the operation and management of rail passenger services and rail infrastructure services, and
- Gold Coast Waterways Authority - a statutory authority managing the development and use of Gold Coast waterways, (including rivers, canals, lakes and dams), as well as areas at the mouth of the Nerang River, Currumbin Creek and Tallebudgera Creek.

2.6.7 QTRIP Savings management policy

The *QTRIP Contingency and Savings Management Policy* provides a transparent and repeatable framework for the identification, management and reporting of project contingency and savings.

The policy outlines the principles, roles, business rules and decision-making arrangements associated with the governance, management, utilisation and re-allocation of project contingency and savings across TIP.

The policy applies to:

- projects with a total budget equal to or greater than $10M with budget in Years 1 and/or 2, or unspent budget in prior years

- all projects within the following investment groups - state planning program, Bruce Highway upgrades, national land transport network upgrades, state road network upgrades, maritime, rail infrastructure improvements
- all projects within the following investment groups (except for local government grants) - Active Transport, Targeted Road Safety Programs, Bus Infrastructure Improvements, and
- any other project as determined by the department.

The QTRIP Savings Management Policy is based on the concept of Approved Project Delivery Value (APDV) which is used to report the project performance.

Please refer to the Section 5.4.4 and the *QTRIP Savings Management Policy* available internally on the PIP SharePoint page for more information.

Australian Government Savings Management Policy

For federally funded approved Projects listed in the federal NPA schedule (with exception of maintenance and Blackspot Projects), when a major component of the work is awarded to a contractor, the department must inform the Australian Government (DITRDC) of the agreed contract price, including contingency and escalation factors, and provide an updated overall Project Cost estimate (including Base Estimate, P50 and P90 Project Estimates and P50 and P90 Outturn Costs).

For Projects with an Australian Government funding commitment of $100M or above, DITRDC may undertake a formal cost estimation review following award of the major construction contract. Where it has been determined that the project can be delivered for lower than the original estimate based on the contract price, DITRDC may, in consultation with the department, adjust its allocation to reflect the updated estimated cost. Any federal funding savings identified are reviewed jointly between PIP division of the department and the Australian Government.

2.6.8 Integrating portfolio, program and OnQ frameworks with QTRIP

Production of robust project estimation does not occur in isolation of the project's Investment Program (or program of work) and estimators must coordinate with the respective program to ensure effective control of available funding. From those projects considered worthy of further investigation, strategic level estimates are created to enable prioritisation in line with investment strategy. Program development further refines the identified priority projects and its schedule in a program of works.

The department's 10 Year Investment Plan outlines the department's strategic investment direction across the portfolio and its programs (Investment Programs). Decisions must be made on how limited funding can be deployed to best effect across programs. Projects seeking to progress onto the QTRIP need to be identified within one of the portfolio's 15 Investment Programs.

As the construction commencement date for each project draws closer, an options analysis and business case are completed prior to entering the funded years of the QTRIP.

Estimating activities provide key inputs into the development of the project proposal, options analysis and business case.

During the program delivery phase, projects progress from their OnQ business case through tendering to preparation and implementation of their project plans.

Estimating activities provide significant input to the business case, as well as Development Phase Stage 1 Design (S1D), Development Phase Stage 2 Design (S2D) and Estimates for Comparison with Tenders (EFCT).

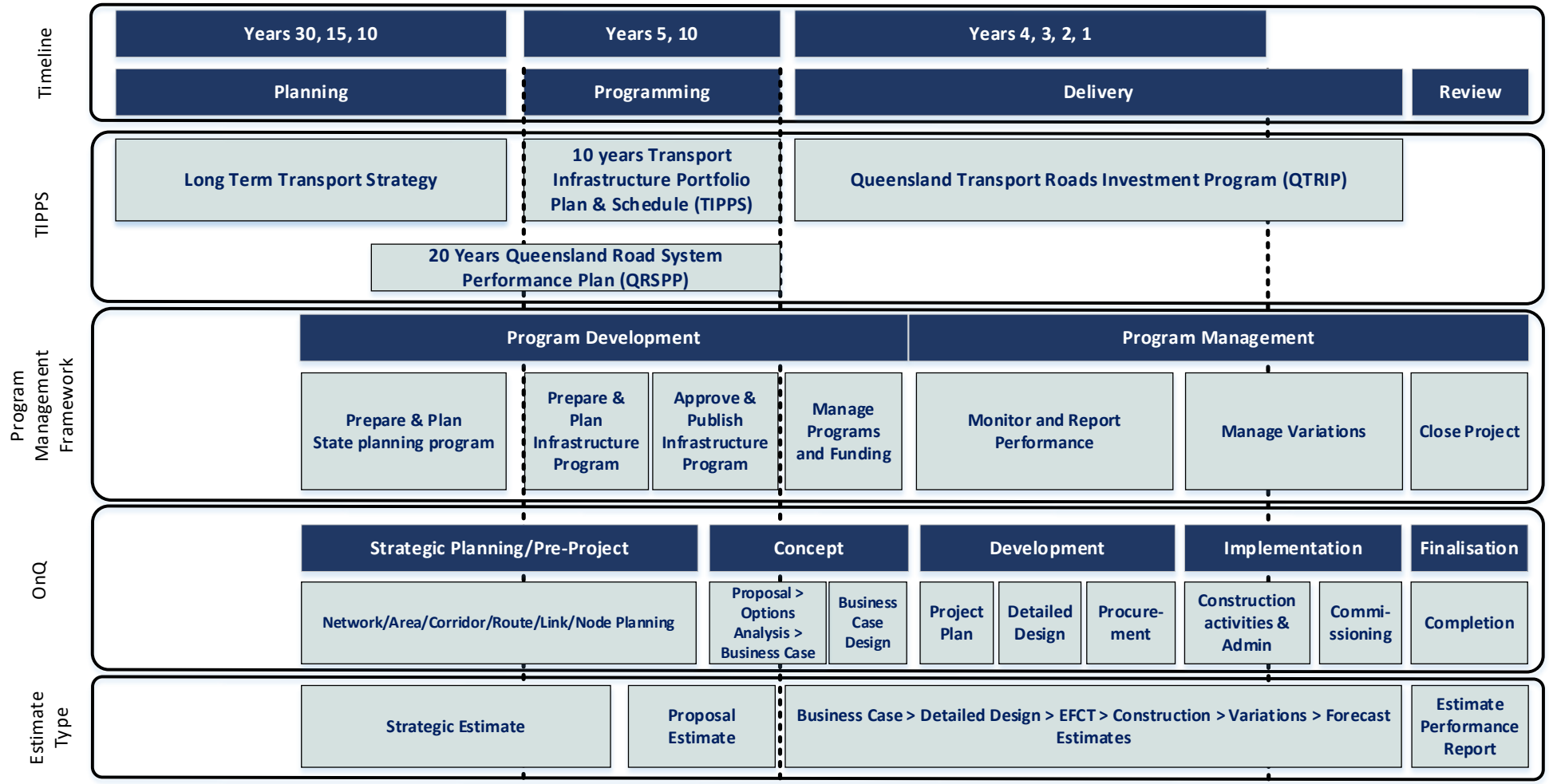
These estimates are used to update the program on current and expected future commitments.

The QTRIP has the following significant business rules for program development and management:

- approved project proposal is required prior to the project being included in Years 3 and 4 of QTRIP
- approved business case is required prior to entering the ‘approved’ Years 1 or 2 of the QTRIP.

Figure 2.6.8 below shows the relationship between the estimating function, the portfolio / program phases and OnQ project management methodology.

Figure 2.6.8 - Relationship between program and project management



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2.6.9 Implementing Transport BPIC requirements for QTRIP projects over $100M

The Queensland Government through the *Queensland Procurement Policy* is committed to maximising benefits for Queenslanders by using procurement to support local jobs and businesses to drive economic, environmental and social outcomes. This includes ensuring quality, safe workplaces for people engaged on major state government projects, through the implementation of Best Practice Principles (BPPs), in accordance with guidance issued by the Department of Energy and Public Works and the Office of Industrial Relations.

The BPPs, as outlined below, apply to major projects of $100M and above and will be evaluated as part of the value for money assessment process and include the following principles:

- workplace health and safety systems and standards
- commitment apprentices and trainees
- best practice industrial relations.

Transport and Main Roads supports the Queensland Government's priorities to improve matters such as employment conditions, safety and training opportunities for the transport civil construction industry and ensure the industry is, and remains sustainable, safe and progressive.

Given the substantial investment by the Queensland Government in relation to QTRIP, the department has developed a guidance document entitled *Best Practice Industry Conditions for Transport Civil Construction Projects* (Transport BPIC). In developing the Transport BPIC in consultation with stakeholders, relevant enterprise agreements, awards and legislation to the transport civil construction industry were analysed to ensure the guidance document reflects modern and progressive industrial practices for the civil construction industry.

The Transport BPIC is a guidance document that may assist projects attract and retain a workforce with optimal levels of skills and experience and promote positive, collaborative and productive interactions with relevant stakeholders through to successful project completion.

The cost estimates prepared for projects with a project value of over $100M need to consider the potential cost impacts of implementing the Transport BPIC. The factors affecting the Transport BPIC include an uplift in labour rate costs through more favourable wage rates and employee entitlements compared to current labour costs on transport civil construction projects.

The BPIC is a guidance document and is not mandatory. The costs for implementing the Transport BPIC will be variable and as such, need be calculated on a project-by-project basis. The costs associated with implementing the Transport BPIC are to be presented in the cost estimate, including the assumptions and methodology used to calculate them.

For further information about the Transport BPIC, including a presentation and frequently asked questions, please email collaborativecontracting@tmr.qld.gov.au.

2.6.10 Portfolio, Program, Project and Contract Management (3PCM) system

The Portfolio, Program, Project and Contract Management (3PCM) project was introduced to improve the systems and processes used to plan, manage and deliver the Transport Infrastructure Portfolio (TIP).

The 3PCM system consists of a suite of Oracle products including Oracle Primavera Portfolio Management, Oracle Primavera Unifier and Oracle Primavera P6. There are also some ancillary applications that support the generation of reports and the storage of files:

- Oracle Primavera Portfolio Management OPPM is used for investment prioritisation, planning investment programs, evaluating portfolio performance and QTRIP / Portfolio reporting
- Unifier is used to deliver projects, contracts and programs, and
- P6 is used to deliver capability that enables integrated planning and project schedules and resource management across 3PCM system.

The diagram below outlines a brief description of the proposed use of each Oracle Primavera product.

During the Implementation Phase, the activities and tool relationship will be refined.

Oracle Primavera Portfolio Management (OPPM)

OPPM – a portfolio management software used for Investment Prioritisation and Portfolio related activities including the funding and planning of investment programs, evaluating portfolio performance, QTRIP and portfolio reporting.

The core functionalities of **OPPM** within **3PCM** system are:

- investment program and sub program management
- investment prioritisation, and
- investment funding.

Oracle Primavera Unifier

Unifier - a project and contract management system which is used to enable a large proportion of delivery functionality, and also to deliver Project, Contract and Delivery Program Management functionality.

The core functionalities of **Unifier within 3PCM system** are:

- delivery program management
- project management, and
- contract management.

Oracle Primavera P6

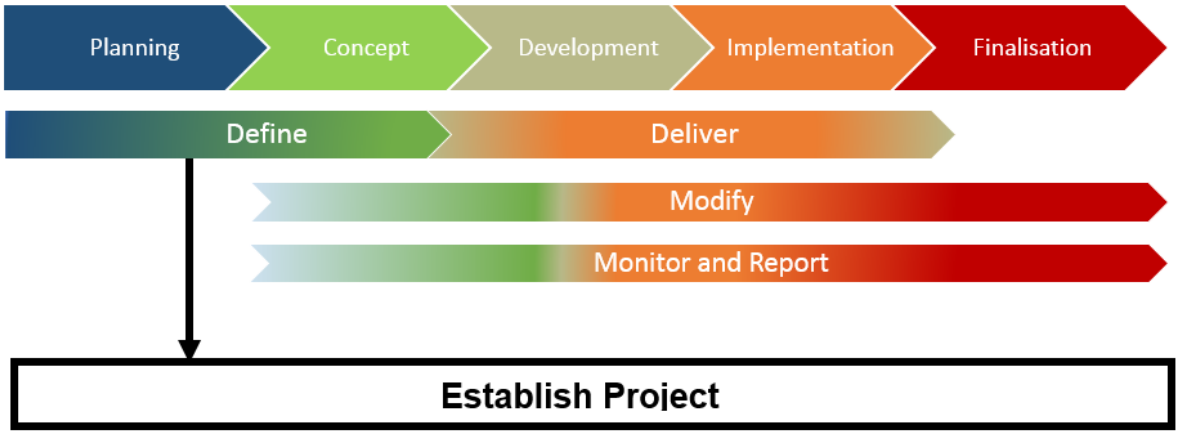
P6 - an integrated project management and work scheduling solution, used to deliver capability that will enable integrated planning, project schedule and resource management across the solution.

The core functionality of **P6 within 3PCM system** are:

- enterprise wide reporting
- data analysis, and
- dashboards.

Figure 2.6.10(a) demonstrates the alignment between the 3PCM system and the OnQ for project management methodology and the process at different project phases.

Figure 2.6.10(a) - Alignment between OnQ methodology and 3PCM Project Management process

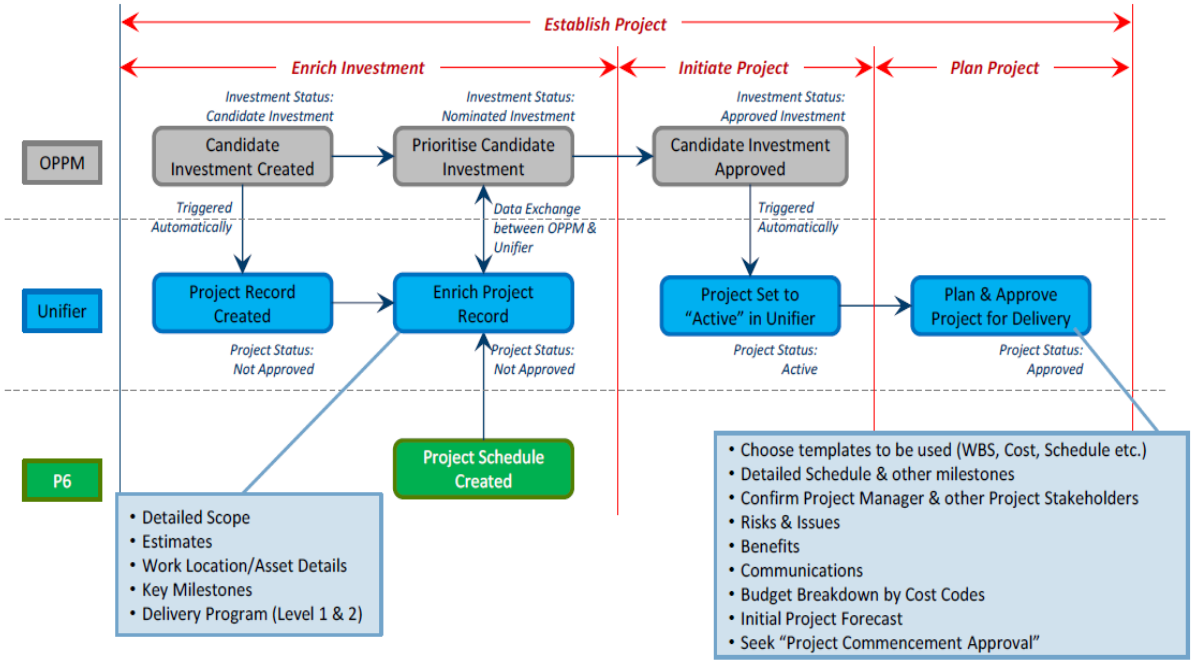


The major changes that have occurred to the planning, management and delivery of the Transport Infrastructure Portfolio (TIP) environment due to the 3PCM system introduction is shown below:

- increased automation of contract payment processing and reduction of post-processing cost reconciliation, by linking contract schedule line items to Unifier cost codes
- enable the new corporate policy / direction of splitting costs by CapEx / OpEx, and
- will use the unique, sequential project number as the new project number.

Note: Figure 2.6.10(a) demonstrates the relationship (for estimating, and alignment) between the 3PCM system and the OnQ project management methodology for the different project phases.

Figure 2.6.10(b) – High-level view of 3PCM Unifier Project Management process

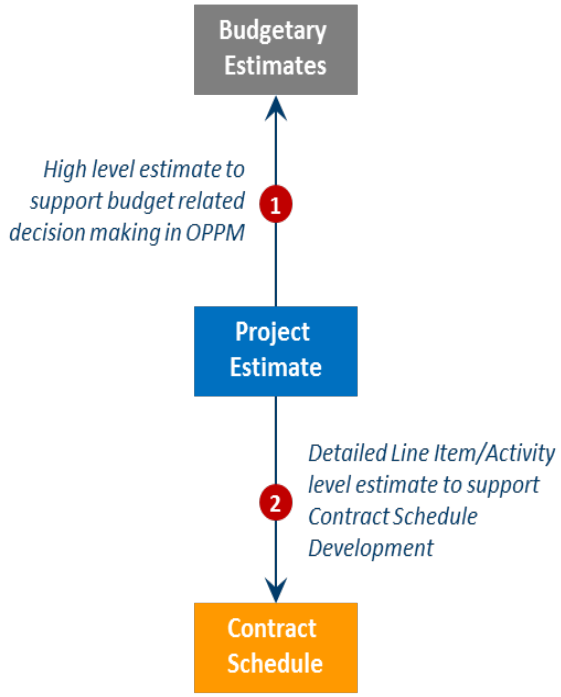


2.6.11 Cost estimating context in 3PCM system

Within 3PCM system, the high level cost estimates provide information for the budget-setting and decision-making process at OPPM level, and the detailed activity-level estimates support the tender generation and contract scheduling.

The supporting diagram below demonstrates the relationship between budget estimates, project estimates and contract schedules.

Figure 2.6.11 - Alignment between project estimates, budgets and contracts within 3PCM



The project creating process within 3PCM system generally occurs as described below:

- candidate investment for all new programs and projects is created in OPPM layer
- any additional information on the proposed investment such as detailed scope, anticipated milestones, and other important information deemed necessary is also gathered / entered, and presented along with an accompanying high-level estimate, to provide a portfolio of information for the investment approval decision, and the initiation of the project, and
- once the enrichment process for an existing candidate investment is approved within OPPM layer, that record will be closed within OPPM, and the project will then appear in the Unifier layer.

All data captured in Unifier is stored in the 3PCM data warehouse application. This includes information entered for estimates and contracts (such as tender rates for MRS items).

The stored data can be extracted using applications available in the 3PCM, such as Business Intelligence Publisher (BI Publisher) and Oracle Business Intelligence Enterprise Edition analytics tool (OBIEE).

2.6.12 Estimate template

Once cost estimates are created in 3PCM system, such estimates can be linked and generate tender prototype documents.

Cost estimates can be created in 3PCM system via two methods:

- entering estimate line items directly into the system by using the Estimate Form, or
- create estimate line items in Estimate Import Template and upload into 3PCM system later.

The method of entering estimating data directly into the 3PCM system is recommended for small estimates with less than 20 cost line items. In this method the estimators are required to possess all the information such as WBS, MRS numbers, quantity, rate and the relevant cost code for each cost line item.

To eliminate the data entry errors and to expedite the process, users can create cost estimates directly in the Estimate Import Template which contains a library of all MRP, MRS and Non-Standard work items in Excel format and in 3PCM system compatible format. This template is updated periodically to align with the tri-annual publication cycle of department's Technical Specifications (MRS and MRP).

The estimate template structure contains four levels for easy navigation across work items:

- Level One: Principal (MRP) / Construction (MRS) / Non-standard (90000 series Items)
- Level Two: Specification Suites (MRS / MRP)
- Level Three: Work Break Down Structure (WBS) (Groups within MRP or MRS Suites), and
- Level Four: Work Item IDs.

The guidance document on how to use this template to create cost estimates can be found on the internal PIP SharePoint page under Estimating.

2.6.13 Work packages

A work package is a group of tasks with a specific scope of work and are sub-components of the project. Tasks are typically grouped into work packages based on geographical area, asset class, engineering discipline, funding source or the geographical location.

Each Work Package constitutes a separate schedule of works to be completed and it is at the discretion of the estimator how many work packages are required to deliver the project and what types of work items are to be included in each work package.

Following are some examples of when and where the Work Packages are typically used in QTRIP projects:

- To separate type of work activity (for example, if a project contains a large bridge, road widening, and line marking, separate work package may be required for each component).
- To separate principal's cost and construction cost in a schedule.
- Geographical location of works of a same road (for example, Chainage 100 km to 105 km section, 150 km to 152 km section of Bruce Highway upgrade and so on), and
- To differentiate the multiple sources of funding (for example, a project may be receiving funding from element management as well as capital funding. In such situation work done under each funding component be separated by work packaging).

2.6.14 Project to contract relationship

3PCM system has the capability to manage and report on a contract that spans across multiple projects. A contract can be linked to multiple projects (and vice versa), where each project represents a different funding source. To enable such capability in 3PCM system, work packages are created in the project level and provide the linkage between contract and project modules.

Project Manager determines best way to package a contract to deliver projects based on budgets, location, scope and timing.

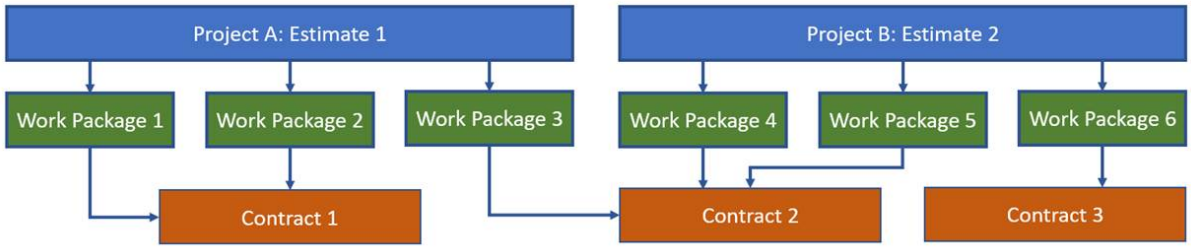
Figure 2.6.14 - provides an overview of linkage between projects and contracts.

Work packages 1 and 2 (within Project A) are delivered under Contract 1.

Work package 3 (Project A) and work packages 4, 5 and 6 (Project B) are delivered under Contract 2.

In this particular example, the Project A may be a bridge construction project, funded from the capitals works budget and the Project B may be a line marking project funded from the Element 45 budget allocation.

Figure 2.6.14 - Hierarchy of projects, work packages and contracts



2.6.15 Transport Infrastructure Portfolio Plans and Schedule (TIPPS)

The Transport Infrastructure Portfolio Plan and Schedule 10 Year Investment Plan (TIPPS) aims to translate department's policy, strategy and long-term planning outputs into a ten-year transport infrastructure portfolio investment view within an affordable funding program and outlines the choices that the department has made on transport infrastructure investments.

TIPPS also informs the annual development process for the Queensland Transport and Roads Investment Program (QTRIP) which, when published, outlines the department's planned investments on transport infrastructure over the coming four year period.

The TIPPS is part of the annual portfolio definition process and is generally finalised in the first half of each financial year whilst development of the QTRIP is generally finalised in the second half of each financial year.

Projects seeking to progress onto the QTRIP need to be identified:

- in the TIPPS within one of its fifteen investment groups
- as a priority on the State Planning Program (a subset of the TIPPS) to receive funding for project development up to business case, and
- identified as a priority for national funding.

2.6.16 Building Information Modelling (BIM)

Digital Engineering Framework is a comprehensive approach involving the generation and management of transport infrastructure assets using 3D digital representations of their physical and functional characteristics. Digital Engineering includes implementation of Building Information Modelling (BIM) technology, processes and systems throughout the infrastructure acquisition, management and operations lifecycle.

With BIM, digital data sets are created which incorporate graphical (3D Models) and non-graphical information (documents) in a shared digital space known as a Common Data Environment (CDE). The non-graphical information is linked to the graphical 3D model. For example: an object within the 3D model can provide the user information on the material type of the object, quantity, cost, and spatial location.

The use of BIM in infrastructure construction projects can improve the accuracy and reliability of cost estimates from design to construction stages. There are also benefits in terms of improved design process, reduced construction costs (from increased efficiency and reduced rework), and reduced operations and maintenance cost.

Further information on the department's Building Information Modelling can be referred to the Digital Systems Team in Infrastructure Management Division of the department.

2.6.17 TMR Accessibility and Inclusion Strategy 2020

TMR Accessibility and Inclusion Strategy

The *TMR Accessibility and Inclusion Strategy 2020* reinforces the department's commitment to providing dignified, accessible and inclusive transport that allows everyone to move easily and outlines the strategy for developing the capabilities, and guiding principles for building transport. It includes a commitment to budgeting, co-designing and engaging with the department's customers, in the infrastructure development process.

Disability Services Plan

The *TMR Disability Service Plan 2017–2020* prepared under the *Disability Services Act (Qld)* 2006 outlines how the Queensland Government will improve accessibility for people with disability or reduced mobility using the public transport system. This plan outlines the department's continued commitment to improving accessibility for people travelling to and from the transport stop, boarding and travelling.

The project managers, planners and estimators and project delivery staff must adhere to the department's commitments to the *Disability Service Plan* by incorporating the principles as part of the project's objectives when proposing infrastructure and non-infrastructure solutions. They must ensure transport infrastructure provisions have been considered and designed to comply with the requirements of the *Disability Discrimination Act* 1992 and *Disability Standards for Accessible Public Transport* 2002. Details of accessibility design principles and how they have been applied in the project design is documented in Section 1.4.3 of the Accessibility Compliance Report.

All projects must have evidence of the appropriate investigative rigor in establishing the requirements for people with disability and people with reduced mobility followed by the application of the applicable design standards and guidelines to the project deliverables.

The estimator shall incorporate costings for anticipated accessibility and mobility requirements (including where there is public transport infrastructure) and related design costs, implementation costs and sufficient risk / contingency for accessibility risks assessments.

The estimate is part of the documentation that supports an Accessibility Compliance Report used for accessibility and mobility assessments which include a disability standards consideration and provisions for whole of life equivalent standards.

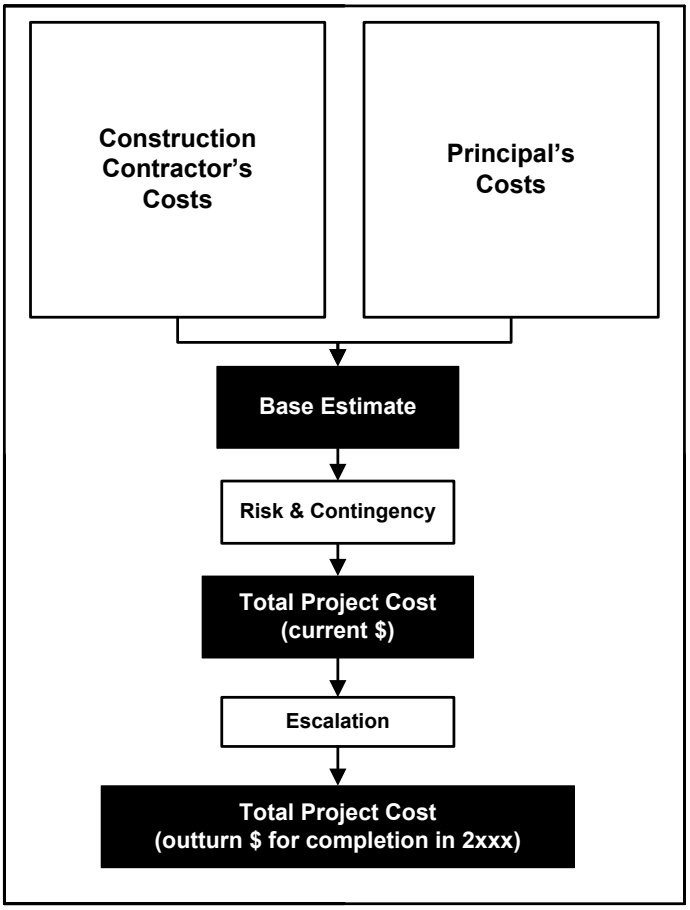
The estimate of the finalisation phase activities should include costs for adequate handover of information to the transport operators and asset managers to ensure that the identified accessibility and mobility requirements can be implemented on an ongoing basis post project completion.

3 Estimate structure

3.1 Overview

The estimate structure depicted in Figures 3.1(a) and Figure 3.1(b) highlight the two major components of every cost estimate prepared for a project. A base estimate is developed by adding the contractor's cost and principal's costs together. The risk and contingency are added to the base estimate get the total project cost.

Figure 3.1(a) - Condensed project estimate structure



Each of the following cost groups have work activities with a unique number assigned according to the standard work items detailed in the department's Technical Specifications (MRS) and principals' activities (MRP).

Construction contractor's costs

This is the cost component required to complete the tasks or activities associated with the construction elements of a project. Typically, construction costs are the costs paid to the external construction contractor, and comprise both direct costs, indirect costs and margins.

Examples of direct construction costs include the estimated cost of labour, plant, materials and specialist subcontract work required to deliver the project.

Examples of indirect construction costs include project insurances, site management and supervision.

Overheads and margins include contractor's corporate costs, business unit costs, contractors risk allowance and the profit margin.

Principal's costs

Principal's costs are those costs which the principal incurs to plan, conceptualise, develop, deliver and finalise a project for all phases of the project. These costs include project management, contract management, stakeholder consultation, property resumptions, PUP relocation, fees and levies, and principal supplied materials.

See Section 3.3 Principals Costs for more information.

Base estimate

The base estimate is the combination of estimates for contractor's and principal's costs without inherent and contingent risk values, or escalation allowances applied. It is then recorded in current dollars.

Risk and contingencies

Understanding the risk associated with the project and having a clear definition of contingency coverage is important for the successful delivery. The project team needs to assess the impact on the estimate and include an appropriate allowance in the estimate.

A contingency allowance is the measure of the residual risks that exist with the project, relative to achieving the project objectives and is expressed as a level of uncertainty or confidence.

Quantification of contingency allowances for cost items is achieved by applying the risk management processes detailed in ISO 31000:2018. Further information about managing risks can be found in Section 10 of this manual.

Risk must be managed in accordance with the TMR Risk Management Framework. Refer to Section 3.4 – Risks and Contingencies and Section 10 – Risk management and Contingency Calculation, for more detail.

Total project cost (current dollars)

Contingency added to the base estimate provides a total project cost in current dollars. It is important to record the date for current dollar values used, to retain visibility of relevance and historic estimate validity.

Escalation

Escalation is applied to project estimates to provide adequate capital funding to compensate the project for cost increases due to inflationary factors that occur during the life of the project and to express estimates in outturn dollars.

The escalation process considers a variety of local and global factors and in doing so becomes more relevant for use and inclusion in Queensland than the use of national indices. Escalated figures are applied to total project costs (current $) for each year going forward to obtain an outturn dollar value. Spreadsheet tools are available to help calculate and document escalation (Annexure H – Escalation Calculator). See Section 3.5 – Escalation for more information.

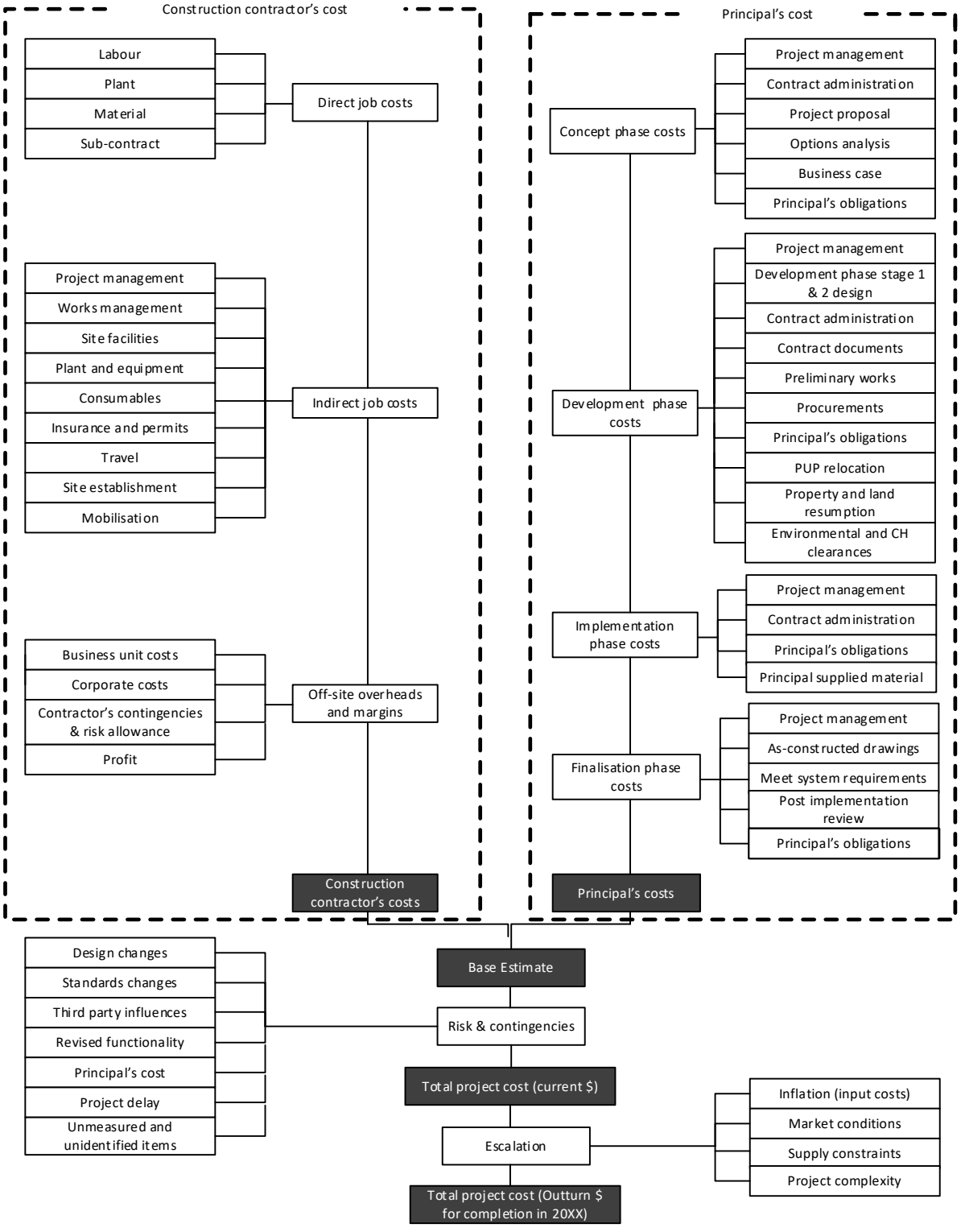
Total project cost (outturn dollars for completion in 20XX)

Total project cost in outturn dollars is used for planning and budgeting purposes. The sections below examine the major elements of the estimate structure:

- construction contractor's costs
- principal's costs
- risk and contingency allowance, and
- escalation allowance.

A more detailed version of the cost structure of a typical project is illustrated in Figure 3.1(b).

Figure 3.1(b) – Detailed project estimate structure



3.2 Construction contractor's costs

3.2.1 Direct job costs

Direct costs are those incurred / associated / involved with the actual construction and generally include the costs of materials, labour and plant and subcontractors.

To determine the direct cost of the activity, these inputs are allocated to the scheduled quantity of work according to its resource availability, production rates and unit costs.

The sum of the activity direct costs generally helps determine the direct job costs of the project.

Costs included in direct job costs are expressed in current dollar terms and are summarised in Table 3.2.1.

Table 3.2.1 - Examples of direct job costs

Components	Subcomponents
Labour	Gross wages and salaries. Award allowances (for example construction worker allowance, construction camp allowance, overtime loading, annual leave loading, site-specific allowances and severance allowances). Other associated costs such as, superannuation, training, work cover, payroll tax, personal protective equipment, labour administration support costs.
Plant	Plant hire rates for contractor's plant and plant supplied externally on a dry hire basis (that is exclusive of fuels, oils, expendables, ground engaging tools and operator), fuels, oils, consumables and ground engaging tools of plant items and transport of plant items.
Materials	Permanent material incorporated in the final works (for example supply and delivery of pavement materials, supply only of pipe and box culverts, supply of bridge expansion joints, etc.). Temporary materials not incorporated in the final works (for example traffic barriers, sheet piling, formwork, silt fences, setting-out and survey pegs, etc.).
Subcontract	Components of the work (permanent or temporary) subcontracted by the head contractor (erection of deck units, installation of sheet piling etc.), and subcontractors indirect job costs and offsite costs, subcontract plant hired on a wet hire basis (for example plant including fuels and oils, expendables, ground engaging tools and operator).

3.2.2 Indirect job costs

Indirect job costs include the allowances that contractors require included in the estimate to manage the project and cover which are not directly related the project delivery.

Estimates prepared by the department and its service providers must show specific line items for each of the indirect cost categories.

There are two ways to develop indirect costs:

- show the individual scheduled items for indirect costs separately, and
- show indirect costs as distributed through the scheduled activities, either as a uniform percentage mark-up on direct job costs or allocated to specific activities.

Contractors preparing detailed estimates for tenders normally estimate these costs using the basic cost method at the subcomponent level, as summarised in Table 3.2.2 below.

Table 3.2.2 - Examples of contractor's on-site indirect job costs

Cost category	Component	Subcomponent
On-site indirect job cost overheads (recurring)	Project management	Project manager, project engineer, supervisors
	Works management	Administration officer, systems officers, surveyor, laboratory technician
	Site facilities	Office rentals, accommodation, photocopier, computers and software etc. Service utility charges (telephone, power, water and sewerage) Cleaning charges (office cleaning, septic pumping, refuse disposal, etc.)
	Plant and equipment	Site staff vehicles, job trucks, pumps, generators, floating plant and loose tools
	Consumables	Stationery, miscellaneous materials
	Insurance and permits	Queensland Government and local government permit fees, insurances required by the contractor, bank guarantees and financial charges
	Travel	Travel costs not included in wages and salaries
	Site establishment	Transport and erection / construction of site facilities
On-site overheads indirect job costs (fixed)	Mobilisation	Mobilisation, site offices and amenities for contractor, principal's team and in some cases, subcontractors

3.2.3 Off-site overheads and margin

Off-site indirect costs, often referred to as off-site overheads are summarised in Table 3.2.3 are the costs inherent in the performing of an operation which cannot be charged or identified with a part of the work item, and therefore, must be allocated as a business expense independent of the volume of production.

Table 3.2.3 - Examples of contractor's off-site indirect job costs

Cost Category	Component	Subcomponent
Off-site indirect job costs, corporate overheads (recurring)	Business unit costs	Local area costs associated with the management of operations, finance, human resources and business systems
	Corporate costs	Costs associated with contract administration, business development, finance, human resources, technical and contract advice
Off-site allowances (fixed)	Contractor's contingencies and risk allowances	An allowance included in the contractor costs to cover unforeseen items which are not provided for elsewhere in the total job costs
Margin	Profit margin	Profit is often calculated and included for site overheads

3.3 Principal's costs

Principal's costs are the costs which principal incurs to plan, conceptualise, develop, deliver and finalise a project.

These costs mainly apply to the non-construction activities and may occur in more than one phase.

These costs are arranged in accordance with the department's WBS standard and Cost Breakdown Structure (CBS), which identifies work in project phases, then in either project management or work management domains and ultimately continues down to individual work item numbers as detailed in the Table 3.3.

The estimator must allow for the principal's costs as separate line items in the estimate. Note: Contract costs attracts overheads and margins, but the principal's costs do not.

Table 3.3 - Examples of principal's costs

Cost Category	Component	Subcomponent
Establishment costs	Planning, design, land acquisition	Planning, community consultation, land acquisition, geotechnical surveys, cadastral and engineering surveys, principal arranged insurance (PAI).
Contract management	Administration costs	Accounting, legal fees, probity auditor costs, document and records control, including drawings, transmittals, archiving, and contracts and so on.
Project management	Business Requirements	Project management costs involving project proposal, options analysis, business case, project plan, contract supervision and project finalisation activities. Refer to the project finalisation manual for more details.
	PUP relocation	All direct and indirect costs incurred by the contractor including overheads.
		All direct and indirect costs incurred by the principal including PUP coordination, service location, design and project management.
		Civil works associated with the PUP relocation.
	Property resumption	Planning, community consultation, land acquisition, geotechnical surveys, cadastral and engineering surveys, valuation, legal fees.

The cost-centre standard hourly rates for departmental staff are usually determined annually as assessed and agreed for each financial year and are available from the relevant branch or region / district of the department.

3.3.1 Planning phase costs

The Planning Phase is for pre-concept activities of an OnQ or PAF project where a strategic planning project has been defined within a program (usually the Transport System Planning Project). The project has a defined planning intent or need (for example, identified by an Integrated Regional Transport Plan or Freight Strategy). Also, the planning project would relate to a specific transport corridor or area. In the 3PCM system, this phase is called Strategic or Detailed Planning. Such planning studies (excluding purchase price of hardship resumptions, if applicable) are considered OpEx for reporting purposes.

When Australian Government funding is sought through the PPR process, this phase called the Project Identification phase. It requires an appraisal / study of broad alternatives such as road and rail technology, travel demand management, land use and so on to solve a particular transport problem. The appraisal considers how well the broad alternatives address the problem to meet the Infrastructure Investment objectives and identifies a preferred alternative solution for progression to the Project Scoping phase.

As outlined in the Transport System Planning Program (TSPP) Guidelines, upon department's approval to progress to Concept Phase, the district is required to transfer all associated planning costs to the new Concept Phase project number. This will ensure project planning phase costs are accounted-for in the overall project cost.

Note that as per the department's Cost Classification Guideline (Section 3.2), the following annual strategic planning process activities are out of scope of QTRIP funding (activities funded under Stewardship budget categories) and are therefore not part of the project budget:

- QRSPP development (primarily corporate plus regional consultation)
- element management plan development (corporate leadership plus regional participation in reference groups), and
- tactical asset management plan development.

3.3.2 Concept phase costs

Concept phase costs are those costs incurred and associated with developing project proposals, analysing options, selecting the preferred option and preparing an estimate to a sufficient level of confidence. These costs contribute towards business case preparation.

Depending on the complexity and potential risks of the project, the other principal’s costs may include business case / federal Project Proposal Report preparation costs, land acquisition costs, the principal’s component of the PUP relocation costs, cadastral and engineering surveys, geotechnical and design investigations. These costs contribute towards scoping phase costs.

Concept phase costs may range from relatively small up to a substantial amount for large complex projects and charged to Investment Planning. The concept phase of the planning project is reported as OpEx and classified in the 3PCM system as Investment Planning.

As outlined in the *Transport System Planning Program (TSPP) Guidelines*, upon department's approval to progress to construction, the district is required to transfer all associated planning costs from Planning and Concept Phases to the new project number. This will ensure project planning phase costs are accounted-for in the overall project cost.

The expenditure associated with the concept phase activities (that is project proposal, option analysis, preferred option and preparation of business case) are reported as OpEx (excluding purchase price of hardship resumptions, if applicable).

The business case estimate should reflect the key work packages required to achieve the project intent which should be reported with separation of costs, including contingencies.

The total project P90 estimate at business case phase now needs to include the following costs, and which are to be reported and shown separately as:

- CapEx total
- OpEx total, and
- Project total.

3.3.2.1 Project proposal costs

These costs are incurred during the preparation stage of the project proposal phase and include:

- all documentation (including undertaking feasibility studies)
- environmental impact and heritage assessment studies
- preliminary traffic modelling, and
- public consultation, and the like.

The major component of the project proposal costs are the project management costs involving departmental staff, which should be determined by first principles-costing or from benchmarked values. These costs are reported as OpEx.

This will be Strategic Assessment of Service Requirements (SASR) costs for PAF projects.

CapEx and OpEx cost components of the total project cost estimate developed during the project proposal stage can be determined by:

- consulting with key stakeholders involved in project handover, including asset managers, PUP service providers and Local Government utility agencies
- identifying the work elements in the Concept Estimate, and
- estimating the effort required (time and cost) in delivering each work element.

See Section 3.3.6 Project Management Costs for further details.

3.3.2.2 Option analysis / preferred option costs

Option analysis entails the process of developing / investigating specific options that achieve the preferred option to include in the business case.

The activities to be undertaken at this stage include developing comparative options with supporting evidence such as preliminary environmental and heritage assessments, traffic modelling, community consultation and cost estimates for each option. Activities required to establish the preferred option involve both work management and project management domains.

For PAF projects this will be the Preliminary Evaluation stage and will have similar costs.

Total project cost estimates for PAF or OnQ Type 1 projects are determined by first principles costing process with the development of a concept design of the preferred option, or from benchmarked values for comparative cost estimates as part of assessing the various possible project options.

These costs are incurred in further developing the preferred option and preparing the documentation of the business case. Activities will be required in both work and project management domains.

One of the most important activities undertaken at this stage is the development of a total project business case estimate with a P90 confidence level, which is a prerequisite for any project to enter the

QTRIP in funded years. First principles estimating for larger scale projects are derived from concept phase designs of the preferred option using a bill of quantities schedule and risk analysis. For PAF projects, the recommended outcome are two independent viable options with P50 and P90 estimates for each option.

These costs can be determined from benchmarked values derived from the PCB. See Section 3.3.6 Project Management Costs for further details.

3.3.3 Development phase costs

This phase commences with an approved OnQ Project Plan documenting proposed activities involved in this phase. These activities typically include detailed cadastral and engineering surveys, community engagement, geotechnical investigations, hydraulic and hydrological studies, detailed environmental assessments studies, cultural heritage risk assessments, field assessments or surveys, consultations, agreement or plan negotiations, heritage approvals (if applicable), utility locations and searches, and design work to further develop the recommended concept design in the approved Business Case.

Development phase costs include project management costs (Section 3.3.6) and principal's costs (Section 3.3).

For projects that are funded by the Australian Government, the development entails detailed planning and design of the preferred option and an updated Benefit Cost Ratio (BCR), detailed and refined project budgets, timings (including a pre-tender estimate) and a procurement method.

This phase might also involve pre-construction or preliminary construction work and land acquisition. The development phase cost estimates can include both operational (OpEx) and the capitalised (CapEx) costs.

These cost estimates provide the basis for tender schedules which need to be accurately dissected into CapEx / OpEx categories.

For project managers and estimators to correctly identify the costs associated with each cost category, the Development Phase work activities will need to be clearly identified from the outset.

3.3.3.1 Development phase Stage 1 design costs

The Development Phase Stage 1 Design (S1D) is used to confirm that the design matches with the approved scope and its project estimate falls within the approved budget prior to moving to Development Phase Stage 2 Design (S2D). This includes the cost of detailed investigations, detailed surveys, and so on.

Costs to advance the preferred option to the advanced S1D phase will involve work management activities.

Not all projects in the department will have a S1D step. Some Type 2 projects and most Type 3 projects may not require this step and instead progress directly to the S2D stage. If this activity is done by an outside consultant, the payment to the consultant will fall under this category.

3.3.3.2 Development phase Stage 2 design costs

Development phase Stage 2 design activities include finalising the S1D and producing detailed drawings accompanied by a S2D estimate suitable for a construction contract.

These costs can be determined by first principles costing methods, or from benchmarked values. Refer to project management costs in Section 3.3.6 for further information. If this activity is done by an outside consultant, the payment to the consultant will also fall under this category.

3.3.3.3 Contract documentations costs

The relevant contract delivery method is determined using the department's transport infrastructure project delivery system. Costs associated with preparing contract documentation will involve work management activities.

These costs can be determined by first principles costing or from benchmarked values. See project management costs in Section 3.3.6 for further information.

3.3.3.4 Procurement costs

Procurement stage costs include the activities such as the preparation of tender documentation, advertising, responding to Requests for Information (RFIs), preparing Notices to Tenderers (NTTs), and tender analyses, obtaining financial approvals, and appointing and engaging the successful contractor incumbent/s.

These costs can be determined by first principles costing or from benchmarked values. See Project Management Costs in Section 3.3.6 for further information.

3.3.4 Implementation phase costs

Implementation phase costs include all costs associated with the delivery and management of the project including project management costs, the administration of construction contracts, site visits and meetings, and the like.

Costs of the construction need be developed separately under construction contractor’s costs as detailed in Section 3.2 Construction Contractors Costs. Implementation phase costs also include principal’s costs and see Section 6 Project Management Costs for further information.

Most of the costs associated with the Implementation Phase activities are considered to be CapEx. However, there may also be some incurred operational (OpEx) costs as well depending on the circumstances this may typically be:

- demolition costs
- public utility plant relocations, and
- training.

Refer to the department's Cost Classification Guide available in the PIP SharePoint web page for a complete list of operational cost categories.

3.3.5 Finalisation phase costs

The Project Finalisation phase is an ongoing process commencing from the early stages of the project life cycle, and due consideration should be given for the assessment and inclusion of any / all costs associated with project finalisation activities as they are generated and incurred throughout the entire project life.

According to the OnQ project management framework, the key project management activities in the project finalisation phase are:

- handover - transition control of the product to the customer

- review and evaluation - against success criteria and key performance indicators
- close out - close down the project office and disband the project team, and
- post-implementation review - evaluate outcomes against project intent and lessons learned.

The costs associated / involved with the finalisation phase activities should be properly costed at the concept phase and incorporated into the business case phase project cost estimate. In the absence of such allowances for project finalisation costs in the project budgets at concept phase may require additional budget submissions in development or implementation phases once the full cost of the finalisation phase activities is realised.

Some of the key outputs that are required to be completed include:

- as constructed or developed plans
- updated corporate asset management systems
- maintenance responsibility and operation plans
- completion of state-controlled road declaration processes
- a register of commitments/project variations / decisions
- secure storage of forensic data (physical and electronic records) files
- a project learnings report
- a project handover report
- a project completion report
- a surplus land and property report
- limited access plans, and
- returned works agreements.

All costs incurred and associated with the Finalisation Phase are reported as (OpEx).

The list of the activities which need to be completed for project finalisation is shown in the *Asset Information and Finalisation Guideline* for Transport Infrastructure Projects available on the department's intranet.

3.3.6 Project management costs

Project management costs are the costs incurred to prepare the project plan, and those costs incurred to manage (monitor and control) the entire project. This however does not include the administration of construction contracts.

Project management costs are expended in each of the four project management phases and are to be estimated separately for each phase / stage.

These costs are derived using first principles methods, and by determining the tasks to be carried out, the number of human resources allocated or required for each task, each person’s required work effort (hours, days), and the resource charge-out rate ($/hr, $/day). Costs of these tasks are then accumulated and totalled to arrive at the estimated project management cost for each phase / stage.

The standard hourly rates for departmental staff are determined each financial year and are available from the relevant branch, region or district of the department.

The relevant project managers are to separate the project management cost estimates into capital (CapEx) and operating (OpEx) cost components in accordance with the Project Management Work Breakdown Structure (PM-WBS).

This cost categorisation is based on the project phase and the work activity. Refer to the *Cost Classification for Transport Infrastructure Projects, September 2020* guideline available in the PIP SharePoint (internal) page, for details.

3.3.6.1 Principal's obligations

Principal's obligations typically include principal-supplied materials (see Section 3.3.6.4), acquiring the right-of-way (see Section 3.3.6.2 Property Resumptions), public utility plant (see Section 3.3.6.3 Management of Public Utility Plants) investigations and alterations, and other similarly associated or incurred payments and costs. Pending on the urgency, some of these costs may occur during either the concept, development or implementation phases. Resumption resulting from hardship cases may necessitate land acquisition early on during the concept phase. PUP alterations may however still be required later during the implementation phase.

Expenditure relating to third party assets, including public utility plant, are to be recorded and included as Operating Costs (OpEx).

3.3.6.2 Property acquisition (resumptions)

Due to the complexity and potential cost risks associated with property acquisitions, if any property impacts are identified, then advice should be sought from the Property Acquisitions and Disposals (PAD) unit. An example of the property acquisition and associated costs are shown in Table 3.3.6.2.

PAD must be provided with the project scope (including all alignment options) and associated drawings showing property impacts. Early consultation with PAD is highly recommended as their advice and property acquisition cost estimates may influence the alignment selection. Early engagement will assist with meeting project timeframes as there are fixed statutory timeframes associated with the resumption of land.

The department acquires property in two ways:

- The first method is formal resumption (refer to flow chart in Annexure K – Land Resumption Flowchart), which does not typically occur until a project has been given approval for construction, and
- The second method is early acquisition by contract of sale negotiations. This will occur when a project's construction phase is not planned for the immediate future. For further information regarding the early acquisition application and approval process please refer to both the Approved Planning Policy and the Early Acquisition Policy or contact DTMR.early.acquisitions@DTMR.qld.gov.au.

PAD will undertake a cost estimate based on the market valuation of land to be acquired and will determine compensation on a case by case basis. For full takes, the valuation disregards any possible or pending impacts from the proposed project. For partial resumptions, the impact of the project, positive or negative (injurious affection, severance or enhancement) upon the value of the remaining land is considered in estimating compensation costs.

An allowance for disturbance items will be included in every property cost estimate, which covers expenses and costs such as:

- relocation expenses (such as removalist costs)
- stamp duty on the purchase of replacement property of equivalent value
- other repurchase costs
- reasonable professional fees incurred in preparing the claim for compensation, and
- business relocation / loss of profits.

People or stakeholders who hold an interest in the land, such as leases running a business, may potentially suffer losses because of the impact of the project. These potential incurred losses can be temporary (during the construction period), or permanent. Business owners may also be compensated for costs associated with the relocation of their business.

PAD also incurs costs associated with acquiring property and the negotiating of compensation after resumption. These costs can include, but are not limited to external valuation, town planning, legal and accounting advice. These costs are also included in the cost estimates. In addition to PAD's costs incurred in managing the acquisition, PAD charges a commission for acquisition services. Due to financial accounting practices, PAD's commission expense is not accrued with the compensation and PAD costs as set out above in the total land resumption accrual, but it is an expense to the project which should be budgeted.

Property acquisition may also incur costs related to environment matters such as contaminated land remediation, biosecurity management and waste management. In addition, there may also be ongoing management costs associated with land acquired for the purposes of environmental offsets.

It is important to consider the land that would need to be acquired for each option. An emergent risk that needs to be considered in this stage that will affect project viability is emergent land / groundwater contaminants. The one currently of consideration is firefighting foams (PAFS/PFOA). These contaminants are mobile in groundwater and contaminate soils. Costs for dewatering need to be considered prior to land acquisition as costs to manage dewatering can run into the tens of millions of dollars.

Thus, proposed options that are in high risk zones for possible PFAS would be required to complete a contaminated land and groundwater assessment well in advance of formal business case to determine costs that need to be built into the business case for the site clean-up. This cannot be left to construction and delivery phase as these contaminants have ultra-trace release thresholds, and sensitivity in the community.

Some clean-up costs are sufficient to stop projects if they are not captured, and in certain cases may influence option selected as it may be better to avoid the site entirely. Hence consideration in OA is mandatory.

If a project is limited by route selection, it is required to assess risks of this tis nature to ensure business cases are properly formed, including costs for environmental contaminants, and not left for project contingency as these are in some cases unlikely to be sufficient.

Property acquisition (purchase price) costs are reported as project CapEx and the resumption compensation / disturbance payments and administration are classified as OpEx.

Table 3.3.6.2 - Example property resumption costs

1 Smith Street – Total $746 900			
Owner Costs		**Tenant Costs**	
Property	$500 000	Business losses	$75 000
Disturbance items	$50 000	Disturbance items	$15 000
PAD costs	$20,000	PAD costs	$15,000
PAD commission	$55 000	PAD commission	$9 000
Sub Total	$625,000	Sub Total	$114,000
10% Contingency	$62,500	10% Contingency	$11,400
Total	**$687,500**	**Total**	**$125,400**

3.3.6.3 Management of Public Utility Plant (PUP)

Public Utility Plant refers to assets (plant) owned by other parties (e.g. Service Authorities) permitted under State Legislation or a Commonwealth Act to be located in the road or transport corridor. PUP costs include all adjustments, replacements, relocations, etc. that are required because of the project regardless if undertaken by the responsible authority, a contractor engaged by that authority, or undertaken by the department either as part of the main contractor's works or by separate contract.

All significant PUP relocation costs must be identified on all projects above a nominated threshold of $25M by the following dissection:

- principal costs (for example, Transport and Main Roads staff costs in timesheets)
- contractor costs (where the Principal Contractor arrange PUP works on behalf of the Principal)
- utility company costs (for example, gas, water, sewerage, telecommunications), and
- traffic signal costs.

Should the value of the estimated project cost be less than $25M, then single-line reporting of PUP costs is deemed sufficient.

In some instances, utility service adjustments might be undertaken partly by the project's appointed main contractor, and partly by others, outside the main contract scope of works, but still within the overall project scope. In such circumstances, care must be taken to ensure that the correct scope of utility adjustments is contained in the main contract scope and in the scope of other works, and that the appropriate scope description makes this division clear.

It is often difficult to ascertain the potential costs associated with PUP relocation of a project. For example, where costs are shared, a utility authority might not agree to meet the cost of the relocation of a utility that was not supposed to be in the vicinity. Appropriate contingency allowances should be made, and these are likely to be among the highest adopted for the project, particularly in the early stages of a project in metropolitan areas.

PUP work typically includes the protection and relocation (typically installation of new assets then removal of old) of non-transport related public utilities. Non-transport public utilities are distribution / reticulation and transmission gas, electricity, telecommunications, potable water, sewage and wastewater assets (but not bulk water).

There third-party assets such as stormwater pipelines or commercial utility assets, are not considered as public utility plant.

The department has memoranda of understanding (MOU's) with selected PUP owners such as Energex, Ergon and Telstra within regions. These MOUs provide the basis for the design, costing and implementation of their PUP asset alterations. These MOUs can be found on the department's intranet.

Estimators and project managers are encouraged to read and understand requirements in the department's Engineering Policy 174 *Utility Infrastructure Relocation and Protection Management Policy and Procedures* (published internally) which identifies the legislation, roles and responsibilities and procedures to mitigate risks and support a best practice approach to manage contestable and non-contestable Public Utility Plant (PUP) works in the department's projects.

Utilities costs might include but are not limited to:

- design costs associated with diversions
- Telstra, Optus and other communications carriers' adjustments
- electrical services adjustments
- water and sewerage adjustments, including possible protection of heritage services
- gas mains adjustments
- fuel pipelines
- QR railway track adjustments, and
- department's project management of the necessary relocations.

The costs of all above utility service adjustment must be considered even during the strategic estimate stages.

All project cost estimates must include a clear breakdown of costs associated with PUP work and are to include both direct and indirect costs. These direct costs are the actual expenditure incurred with PUP providers including sub-contractor costs. The indirect costs are the expenditure associated with PUP design, project management, auditing, testing, contingency, civil construction and unspecified resumptions.

The department may be responsible to meet costs associated with relocating third party assets as part of a project, though it does not have any operational and management responsibilities for managing, altering or relocating any such assets.

Each PUP cost component within the estimate is to be categorised in accordance with the Principal versus Contractor versus Utility company and classified into CapEx or OpEx depending on asset ownership as below.

For example:

- Where the department is responsible for operation of any PUP infrastructure such as Rate 3 lighting at a roundabout or Intelligent Transport Systems, such costs incurred should be reported as CapEx.

- Where PUP services are connected to the department's infrastructure (e.g. power connections for traffic signals), the PUP component managed by the service provider is then reported as OpEx, whilst the department's infrastructure component is to be reported as CapEx.

Energex have developed *Estimating with Pictures Manual* to guide their stakeholders who would like to prepare high level cost estimates at planning stages. The project managers are encouraged to refer to this manual, to get an idea about potential costs associated with the Energex asset relocation at planning stages.

However respective Energex representatives must be consulted to get an accurate costing for the power assets relocation to include in the business case estimates.

The workflow arrangement for PUP relocation works are available at Annexure O of this document. Project managers should also refer to the Utility Management site within the department's internal intranet.

3.3.6.4 Principal supplied material

The department has statewide Standing Offer Arrangements (SOA) for the provision of a range of road construction materials such as cement, guardrails, traffic lanterns, lighting poles, electrical cables and traffic signs.

These SOA's enable materials required for a project to be procured in the most economical way.

Although the principal elected to arrange the supply provision of other materials such as precast concrete stormwater drainage products, manufactured quarry aggregates, road pavement materials, or bridge components) the costs of such items form part of the construction costs.

All arrangements and user guides are published on the Queensland Contracts Directory which can be accessed via GovNet. The internal Procurement SharePoint site of the department also features a range of listed and common departmental, whole-of-government and other agency arrangements.

For further information on these SOA's refer to the internal Chief Procurement Office SharePoint page of the department.

3.3.6.5 Other payments and costs

Other payments and costs that are included within the principal's costs include:

- Principal Arranged Insurance (PAI)
- miscellaneous charges including lighting and cultural heritage payments
- fees and levies required of the principal, such as Portable Long Service Leave (PLSL) or QLeave, Workplace Health and Safety (WHS) and environmental fees
- any compensation due to road infrastructure development, and
- performance incentives or bonuses.

3.3.6.5.1 Principal arranged insurance (PAI)

The Principal Arranged Insurance (PAI) program covers infrastructure construction risks of the department and its contractors. PAI insurances represents a series of different insurance policies such as:

- Contract Works

- Public and Product Liability
- Professional Indemnity, and
- Environmental Liability.

As the department experienced considerable increases to rates for the 2021 to 2023 PAI program, the PAI premium levy to eligible projects awarded beyond 31st December 2020 increased. The estimates prepared after this date shall make sufficient allowances to accommodate this increase. Refer to Annexure F - Principal Arranged Insurance of this manual for further details.

3.3.6.6 Demaining

The projects may also include construction of new assets such as service roads and/or upgrading existing assets managed by third parties (for example, local government authorities) provided it complies with program management rules.

Costs of planning, pre-construction and construction, including public consultation, environmental assessment, design, land acquisition, and traffic management, provided they are within the agreed scope of a project. Care should be expressed to ensure that demaining costs, such as investment in associated local government network, are included within scope of the PPR, if Australian Government funding is sought for such activities.

In such circumstances the department may either bring about improvements or refurbish and/or resurface the existing road prior to its transfer of custody to the local government, or possibly contribute towards the future cost of maintenance of the existing road.

The project manager should engage the local government as early as possible to gauge and establish the existence of any such potential cost impost, and also make provision for such costs to be included in the project estimate.

The expenditure for road infrastructure component which is expected to be managed by a third party (such as local government) should reported as OpEx.

3.3.6.7 Environmental offsets

Environmental offsets are defined as an action taken to counterbalance unavoidable negative environmental impacts that could potentially result from a proposed activity or development.

Where a project cannot avoid impacting on particular environmental values, estimates require provisioning offsets to mitigate these impacts.

Triggers for offsets are established by legislation and requirements are generally either prescribed within the legislation, are a condition of a development approval, or are contained within codes of compliance which the department must comply with. Offsets are generally delivered as a one off financial payment or as land. Refer to the department's *Environmental Offsets Policy* for guidance. As the impacts on environmental values are sometimes difficult to predict and offsets are negotiated on a case by case basis, the appropriate local Environmental Officer should be engaged to assist in helping to determine any potential impacts and associated costs during the early project stages.

It should be noted that the cost associated with delivery of a non-financial offset may extend beyond practical completion of a project. It is important to capture these ongoing costs in project estimates, so compliance is achieved.

For projects within South East Queensland, there may be specific obligations to manage potential impacts on koala habitat or koala movement. Infrastructure such as fauna fencing, and underpasses may need to be included in the design as a mitigation measure.

3.4 Risks and contingencies

The purpose of any cost estimate is to provide a realistic indication of the outturn cost for a given project scope. This consists of an initial base estimate to which a contingency amount is added to allow for the uncertainty that is inherent within any estimating process.

A contingency allowance is the measure of the residual risks that exist with the project, relative to achieving the project objectives and is expressed as a level of uncertainty or confidence.

A key element of the cost estimate is the inclusion of a realistic contingency allowance which has two basic requirements:

- likelihood of the risk occurring, and
- consequences of the risk occurring.

Quantification of contingency allowances for cost items is achieved by applying the risk management processes detailed in ISO 31000:2018. Further information about managing risks can be found in Section 10 of this manual.

Because of the uncertain nature of risk, it is difficult to be prescriptive as to how contingency costs should be estimated. The estimator and project manager should use their experience and professional judgment to weigh, value and assess any competing factors to arrive at the most likely outcome value. Historical events may also be considered or used as a guide.

Table 3.4 below provides some guidance as to contingency percentage above the base estimate.

The project managers, estimators and designers are expected to follow appropriate processes on risk identification, evaluation and management.

Contingency allowances outside of these ranges or larger contingencies must be justified by a detailed risk analysis approach using tools such as a project risk management workshop or a Monte Carlo analysis as detailed in Section 10 - Risk Management and Contingency Calculation of this manual.

Table 3.4 - Expected contingency range

Base estimate stage	Level of project definition	Typical contingency ranges
Strategic estimate	1% to 15%	40% to 70%
Project proposal estimate	1% to 15%	40% to 70%
Options analysis estimate	N/A	N/A
Business case estimate (P90)	10% to 40%	30% to 40%
Development Phase Stage 1 Design estimate	30% to 65%	20% to 30%
Development Phase Stage 2 Design estimate	40% to 80%	10% to 20%

Note: These contingency ranges were in use by the department since the Second Edition release of this manual in 2004. The Association for the Advancement of Cost Engineering International's Cost Estimate Classification Matrix provides ranges of expected accuracy wider than those shown, however departmental experience has not yet indicated a need to modify these ranges.

A table of risk percentages used for high level strategic and project proposal estimates can be found on Annexure E – Principal Arranged Insurance for Projects. A risk matrix is also available for guidance on the department's website.

The categories of cost changes are detailed in Section 10.8 and include suggested ranges for estimating their cost.

3.5 Escalation

Escalation is applied to project estimates to provide adequate capital funding to compensate the project for cost increases due to inflationary factors that occur during the life of the project to present estimates in outturn dollars. An escalation allowance is a provision in costs or prices for changes in technical, economic and market conditions over time. Table 3.5 below provides details of items likely to influence the determination of escalation rates.

Table 3.5 - Escalation drivers

Item	Description
Inflation and CPI	Often referred to as rise and fall and entails inflation for labour, plant and material.
Changes in market conditions	Competing pressures from the global and local conditions to road and other sectors cause an effect on tender prices and contractor’s project delivery financial margins.
Supply constraints	Additional costs incurred relating to time constraints on the supply of scarce materials or services. This can also result from the artificial demand for resources created by the unexpected occurrence of natural disasters, such as flooding.
Project complexity	The department follow rigorous processes and incur significant costs to manage and implement appropriate interaction strategies and measures associated with construction and to mitigate / prevent risks associated with network breakdown.

All estimates developed for QTRIP projects are expressed in outturn dollars at P50 and P90 confidence levels for all business cases in years one and two of the Queensland Transport and Roads Investment Program (QTRIP), including nationally funded projects. The outturn costs are developed by applying escalation factors to estimated cashflow expenditure values each in the entire cashflow.

For consistency, the department adopt escalation rates issued by the Australian Government for all QTRIP projects, except rail project.

Due to the bespoke nature of rail projects, escalation for rail projects may be considered separately and on a case by case basis. Australian Government encourage jurisdictions for early engagement on potential rail projects so that analysis and consideration of the escalation rates proposed can take place.

Submission of the PCB together with the Project Proposal Report is mandatory for all projects seeking federal funding. The escalation rates are embedded in the Project Cost Breakdown (PCB) spreadsheet which is pre-loaded with the department specific index series and allows escalation rates to be automatically calculated. The PCB spreadsheet shall also be used to index historic project estimates from previously estimated dates to the current date.

In that context, it must be noted that escalation, while being a unique 'risk' cost that must be estimated, should not be included within project contingency. Escalation and contingency are

determined using different methodologies and used for different purposes. Note that the PCB has a zero floor policy, in that escalation rates within a year cannot be negative.

More information on escalation can be found in the federal Guidance Note 4 – Escalation. Copies of the PCB templates for road infrastructure and rail projects are available internally on the PIP SharePoint page.

3.6 Types of Work Items in estimates

A cost estimate schedule may consist of different types of work items as described in the MRS01 *Introduction to Technical Specifications* as described below. The estimators must use the unique identifier or 'Work Item Number' against each work item in the cost estimate when assigning costs. The Work Item Numbers can be obtained from the MRS / MRP suite which is also used to create tender schedules. The Technical Specifications suite is available to download from the departmental website https://www.tmr.qld.gov.au/business-industry/Technical-standards-publications/Specifications.

3.6.1 Standard Work Items

All work items listed in the Technical Specifications suite of the department are referred to as Standard Work Items. All Standard Work Items have a description in terms of Work Operation with a quantity and unit of measure such as cubic metre, lump sum and so on. The Standard Work Items are detailed in the department's MRS Specification (Measurement) documents suite.

3.6.2 Supplementary Work Items

From time to time, certain work circumstances demand the Standard Work Items be altered to address change in Work Operation or Technical Specification. Such Work Items are referred to as Supplementary Work Items and denoted with suffix 'S' against the Work Item number and amended Work Item description as required.

The estimators may need to describe the induced change further in the supplementary specification or the 'supplementary requirements' in the relevant Technical Specification Annexure.

3.6.3 Provisional Quantity Work Items

The purpose of using Provisional Quantity Work Items is to accommodate work elements which are difficult to accurately quantify for practical reasons. An item of work where quantities cannot be accurately estimated are denoted with a suffix 'P' and classified as per Table 3.6.3.

Table 3.6.3 - Categories of provisional quantity items

Provisional Category	Limit of Accuracy	Remarks
Provisional Quantity	±50%	The quantity in the tender schedule can vary within the limit of accuracy. If it exceeds the limit of accuracy, the contractor can negotiate a new rate of excess work to be carried out.
Provisional Quantity, as directed	±50%	The contract administrator will direct or mark out the extent of the work. The Contractor shall not proceed until the extent of the work is agreed.
Provisional Quantity, if ordered	±100%	Work can be undertaken by the contractor only if instructed in writing by the contract administrator.

Project team should endeavour to minimise the conversion of Standard Work Items in to 'P' items as much as possible, because it may cause unintended adverse consequences at the tender stage such as not achieving value for money tenders (such as inflated tender prices) due to contractor's uncertainty over the risks involved with 'P' items.

3.6.4 'Provisional Item, if ordered' Work Items

For the 'Provisional Item 'if ordered' Work Items, the contractor shall only be entitled to be paid for that work if the Contract Administrator has directed the contractor in writing to undertake that work. If any cost estimate contains excessive P items, which will eventually become the contract schedule, it will create lot of uncertainty later in the delivery phases for project manager and the contractors.

3.6.5 'Provisional Sum' Work Items

A Provisional Sum is an allowance, estimated by the principal, that is entered in the tender documents (tender schedule) for a specific element of the works. Provisional Sum Work Items means a sum (if any) specified in the Contract as a provisional sum, for the execution of any part of the works or for the supply of plant, materials or services.

If the contract includes a Provisional Sum, the contractor must not carry out the work to which a provisional sum relates unless directed to do so by the Contract Administrator. The Contractor acknowledges that the Contract Administrator has no obligation to direct any work to be carried out in relation to a Provisional Sum.

Provisional Sum Item may include below works:

- works that cannot be quantified at all and no clear scope
- subcontractor work, and/or
- nominated subcontract work.

The contractor is entitled to payment including profit and overheads for work carried out in respect of a Provisional Sum Work Item.

Clause 11 of the General Conditions of Contract (C7830) includes further information related to Provisional Sum Work Items.

3.6.6 Non-standard items

From time to time, estimators are required to include Project Specific Work Items in estimates to address an issue that is unique to the circumstances of a project. Such Work Items are not covered by any other Standard Work Item description or Technical Specification suite. This category of Work Items is known as Non-Standard Work Items for which the estimators are required to develop Specifications for the work to be delivered and define a unit of measure on how it should be measured.

Non-Standard Work Items are listed as 90000 series items in the MRS suite. Non-Standard Work Items are organised into pre-defined ranges, with each range allocated a specific unit of measure.

All Non-Standard items with 'lump sum' as the unit of measurement are in the 90101 to 90499 range.

4 Estimating processes

4.1 Process overview

Regardless of the estimate stage, there is a streamlined process to be followed as shown in Figure 4.1(a).

The appropriate level of detail that can be generated in an estimate is in direct proportion to the amount of design and other documentation available at the time.

The estimating process includes the following key activities:

- establish the project scope
- gather project background information, including a detailed site assessment to establish and verify site location and environmental constraints
- gather site location local knowledge on available resources
- estimate and resource planning
- cost estimate development
- conduct reality checks
- risk identification and evaluation
- contingency quantification using deterministic or probabilistic methods
- escalation, and
- review and approval.

The procedure for peer and concurrence reviews, and the approval of estimates at business case, S1D and S2D is illustrated in Figure 5.3.3.1(a) and Figure 5.3.3.1(b).

To satisfy reporting requirements where a single estimate figure is required, the pessimistic estimated outturn cost is to be reported as the estimated total project cost.

The preferred contents to be communicated when presenting an estimated project cost are:

- the project cost with sufficient contingency to provide a 90% likelihood that this cost will not be exceeded (P90)
- the project cost with sufficient contingency to provide a 50% likelihood that this cost will not be exceeded (P50)
- the category of estimate (refer to Section 7.4.2 Estimate Confidence Categories)
- the estimated or anticipated project duration and completion date, and
- the estimated costs and contingencies are to be separated and categorised as CapEx and OpEx costs.

The relationship of the cost variables is shown in Figure 4.1(b). A description of estimate confidence categories follows.

Figure 4.1(a) - Generic estimate flowchart

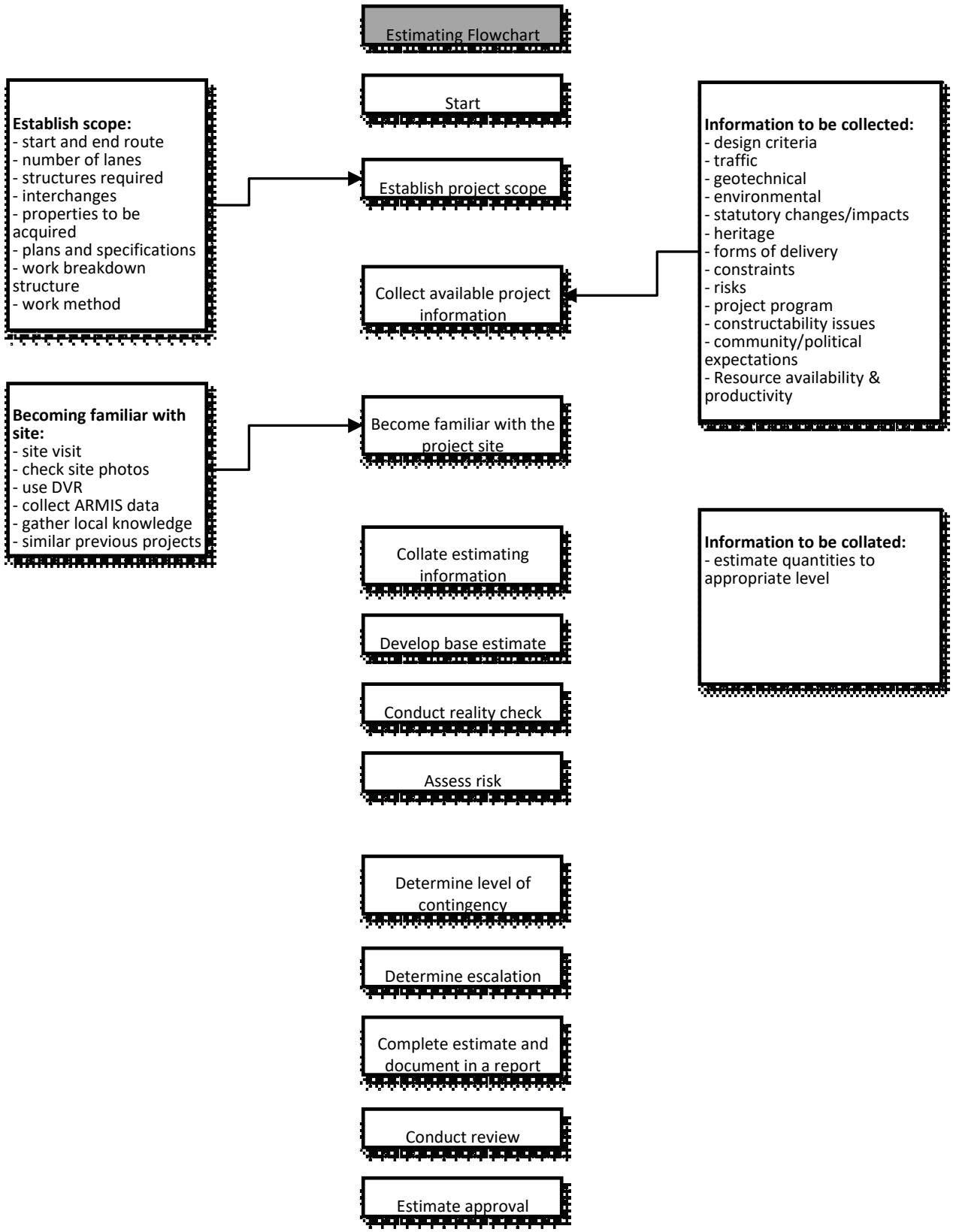
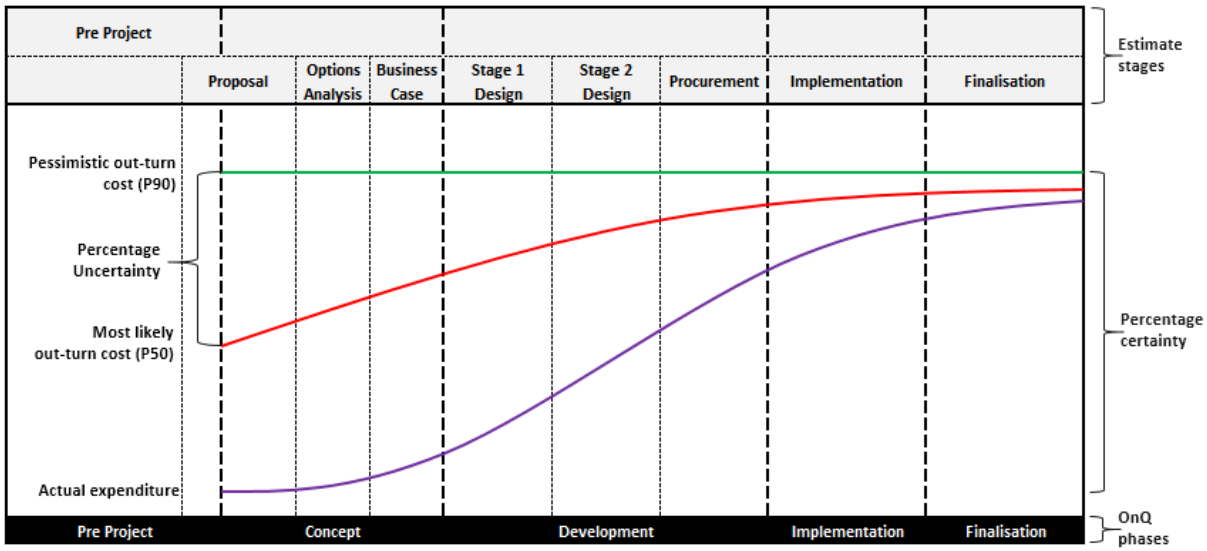


Figure 4.1(b) - Estimate confidence profiles in the program life cycle for traditional project delivery



4.1.1 Establish project scope

Project scope definition is the biggest factor that affects the reliability of any cost estimate. Inability to define the scope potential to have a significant impact on the overall project outcome and costs.

The scope statement provides a documented basis for a common understanding between the project and its stakeholders. It provides the estimator with the understanding, confidence and ability to confirm the basis for developing the estimate, especially when supplemented by the project plan, design drawings and technical specifications.

The project scope is defined from a number of perspectives, each of which has an influence on the final outcome. These may include features of the product or service to be delivered. Proper scope definition in terms of the physical scope of the project and work methods remains critical to achieving accurate estimates.

The scope will be defined based on the business outcomes required, the functions the project is to perform, the funds available and the expected return on investment. Future management, operation and maintenance factors should also be considered. The process includes a number of hold points or stages where the details of the project progress can be reviewed and give approval to proceed to the next stage.

The principal remains responsible for the scope throughout the life of the project. Part of the process of defining the scope should include identifying and analysing the project risk to ensure that assumptions and exclusions in the scope are well founded.

Effective project scope definition incorporates:

- Location – site remoteness, transportation, terrain type, population density
- Geotechnical – availability of materials, construction conditions
- Physical dimensions – length, width, number of lanes
- Service standards – traffic capacity, traffic delay, access control, disruptions during construction

- Quality standards – design speed, design standards, technical specifications
- Environment – noise levels, rainfall, flora and fauna constraints
- Timing – time for completion or putting infrastructure into service
- Estimate of Cost – cost estimate puts a boundary on the project cost, and
- Programming and Budget – total funds provided and distribution of funds over life of project.

The project manager holds responsibility for clearly articulating the project scope elements to the estimator. However, the estimator is interested in estimating scope rather than overall project scope which may have several phases / stages. It is the estimator's responsibility to obtain any perceived or outstanding details from the project manager.

The project scope is progressively defined and refined during the project life cycle as follows:

- pre-project level / identification phase (establish project objectives and requirements based on project intent)
- concept phase / scoping phase (defining the solution), and
- development phase (detailing the solution).

At each stage of the project life cycle, scope, delivery timeframes, staging and any variations are to be agreed and confirmed by the project manager, and with the project customer. The various OnQ templates and variation approval forms provide the formal documentation instruments for this to occur and be officiated.

4.1.2 Collect available project information / data

The estimator holds the responsibility to give due consideration to all known, available and relevant information for the project such as:

- an understanding of the proposed contracting strategy for the project (for example design and construct, early contractor involvement, open tender, sole invitation and so on)
- an accurate description of the scope and limitations of the project
- inclusions / exclusions
- project schedule
- a schematic plan of the proposal
- details of the budgets and costs to date
- a risk assessment
- material availability (local sources, haulage distances, and so on)
- staged construction possibility
- environmental and cultural heritage constraints and opportunities
- WHS requirements
- details of any other projects occurring in the area which may influence this project
- constructability issues

- any existing studies or reports that might influence the costs for example geotechnical report, environmental assessment, hydrology and so on
- key dates for commencement of design, construction or finalise the project
- potential environmental approvals with conditions
- any early works components, noting that things such as federal environmental approvals may preclude early works commencement unless handled appropriately following current guidelines
- any other available information, such as previous site visit records, photographs, aerial photographs, sketch plans, general property valuations, utilities and so on
- sustainability and climate change requirements, and
- accessibility requirements.

To assist in future estimate adjustments and in programming any work, the estimator must make use of all information available and any assumptions made must be clearly recorded.

4.1.3 Become familiar with the project site

Each project has its own and unique site-specific issues which can have an impact the cost of the project. Where known, estimators must take such issues into consideration, make appropriate adjustments and include allowances in the estimate.

Some typical (but not limited to) examples of issues influencing estimates are:

- geotechnical – ground conditions and structure, nature of the terrain, flood plains
- climate or weather factors rainfall & drought, flooding and water resource shortage interruptions
- access – logistic barriers, accessibility to the site, heavy plant access, storage facilities and so on, environmental sensitivity protected fauna and flora, wetlands presence / preservation
- proximity to residential areas – noise, dust and vibration issues, constraints on construction times, work duration times, blasting restrictions, a need to use local roads for access and cartage
- historical land use – potential for contaminated land that will need to be managed
- availability and sourcing construction materials – quarry materials, location of the pits, concrete and bitumen supply availability
- availability of labour resources – remote locations, unskilled labour, site specific wage increases, and
- heritage and cultural areas of significance – need to realign the road to avoid significance areas.

The estimator should make every endeavour to conduct a site visit, preferably accompanied by the project manager to improve their understanding of the site conditions, uncertainties and known risks.

The information gathered during site visits should be recorded in Annexure A - Project Site Visit Checklist.

Aerial photos and/or Digital Video Road images (DVR) may be used if a physical site visit be deemed impractical.

4.1.4 Collate estimating information

The following data needs to be gathered and collated:

- Global quantities - quantities that are likely to be of a very strategic and approximate nature and will be very broad in character, based on an understanding of the project proposal scope.
- Global rates - strategic global rates which can be adopted from completed projects in the absence of other relevant information. Historical unit rates or rates determined from first principles might be used if there is sufficient information to calculate quantities, and
- Provisional items – the cost elements cannot accurately quantify at the time of estimating. Such items are added to cost estimates as 'P' items to obtain tender rates. The limit of accuracy can vary with the type of provisional category used. Refer to Section 3.6 Types of Work Items in Estimates for more details.

Quantities and rates adopted must be compatible with the project scope. The rates used must be applicable to the quantities adopted. If not already included, allowance for waste must be added to some items.

4.1.4.1 Understand historical data

Historical data projects and contracts is available from the 3PCM system which can then be used to analyse:

- prevailing market conditions at the time which the data was collected
- any peculiarities of the project from which the data was collected
- legal environment prevailing at the time the data was collected
- departmental requirements at the time the reference data was collected
- an approximate allowance for contractors on and off-site overheads and profit (if available), and
- the project delivery method.

4.1.4.2 Adjust historical data

Historical data available within the region / district must be adjusted prior to use for the:

- inflation or historical escalation rates
- site location and site conditions
- project variations
- effects of government legislation
- changes in policies and specifications at the time of project delivery
- contractor’s on-site / off-site overheads and profit margins
- method of project delivery (design and construct, early contractor involvement, and so on).
- inflation or historical escalation rates

- site location and site conditions
- project variations
- effects of government legislation
- changes in policies and specifications at the time of project delivery
- contractor's on-site / off-site overheads and profit margins, and
- method of project delivery (design and construct, early contractor involvement, and so on).

4.1.5 Develop base estimate

It is necessary to ensure that the base cost estimate is an accurate reflection of the project's scope of work and includes all necessary items and has accurate quantities with appropriate rates.

It is necessary to ensure that the base cost estimate is an accurate reflection of the project's scope of work and included all necessary items and have accurate quantities with appropriate rates.

4.1.6 Reality checks

The estimator shall undertake a reality check of the base estimate prior to peer review. This process helps to identify gross inconsistencies.

The standard reality checks can include:

- cost per km of and (or per lane-km of the road)
- cost per square metre of the structures
- principal costs as percentage of the total project cost, and
- development phase cost as percentage of the total project costs.

Reality checks are applicable to estimates at all stages of the project.

4.1.7 Assess risks

The most important risks at base estimate stage of the project are:

- the possibility that the project scope (even if one has been assumed) will change
- the information upon which the estimate is based is found to be incorrect, and
- the risks associated with providing an estimate at this early stage of the planning life cycle.

4.1.8 Determine level of contingency

Appropriate contingency component must be added to the project estimate to cater for residual risks.

Contingency must be determined to reflect the confidence and reliability of the information used in preparing the estimate and to take into consideration the risks associated with the project.

Table 3.4 outlines the expected range of contingency for a typical project, but it is the project manager's responsibility to ensure the contingency applied to project is at appropriate level.

For more detailed guidance for calculating contingency values for Strategic estimates, refer to Annexure E – Contingency Example.

4.1.9 Determine escalation

The escalation allowance is necessary to provide adequate capital funding to compensate for likely cost increases in the project over time. Refer to Section 3.5 Escalation for more information.

4.1.9.1 Program of works

A realistic project program of works (or schedule) is key to the development of an estimate. This program of works must incorporate all phases and activities with realistic durations. The level of detail will depend on the stage of the project at the time when the program is developed and the information available.

At the strategic phase, the activities included in the estimate may be based on the department's WBS structure and sequence levels 1 and 2 as outlined in Section 7.1 Work Breakdown Structure. At this stage the program may be in a timeframe of years depending of the project type.

The concept phase activities to be considered in the project program should include those outlined in Section 3.3.1 Planning Phase Costs. The activities breakdown in the schedule should be based on the WBS structure and sequence levels 1, 2 and 3. At this stage the program may be in a timeframe of months depending on the project type.

Within the development phase, the activities to be considered in the project program should include activities outlined in Section 3.3.2 Concept Phase Costs. The activities breakdown in the schedule should be based on the WBS structure and sequence levels 1, 2 and 3. At this stage the program may be in a timeframe of months, weeks or days depending on the project type.

At implementation stage, the activities considered in the project program include tendering and appointment of the contractor. Often these activities are not receiving due recognition however they can add significant cost to the project if not planned adequately.

A construction program is essential if the costs are based on first principles. The allocation of time, resources and efficiency will be greatly influenced by the method of construction.

The durations for activities under each stage should be carefully worked out based on past experience and the requirements of the project and project milestones. All activity durations must have a float (time contingency).

All estimates are required to be presented in outturn dollars, in appreciation of the likely program of works. It is necessary to apply escalation to current dollar costs to arrive the outturn costs.

4.1.9.2 Cashflow

Cashflow is the spread of total project costs (base estimate plus contingency) over the project duration in which the funds are expected to be spent. The project cashflow is heavily influenced by the implementation program and the expenditure profile during construction.

To avoid optimism, bias the estimators should be guided to be realistic as to when the project will commence construction and the likely expenditure profile (drawdown rate) through the construction period. The date for commencement of construction will depend on many factors including timing of funding approvals.

The planned construction commencement date and expenditure profile, including funding availability for Australian Government funded projects shall be verified with the Federal Department of Infrastructure and Regional Development before the anticipated project cashflow is finalised to ensure any funding constraints are highlighted.

Projects often experience slower cashflow draw down than that expressed in target programs due to delays. Project approvals, funding approval, land acquisition, delays through inclement weather, shortages of labour or materials all can result in an extended project duration.

4.1.9.3 Escalation

Escalation is the anticipated increase in project cost over time as a result of various factors such as inflation, market conditions, supply constraints and project complexity.

The project estimate is to be expressed in outturn dollars to reflect the actual project cost at completion.

The escalation rates to be applied to QTRIP project estimates to provide adequate funding to compensate the project for cost increases due to inflationary factors that occur during the life of a project, are shown below in Table 4.1.9.3.

Table 4.1.9.3 - Queensland cost escalation rates as of February 2021

Current escalation rates

Financial year	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26
Escalation rate	1.6%	2.8%	3.4%	3.4%	2.8%	2.3%	2.1%

The estimator is responsible for project cashflow forecasting in consultation with the project manager. The validation of forecasts is the responsibility of the project manager.

When preparing road link plans, strategic estimates will be presented in current dollars because the total project duration is uncertain. It isn't until the candidate project has an approved proposal nominating the project timeframes that an estimate can be prepared / converted to outturn dollars.

It is important to update the project estimates as the project is moving forward during the life of the project. Cost estimates are to be revised and cost forecasting to be fine-tuned as the project definition become clearer over the time.

The escalation rates are adjusted on an annual basis. And the most recent escalation rates are published in the *QTRIP Governance Principles* on the department's internal PIP SharePoint page. See Section 3.5 Escalation of this manual for more details. An escalation spreadsheet tool in Annexure H – Escalation Calculator and is available electronically from both the internal PIP SharePoint and the departmental website.

4.1.10 Complete estimate and document in a report

The estimate will be included in the project proposal and should cover the scope, assumptions and all the information utilised to establish the estimate.

Strategic estimates should be quoted as a cost range, in addition to stating a most likely figure within that range and determining the estimate category to reflect the level of uncertainty. Documentation should be in the form of the estimate report format given in Annexure J – Estimate Report Format.

This report may range from a single page to a multi-page document with workings provided as detailed attachments, as appropriate to the nature and scale of the project.

4.1.11 Conduct estimate review

Review of strategic estimates will not be as intensive as subsequent estimates. However, some form of appraisal must exist to ensure the estimate is realistic.

The strategic estimate will also be reviewed as part of the processes for developing route and link planning and project proposals for QTRIP projects.

There are three different review processes that are applicable to an estimate in its life cycle:

- peer review
- concurrence review, and
- program review.

The cost estimate reviews must be undertaken by a the suitably qualified and experienced person such as an experienced internal estimator or prequalified estimating consultant. The person who undertake the estimates reviews should complete the checklist available in the Annexure B – Project Cost Estimate Review Checklist once the process is completed.

The *Federal Notes on Administration for Land Transport Infrastructure Projects of the Australian Government* requires all jurisdictions to provide an evidence that project costs have been comprehensively reviewed and authorised in accordance with their cost estimating guidance documents.

4.1.11.1 Peer review

A peer review shall be focused on aspects such as computational checking, review of estimating method used, review of the quantities and rates used to build the estimate, review of the schedule, reproducibility of the estimate, check assumptions, inclusions and exclusions are valid and review of the scope to determine whether it achieves the project objectives.

A peer review must be undertaken for all types of projects and must be undertaken by an independent and experienced estimator, project manager or specialist officer authorised by the regional / district director.

The peer review officer responsible for the process will:

- check that the adequacy of the documentation submitted by the project manager is adequate for the review process and if not, ask for further documentation
- review item quantities and rates using the Pareto approach (80:20 rule)
- review optimism bias
- identify potential errors in the estimate
- report cost trends for the project
- review benchmarks for similar work
- review project constructability
- review risk registers and checking that contingency allowances are within the appropriate ranges
- assess construction methodologies and review constructability issues

- verify that key assumptions have been listed and appropriate allowances have been made in the estimate, ensuring that the scope is fully understood and addressed, and
- verify that previous quantities, rates, lump sums and contingencies have been reviewed as additional information has become available.

Any concerns or irregularities found during the peer review process shall be reported back to the project manager for action. The project manager shall arrange for a peer review of the estimate and the appropriate documentation which include the completed estimate peer review checklist. Comments made by the reviewer should be discussed, agreed and actioned in the estimate.

4.1.11.2 Concurrence review

A concurrence review is an independent third-party review of a project estimates where the estimator, sponsor and reviewer agree regarding the estimate metrics. This review must be prepared by a suitably qualified and experienced person independent of the project, such as an experienced internal estimator or prequalified estimating consultant.

The purpose of concurrence review is to assess:

- estimate conformance against the estimating standards, and
- estimate reasonableness.

Concurrence reviews shall be undertaken for projects that are:

- state funded projects with an estimated cost greater than $25M
- nationally funded projects with an estimated cost greater than $25M, and
- all projects perceived to be high-risk or complex projects.

The responsibilities of the concurrence reviewing officer are the same as for the peer reviewer.

Any concerns or irregularities regarding the estimate shall be the subject of corrective action by the project manager before being resubmitted to the regional / district director for signing off the concurrence review.

4.1.11.3 Program review

The program manager will review costs of all projects included in the program and prioritise the project based on the information and estimates available.

If there is insufficient funding to include a project within the program, the project may be delayed, cancelled or a review of project scope may be initiated to reduce the overall project cost.

4.1.11.4 Document review

The document review completes the review process, and the documentation ready to be assembled for approval.

The documentation to be submitted for approval include the estimate report with attached workings and the completed Cost Estimate Review Checklist (Annexure I).

4.1.12 Estimate approvals

Cost estimates created for all QTRIP projects must be captured in the 3PCM system for lessons learned purposes. Once cost estimates are created in 3PCM system, they can be linked and generate tender prototype documents.

The cost estimates captured within the 3PCM solution are subjected to the electronic approval process. The approval process applies at every estimate stage and decisions in this process is to be recorded on the 3PCM system. In additional Project Cost Estimate (Summary) and Approval Form M4775 (Annexure L), shall be presented to the project manager.

The Project Cost Estimating Control Checklist Form F4906 (Annexure I) must also be completed and attached with the estimate.

This is to ensure the processes outlined in this manual are being followed before project cost estimate sign-off and approval by regional / district director.

Approval to cost estimate is required for each stage of the project and the approval levels for all estimates are given in Table 4.1.12.

Table 4.1.12 - Approval levels for all estimates

Estimate certification	Appropriate authority level
Prepare estimate	Estimator
Review estimate	Peer or independent reviewer
Recommend estimate	Project manager
Accept estimate	Project sponsor/program manager
Approve estimate	Project customer/regional/district directors

For all projects seeking Australian Government funding contribution and listed in the National Partnership Agreement (NPA) schedules, with the exception of maintenance and Black Spot Projects, are required to submit a Project Proposal Report. All costs listed in the estimate seeking Australian Government funding against a project must be expended on approved purposes and reported GST exclusive.

Note that Australian Government announcement of committed national funding to a particular project, and its subsequent inclusion in the NPA Schedules reflects the Australian Government's commitment to the outcomes of the project but is not a guarantee of funding. Funding must be subsequently approved by the Federal Minister, in accordance with the relevant legislation.

Note that an assessment of the merits of the proposal by Infrastructure Australia for projects seeking $250M or more in Australian Government funding is required and forms part of the approval process. The department is required to provide business cases and relevant supporting information and documentation to the Australian Government and to work cooperatively through its assessment process which may cover:

- base estimate
- contingency
- escalation; and
- constructability.

Further guidance on approval process involving nationally funded projects can be found in *Australian Government Cost Estimation Guidance* document available internally on the department's intranet.

4.2 Estimating responsibilities

4.2.1 Estimate preparation responsibilities

This section details the responsibilities vested with each individual involved in the project delivery process related to cost estimating.

The project manager is responsible for:

- establishing the project scope in consultation with the customer and stakeholders (internal and external), and in accordance with the approved documentation relevant to the project stage (road link plans, project proposal, federal project proposal report, business case and so on)
- providing all necessary documentation to enable the estimator to undertake the estimate
- providing necessary information on work methods and relevant local factors
- establishing panels with appropriate disciplines to carry out appropriate risk management and estimate review processes
- ensure the estimating process is compliant with this manual, and captured in the 3PCM system
- facilitating the estimating process between customer, program manager, stakeholders and estimator
- establishing appropriate CapEx / OpEx separation of cost elements in the estimate, and
- prepare the risk register using the risk context profile in participation with all stakeholders, update, monitor and establish residual risks for contingency.

The estimator is responsible for:

- developing the estimate as per the processes defined in this manual
- seeking advice and assistance from the project manager if any part of the process is unclear
- advising on and bringing any detected discrepancies, changes and varied risk assumptions to the attention of the appropriate project manager, or other interested stakeholders
- undertaking the risk modelling as appropriate for the project Type (Type 1, 2 and 3)
- presenting estimated costs in appropriate CapEx / OpEx cost codes, and
- capturing estimates in the 3PCM solution. If the estimate is prepared by an external service provider, then this will be the responsibility of the project manager.

4.2.2 Estimate review responsibilities

The estimator is responsible for:

- carrying out the reality check of the estimate prior to submitting for peer review / approval
- checking that necessary documentation has been completed and submitted with the estimate
- checking the risk evaluation and risk modelling approach is appropriate for the project type
- assisting the project manager with the peer and concurrence review, and
- updating the estimate to reflect peer / concurrence review findings.

The project manager is responsible for:

- ensuring suitably qualified and experience person is nominated to undertaker the estimate reviews
- ensuring the appropriate review is completed prior to submitting the estimate for approval
- ensuring the appropriate review process is followed (peer / concurrence)
- ensuring appropriate documentation is completed prior to submitting the estimate for approval
- ensuring the review comments are actioned and estimate updated by the estimator, and
- provisioning further endorsement of the estimate for approval in 3PCM solution.

The program manager is responsible for:

- comparing the project estimate to benchmark data or other projects / estimates
- advising any significant changes to the program which impact the project estimate, and
- provisioning additional endorsements as required (for projects over $25M) in 3PCM.

The project customer / regional / district director is responsible for:

- ensuring the estimating processes in this manual have been followed, and
- approving the estimate in 3PCM solution.

Note: all these approvals in 3PCM solution are based on electronic processes.

4.3 Optimism bias

Optimism bias is the tendency to underestimate the likelihood of experiencing adverse events, or the common tendency to underestimate the cost of a project, or a project cost element.

This bias arises in relation to estimates of costs, benefits and task duration. It must be accounted for explicitly in appraisals, if these are to be realistic.

When plans are implemented, optimism bias typically results in cost overruns, benefit shortfalls and delays.

To prevent / mitigate the potential impact of optimism bias in setting unrealistically low contingencies, few control approaches are recommended:

- Benchmark against other cost estimating procedures which describe the contingency range expected at each phase of the project, based on the estimator’s experience and considering experience from a wider industry.
- Cross checking assumptions with different people at different meetings.
- Conducting multiple short risk reviews with more people rather than long risk workshops with limited number of people, and
- Using the ranges which are wide and generally biased on the upside. Emphasis on realistic budgeting and implementation of routine.

5 Estimate development by phase

This section details the estimating process that is required to follow the OnQ project management framework.

According to OnQ, QTRIP projects begin with a pre-project phase and then continue through to concept, development, implementation and finalisation phases.

As the project progresses, various stage estimates will be prepared. Each stage estimate also requires a report (see Annexure J – Estimate Report Format) on the estimate development process with the detailed workings attached.

5.1 Factors influencing estimates

Following are the major factors influencing an estimate:

- project scope
- project constraints (design information quality / availability, potential geological / other latent issues
- constructability
- construction program
- environmental and heritage issues
- traffic management issues
- location issues
- risk
- method of delivery
- sustainability and climate change issues
- key operational policies, and
- Public Utility Plant (PUP) works.

5.1.1 Project scope

To produce a total project cost estimate, all activities throughout the project life cycle need to be considered, in addition to those described in Section 4.1.1 Establish Project Scope:

- Strategic planning – road link planning, gap analysis, strategic studies
- Concept phase – project proposals, traffic / transport modelling, options analysis, business case
- Development phase – project plan, development phase Stage 1 design, development phase Stage 2 design, tender document preparation and specifications
- Implementation phase – construction, land resumptions, PUP relocations, temporary works

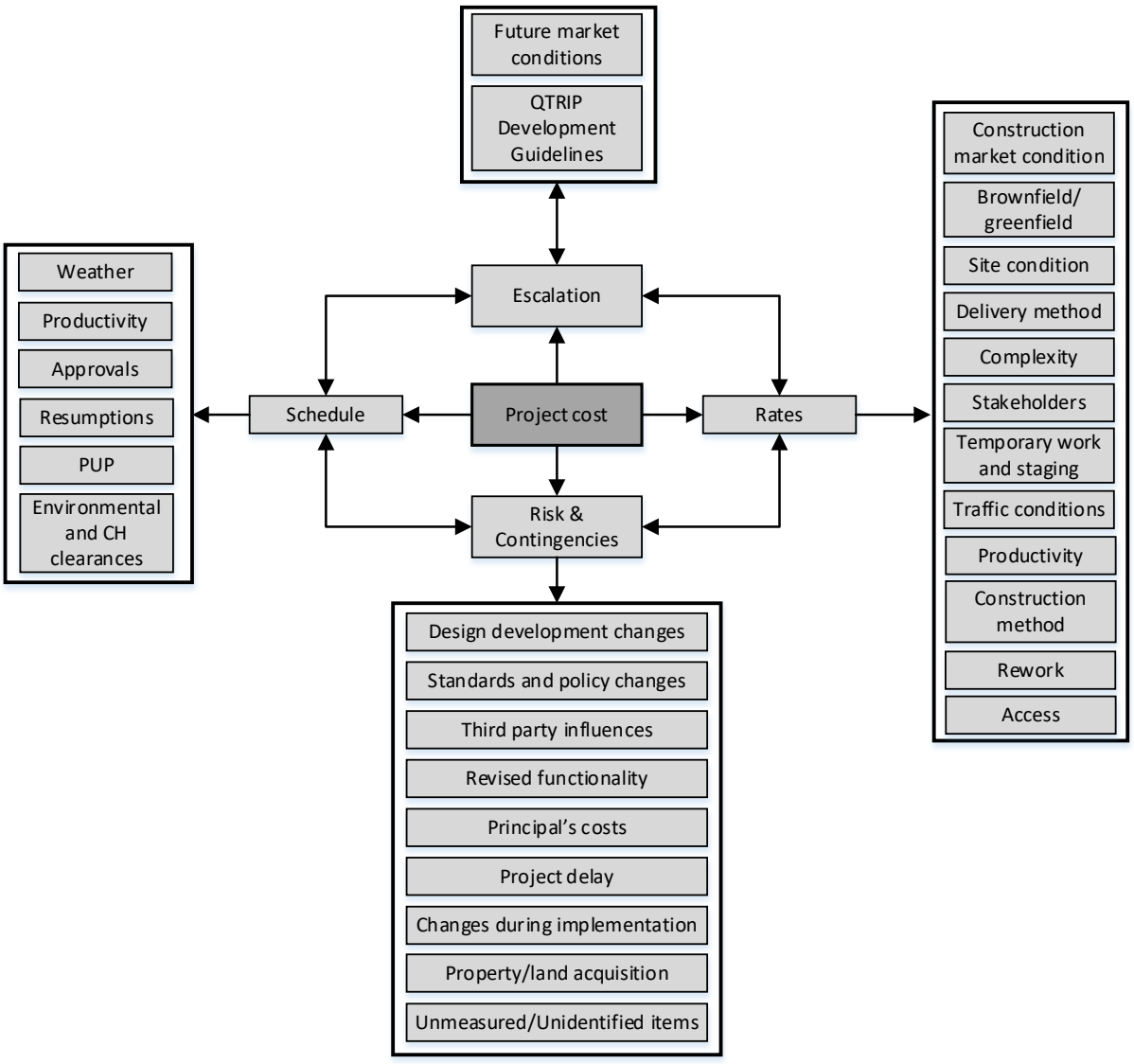
- Finalisation phase – as constructed plans, handover and finalisation reports, and
- Risk, contingencies and escalation - all need to be considered for all phases.

The estimating method needs to be matched to the expected estimate accuracy and information available.

Different estimating methods are outlined in Section 9.1 – Estimating Methods together with comments on their application. More than one estimating method can be applied within an estimate, this is often the case when some items are more cost sensitive than others.

For strategic, business case and S1D estimates, estimators are encouraged to use updated historical information as a reality check when building up the first principles estimates. This requires regions / districts to keep accurate information on previous project costs in their elemental cost databases for resources such as rock, gravel, sand, cement and concrete.

Figure 5.1.1 - Factors influencing an estimate



Because of the wide range of activities to be estimated, components of the estimate may have to be developed within their respective functional areas and combined to form the total project cost

estimate. For example, designers would have input into the estimate for the planning and design components, constructors for the civil construction component, traffic engineers for the traffic modelling component, and so on.

The estimator will collate the various cost components to form the total cost estimate and the process can be described in terms of inputs, key activities and its outputs, as indicated in Table 5.1.1.

Table 5.1.1 - Cost estimating process overview

Inputs	Activities	Outputs
• Plans and specifications • Work breakdown structure • Schedule of rates • Program of work • Risk register • Project cost records • Benchmarks	• Estimate planning • Site visits • Risk assessment • Contingency assignment • Escalation • Estimating review	• Total project cost estimate in current dollars and outturn dollars. • Supporting details • Assumptions • Cost management plan (cost make-up) • Archived records

5.1.1.1 Project definition

Some examples of definition, context, constraints and program documents that the estimator needs to be provided with are the:

- likely project program (both pre-construction and construction phases)
- requirements for temporary works and staging
- type of project to establish level of risk and complexity
- what constraints exist (on access / possessions, staging, continuity of traffic flow, and the like)
- key interfaces so the extent of the project is known and conditions applying at those interfaces
- method of delivery (construct only, design and construct, alliance and so on), and
- defined out-of-scope work.

5.1.1.2 Physical scope criteria

Estimates developed with poorly defined scope often found to be erroneous.

Where information provided is inadequate to develop a reasonable cost estimate, then assumptions have to be made during the process, which must be properly recorded and attached to the estimate.

Some common examples of physical scope criteria that the estimator should be made aware of are:

- nature of work (intersections, new road construction, widening existing road, duplication, bridgeworks, change to traffic signals
- extent and limits of work (so there is less uncertainty as to extent of work costed)
- assumptions made in design of key features (pavement, earthworks, extent of rock
- interfaces, such as property, grade separations, existing infrastructure
- PUP-related work activities, which are generally vastly underestimated, and
- defined out-of-scope work.

In cases where the scoping details provided found to be inadequate, historical projects in similar nature should be referenced to validate the assumptions made.

5.1.1.3 Common scope issues

The more commonly encountered problems in the project scope definition are:

- complete item omission
- incorrect item quantity determination
- inappropriate items included
- ambiguities in the defined scope
- unapproved variations, and
- legislative changes and agency approval requirements.

5.1.2 Project constraints

The project constraints can be physical, environmental, regulatory or visual which may occur on a project at various stages.

Some of the common constraints that affecting the project scope are:

- property acquisition issues
- the need for sound barriers or air-treatment
- treatment of water before discharge
- access difficulties / need for providing access to properties either during construction
- environmental and cultural heritage values, for example, protected plants
- limitations on working hours, and
- restriction on usage of certain type of equipment.

PUP related work activities are potentially one of the most difficult constraints to manage in estimating. Some services that are located underground may require adjustment, relocation or replacement and it is often difficult to ascertain the likely extent or the impact of these assets due to minimal, outdated or lacking as-built data availability, particularly in the early project stages. An appropriate allowance must be included in the estimate to cover such constraints.

Limitations pertaining to working hours and the deployment of environmental controls (noise, dust, water-pollution, and so on) might force the adoption of less efficient construction methods and deploying less than the optimum equipment that might affect the estimated cost.

For an example, at some work sites vibrating rollers cannot be used. In such situations, costs of deploying alternative methods need to be considered and included in the estimate. Furthermore, there may also be restrictions on certain types of equipment when working on marine and rail projects.

5.1.3 Constructability

Constructability is the optimum use of construction knowledge and experience in planning, design, procurement and field operations to achieve overall project objectives.

Constructability assessment is a process of identifying obstacles before the project commencement to reduce or prevent errors, delays, and cost overruns.

Research and studies are often used to determine the feasibility and efficiency of alternative production methods. For example, when considering the construction component of a project, the estimator may need to examine the earthworks mass haul diagram to evaluate haul quantities and distances, borrow and spoil requirements and the most effective construction fleet requirement to suit particular site conditions.

Similarly, for major projects in high traffic areas, it may be necessary to develop traffic management and construction staging plans to evaluate the cost of appropriate traffic management activities.

Estimators need to match the level of estimating effort with the expectations of estimating accuracy for the estimate being considered.

Provisioning constructability assessment is mandatory requirement for projects seeking Australian Government funding over $250M.

5.1.4 Construction program

A construction program must be prepared for every project which should be in accordance with the intended construction methodology showing key construction tasks, relationships, and resources. This may enable the estimator to establish relevant costs of key resources.

A realistic construction program is an important tracking key used to assist in producing an accurate estimate of anticipated project construction costs. The construction program must incorporate all major activities with realistic durations.

The level of detail to be incorporated will depend on the project staging and the quantum and level of information that is available.

The details of the construction program will vary depending on the project stage and the information available at the time of preparation. It is recommended that the project manager should closely work or liaise with the estimator to determine activity durations, constructability and production rates and so on.

It is recommended that potential impacts of environment and cultural heritage constraints on the construction program are recognised. For example, environmental approval conditions may limit construction to outside the breeding season for migratory birds if works are near a wetland area.

5.1.5 Environmental and Cultural Heritage issues

The projects included in the QTRIP must comply with Environmental and Cultural Heritage legislative requirements and where possible avoid and minimise any adverse impacts. It may be necessary for projects to mitigate impacts through delivery of offsets.

This is achieved by undertaking an Environmental and Cultural Heritage assessment prior to project commencement. Estimating costs associated with the preparation of environment and heritage assessments are much simpler than the estimating costs for compliance with the assessments or associated conditions.

The conditions of both Environmental and Cultural Heritage approvals and resultant project changes are usually not known until preparation of the final concept estimate. All preceding estimates must therefore be prepared in the absence of such detailed information, relying on learning from similar projects and advice from local Environment and Cultural Heritage officers. It is appropriate to include a contingency allowance for complying with such conditions.

In order to assist in the cost estimating process, assessment documentation must incorporate a list of Environment and Cultural Heritage related items to be included in the project cost estimate.

From July 2019, all waste being disposed to landfill in Queensland is required to pay a waste levy. This levy applies to general waste streams, including municipal solid waste, commercial and industrial waste, and construction and demolition waste. The levy is payable for waste generated within a waste levy zone or waste generated outside a waste levy zone but taken to a landfill within a waste levy zone. There is a small list of waste types that if disposed to landfill will not attract a levy, such as waste generated from natural disaster, serious local event waste, lawfully managed and transported asbestos waste, dredge soil, clean earth and illegally dumped waste collected by the government. The intent of the introduction of the Waste Levy is to encourage re-use and recycling to reduce the amount of waste taken to landfills.

The waste levy will impact on projects and therefore waste levy provisions should be included in costings / project estimate for construction and maintenance project costs. Different classifications of waste will attract different waste levy rates. Information on waste classifications and levy rates can be obtained from Department of Environment and Science, Queensland (DES).

There are some waste types that if disposed to landfill will not attract a levy, such as waste generated from natural disaster, serious local event waste, lawfully managed and transported asbestos waste, dredge soil, clean earth and illegally dumped waste collected by the government. Therefore, it is important the cost estimator understands the nature of the waste and government requirements.

As discussed in Section 3.3.6.2 Property Acquisition, environmental offsets incurred by a project can incur substantial costs and result in long-term management requirements beyond the life of the project. These costs will need to be considered and captured in the cost estimate.

Places, sites or artefacts of Indigenous or Historical significance might require project diversion or special treatments during the construction phase and could have monetary and time implications.

Potential for such occurrences must be carefully considered and included in the estimate. Environmental costs especially for offsets, fauna management infrastructure and contaminated land can be quite high, so it is important that an accurate estimate is completed and costed in the business case.

5.1.6 Traffic issues

The cost of traffic management is the single biggest cost component in any cost estimates for road infrastructure projects.

The nature of the traffic issues and traffic management approach is project-specific. Therefore, the cost for traffic management differs from project to project. Historical unit rates should not be directly applied without rigorous review and appropriate adjustment.

Some of the common traffic issues that should be considered during the project cost estimating process include:

- traffic management plan (TMP's)
- the modification or diversion of existing traffic (on a single or multiple stage basis) patterns and maintaining an agreed level of service
- the provision of site access for construction vehicles
- working days and hours

- the defining of allowable urban construction truck routes
- the upgrading of existing facilities as part of the project works, and
- the management and maintenance of all traffic management schemes.

The costs of traffic management are strongly recommended to be developed from the first principles.

5.1.7 Location issues

Location issues are site specific and the estimator must make a thorough examination of historical data and compare to present site specifics.

Appropriate adjustments must be made to historical data to account for site specific differences prior to use in the estimate.

Some examples of location issues influencing estimates are:

- geotechnical – ground conditions, nature of the terrain, flood plain, tidal flows and so on
- access – accessibility to the site, heavy plant access, storages and so on
- environmental sensitivity – protected animals, species or trees, wetlands and so on
- proximity to residential areas – noise and vibration issues, constraints on construction times and dates, blasting restrictions, use of local roads for haulage of materials and so on
- weather – will the weather pattern interrupt construction?
- availability / source of construction materials – location of the pits, batching plants and so on
- availability of labour resources – remote locations, unskilled labour, site specific wage increases
- the effects of environmental issues – noise, dust, hours of work and so on, and
- heritage and cultural significance – need for realigning the road to avoid areas of cultural significance.

5.1.8 Method of contract delivery

The department uses a number of contract types to deliver infrastructure projects. Each contract delivery method has its own characteristics which may have significant influence on overall costs. The most common contract delivery methods used at publication are:

- Transport Infrastructure Contract – Construct only (TIC – CO)
- Transport Infrastructure Contract – Sole Invitation (TIC – SI)
- Transport Infrastructure Contract – Design and Construct (TIC – DC)
- CPA (D&C) - Collaborative Project Agreement for major projects where design options exist
- Early Procurement Construction and Management (EPCM), and
- Minor Infrastructure Contract (MIC).

The estimate is therefore required to seek and obtain guidance and direction from the project manager to establish the most likely contract delivery method to be deployed, before initiating and commencing the estimating process.

5.1.9 Sustainability and climate change

Projects that are over $100M, inclusive of Principal's and Contractor's costs, will incorporate a sustainability assessment, using the Infrastructure Sustainability Council of Australia's (ISCA) Rating Tool.

Use of the tool incentivises the achievement of sustainable outcomes across the entire social, cultural, environmental and economic spectrum. These include the state priorities to:

- reduce greenhouse gas emissions
- protect the Great Barrier Reef through improving water quality in reef catchments
- enhance active transport and community connectedness, and
- ensure resilient infrastructure and communities.

Infrastructure sustainability requirements mesh closely with multiple project disciplines, such as:

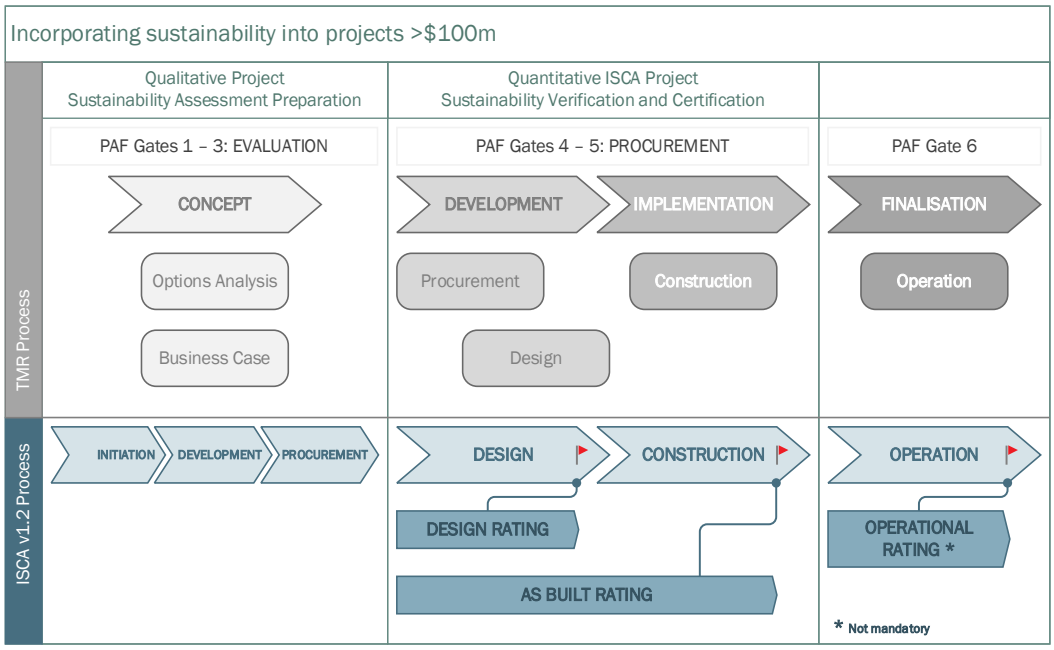
- stakeholder engagement
- cultural heritage assessment
- environmental assessment
- landscape design assessment
- road design, and
- hydraulics.

These cross-connections must be recognised during preparation of the estimate to avoid double counting.

Consideration of climate change is encouraged for all infrastructure projects to identify risks and opportunities for projected project benefits and deliver a resilient fit-for-purpose network.

The sustainability assessment delivered through the ISCA Rating Tool involves two complementary ratings, for Design and As-built (construction). Evidence for the ratings is captured and collated during the concept phase to be submitted for subsequent verification, as illustrated in Figure 5.1.9.

Figure 5.1.9 - ISCA Rating Tool application



For projects delivered via Design and Construct (D&C) contracts, the sustainability assessment is done as a combined rating.

For projects delivered through separate contracts for design and construction, the sustainability assessments must be in separate formal ISCA ratings for each contract. However, the sustainability measures being incorporated, must be clearly specified from the design phase.

The design contractor (or nominated design delivery partner) must obtain a design rating under the ISCA scheme, whilst the construction contractor must obtain an 'as built' rating incorporating design and construction elements, delivered via the construction contract.

The costs of implementing and managing an infrastructure sustainability assessment and obtaining an independently verified rating must be included in the business case project cost estimate (P90).

Registration fees for the ratings are available through the ISCA website.

Further advice on sustainability assessment requirements can be obtained from the Environment and Cultural Heritage unit within the department.

5.2 Pre-project phase estimates (strategic estimates)

Estimates completed during the pre-project phase are referred to as strategic estimates. These estimates are used solely for planning purposes to prioritise candidate projects. They provide, in addition to other information, a meaningful comparison of candidate projects. Strategic estimates are not for financial planning, cost control or budget setting. Estimates in this phase may be based on an assumed solution prior to undertaking a robust problem definition or options assessment process. This uncertainty should be identified in the strategic estimate to avoid representing the problem through the lens of a preconceived solution.

The level of estimate confidence depends on the maturity of the project proposal, the degree of scope definition and the level of project information. Often these estimates are developed with minimal

information and in a very short timeframe. Hence great care needs to be exercised in publishing these estimate figures.

Strategic estimates are generally not expressed as a probability not to be exceeded (for example P90) but should be described as an estimate range with a most likely cost. For example, project X is expected to cost between $15-25M, with a most likely cost of $22M. The challenge for producing strategic estimates is the lack of information to price.

Typical strategic global rates and the costs of completed projects are used as a guide for such estimates. Further information of the role of strategic estimates can be found in the OnQ website.

Projects that are nationally funded or are required to go through the PAF gating process will have different phases and confidence levels compared to OnQ. It is advisable to refer to the relevant guidelines to determine these requirements. Before creating a Strategic Estimate, the project manager will be required to create a new candidate investment in OPPM within the 3PCM system.

5.3 Concept phase estimates

The concept phase represents the period which a candidate project is considered for prioritisation to win funding. The three estimates generally prepared at this phase are:

- project proposal estimates
- options analysis estimates, and
- business case estimate.

Each of the estimates are expected to be more detailed and accurate than the strategic estimates due to improved scope definition and level and quality of project information available, at the time.

5.3.1 Project proposal estimates

The project proposal estimate is generally prepared with information adequate to determine if the solution is warranted to address a particular issue. It lays the foundation for improved project scope and development of the business case. Where multiple potential solutions exist, the project proposal estimate should identify this uncertainty. It is important to get the estimator involved in the risk analysis process to ensure that appropriate contingency allowance is identified.

The project estimate should be updated to reflect the actual costs to date associated with the concept phase as well as future project costs taking into account the improved scope. The recommendations on the estimating methodology for project proposal estimates can be found in Table 9.2.

In order for a project to be included in the unfunded years within QTRIP (years 3 and 4), a project proposal is required with a strategic estimate. The OnQ project management methodology provides templates for project proposal estimate documentation.

5.3.2 Options analysis estimates

Various alternatives for the project are modelled under options analysis estimates and are collected for comparison. Depending on the alternatives proposed, these estimates may require a total project cost for each option or be limited to particular components for which the options will be significantly different.

The standard process for compiling an estimate (see Section 4 Estimating process) is used to derive estimates for each option in the options analysis. Alternatively, where the total project costs of various options are to be compared, then the process for compiling a strategic estimate found in Section 5.2

Pre-project Cost Estimates, can be used. Recommendations on the estimating methodology for options analysis estimates can be found in Table 9.2.

The department's OnQ project management methodology provides templates for option analysis estimate documentation.

5.3.3 Business case estimates

The business case estimate, prepared at the end of the concept phase, will be the benchmark against which all future estimates are referred to.

The objectives of concept phase estimates are to:

- determine the baseline cost to deliver a project
- provide for cost analysis of competing solutions, and
- assist management to set budgets.

An approved business case provides justification for a project and allocation of funding and other resources to deliver products to meet a specified business need. These allocations and the time and quality requirements represent the criteria by which the project will be judged to have succeeded or not.

It is therefore crucial that the estimate is fully developed, considering all available information, and allotting appropriate contingency for risks.

An approved business case (with P50 and P90 estimates) is required for all projects that are intended to be included during the funded years of QTRIP (that is years 1 and 2).

The process for compiling a business case estimate is similar to the process for compiling a strategic estimate (Section 5.2 Pre-project Cost Estimates) however, it is assumed that additional information would be made available at this stage to prepare more accurate estimates.

Recommendations on the estimating methodology for business case estimating can be found in Table 9.2.

The OnQ project management methodology provides templates for business case estimate documentation.

5.3.3.1 Cost benefit analysis

A Cost Benefit Analysis (CBA) provides the economic viability of the project and adds credibility to the project investment.

A CBA should contain an estimate of travel time costs, vehicle operating costs, accident costs and other externalities expected as a result of the project being delivered and should also describe the steps taken to calculate the Benefit Cost Ratio (BCR), Net Present Value (NPV) and first year rate of return.

The project proposal and option analysis estimates should be accompanied by a CBA.

A CBA undertaken during the options analysis may be revised and expanded for the recommended option/s. The report must contain appropriate qualitative analysis of financial, economic and social impacts and risks together with any other impacts associated with the project.

The level of analysis will differ depending on the project’s complexity, risk profile and degree of uncertainty.

The CBA consists of a three-stage evaluation process, namely the:

- strategic merit test
- rapid appraisal, and
- detailed appraisal.

A strategic merit test CBA is to be undertaken in the project proposal, which includes a preliminary estimate of the main benefits and costs. Refer to relevant chapters of the *Cost Benefit Analysis Manual*.

A rapid appraisal is to be undertaken in the options analysis, whilst a detailed appraisal is to be undertaken at the business case.

CBA6 is a computer-based cost benefit analysis tool which specifically designed for economic evaluations of road infrastructure investments.

It uses the current Austroads project evaluation methodology to evaluate a given road project and will report the BCR, net present value and first year rate of return.

Note that P50 estimate of cost is used to develop the BCR regardless of the funding source or project type.

Contact the cost benefits analysis team at CBAteam@DTMR.qld.gov.au for any questions relating to calculating the BCR and for any assistance in preparing a CBA.

Figure 5.3.3.1(a) - Procedure for preparation of estimates and concurrence review and approval

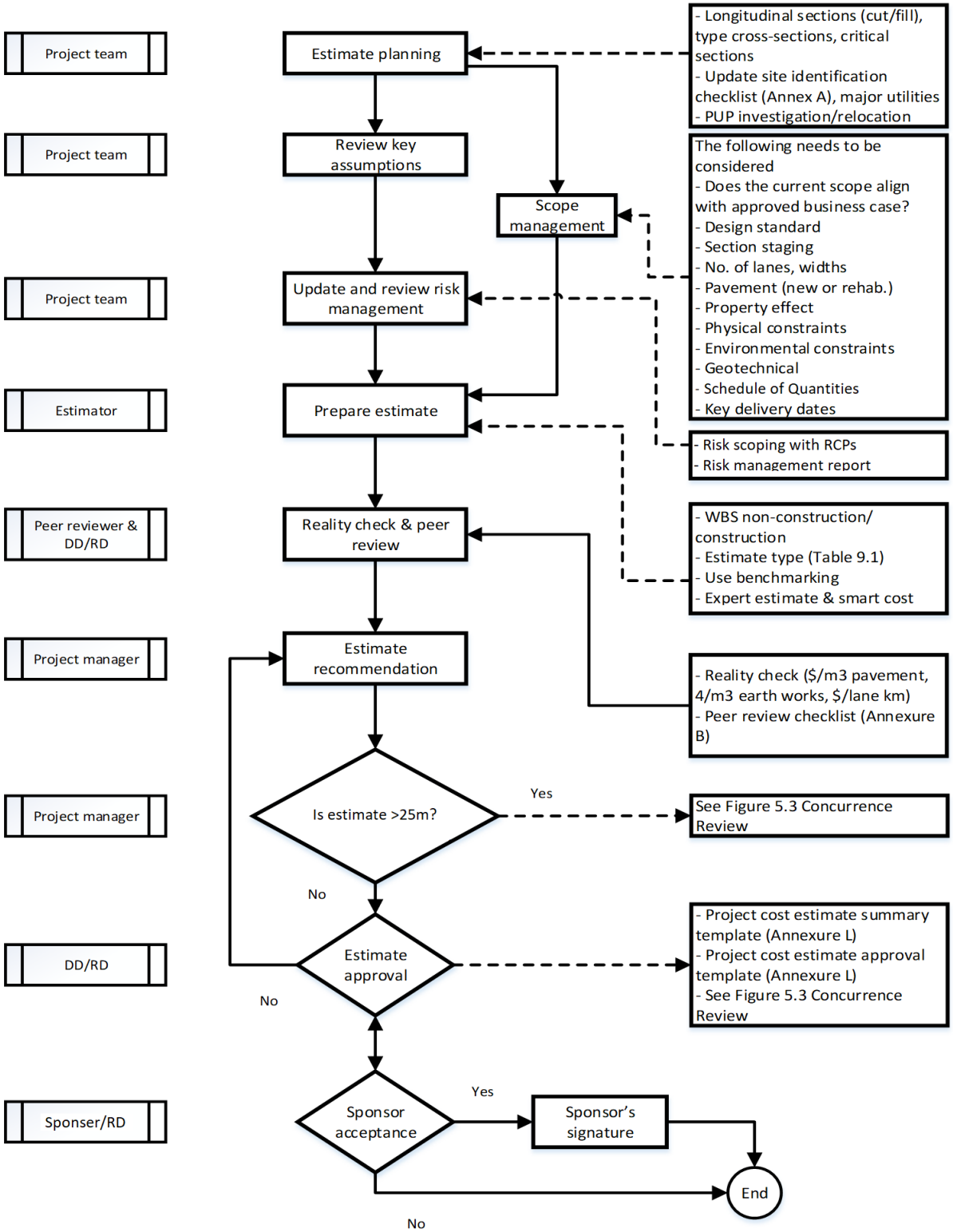
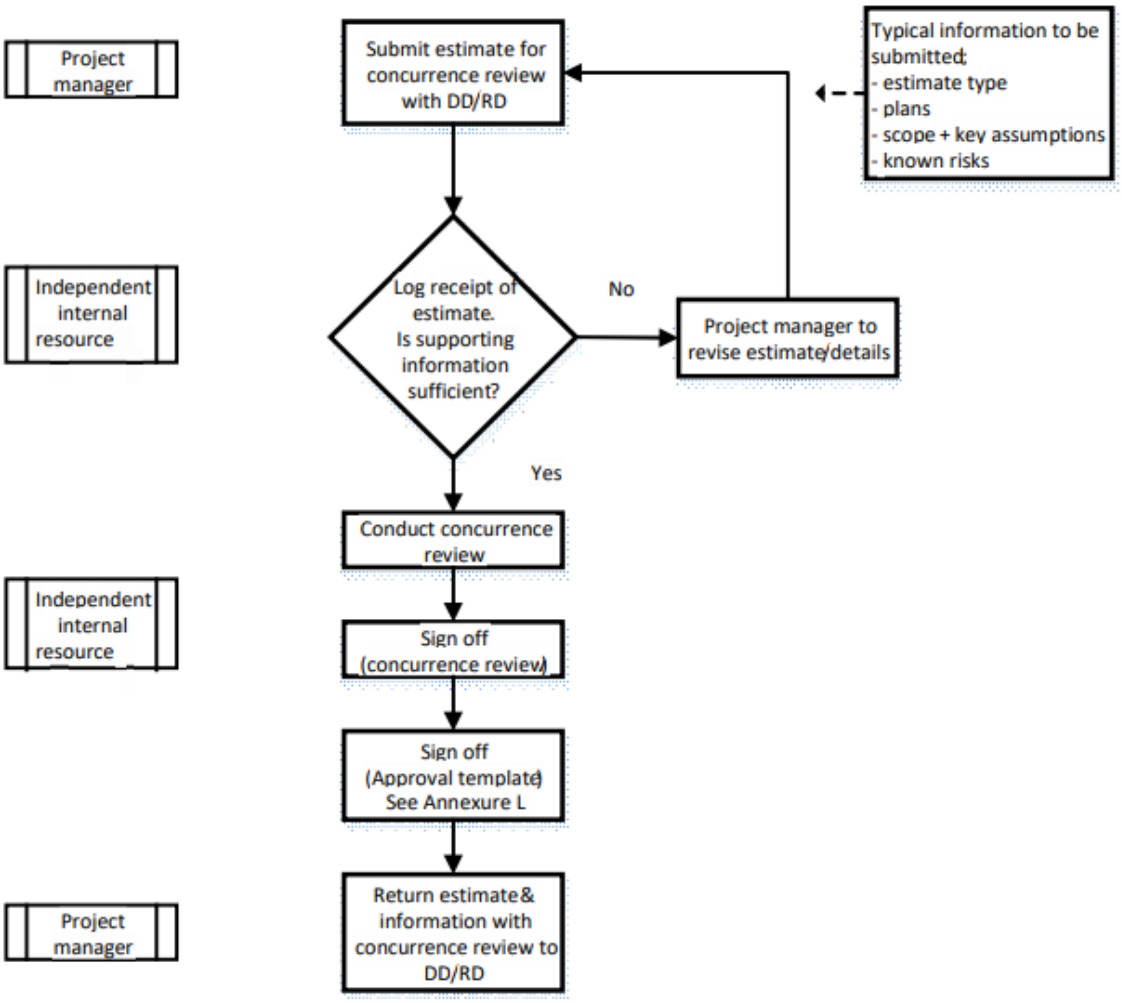


Figure 5.3.3.1(b) - Procedures for concurrence review for business case and design stages



5.4 Development phase estimates

Three key estimates can be created in the development phase, which are:

- Development Phase Stage 1 Design (S1D) estimate
- Development Phase Stage 2 Design (S2D) estimate, and
- Estimate for Comparison with Tender (EFCT).

These estimates are to be documented in the project plan.

While S1D estimate is used for some projects to determine the project budgets, the key outputs of the development phase are the S2D estimate, tender documents and an executed contract ready for the implementation phase.

The S2D estimate informs the estimate for comparison with tenders which, upon acceptance of a tender, informs the construction estimate.

Note that the financial approval process is also determined by the construction estimate.

5.4.1 Development phase Stage 1 design estimates

The purpose of this estimate is to confirm that the advanced design and its associated estimate align with the business case and budget. This is done so that, in the event that project feasibility cannot be established, the project does not incur the costs associated with a full S2D.

The process for compiling a S1D estimate is similar to the process for compiling a strategic estimate found in Section 5.2 Pre-Project Cost Estimates, but using the additional information that will be available at this stage to more accurately determine project scope, its quantities, unit rates and project development work.

Further recommendations on the estimating methodology for this estimate can be found in Table 9.2.

Figure 5.1.9 and Figure 5.3.3.1 explain the procedure for preparation of the S1D estimate along with concurrence and approval processes.

5.4.2 Development phase Stage 2 design estimates

The S2D provides the full set of information on the construction aspects of a project and thus is what a project's construction estimate needs to be based on before construction begins.

The process for compiling a S2D estimate is similar to the process for compiling a strategic estimate (Section 5.2 Pre-Project Cost Estimates) but uses the additional information that is available at this stage to increase scope, quantities and unit rate accuracy. Further recommendations on the estimating methodology for S2D estimates can be found in Table 9.2.

Figure 5.3.3.1(a) and Figure 5.3.3.1(b) explain the procedure for preparation of the S2D estimate along with concurrence and approval processes.

5.4.2.1 Data verification

The estimator must be provided with relevant information, including:

- S2D estimate report
- proposed contracting strategy for the project, and
- any other available information, such as aerial photographs, computer-generated quantities, handover cost estimates, risk register and so on.

The estimator must verify that no unaccounted-for event has occurred since the preparation of the S2D estimate and that no new information has been made available that impacts or changes the values of the assumptions used in its preparation. If an event or new information causes a change to the values and the assumptions made, appropriate adjustments must be made to the estimate.

5.4.2.2 Quantities and rates

The rates adopted must align with the quantities measured. Quantities and rates adopted must be compatible with the project scope and be updated to reflect the latest designs.

Sources of information used to calculate quantities for each item must be documented and summarised.

If some time has elapsed since the S2D estimate was prepared, or if an event has occurred that could influence costs, the estimator must adjust the rates and/or seek validating quotations from local suppliers or subcontractors for these items to update the Estimate For Comparison with Tender (EFCT).

5.4.3 Estimate for comparison with tenders

The estimate for comparison with tenders allows submitted tenders to be compared with the department's estimation of construction costs.

Reasonable market rates should be assumed for the contractor's construction costs in developing the EFCT which then provides the means for validating and comparing tender costs.

Costs factored into the EFCT are dependent on the type of contract used, which should have been determined as early as the business case.

The EFCT is developed at the tender analysis phase of the project.

5.4.3.1 Preparing the estimate for comparison with tenders

The EFCT supports the tender analysis phase of the transport infrastructure project delivery system.

In most cases, this is an extract from the S2D estimate excluding principal's costs, principal's retained risks / contingencies and escalation.

Refer to Section 5.4.3.3 - Exclusions from the estimate for comparison with tenders for development of the EFCT.

5.4.3.2 Review of estimate for comparison with tenders

The estimator must prepare a price schedule that, with the exception of rates, must be identical to the schedule included with the contract document.

For Type 1 projects, the project manager may arrange a peer review of the EFCT, together with all other estimates.

5.4.3.3 Exclusions from the estimate for comparison with tenders

As the EFCT is a comparison of tenders, costs incurred by the principal shall be excluded.

These exclusions may comprise of:

- project management costs
- principal arranged insurance
- project development costs
- S2D and documentation costs unless specifically included in the contract
- property acquisition costs unless specifically included in the contract
- PUP costs unless specifically included in the contract
- finalisation costs
- principal-supplied materials, and
- price escalation adjustments (CPI, other).

5.4.4 Approved project delivery value

Approved Project Delivery Value (APDV) process reviews and validates the costs required to deliver the project to its agreed scope. It also considers the remaining risks and the associated contingency and escalation to enable the successful delivery. The APDV is conducted at the time of awarding the main contract, and at significant milestones for long duration projects. It is the sum of the approved

contract offer, and principal's costs and revised contingency amounts (including revised escalation based on the contractors' construction program).

It does however exclude any identified potential savings, taking into account the known costs to date, any unrealised risks and status of the changed risk profile at contract award. Generally, the APDV project savings are the difference between business case funding (P90) and the APV at the tender award (P75).

APDV is the agreed and approved value of the project identified at the contract award (approval of preferred supplier) stage, taking into consideration completed items of work (such as pre-construction activities and early works), forecast costs to complete the work, and a change to the risk profile to reflect a P75 risk allowance.

APDV is the sum of the approved contract offer and principal's costs (revised base estimate) and revised contingency (including revised escalation based on the contractors' construction timetable) and excludes identified potential savings.

The APDV process is applicable to all projects with a total estimated value over $25M.

The areas identified to explore for pre-program savings are:

- value-for-money workshops
- leadership reviews
- risk mitigation
- concept phase (after the business case design) reviews
- changes to standards
- savings within the program
- design innovation
- fit-for-purpose design
- delivery strategies, packaging and bundling
- appropriate procurement method
- appropriate standards and specifications
- competitive pressure
- OnQ governance
- scope controls, and
- difference between tendered and estimated rates.

Further information about APDV process can be obtained by PCAR team of the department.

5.5 Implementation phase estimates

The focus of estimating in the implementation phase is generally on regular updating of the cost estimate, cost forecasting and contract variations.

5.5.1 Construction estimate

The construction estimate is collated and updated using the information available on the preferred, negotiated and approved tender.

The total project cost is updated, taking into account the updated risk and contingency and escalation prior to comparing it with the project budget.

5.5.2 Regular updates of the cost estimate

There are two activities associated with updating cost estimates on a regular basis:

- incorporating lessons learned from feedbacks, and
- incorporating project and cost changes as a result of approved variations.

Project cost estimates must be updated every time when the project scope undergo changes.

5.5.3 Periodic forecasting

During the life of the project, the project manager must exercise cost control by periodically forecasting the expected project expenditure based on current information.

Periodic cost to complete cost forecasts can also be used to identify and capture residual, anticipated, future variations and contingent project costs, and if added to completed project costs and approved variations, then provides an updated project cost.

The budget forecast for projects is made through the cost sheet contained in the department's 3PCM system. Once the cost sheet is established at the outset, the budget needs be forecasted into individual WBS items (CapEx and OpEX) and across the project duration, including the contingency and escalation allowances. Refer to Section 7.1.3 Project Cost Breakdown Structure for details.

During the implementation stages of the project, the actual project expenditure also recorded against the same WBS elements and across the project duration enabling the project manager to keep an eye of the cost against the budgetary allocation. This process is known as the 'end of the month validation' of costs against the project budget.

The department's business rules require the actual costs to be validated against the forecast on monthly basis for every project in 3PCM system.

5.5.4 Estimating contract variations

The principles used at the time of preparing the pre-contract estimates should be adopted to prepare any contract variations proposed by department or requested by the contractor.

All contract variations are managed and processed via the contract module within the 3PCM system.

5.5.4.1 Pricing the variation

A variation must be prepared in a clear, concise and transparent format that is explicit and consistent with the method of construction, as well as the circumstances and timing during which the variation occurs.

A variation may result in:

- an increase / decrease or omission of any part of the work under the contract
- a change of the character or quality of any material or work

- a change of the levels, lines, positions or dimensions of parts of the work under the contract
- execution of additional work, and
- demolition or removal of material or work that is no longer required.

The calculation of indirect costs, overheads and profits should only be addressed when the direct cost pricing has been completed and the additional time involved (if any) is calculated.

5.5.4.2 Scope variations

The same principles used in the preparation of estimates can be adopted to prepare scope variations which are either proposed by the project manager or requested by the customer and/or contractor.

All variations should be accurately recorded at all phases of the project.

The requirements for assessing the construction component of the variations must comply with the requirements described in Section 5.5.4.1 – Pricing the Variation.

In addition to the construction component, allowance must be made for additional costs associated with:

- development phase
- investigation and design
- project management
- traffic management
- contract administration
- principal's costs
- property acquisition
- PUP adjustment costs (that have not been included in the construction portion)
- insurance
- environment and heritage management amendments, additional environmental approvals or re-negotiation of approval condition, and
- finalisation phase.

The scope variations also include the changes made to the project's program as a result of time variations. Therefore, when approval is sought for scope variations, it must include both financial and time costs.

5.5.4.3 Submission of variations

The state-wide program investment delivery application shall be used to submit program variations which must be approved by either the sponsor or the customer.

Program variations are approved according to the applicable business rules for a particular business program.

5.6 Finalisation phase estimates

Information on a project's cost is an important source of data for future planning and to gauge the estimating performance.

Estimators should undertake regular benchmarking of project costs based on the actual data, and performance standards (in Section 2.4 - Performance Standards and Measurement) to complete documentation such as project learnings register and OnQ project completion report.

For PAF and for Australian Government funded projects, additional reports may be required.

5.6.1 Project learnings

The project learnings regarding estimating can be summed up with one question:

> *"How much did the project finally cost, when compared with the originally approved budget and the business case P90 estimate?"*

If there is a large gap between the business case estimate, the approved budget and the final project cost, the discrepancies may be related the estimating process. Generally, the reasons for the differences could lie with:

- project cost estimating
- project cost management
- contract management, and
- adoption of project management processes, in particular the scoping and risk analysis / management.

The project learning information should be captured in the following areas:

- the project learnings register
- the project completion report
- the project financial close-out report
- any documented project reviews
- contract documentation
- archived data, and
- performance reviews.

Records of project learnings will improve the decision making and the planning processes for new projects, as well as support the development of revised organisational strategies.

5.6.2 Post implementation review

A Post Implementation Review is conducted after completing the project. Its activities aim to evaluate whether project objectives were met, how effectively the project was run, lessons for the future, and the actions required to maximise the benefits from the project outputs.

Any project which has activities that triggered the environment and heritage approvals, post implementation process requires finalisation of reporting and surrendering the approvals. This may also require future post-construction monitoring and management of post project completion actions.

Unexpected failure of re-vegetation due to weather or other external factor may require additional re-vegetation and should be considered within the project's contingency allowance.

More information can be found in the *TMR Asset Information and Finalisation Guideline* located internally on the PMI SharePoint page.

5.7 Exceptions with maintenance and operations

Compliance with this manual is mandatory for cost estimates prepared for department's infrastructure projects.

However, an exception is applied to the following project categories:

- Asset maintenance projects (such as Road Maintenance Performance Contracts – RMPC's) are typically lower in risk and value than major infrastructure projects.
- Projects in the Maintenance, Preservation and Environment (MPE) and Road Operations (RO) Elements, as published in the Queensland Road System Performance Plan (QRSPP), and
- Projects which are smaller in scale and are currently treated as either CapEx or OpEx and no further dissection of cost estimates are necessary. For example, a pavement rehabilitation project against Element 18 is considered as CapEx costs only.

Essentially, this exemption relates to the requirement for developing cost estimates with P90 confidence level.

The same exemption also applies to maintenance projects that are funded by the Australian Government.

Special consideration should however be given, to identify any items of the estimate where a relatively minor change could have a major impact on the final costs.

It is recommended that the estimator / project manager prepares an estimate for maintenance so that proper skills and resources are available and are applied to the preparation of the estimate.

In some instances, because of project size, the standard project management and estimating stages are combined for efficiency reasons.

6 Roles and responsibilities

6.1 Senior management roles and responsibilities

High level officers responsible for the cost estimating process the department are:

- General Manager (Portfolio Investment and Programming)
- General Manager (Integrated Transport Planning)
- General Manager (Program Delivery and Operations)
- General Manager (TransLink), and
- Chief Engineer (Engineering and Technology).

These officers are the main drivers for implementation of estimating practices and processes and for creating a culture that deliver accurate estimates for QTRIP projects.

The General Manager (Portfolio Investment and Programming) is the accountable officer for the project cost estimating function, who is responsible for periodic updating of the estimating policy and the project cost estimating manual, managing estimating tools, supporting development and implementation of estimating practices and processes, reviews project benefits and liaising with the state and federal governments on estimating requirements.

The General Manager (Portfolio Investment and Programming) also responsible for managing the QTRIP, and for obtaining ministerial approval for its implementation.

The General Manager (Project Delivery and Operations) is responsible for delivering projects with approved budgets.

The General Manager (TransLink) is responsible for delivering public transport infrastructure projects led by the department ensuring the estimating practices for rail infrastructure are met.

6.2 Regional / district roles and responsibilities

Regional / district directors are responsible for effective implementation of estimating practices for projects included in the regional / district programs.

They also responsible for the development and approval of estimates which are the basis for project planning and leading to inclusion within the QTRIP.

The regional / district program managers and project managers are responsible for ensuring the accuracy of estimates at all stages in the project life cycle. They are also responsible for compliance with the content of this manual by their staff.

It is the responsibility of regions / districts to deliver the projects and programs in accordance with the processes outlined in the OnQ framework.

6.3 Project roles and responsibilities

Estimators are responsible for preparing cost estimates in accordance with this manual and developing necessary documentation for approvals ensuring the processes in this manual have been complied with.

Project managers must ensure that the cost estimates are based on:

- a sound scope agreed to by the principal

- appropriate work methods
- all relevant local factors
- appropriate Monte Carlo risk assessment as necessary, and
- appropriate contingency distribution to scheduled items.

Project managers are also responsible for organising review of the cost estimates as recommended in this manual.

See Section 4.2 Estimating Responsibilities for details.

7 Presentation of estimates

The department requires the estimates to be presented on established proformas and templates at all stages.

These templates can be found in Annexure J - Estimate report format and Annexure L - Project Cost Estimate (Summary) Form M4775.

7.1 Work breakdown structure

Successful project management largely depends on the project manager's ability to specify the project work content in terms of deliverables and activities. One of the principal tools for planning, organising and controlling work content is the development of a WBS.

A WBS is a hierarchical listing of the work to be undertaken to meet project objectives. The WBS organises and defines the total scope of the project. It is commonly developed at the beginning of any project and used throughout the project length for defining the project scope, scheduling and estimating costs.

The WBS is useful for:

- turning projects into manageable pieces
- facilitating development of the works program
- assisting the costing and budgeting process
- aiding the risk identification process
- providing the basis of project control, and
- defining project responsibilities and therefore planning resourcing and costing requirements.

The general project WBS presented in the OnQ project management framework is shown in Figure 7.13. It shows the project management activities within the four project phases. These activities form a series of processes that describe the development of options and design processes from concept through to finalisation.

It is intended that the WBS be used with flexibility to accommodate the varying size and complexity of projects encountered in the QTRIP. Activities may be deleted or added within the series to reflect the scope of the particular project.

The work breakdown level adopted for particular activities will also reflect the likely delivery method. For example, if the S2D is being contracted out, it may be represented by a single activity based on the consultancy cost. However, if the S2D is expected to be delivered internally, then the cost must be built up using design components such as geometric design, drainage design and so on.

See Annexure C – Work Breakdown Structure (Construction activities) and Annexure D - Work Breakdown Structure (Principal's activities) for details.

7.1.1 Project management work breakdown structure

The department's Project Management Work Breakdown Structure (PM-WBS) as outlined in Table 7.1.1, organises project management work by phase, activity group and then into individual activities.

This WBS deals predominately with principal's costs relating to the development of estimates, documentation and project management.

Note that the WBS which is used by estimators for detailed construction estimates will be different to that used by the project manager to develop the program of works.

It is expected that estimators will develop a construction estimate based on a WBS that reflects the level of information available for the estimate stage under consideration.

For example, a strategic estimate might only be able to be estimated to broad work packages which correspond with WBS levels 1 or 2.

Development phase Stage 2 design estimates will require most activities to be dissected to Level 3 and project managers will need to use their experience to breakdown the WBS to levels 4, 5 and so on.

A general level structure for a PM-WBS is as follows:

- Level 1 contains the unique project number identifier (project number is created in OPPM layer of the 3PCM system) and the project name
- Level 2 relates to the OnQ project management methodology phases; concept, development, implementation and finalisation
- Level 3 refers to the work packages that need to be delivered under each project management phase
- Level 4 subdivides the work into individual activities and represents the minimum level of detail required to prepare detailed cost estimates for and plan, develop and manage projects, and
- Level 5+ divides activities into individual sub activities or portions of works. Where Level 4 might be 'create a document' Level 5 sub activities might be 'write draft', 'review draft' and so on.

Table 7.1.1 below demonstrates an example of WBS.

Table 7.1.1 - Example PM-WBS

Description	PM-WBS Level	Contractor Level
Project: 060608/WBS-1 Pacific Motorway	1	N/A
CONCEPT PHASE	2	N/A
Concept phase project management	3	1
Concept phase – project management (general)	4	2
Appoint project manager	4	2
Community engagement – concept phase	4	2
Project proposal	3	1
Determine functional requirements & scope	4	2
Produce project proposal	4	2
Development of options analysis and recommendations	3	1
Develop concept planning brief	4	2
Procure concept planning consultant	4	2

Description	PM-WBS Level	Contractor Level
Produce options analysis and recommendations	4	2
Compile draft options analysis & recommendations	Activity (trigger)	
Review draft options analysis & recommendations	Activity (trigger)	
Finalise options analysis & recommendations	Activity (trigger)	
Liaison with principal	5	3
Contractor's internal project management	5	3
Environmental management	5	3

Where the end product is expected to be delivered by a contractor, Levels 1 and 2 are generally not included in the project program. In these situations, the existing Levels 1 and 2 become internal only and the contractor will refer to Levels 3 to 5+ as Levels 1 to 3+.

7.1.2 Construction activities

Construction activities are assigned a unique number according to the standard work items detailed in the main road's specifications, with particular attention paid to MRS01.

The standard item numbering system detailed in standard specifications has been retained as the basic building block for construction activities. The specifications describe the work activities and quality standards required to complete each item of work.

It is expected that estimates will be developed with WBS that reflects the level of information adequate for the estimate stage under consideration.

At initial estimation stages, a cost may be placed against the parent category only for example 3200 - General Earthworks. but in later stages it would be beneficial to break it down into child components such as 32001 - Clearing and Grubbing, 32003P - Stripping of Topsoil and so on. Table 7.1.2 gives a summary of construction WBS.

Table 7.1.2 - High level WBS for construction activities

Work breakdown structure		
Standard item number group		**Description of work**
From	**To**	
10000	19999	Principal Items
20000	29999	Overarching specifications such as Environmental
30000	39999	Earthworks, Drainage and Geotechnical
40000	49999	Pavements and Surfacing
50000	59999	Road Furniture and Surface Delineation
60000	69999	Electrical and ITS
70000	70999	Bridge, Marine and Structures
80000	80999	Others (Rail and TransLink)
90000	99000	Non-Standard Work Items

7.1.3 Project cost breakdown structure

The Cost Breakdown Structure (CBS) provides a structured approach for the department to manage the financial data of infrastructure projects with the amount of information scaled appropriately to the project size, complexity and risk.

The CBS provides a view of project financials by cost codes (types of costs) and the financial flow to occur between SAP work breakdown structure and CBS available within the 3PCM system. The Annexure N - Cost Categories for Project Administration for a Transport Infrastructure Project, of this manual provides cost code extract for an infrastructure project.

The following typical cost breakdown structures are available for various project categories:

- **Planning** – for strategic and detailed planning projects, undertaken at the concept phase in the form of PAF, Type 1, 2 and 3 projects.
- **Major projects** for project >$100M where significant PUP works are required.
- **Infrastructure Large** – For OnQ Type 1 projects where large preliminary works in development phase, resumptions and significant PUP works are required.
- **Infrastructure Medium** – For OnQ Type 2 projects with significant 3rd party works, e.g. local government bikeways carparks or road upgrades are required.
- **Infrastructure Small** – For OnQ Type 3 projects that involves capital components greater than elements.
- **Elements** – to be used for maintenance and operations. There are no OnQ phases as all costs are sent to the relevant element cost codes.

The department considers the following costs as material and/or reportable. This means the cost needs be recognised, irrespective of value and identifiable in a cost breakdown structure:

- third party costs (including direct PUP costs)
- compensation, disturbance costs and special payments
- native title (although immaterial, this is a reporting requirement)
- demolitions, and
- costs prior to a business case being approved.

Further information on cost breakdown structures can be found from the *Cost Classification for Transport Infrastructure Projects* available internally on the PIP SharePoint page.

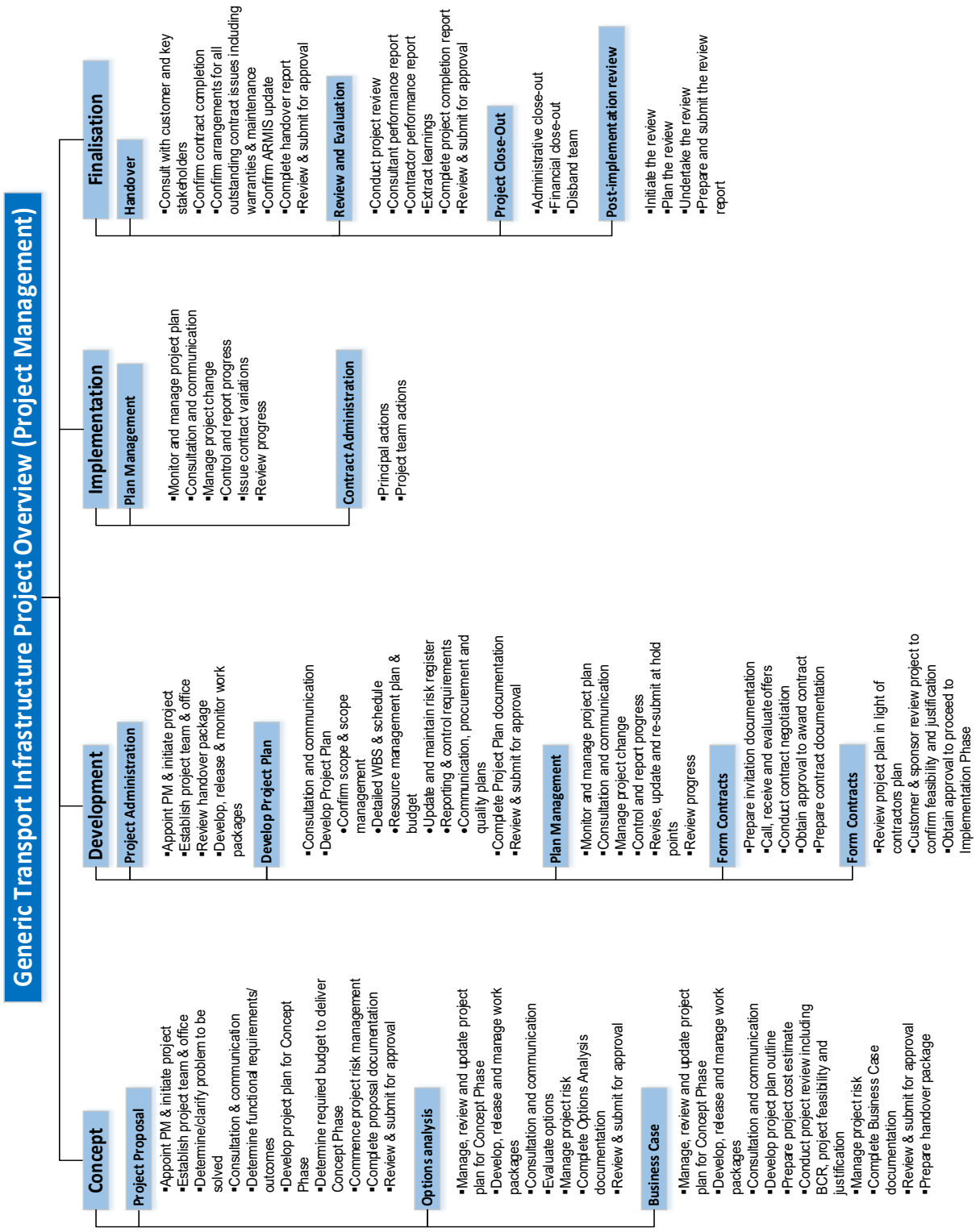
The purpose of cost codes attached to the detailed work items in activity level cost estimates is to support the budget decisions. Allocating appropriate cost codes to estimate line items ensures the accurate recording and reporting of the expenditure for assets and projects.

The cost sheet available in the 3PCM system is a tool that summarises project budget and the project expenditure information in a single location. The budget and cost information are sourced from various business processes or entered directly such as Estimated Final Cost (EFC).

Every project in 3PCM system must have created a cost sheet from the outset with adequate cost codes to deliver the project. The cost sheets appropriate for the project should be selected from the templates described above. The cost sheets are scalable to suit the project complexity.

The project control team in local business areas is responsible for establishing and updating the appropriate cost sheet for project at early stages in consultation with the project manager.

Figure 7.1.3 - Road infrastructure project overview



7.2 Project cost estimate presentation format

The Project Cost Estimate Summary and Approval (Form 4775) should be used to present cost estimates for QTRIP projects.

The project costs should be appropriately dissected as per the cost estimating structure provided in Figure 3.1(b).

7.3 Supporting information

It is important that all cost estimates presented with supporting information that are transferable across the project life cycle.

Supporting information should include but not be limited to:

- a detailed scope statement accompanied by current plans
- a current risk logs
- a current program showing staging and significant activities
- assumptions
- options analysis
- constraints
- significant issues
- current approval status, and
- estimate review reports (if any).

7.4 Communication of project cost estimates

Communication plays an important part in any project and needs to be planned to ensure that the correct information reaches the target audience.

Furthermore, it is also very important to note that some information, data and documentation could be sensitive in nature, and is therefore not always suitable for broader distribution or release.

Unapproved cost estimates form part of the deliberative process of project development and consequently have no status as a project cost estimate. Such estimates are restricted to internal communications only as part of the project estimation and management processes.

Public information on project costs is published each year in the QTRIP. These budget figures are based on estimates that have been approved as part of a business case and any subsequent updates will need to be expressed in outturn dollars.

Note: Supporting information should be provided whenever project cost information is communicated to ensure the basis of the estimate is clearly understood.

7.4.1 Project cost estimating control checklist

The completed project estimating control checklist (Annexure I – Form F4906) must be included when submitting estimates for approval by the customer (regional / district director / program manager).

This will enable the customer to be satisfied that the processes and practices used to prepare estimates have complied with this manual.

7.4.2 Estimate confidence categories

There can be instances where estimates may not have prepared with required rigour. In such situations, the customer should be made aware the confidence level that carry with the estimate at the time of submission for them to make an informed decision. The department has introduced six estimate confidence categories as shown in Annexure G – Estimate Categories for this purpose. The benefit of adopting such categories is the approving authority is able to quickly gauge the certainty of the estimate regardless of the project phase.

- Category 1 indicates the least amount of information and/or time available to analyse data, and
- Category 6 indicates a detailed analysis and review of information from a well-defined scope.

For example, typical confidence levels required within strategic estimates require that actual costs will not exceed the pessimistic estimate cost (Category 1), whereas business case P90 estimates are Category 3.

Estimates will usually move from Category 1 through to Category 6 as a project matures during the project life cycle. Refer to Table 7.4.2 for further details.

Abnormal circumstances that circumvent normal development progression and are allowed for, as the following examples demonstrate:

- A lapsed but previously designed project is initiated years later. The estimate could be categorised as Category 3, 4 or 5, given the amount of information available and sufficient time to process it.
- A poorly defined priority project with approved funding is mandated at short notice. The business case estimate resulting from a truncated project development life could be categorised as Category 1 rather than 3, as it would be expected at this stage.

Table 7.4.2 - Estimate confidence categories

		Category 1	Category 2	Category 3	Category 4	Category 5	Category 6
Level of project definition		<2%	1% to 15%	10% to 40%	30% to 65%	40% to 80%	50% to 100%
Estimate basis		No formal scope	Simple scope and strategy	Agreed scope, preferred option	Schematic design	Developed design	Contract details
Input to		Initial budget	Project phase or detailed budget	Detailed budget	Basic cost management	Detailed cost management	Implement phase budget and cost control
Information available		Similar projects	QTRIP candidate project details	Project plan, option analysis, investigations	Schematic design	Development phase Stage 2 design, full drawings and documents	Accepted tender
Estimate confidence		Very low	Low	Low to Medium	Medium	Medium to high	High
End usage		Concept screening	Study or feasibility	Budget, authorisation, control	Budget, authorisation, control	Authorisation, check tender	Cost control
Expected at project stage	**OnQ**	Strategic planning / pre-project	Project proposal / option analysis	Business case	Development phase Stage 1 design	Development phase Stage 2 design	Implementation
	PAF	Strategic planning / pre-project	Strategic assessment of service requirement / Preliminary evaluation	Business case	Supply strategy development / source suppliers		Establish service / deliver service
	Federal	Identification phase		Scoping phase	Development phase		Delivery phase

8 Benchmarking and quality assurance

8.1 Benchmarking

The underlying principle of estimate benchmarking is to improve the confidence in the estimating process and the quality of estimates.

The method used to do this is to take actual project information and store it in categories, enabling repeating trends to be detected. This information can be used for reality checking of estimates and/or their make-up components.

Benchmarking of project costs are undertaken by the PMD and the individual regions / districts. The process can be performed in every phase of project's life cycle, however actual costs from the finalisation phase will provide the most accurate data to determine total project performance.

The regions / district retains the ownership of their benchmark costs.

8.2 Gathering suitable information to benchmark

Sources of benchmarking information used by the department include:

- 3PCM data warehouse
- any elemental regional cost database
- SmartCost database
- recent tenders and quotations, and
- similar projects.

8.3 Benchmarking methods

The benchmarking methods may involve four comparisons:

- global rates
- comparative cost analyses
- key items rates, and
- construction production rates.

These methods are applicable to all types of projects.

These rates can vary considerably between regions / districts and also within each region / district itself, depending on the circumstances and environment for individual projects.

The comparative cost analysis is mainly applicable to major projects; however, this can be applied to smaller projects also.

8.3.1 Global rates

Following are some examples of global comparisons used in estimating:

- cost per km of road (a comparison of total project cost and length of the main carriageway)
- cost per lane km of road (a comparison of total project cost against total lane lengths such as acceleration / deceleration lanes, left / right turn lanes and ramps), and

- cost per square metre of the structure (calculated using total deck area and total cost of the structure).

8.3.2 Construction production rates

Following are some construction production rate comparisons used in estimating:

- clearing and grubbing (m²/hr or ha/day)
- general earthworks (m³/hr)
- paving (m³/hr)
- drainage (m/day or number of pipes/hr)
- piling (m/day)
- pavement surfacing materials (tonnes/shift or tonnes/day), and
- provision for traffic as a percentage of direct job costs.

These rates can be benchmarked against the SmartCost database which provides the production rates for most of the general construction items.

8.3.3 Key items rates

Following are some key items rates comparisons used in estimating:

- asphalt ($/tonne)
- reinforcement ($/tonne)
- pavement materials ($/m³), and
- steel piles ($/m).

The forecasted rates are available from the SmartCost database and the tendered rates can be extracted from the 3PCM system data warehouse. Note that the rates provided in the SmartCost database are direct costs only. They do not include indirect job costs or contractor's overheads and profit margin.

8.3.4 Comparative cost analyses

The following are some examples for comparative rolled-up cost analyses:

- indirect job cost vs direct job cost
- design cost vs construction cost
- design consultant fees vs project / phase cost
- traffic management cost as a percentage of direct job cost
- pavement area vs structures area (indication of the complexity of the project), and
- project management / principal costs as a % of the total project cost.

Regions / districts may modify their local procedures to reflect the processes outlined in the manual.

8.4 Quality assurance

Quality assurance is a documented process control that is focussed on minimising or eliminating mistakes and errors in an estimate.

Due to the detailed nature of the estimating process and the multitude of assumptions making throughout the project lifetime, estimating is an activity where errors can be easily made or unintentionally be incorporated, but difficult to detect.

Complying with the processes and guidelines contained in this manual will assist in achieving a reliable and consistent project cost estimate.

8.5 Project cost benchmark

All projects over $25M and which are funded by the Australian Government required to have a Project Cost Breakdown (PCB) spreadsheet completed and submitted as part of the project estimates. This information is used for benchmarking purposes by the Australian Government.

The application of the PCB is not mandated for state projects, but its inclusion is highly encouraged for a comprehensive project package.

The cost estimates for all QTRIP projects are expected to be captured within the 3PCM system. Once captured, the cost information will be stored within the 3PCM data warehouse including estimate line items, tender responses and contract schedules.

Item level cost data in construction contracts, including historical contracts, can be extracted using the Oracle Business Intelligence Enterprise Edition (OBIEE) application within the 3PCM system. This data provides valuable benchmarking input for analysis of current market rates for construction items and principal's cost.

9 Tools and techniques

9.1 Estimating methods

There are numerous ways to develop a cost estimate depending on the context and the resources / time availability to develop the estimate. The basic differences between these methods are the level of detail, estimate confidence and the additional time / resources required to develop the estimate.

It should be noted that the more rigorous process used, the greater the certainty of estimate accuracy.

The following estimating methods are used within the department in the order of increasing confidence levels.

9.1.1 Global estimating (benchmark rates)

Global estimating (or order of magnitude estimating) method is an approximate estimating method for which group of major project items are considered as one estimating item.

The project could be considered as consisting of one estimating item only and the estimate prepared on this basis (approximately a Level 3 PM-WBS). Examples of global estimates include road cost per km and bridge costs per square metre of deck area.

The reliability and the confidence of global estimates are very low for departmental estimating standards, even at the strategic estimating stages. As such the global estimates must not be presented for purposes such as budget development or public announcement in the media.

9.1.2 Unit rate estimating

Unit rate estimating is the most commonly used practice across the department. It develops estimates by multiplying the quantity of work by historical unit rates. Unit rate estimating is a relatively quick method of estimating but lacks precision, especially in the interpretation of what exactly is provided for in the unit rate. Accuracy of an estimate requires emphasis on scope, reflected in a comprehensive schedule of Work Items that is unique to the project.

Unit rates vary from project to project, however after making adjustment by an experienced estimator and applied to a detailed schedule of rates, produces a far more accurate estimate than a global estimate.

The unit rates are normally determined from a careful analysis of unit costs from recently completed projects of similar type (or scope), with appropriate corrections. It is important to remember that the historical rates usually include indirect costs such as contractor's management, risk, overheads and margins, which must be adjusted before applying to new cost estimates.

When adjusting the historical unit rates, following factors need be considered:

- inflation or historical escalation rates
- ground / site conditions (mountainous or flat terrain)
- market conditions
- on-site and off-site overheads and profit
- scale of works (large or small quantities)
- site location (urban or remote)
- design complexity (unique or routine)

- risk profile, and
- construction methods (specialised or conventional).

With a sufficient level of information in terms of the scope of the project, work structure, quantities and careful selection of appropriate historical rates, the unit rate estimating method is capable of producing estimates suitable for all project stages through to the Development Phase Stage 2 Design (S2D).

Note: Historical costs can sometimes be misleading as they are not current rates and caution will need to be exercised in the absence of a controlled set of historical cost information.

9.1.3 First principles cost estimating

The foundation of first principles estimating, (sometimes referred to as basic cost estimating), is the calculation of project-specific costs based on a detailed study of the resources required to accomplish each activity of the work schedule and the cost break down at granular level.

The basis for first principles estimating method is to build the unit rate cost from the ground up for a work item, by considering the labour, plant, material and subcontract required to deliver the work.

Before using first principles estimating methods, estimators without sufficient experience or knowledge, should seek assistance from peers about key factors such as production rates, resource rates and so on.

The first principles method enables the development of far more accurate cost estimates compared to unit rate method, as the project specific information (such as design requirements and the construction program) and resource rates are used to determine the overall costing for a Work Item.

In Transport and Main Road's, this process is facilitated by computer software such as Expert Estimation and SmartCost database. SmartCost database, contains detailed cost estimate breakdowns based on MRS work items and latest resource rates for about, plant, material and subcontract. This database facilitates the preparation of cost estimates using first principle methods using the Expert Estimation software. The users are able to change first principles breakdowns for Work Items provided in the SmartCost data library to suit the specifics of the project.

In adjusting the estimate breakdowns for Work Items in the SmartCost database, the following factors need to be taken into consideration:

- site conditions
- program of works
- applicable work methods and possible alternatives
- resource availability
- productivity of labour and plant
- procurement of materials and subcontractors, and
- risks likely to be encountered during the course of the project.

The first principle methodology should be adopted for developing cost estimates for major high-risk items rather than to derive them as percentages. Some of such items are:

- contractor’s site facilities and camp
- provision for traffic

- pavements (changing haul distances and gravel prices)
- earthworks (haul distances, spoils, and multiple handling), and
- project specific high value and high-risk items.

9.1.4 Hybrid estimating

Usually hybrid estimates are completed in a similar manner to first principles estimates, with the application of typical percentages for on-site and off-site overheads and profit to direct job costs.

A weakness in this method is, however, its heavy reliance on the availability of direct cost unit rates (that is rates which are equivalent to the direct job costs portion of the first principles method before the distribution of indirect costs). These are not normally available from the industry unless the department itself carries out basic cost estimating.

When provided with the appropriate and correct information, experienced estimators are generally able to analyse contractor's tender schedule of rates and revert / bring the costs back to a direct cost level.

For example, a business case with limited project development detail may use the first principles method for high value, high risk components and the unit rates method for low risk work items.

9.1.5 Deterministic estimating – Factor-based

The factor-based deterministic approach is most applicable when estimating projects at the early stages of a project life cycle, acknowledging that there may be insufficient information, resources or time available at that stage to undertake a more detailed assessment.

The aim of this approach is to achieve an appropriate contingency allowance by a strategic review of the factors that will influence the (cost) outcome of the project.

This approach is also intended to provide consistency in the assessment of risk across projects using this method, by providing a common template for assessment of risk against a set of stated criteria.

This approach usually does not separately calculate contingency for inherent and contingency risks, but rather calculates a single overall range of contingency allowance. The rationale behind a factor-based approach is that it attempts to properly identify those items that can have a critical effect on the project outcomes and applies ranges only to those items.

In deterministic estimating models, contingency amounts are derived through the linear multiplication of the residual risk severity value and the likelihood of actual occurrence. These methods do not take the conditional nature of risk occurrences into consideration and likely to derive very inaccurate contingency provision amounts.

Accuracy of the estimates derived from this method is very low, and therefore such methods are only applicable for low risk and low value projects.

Further details about this method can be found in the *Federal Cost Estimation Guidance Note 3B – Deterministic Contingency Estimation* document.

9.2 Selecting the appropriate method

Estimates for projects are prepared using a range of methods as described in Section 9.1 Estimating Methods.

In selecting an appropriate estimating method, the estimator needs to consider the following:

- relevant project phase – Strategic planning, Concept, Development, Implementation, Finalisation
- relevant project stage within a given project phase (Stage 1 design / Stage 2 design)
- purpose of the estimate – to assist planning, project approval, publication, seek funding
- relevant data availability – can the historical data be used as a guide for costing
- knowledge of risks associated with the project – location, availability of materials, services, political, and
- size and the complexity of the project.

The selection of an estimating method depends on both the intent for which the estimate is to be used (and therefore the required level of confidence of the estimate) and the level of detail available.

In practice, it is common to combine estimating methods when developing estimates for budget setting stages (see Section 9.1.4 – Hybrid Estimating). Most of the effort should be directed to ensure the accuracy of the 20% of items that often make up 80% of the costs, known as the 'Pareto Approach'.

The recommended methods for estimating for various project types in the department are shown in Table 9.2. The project manager has the overall responsibility to determine the estimating methodology to be employed in consultation with the estimator, based on the project type and the estimate stage. It is recommended that Table 9.2 should be used only as a guide.

Table 9.2 - Recommended estimating methods

Estimate stage	Type 1 project	Type 2 project	Type 3 project
Strategic or pre project	Unit rate method	Global estimate	Global estimate
Project proposal	Unit rate method	Unit rate method	Global estimate
Options analysis	60% value at unit rates estimate, 40% value at first principles estimate	Unit rate method	Global estimate
Business case	First principles estimate at WBS Level 4 or 5	Approx. 60% value of estimate by unit rates, 40% by first principles	Unit rate method
Development phase Stage 1 design	First principles estimate at WBS Level 4 or 5	Approx. 20% value of estimate by unit rates, 80% by first principles	Not applicable
Development phase Stage 2 design	First principles estimate at WBS Level 4 or 5	First principles estimate at WBS Level 3	First principles estimate at WBS Level 3

9.3 Probabilistic estimating

Deterministic cost estimating methods generally do not allow any flexibility in the estimating process, therefore the quantities and rates (and overall cost) are often presented as a single value. Each cost element (quantity and/or rates) in the project schedule is however subject to some level of variation over the project duration. This can be addressed by considering range estimates for cost elements rather than a point estimate.

Probabilistic estimating methods identify the cost components, determine the likely range and associated probability distribution of each component, and undertake a simulation process (e.g. Monte

Carlo or similar analysis using a computer software program) to generate a probability distribution of project costs.

Probabilistic estimating methods generate estimates and take into account that quantities measured (or allowed for) can change, also that rates assumed can vary, and that risks with a probable outcome can actually materialise.

Probabilistic estimating methods involve running a large number of iterations using costs of each element to build up a probability distribution of overall project cost. The model then represents all possible risk outcomes of this sampling in a graphical form so that the estimator is able to pick a most probable outcome that is based on the governing parameters, such as P50, P90 and so on.

The probabilistic estimating tools such as @Risk, models each dimension (risk severity and likelihood) and allows the estimator to choose contingency levels in line with business requirements (P50, P75 and P90).

Section 10.3.4 provides more detail on the probabilistic estimating process. Also refer to *DITRDC Guideline 3A – Probabilistic Contingency Estimation* on the internal PIP SharePoint page for further information.

9.4 Estimating tools

The department uses a range of estimating tools to ensure consistency across project cost estimates developed for its infrastructure projects and programs.

The following are the estimating tools used by the department:

- Expert Estimation – a first principles cost estimating tool
- SmartCost – a unit rate database of standard MRS items used with the Expert Estimation tool, and
- @Risk – a probabilistic risk assessment software based on Monte-Carlo analysis.

9.4.1 Expert estimation

The department uses Expert Estimation software to develop first principles cost estimates with the SmartCost database.

Some of the main features in the Expert Estimation software include:

- compatibility and transportability – data is easily imported from other programs such as Microsoft Excel
- collaboration – multiple users can work on a single project from multiple locations
- formulae – it has a range of inbuilt formulae to utilise during estimate creation, and
- reporting – this program contains over 50 customisable report formats which can be exported into Microsoft Excel.

9.4.2 SmartCost

SmartCost database is used with the Expert Estimation software to develop first principles estimates for department's road infrastructure projects.

This database contains over 5,000 Work Items and 6,800 resources that are tailored for department's needs, specifications and WBS.

The resources in the SmartCost database are linked by rolling formulae which enable the users to develop detailed cost estimates with speed and accuracy.

This database also maintains most up-to-date resources that are tailored into five specific geographic SmartCost Regions as follows:

Table 9.4.2 - SmartCost regions

SmartCost region	Department of Transport and Main Roads regions	Database identifier
South East Queensland	Metro, South Coast, North Coast	SEQ-SmartCost
Central Coast Queensland	Mackay/Whitsunday, Fitzroy, Wide-Bay/Burnett	CCQ-SmartCost
Southern Inland Queensland	Darling Downs, South West	SIQ-SmartCost
Central Inland Queensland	Central West, North West	CIQ-SmartCost
Tropical North Queensland	Far North, Northern	TNQ-SmartCost

Further information can be obtained via TIP_Business_Support@tmr.qld.gov.au.

9.4.3 @Risk

Probabilistic risk evaluation (also known as Monte Carlo simulation) is the department recommended methodology for analysing project risks of the high value / high risk projects (i.e. Type 1 and 2). It is the recognised way of calculating P50, P75 and P90 estimates to comply with cost estimating standards.

@Risk is the recommended risk evaluation software by the department and the Australian Government for probabilistic (or Monte Carlo) analysis of project risks. It is also the tool used by the road contracting industry for high risk / high value projects.

@Risk tool has the capability to analyse different scenarios with multiple variables in quick time and empowers the project managers to continuously analysis risks at subsequent project stages. Section 10.3.4 Risk Analysis provides more detail on probabilistic estimating process using the @Risk tool.

10 Risk management and contingency development

This chapter provides an overview of the factors and principles to be considered in risk management and contingency development.

10.1 Risks

Risks related to the projects are continually assessed as the project progresses through its life cycle whereby contingency is adjusted accordingly to reflect the appropriate risk assessment and monies spent to mitigate risk activities at that level.

- **Risk** is often characterised by reference to potential events and consequences, or a combination of these and is often expressed in terms of a combination of the consequences of an event (including changes in circumstances) and the associated likelihood of occurrence.
- **Risk management** refers to a coordinated set of activities and methods that is used to control the risks that can affect an organisation's ability to achieve objectives.

The primary objective of project risk management is to increase the likelihood of achieving the project objectives by minimising any adverse impacts, and therefore improving the project performance.

The project risks need be managed as described in the TMR Risk Management Framework and the principles in IS 31000:2018, as shown in Figure 10.3.

10.2 Contingency

Contingency is a financial reserve included in the cost estimate to offset project risks. In terms of managing risk associated with a project, it can take many forms. It can be a time allowance in the program of works for delay or a cost allowance in the project cost estimate to account for residual risk.

The amount of the contingency is re-assessed at project review points to reflect current knowledge and level of uncertainty of the project, with a view to forecasting the most likely outcome.

In preparing estimates for the department's infrastructure projects, it is also important to recognise that there are many situations where the inputs to the cost estimate variables are not always available.

This does not necessarily derive from identifiable risk events but rather from the level of accuracy in the estimating. See Section 10.4 for more details.

10.3 Risk management

The department has a responsibility to establish and maintain appropriate system to manage risks as required in the *Financial Accountability Act* 2009 and the *Financial and Performance Management Standard 2019*. The department's risk management process is aligned with ISO 31000:2018.

The department has therefore adopted:

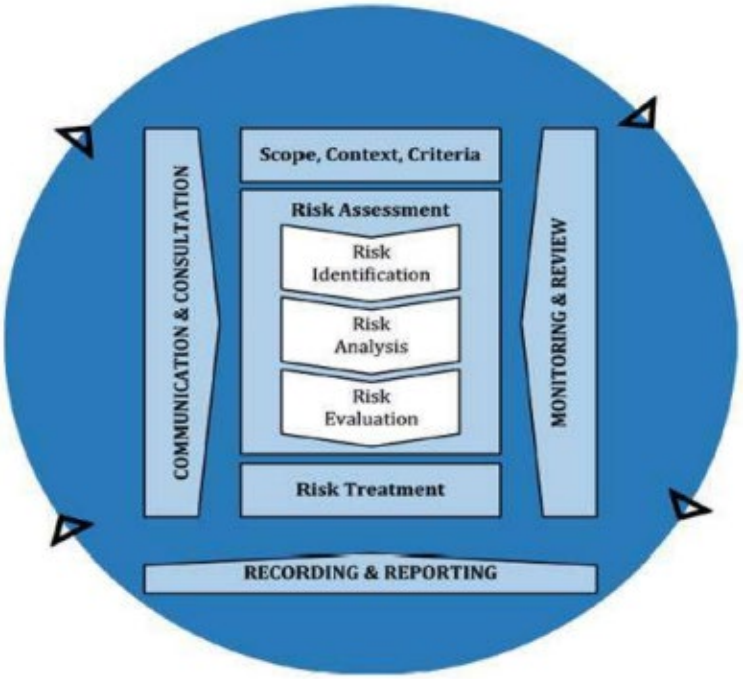
- A risk management organisational policy that applies to all departmental employees including temporary, casual and contracted staff.
- TMR Risk Management Framework which provides the structure for designing, implementing, monitoring, reviewing and continually improving risk management practices across the department, and
- Engineering Policy 153 *Risk Context Profiles* which supports required project-specific risk context profiling to be undertaken on construction projects to identify the effect of risk on the project.

The TMR Risk Management Framework aligned with the international risk management standard and provide the minimum requirement for risk management across the department. It recommends managing risks in following layers within the department:

- strategic level
- divisional level
- portfolio level
- program level, and
- project level.

The policy and the framework are consistent with the OnQ project management methodology, which identifies specific risk management activities that need to occur at various project stages.

Figure 10.3(a) - Risk management process



Reproduced from the *ISO 31000:2018, Risk management — Guidelines* with the permission of SAI Global Ltd

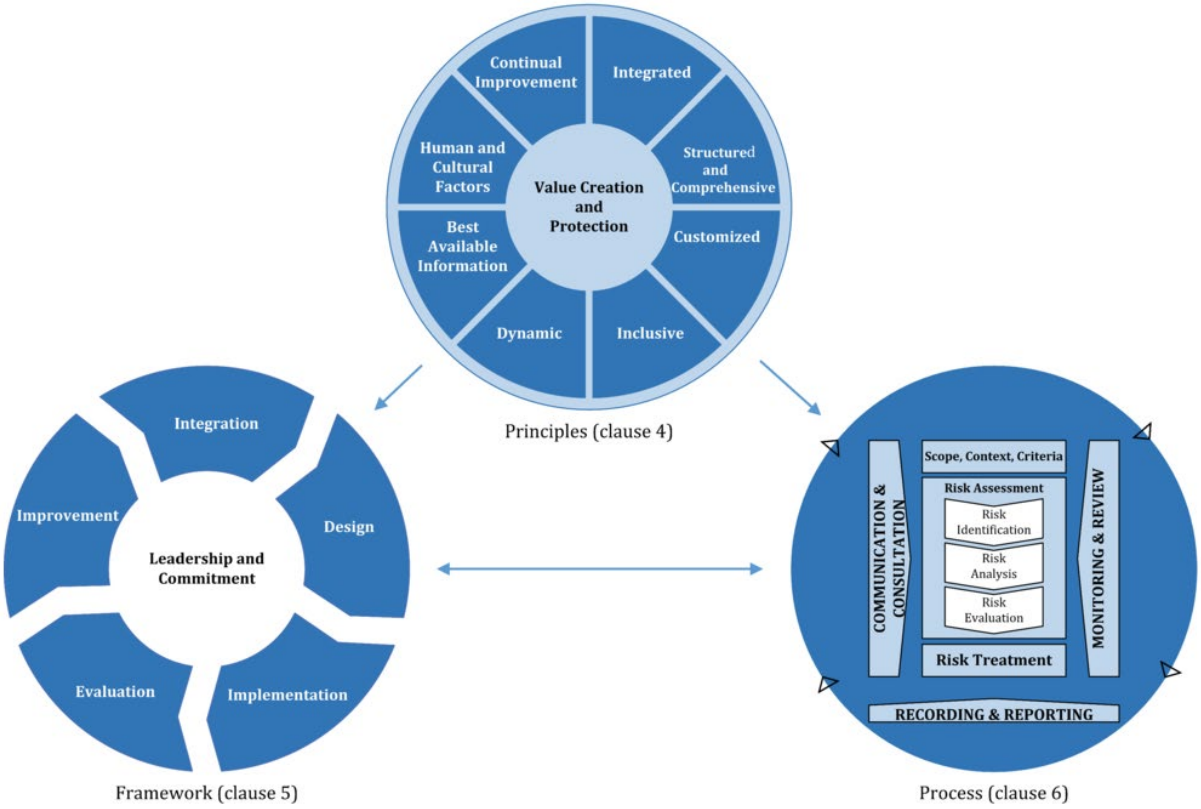
Project risk management is a feature in all the phases of a project's life cycle and the responsibility for identifying, evaluating and managing risks at project level is vested with the project manager.

The key estimating risk management strategy stages by the ISO 31000 are:

1. Establish the context
2. Risk assessment:
    a. identify all risks
    b. analyses risks
    c. evaluate risks

3. Risk treatment
4. Communication and consultation, and
5. Monitoring and Review.

Figure 10.3(b) - Principles, framework and process



Source: Figures 2, 3 and 4 – ISO 31000-2018)

Effective project risk management is sensitive to a number of different factors such as organisational needs, environment and internal capacity. It provides visibility and transparency as well as the best information available on which to base decisions.

Risk management is not a one-size-fits-all process, or solution aimed at satisfying compliance criteria. The key focus in implementing the most appropriate risk management mechanism is to meet the department's objectives.

Regardless of the tools or techniques used, risk management should be embedded into all business activities and applied with appropriate rigour to ensure risks are managed robustly while providing a solid platform for innovation and opportunity.

Sometimes managing risks requires a combination of varied techniques and methodologies.

The TMR Risk Management Framework, including the policy and strategy can be found on the department's internal intranet site.

10.3.1 Establish the risk context

ISO 31000:2018 requires that all risk assessments consider the context in which the assessment takes place. Understanding of the context ensures that risks to a project are clearly identified.

Setting the context determines the environment in which the project operates and the basic parameters for risks to be managed.

Whilst the risk identification process may vary in the type of project and location, the following risk factors however are common for most projects:

- governmental risks, delays in approvals, modifications, withdrawal, scope changes, or additions that result from multi levels of government and local participation and sponsorship
- regulatory compliance risks, including environmental and third-party issues, such as permits, rail, and utility company risks
- land acquisition risks including costs, appraisals, resumptions, relocation delays, judicial reviews, and court costs
- design issues, safety considerations and constructability issues
- delays in the program of works
- contractors / supplier's capability and availability, and
- stakeholder acceptance of the completed product.

Engineering Policy 153 *Risk Context Profiles* requires the project-specific risk context profiling be used to identify the effect of risk on the projects. The risk context profiles are provided in the RCP register available internally on the PDO Rise Team site.

The ten risk categories applicable for RCP's are:

1. Geotechnical
2. Environmental and Cultural Heritage
3. Weather
4. Stakeholders
5. Procurement
6. Project Management
7. Preconstruction
8. Contract Administration
9. Construction, and
10. Finalisation.

The above risk categories provide useful prompts for project managers to identify appropriate risks associated with individual projects covering all project phases.

Where project approval is sought, and the approval requires a project cost estimate to be submitted, the project cost estimate should be supported by a risk register developed in accordance with the RCP process.

Any queries on EP153 and RCP process should be directed to PDO Rise Team via tmr.techdocs@tmr.qld.gov.au.

10.3.1.1 Planned (inherent) and unplanned (contingent) risks

During the risk identification process, the project risks are categorised into two major classifications, namely planned and unplanned risks, based on the distinctly different nature of the risk.

Planned (inherent) risks relates to measured items, that is, items that are specifically identified within the various elements of the base estimate and which contribute to project cost. The accuracy of the quantity and rate remains uncertain or reliability of the amount in the base estimate is low.

Risk can be treated independently to the quantity used and to the rate applied for each measured item (measured cost component), or simply be applied to both the quantity and rate combined.

Inherent risks can contain not only in direct costs but also in indirect costs, margin and principal's costs. Items with no information but known to be required should be included as lump sum allowances in the base estimate and not rely on the contingent risk assessment process to make up differences.

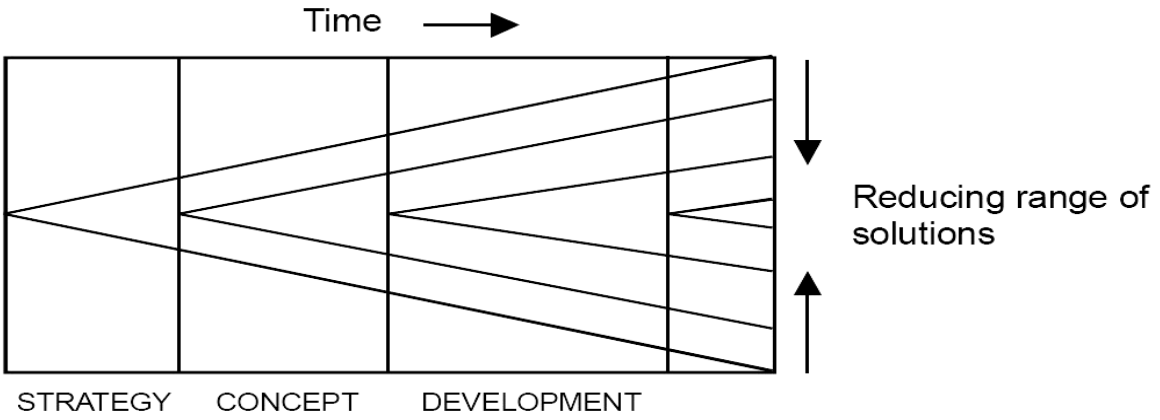
Unplanned (contingent) risks relate to the risk attached to unmeasured items (i.e. those items not listed in the base estimate because they are unknown or loosely identified and they may not occur and thus may or may not contribute to project cost). Typical contingent risks include adverse weather impact, industrial issues, safety, planning approval conditions, design development, changes to design standards, client requirements, unknown geotechnical conditions, and potential claims from contractors.

10.3.2 Risk assessment process

Risk management is a multi-faceted process, some aspects of which are often best carried out by a multi-disciplinary team. It is an iterative process designed to progressively diminish risk as uncertainty about the project outcomes is reduced.

The concept of a cone of accuracy in Figure 10.3.2 shows how the risk uncertainty changes with time.

Figure 10.3.2 - Cone of accuracy



As the project moves through the phases, the range of solution options diminishes as uncertainty is reduced. The uncertainty cone is truncated as the project progresses through time (moves to the right).

The risk assessment process includes risk workshops, reviews of past project documentation, and talking to the experienced project managers.

For projects that are assessed as extreme or high risk, the project manager must ensure that regular risk management workshops are facilitated on regular basis, a risk management plan and risk register are prepared and implemented.

10.3.2.1 Conduct risk workshops

A risk workshop is an essential tool to get the whole project team involved in identifying the risks that are likely to impact on the success of the project. Project managers should organise risk workshops at every key project milestone for all large and complex projects to assess risks in an open and live environment.

It is important to choose workshop attendees from all key areas such as planning, design, construction, environmental, PUP and communication, ensuring each area is well represented and providing insight into specific business operations.

A facilitator may be arranged, if required, to conduct the risk workshop in a structured and systematic manner, tailored to individual project needs and operational risk profile.

The project manager should prepare a suitable agenda, arrange a venue and allow ample time to go through the risks register.

The purpose of the risk workshops is to:

- establish the risk context by determining the priority risk dimension area for the project
- determine the risk items under each risk dimension area, as detailed in Section 10.3.2.2
- determine the consequence rating
- determine the likelihood rating
- develop a treatment to mitigate risks, and
- determine the residual risk financial impact which informs the contingency.

10.3.2.2 Define the risk dimension areas

Each identified project risk need be categorised into risk dimension areas as defined in the department's *Risk Assessment Matrix and Ratings Matrix* available on the internal intranet site.

The defined risk dimension areas for the department's projects are:

- Workplace Health and Safety
- Time or Schedule Delay
- Assets, Operations and Services
- Performance and Capability
- Historical and Indigenous Heritage
- Environmental / Climate
- Media and Reputation, and
- Financial.

For projects with complex risk areas, advice must be sought from the subject matter experts with site specific information to determine the risk items.

10.3.2.3 Define the risk measurement – Likelihood and consequence

In order to establish the magnitude of an identified risk, it must be defined in a two-dimensional model (likelihood and consequence).

This process considers several classifications used to define risk and the effect it will have on the project. However, all the risk dimensions listed in this matrix may not be applicable for all projects.

Once the likelihood and the consequence are determined of each risk in the risk register, it must be presented to the risk workshop to validate each dimension.

10.3.2.4 Develop treatment options and cost the treatment

The risk rating determined through the assignment of a likelihood and consequence relates to level of management or action required in managing each risk.

The risk workshop attendees are expected to validate the risk treatment response to each risk based on SMART approach. That is, Specific, Measurable, Assignable, Realistic, and Time-related. As detailed in Section 10.3.6 of this manual.

10.3.2.5 Determine the financial impacts of the residual risks

During the risk workshop, the financial impact of the residual risks is determined with collaboration with all attendees. This information is used to determine the project contingency.

10.3.3 Risk identification

This process includes identification of risks that could impact on the project. It documents these risks and produces a list of risks that can be monitored throughout the project development and delivery process.

Risk identification is continuous process across the project life cycle and there should be a continual search for new risks requiring inclusion in the process.

10.3.4 Risk analysis

The risk analysis process commences with the development of a risk register. All cost estimates shall contain an appropriate cost provision to cater for residual risk as assessed from the risk register.

There are two broad ways to analyse risks, which are qualitative and quantitative methods.

A qualitative risk analysis identifies the risks and opportunities and assesses the potential consequences and treatment measures. It is the first step in the risk evaluation process which guides the project manager on whether the project risks can be avoided, treated or minimised.

A quantitative risk analysis is performed on risks that have been prioritised through the qualitative risk analysis process. The quantitative risk analysis is performed on risks that have been prioritised through the qualitative risk analysis process.

The purpose of quantitative approach is to capture uncertainty in such areas as cost estimating methodology, completeness and reliability of the information available, technical risk, and programmatic factors in order to go from a deterministic point estimate to a probabilistic estimate.

Traditionally quantitative approach employs probabilistic tools, techniques, templates and specialist software such as @Risk for risk evaluation. Probabilistic risk evaluation (Monte Carlo simulation) approach is mandatory for all major projects (which refer to PAF framework) and OnQ Type 1 and Type 2 (large) projects.

Projects with a total anticipated Outturn cost (including contingency) under $25M may use deterministic approach, however the Australian Government recommends using a probabilistic risk evaluation method where possible. In contrast probabilistic approach must be used for risk analysis for projects that are funded by the Australian Government with a total Outturn cost (including contingency) exceeding $25M.

10.3.5 Risk evaluation

The purpose of this step is to assist in making decisions about how to manage the risk.

These decisions are based on a comparison of the consequence and likelihood of the risk eventuating using the criteria developed in earlier steps of the risk management process.

Risk evaluation uses the understanding and agreement of risk obtained during risk analysis to make decisions about future actions. Ethical, legal, financial and other considerations, including perceptions of risk, are also inputs to the decision-making process.

In some instances, evaluation can lead to a decision to undertake further analysis. In considering the cost of treating the risk or other considerations, compared to the level of the risk and a low probability of the risk eventuating, it may be determined not to treat the risk other than by maintaining existing controls.

Information gathered during the risk assessment phase should be recorded. Risks should be documented in clear and understandable terms together with the assessment results (consequence, likelihood, risk level, actions to be taken, risk owner, completion dates, reporting schedule) as well as a target level which includes the level of risk acceptance or the retained level.

Once the risk evaluation process is completed, the information should be updated in the risk register.

10.3.5.1 Qualitative approach of risk evaluation

Qualitative risk analysis is usually a rapid and cost-effective means of establishing priorities for risk treatment and lays the foundation for quantitative risk analysis.

The outcomes from this analysis are used as inputs to the quantitative analysis. Once the project risks are identified and subjected to appropriate treatment (avoid, treat or minimise), the base estimates are prepared with residual risks. From these estimates, residual risks are modelled for each element of the project. This process leads to the quantitative aspect of the risk assessment.

The qualitative risk analysis is undertaken using the department's risk assessment and rating matrix found on the department’s website.

Generally qualitative risk analysis approach is adequate for Type 3 QTRIP projects.

10.3.5.2 Quantitative approach of risk evaluation

Generally quantitative approach employs probabilistic tools, techniques, templates and specialist software such as @Risk for risk evaluation to estimate contingency. This simulation, known as Monte Carlo, allows to account for risks in quantitative risk analysis and decision-making.

The quantitative risk analysis allows for a range of possible values of each input variable, namely lowest likely, most likely, or highest likely values, and is based around the modelling of individual risks, to provide greater levels of certainty and confidence.

The circumstances in which the quantitative approach is explained in Section 10.3.4 Risk Analysis.

10.3.5.3 Monte Carlo simulation

Monte Carlo simulation is a statistical sampling technique which generates a sample of a large number of possible outcomes of a model, all of which are feasible. The likelihood of outcomes in a given range is determined by the probability density functions of the inputs and is taken to reflect the likelihood of an outcome in that range arising in reality.

It runs a large number of iterations of different cost combinations for an estimate element to build up a probability distribution of overall project cost.

Monte Carlo simulations provide the following advantages over deterministic risk analysis:

- Probabilistic results show not only what could happen but show how likely each outcome is to occur.
- The graphical results that it generates for different outcomes and their chances of occurrence are a great communication tool for use with other stakeholders.
- Sensitivity analysis provides a tool to rank inputs that will have the biggest impact on bottom-line results. A single-point estimate makes it difficult to see which variables are likely to impact the outcome most, and
- In deterministic models it is difficult to model different combinations of values for different inputs to see the effects of different scenarios. Monte Carlo simulations addresses this issue.

The department's estimating policy mandates that all project estimates beyond the business case milestone to have P90 confidence level. P90 estimates are generally developed using a quantitative approach and probabilistic risk evaluation software such as @Risk.

Prior to apply the Monte Carlo model for risk evaluation process, the estimators are required to define appropriate cost variation ranges for all risk elements. There is no set theory for determining these ranges however project managers should provide guidance on the most appropriate range based on his understanding of the project stage and the likelihood of the risk to be eventuated.

Correlation is the parameter (or statistic) used to describe the degree to which two variables are related (or the degree to which one variable’s probability distribution is related to another).

Many costs in a project will be linked because there is a common cause or driver that affects each in a similar way. Usually this dependence, or correlation, will be positive and it is rare that an increase in costs in one area are offset by corresponding benefits in another because of a common underlying influence. Such offsets do happen by chance of course when two costs are uncorrelated so that one might rise as another falls.

There are several ways of accounting for correlation in cost-risk analysis which are described in *Guidance Note 3A – Probabilistic Contingency Estimation* issued by the Australian Government.

10.3.5.4 Types of probability distributions

Most probabilistic risk evaluation software such as @Risk provides a variety of probability distributions for risk modelling. However, the most common distribution types used to model risks associated with transport industry are Uniform, Triangular, Pert, and Discrete.

The estimated quantities and rates can vary in the base estimate and therefore, they must be subjected to a probability distribution to allow for uncertainty and possible variation in their quantitative value.

This variation is known as quantity and rate risks (or planned risks) which are generally analysed using continuous probability distributions such as Triangular and Pert.

Unplanned risks have two risk dimensions (risk severity and the likelihood) which can vary independent of the other and can have significant impact to the overall costs.

Due to two-dimensional nature of the unplanned risks, they are generally modelled using Discrete, Bernoulli or Binomial distributions.

The probability distribution adopted must be based on historical records, industry performance, technical capabilities and other relevant performance information. The probability distribution must be chosen to represent the variance of the estimated value in a probabilistic model of the estimate.

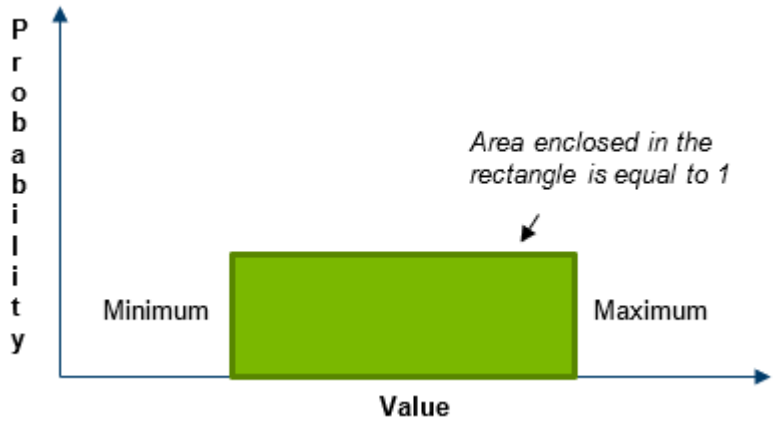
When there is insufficient information available, it is suggested that one of the following distributions be adopted to model the risks.

Uniform distribution

The uniform distribution uses a first guess for quantities believed to be randomly varying equally between a maximum and a minimum.

This distribution can be used when actual knowledge of the probable cost is not known with any confidence, but the range of the possible costs is reasonably determined, for example items, lump sums, and so on.

Figure 10.3.5.4(a) - Uniform distribution

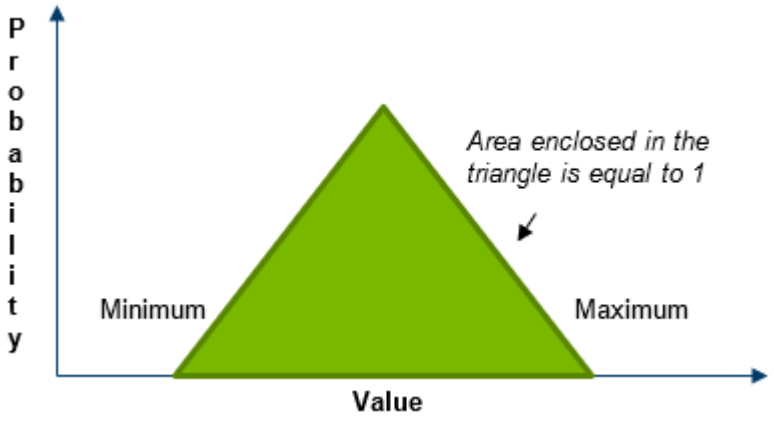


Triangular distribution

A value is chosen to be bounded by a maximum, most likely and a minimum. The most likely must be the value adopted for the base estimate.

This distribution can be used when there is reasonable confidence in the rate or the quantity adopted but there is a possibility that this figure could vary between two extremes, for example rates for cost items, quantities with a possible error in measurement and so on.

Figure 10.3.5.4(b) - Triangular distribution



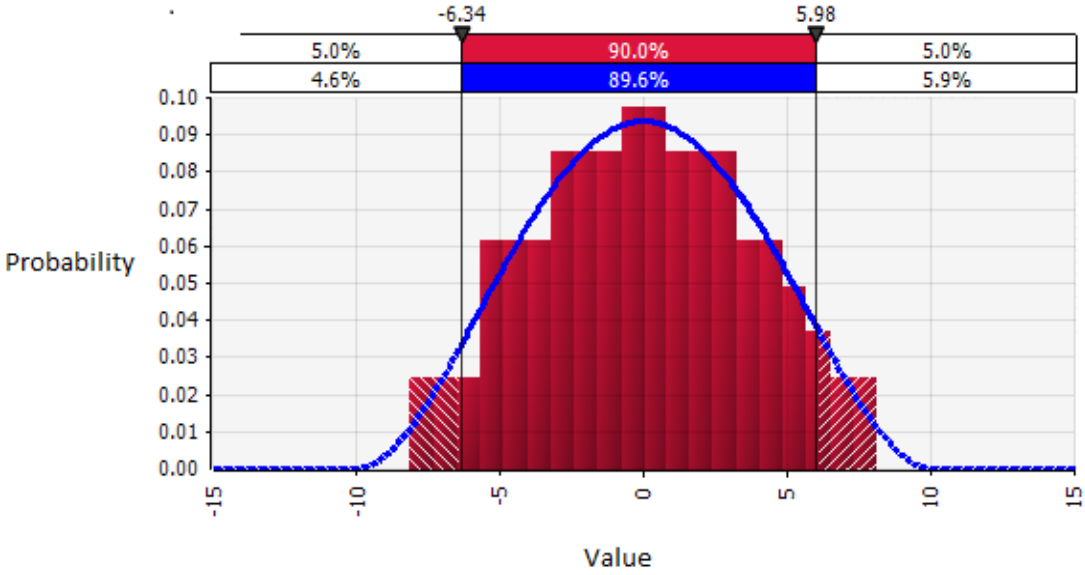
PERT distribution

PERT distribution is essentially a bell-shaped triangular distribution which is the commonly used for modelling planned risks.

The PERT distribution constructs a smooth curve which places progressively more emphasis on values around (near) the most likely value, at the expense of values around towards the tails.

In practice, the estimator has to have confidence on the most likely value, though it may vary between the lowest likely and highest likely value ranges of estimate.

Figure 10.3.5.4(c) - PERT distribution



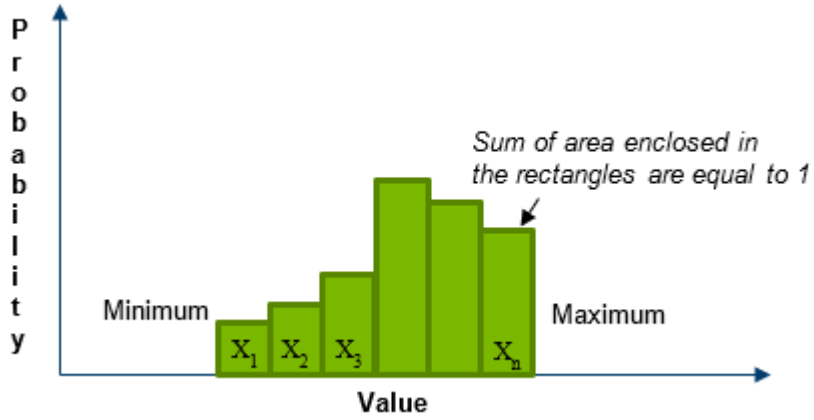
Discrete distribution

Discrete distributions are used to model event occurrence. This approach generally answers the question of 'did the event occur?' and 'how frequently does this event occur?'.

A value for a probability is attached to each possible value. This distribution can be used when historical records exist or when an analysis of the possibility of occurrence has been undertaken.

Generally unplanned risks are modelled using discrete distributions.

Figure 10.3.5.4(d) - Discrete distribution



10.3.6 Risk treatment

Decisions made during the evaluation phase will have determined which levels should be treated formally and which are within the tolerance level of the department and will be managed. This should be recorded in a risk register, along with the assessment of contingency amounts to be provided for in the project cost estimate.

The project risk register will become an important source for organisational learning and should be reviewed in the project finalisation activities.

Options for risk treatment are detailed in Table 10.3.6, which gives treatment options as outlined in ISO 31000:2018.

Table 10.3.6 - Options for risk treatment

Treatment options	Description
Avoiding risk	This is about eliminating the risk and reduce it; it aims to eliminate the source of the risk altogether sometimes to replace it with smaller more easily manageable risk. **Example**: The project manager may decide to avoid exposure to acid sulphate soils by eliminating excavation in the affected area. The cost implications arising from avoiding the risk should be allowed in the project schedule. Inappropriate risk avoidance may increase the significance of other risks. ***Note**: It may be appropriate to transfer the risk to an insurer thereby minimising the impact of the consequences. For instance, the department's construction and minor works projects allow for either contractor controlled (all risks) insurance or Principal Arranged Insurance (PAI). The department has adopted, as policy, PAI on open bid contracts for construction work forming part of the QTRIP. The PAI policy is designed to comprehensively cover construction risks of all project works at all levels including the principal, contractor and subcontractors.*

Treatment options	Description
Taking opportunity	**Realisation of an opportunity** refers to the chance to deliver the same or better outcome for reduced cost. For example, there may be an opportunity through innovation / packaging / acquisition of different resources to complete a project earlier or cheaper with reduced or different resources, or to achieve additional features / scope at no additional cost. **Enhancement of an opportunity** refers to both the identification and realisation of an opportunity. For example, a pavement rehabilitation may be combined with a pavement widening over the same section to reduce the costs of both tasks. **Exploitation of an opportunity** refers to changing the project's scope, supplier or specification to achieve a beneficial outcome without changing the objectives. An example is where a lower price can be obtained from an alternative supplier on multiple contracts, such as bulk purchase of aggregate and/or bitumen for a reseal program. In estimating for projects covered under the PAI program, provision needs to be made for insurance premiums. Further information on PAI can be found on the department's intranet.
Removing risk source	The risk source is removed.
Changing the likelihood	The chance of a risk event happening is changed, whether defined, measured or determined objectively or subjectively, qualitatively or quantitatively and described generally or using mathematic terms such as probability. ***Example**: It may be decided to carry out detailed geotechnical investigations into soft ground conditions in order to make provision in the design for the risk of embankment failure during construction and in service. The cost of this risk reduction treatment will be reflected in the investigation costs of the project.*
Changing the consequences	The outcome of a risk event that affects the projects objectives is changed. Note that an event can lead to a range of consequences. Note that initial consequences can escalate through cumulative events. ***Example**: It may be appropriate to design a bound pavement as an alternative to a granular pavement to minimize the damaging effect of wet weather. The cost implications would be reflected in the cost of the substitute items.*
Sharing the risk	This involves sharing the risk with other parties. For example, some procurement methods such as alliancing commonly entail a form of risk sharing through the application of a pain / gain formula. Other options may include the use of different forms of contracts, and organisational structures such as partnerships and joint ventures. The department's construction and minor works projects allow for either contractor controlled (all risks) insurance or principal arranged insurance.
Retaining the risk	A conscious and deliberate informed decision is taken to retain the risk, having discerned that it is more economical to treat the risk through other treatment options. The risk should continue to be monitored to ensure that it remains tolerable. To ensure the initial project cost is not exceeded, it must include sufficient contingency (time and dollars) to cover the possibility of the risk.

The selection of a final treatment must be made on a value basis. The cost of managing the risk should be commensurate with the benefits obtained. Once implemented, treatments become controls

to manage the risk. Monitoring and reporting should be an integral component of any treatment plan. It is important that a risk owner is identified and become involved in the development of treatment plans.

10.4 Contingency management

Contingency management is an integral component of the overall risk management process. Contingencies that were provided in the early project stages need be reviewed or adjusted across the project life cycle.

The risk register is the most appropriate record to assist with such decisions, regardless of whether the risk is owned by the customer, contractor, or the project manager.

It is important to note that contingencies are only related to circumstances within the approved scope of the project. In the event that there are any changes to project scope during the process, the project intent will need to be re-justified.

This process would be required each time when there is scope change and a new estimate will need to be developed reflecting a level of contingency applicable to the revised scope.

The project manager is responsible for:

- determining the contingency amount
- the ownership of the contingency amount, and
- the delegations for the spending of the contingency with the Project Director.

For national projects, the Australian Government retains the allocation of contingency between P50 and P90.

10.5 Contingency categories

The contingency amounts that result from the risk management process can be categorised as follows:

Planned Risks:

- contingency for Construction Contractors cost component, and
- contingency for Principals Costs component.

Unplanned Risks:

- project wide contingency component.

10.6 Reporting contingencies

The contingency in all cost estimates, together with the base cost, must be dissected into CapEx and OpEx categories. Appropriate CapEx and OpEx contingency cost codes made available for each project activity line item are used for this purpose.

For example, contingency component associated with the PUP works must be allocated are expenditure reported as OpEx.

Section 2.6.1 *Transport and Main Road's Infrastructure Asset Accounting Policy and Guidance* provides further information on this, together with typical contingency ranges for the various estimate stages.

Contingencies that were provided in the early project stages also need be reviewed or adjusted accordingly.

Usually the project manager owns the contingency for planned project risks and the program manager owns the contingency for unplanned project risks.

Please refer to the *QTRIP Savings Management Policy* available internally on the PIP SharePoint page for more information.

10.7 Categories of cost change risks

The categories causing cost change serve as a management tool to identify regular issues that cause change to estimated costs and help find ways of managing them on future projects.

These costs are also called ‘known unknowns’ as they can be expected to occur but cannot be justifiably allocated to any particular above-the-line item in the base estimate.

10.7.1 Design development changes

Design development changes are caused by the advancement of the design, resulting greater amount of detail required on plans to meet the previously stated performance requirements (scope).

The department's historical data suggests this risk category is in the order of 3 - 8% of the estimated construction costs per design stage (that is 3 - 8% from business case stage to completion of S1D, then another 3 - 8% from S1D to S2D).

10.7.2 Standards and policy changes

This category focuses on the changes to be made to the design standards, policy changes by state government or Australian Governments and management decisions imposed at later project stages.

These changes are of a continuous improvement nature based on ongoing research and evaluation.

The specific policies or standards that may change could be unknown during early project phases. However, the designers and estimators should keep vigilant about pending standards or policy changes to ensure the project meets current standards before moving through to the implementation phase.

The department publishes numerous updates to technical specifications each year, some of which will incur cost in delivery. The data suggests the impact of this cost category to be in the order of 5% - 7.5% of the construction and principal’s costs per annum.

One of the most applicable policy changes that can have cost implications, relates to environmental offsets and emissions trading. The project managers should liaise with environmental planners about these changes throughout the project life.

10.7.3 Third party influences

In some situations, utility adjustments may be undertaken partly by the contractor and partly by others. In such circumstances, care must be taken to ensure that the correct scope of utility adjustments is contained in the schedule of works.

It is often difficult to ascertain the potential costs of adjusting existing utilities in early project stages. For example, where the costs are shared, a utility authority may not agree to meet the relocation costs of a utility that was not supposed to be in the vicinity. Appropriate contingency allowances should be made to address such situations, particularly in the early stages of a project in metropolitan areas.

Utility adjustments are not limited to just power poles, cables, service pits and pipes. They also include tunnels or buildings where utilities are housed. See Section 3.3.6.3 Management of Public Utility Plant for more details about the utility services.

Utilities costs might include but are not limited to:

- costs associated with diversions, upgrades or modifications including protection of heritage services
- telecommunications services adjustments
- electrical services adjustments
- water and sewerage adjustments
- gas mains adjustments
- fuel pipelines adjustments
- Queensland Rail railway track adjustments, and
- departmental project management of the necessary relocations.

10.7.4 Revised functionality

This category accounts for scope change that result in revised project benefits (either increased or reduced).

These changes are caused by social, economic and safety reasons such as varied requirements for traffic capacity, axle loadings, access points, or design speed compared to that originally described at project definition. A cost benefit analysis will determine if these changes are warranted and justifiable.

The appropriate allowance for this risk category needs to be determined by the estimator in consultation with the project manager.

10.7.5 Principal's costs

Generally, the principal's costs are estimated from first principles method.

However, if the principal's costs are estimated as a percentage of construction costs, a sufficient contingency allowance must be made in the estimate to reflect the risk and uncertainty in the overall project cost.

The data suggests that the impact of this cost category is in the order of 30% of the unspent portion in the early stages of the project, depending on the project complexity.

10.7.6 Project delay

Research work undertaken in the UK (Flyvbjerg, 2004) found that projects, on average, are delayed 20% from the practical completion date announced in the business case to the actual practical completion date.

Delays can occur any stage of the project life cycle and most common delays occur or are due to the difficulty in securing funding, election caretaker periods, and impact of adjacent projects, reprioritisation, staff turnover, environmental issues and unforeseen natural events such as flooding and so on.

These unplanned delays can cause significant impact on the project budgets for example a $100M project that is scheduled to be completed in five years from the business case to completion, will add

over $10M to the project cost if it is completed in six years. Accounting for this in outturn dollars increases the overrun to $17M (based on current escalation rates at the time of this manual's publication).

This risk category is difficult to estimate so project managers and estimators should use historic data and experience to determine the appropriate contingency amount.

10.7.7 Changes during the implementation phase

The department examined past projects that used various delivery methods and found the average cost increase during construction was 11% of the EFCT.

This review did not look at what caused these increases, so there is no information available on whether it was due to scope creep, contractor's claims, quantity increases or the like.

However, these results are consistent with cost increases reported in the recent QTRIP publications. When including these costs care must be taken not to double count increases due to escalations.

10.7.8 Property acquisition

Risks associated with property acquisition are complex to handle and generally unknown in the early estimating stages. Due to this uncertainty, an appropriate level of contingency must be allowed for projects that could require property acquisitions.

The value of all land required, either as the acquisition cost for newly acquired land, or the potential sale value for previously acquired land, must be included in the project cost. Where the land is only required for the period of construction the residual land value must be credited against the project cost.

In some cases, this might be the same as the acquisition cost of the land but could be less than the acquisition value due to the proximity of the project works, or more if the land can be rezoned.

Property acquisitions requirements may include:

- areas utilised permanently for the project, including sub-surface easements and acquisitions (for example for tunnels)
- any land that might be permanently or temporarily required for compensatory habitats
- contractor's work and site facilities (if provided by Transport and Main Roads) including provision for site offices, temporary environmental works, traffic diversions and so on
- departmental site office and facilities areas, if separate from the contractor's area, and
- land required for any department's works to be undertaken as part of the project.

Apart from the costs of the land to be acquired for project purposes, there are other associated costs in the land acquisition process which are:

- compensation paid to landowners due to project impacts on their land
- the residual value of land temporarily acquired, or made available by demolition of existing infrastructure replaced by the project works, and
- adjustments to property access, footpaths, fences and so on.

Once each property is purchased or accommodation works finalised, the risks associated with this cost category needs to be removed.

Refer to Section 3.3.6.2 Property Acquisition (resumptions) for further details.

10.7.9 Unmeasured / unidentified items

Often cost estimates find missing some key items or underestimated the impact. There must be provisions for items which have not been identified or measured during the quantity take off process at strategic planning, concept and development phases. It is recommended the estimator allow the following lump sum amounts in the contract works contingency schedule to account for:

- development phase Stage 2 design estimate – allow 1% to 3% of total construction cost
- business case estimate - allow 3% to 5% of total construction cost, and
- strategic estimate – allow 5% to 7% of total construction cost.

These contingency allowances will account for any unidentified or unmeasured items in the schedule which will enable the estimate to reach the confidence level that will be unlikely to be exceeded, but also not be excessively conservative.

10.7.10 Opportunity management

According to the TMR Risk Management Framework, an opportunity is an uncertain event that would have a favourable impact on objectives if it occurred.

Opportunity management is the ‘flipside’ (not the opposite) of risk management. Opportunity management refers to a process that is used to effectively optimise the benefits of opportunities in order to enhance an organisations’ ability to achieve its objectives.

The *TMR Opportunity Assessment and Ratings Matrix* ensure that potential opportunities are identified, assessed and rated consistently. The opportunity matrix will provide a qualitative and semi-quantitative approach to determine the ‘maximum benefit’.

A guide for using the opportunity matrix can be found within the risk management section on the internal PIP SharePoint page.

11 Estimation of non-road infrastructure

The purpose of this chapter is to provide rules and standards for the preparation of estimates for infrastructure projects other than roads and bridges such as:

- rail transportation systems (including light rail)
- marine environment infrastructure
- assets such as - Intelligent Transport Systems (ITS), and
- bus transport infrastructure.

This section is to be taken as additions and replacements (where stated) to the previous sections of the document.

11.1 Rail infrastructure

Rail projects, unless within greenfield environments tend to be major upgrades, duplications, or enlargements to existing rail infrastructure.

Unlike road projects, rail projects usually have a high level of manufactured items of a proprietary nature such as turnouts, signalling, communications, power equipment, rolling stock and so on.

Rail construction work within operating rail networks has to be planned and estimated around possessions, which are windows of time when normal train operations are shut down and site access is provided to enable work to take place.

The influence of planning around possessions makes rail construction cost estimating different to cost estimating for roads construction and arguably more variable. Historically, rail projects also have a greater tendency to optimism bias than road projects.

From pre-planning stages through to project delivery, there are many factors that differentiate rail projects from infrastructure projects that can have considerable impact on the costing outcomes.

As per the *Federal Best Practice Cost Estimation Standard for Publicly Funded Road and Rail Construction Guide*, there are number of key factors that require special attention when costing rail projects.

These include but are not limited to:

- Costing of rail systems such as signalling, and communications requires specialist knowledge and needs to take into account the interim staging of the works.
- Work done in brownfield rail reserves with limited physical access and which specify rail safety requirements tends to result in extended program duration, resulting in a significant proportion of indirect costs when compared with a road project.
- Additional requirements from the operator including the continuity of rail operations throughout the construction adds to the complexity of site works and significantly increases the indirect job costs.
- There can also be multiple principals in a rail project environment for example, the principal delivery agency can be either the rail operator (such as Queensland Rail), or the department as with the Moreton Bay Rail Link), or the project environment could have both parties as joint principal.

- Rail projects also involve a significant level of proprietary or manufactured items (for example turnouts, signalling, communications, power equipment and so on.) that are either not locally produced or mass produced. These items can significantly drive up costs and delivery timeframes.
- The need to use specialist rail approved contractors for projects which can also increase contractor costs.
- Working on a live railway networks asset may require either night-time or weekend closures of the traffic via the Scheduled Corridor Access System (SCAS), which can incur labour uplifts and standby equipment costs. Rail cost estimation in brown field locations are usually needed to be broken down by possessions rather than work type, like it is done for road projects.
- Working on or near electrified rail lines require specialised equipment controls, isolations and an approved contractor.
- Working close to a live railway requires additional supervision from track protection officers and lower productivity as works need to stop whilst trains are passing through, and
- Generally, rail project sites are linear and with restricted access which can have a major effect on construction methodologies.

From the supply chain perspective rail projects are significantly different from roadworks due to:

- limited numbers of suppliers of specialised equipment
- specialised plant and associated availability of that plant
- technology interface issues with controls systems, limiting supplier options, and
- technology designed on a one-off basis leading to an uncertainty of design durations and costs.

In delivering rail projects the department and QR should follow the requirements in:

- this manual
- the *OnQ Project Management Framework*
- the *Queensland Rail Project Management Framework*, and
- the *Best Practice Cost Estimation for Publicly Funded Road and Rail Construction Guide*.

11.1.1 Project definition

The following activities should be considered in the project definition for rail projects:

- requirements for enabling works, staging and commissioning strategy
- constraints (available possessions, access to the existing infrastructure, current traffic, commissioning strategy, existing rail systems technology), and
- key interfaces with current and future projects – define extent as it is understood at the time of preparation of the estimate.

11.1.2 Physical scope criteria

Rail specific physical scope criteria that need to be considered include:

- the nature of work (new track and systems infrastructure, integration/modification of existing rail and system infrastructure and platforms / passenger services)
- the extent or limit of works (so there is less uncertainty as to the extent of works costed)
- any assumptions made in the design of key features
- any / all interfaces, such as property, connection to the existing track (turnouts), existing overhead and signalling infrastructure and so on, and
- PUP and signalling services relocations as these are generally vastly underestimated.

Where information is not provided for the preparation of the estimate, the assumptions made must be recorded in the estimate report and submitted with the estimate.

11.1.3 Principal's costs

For rail projects, principal's costs include the costs incurred by both the department and Queensland Rail (QR) throughout the project life cycle.

Those costs include items such as project management, consultancy, community consultation, public utility plant, rail enabling works, track protection, commissioning, and land resumption.

Table 11.1.3(a) details benchmark client costs based on historical data to assist in preparing pre-business case project cost planning and reviewing post business case estimates.

Table 11.1.3(a) - Benchmark principal's costs at development phase

Phase activity	Complexity	Agency	Benchmark costs
Project management	All	Department	1 - 2% of the construction costs
	All	Queensland Rail	3 - 4% of the construction costs
Development phase Stage 1 and 2 design	Typical	Department	3 – 4% of the construction cost
	Complex	Department	6 – 8% of the construction cost
Civil Stage 1 and Stage 2 design	Typical	Queensland Rail	7.5 - 10% of the civil construction costs.
	Complex	Queensland Rail	10 - 15% of the civil construction costs
Track Stage 1 and Stage 2 design	Typical	Queensland Rail	7.5 - 10% of the track construction costs
	Complex	Queensland Rail	10- 15% of the track construction costs
Signalling and telecommunications Stage 1 & Stage 2 design	Typical	Queensland Rail	7.5 -12.5% of the signalling and telecommunications construction costs
	Complex	Queensland Rail	12.5 - 20% of the signalling and telecommunications construction costs
Overhead Stage 1 and Stage 2 design	Typical	Queensland Rail	8 - 12% of the overhead construction costs
Commissioning (costs associated with bus replacement and TPO's)	Typical	Queensland Rail	10 – 12% of the construction costs.

The relevant project delivery method will be determined in consultation between the Department of Transport and Main Roads and QR for the various work packages.

Costs associated with preparing the contract documentation will involve work management activities.

The costs and time required to investigate and relocate rail structures and rail systems are to be kept clear from the costs of the proposed scope of works.

These works will be required prior to the implementation phase and need to be understood early in the development of the project life cycle.

Table 11.1.3(b) - Benchmark principal's costs at implementation phase

Implementation phase activity	Type	Agency	Benchmark costs	Comments
Project management	All	Transport and Main Roads	1 – 2% of the construction cost	Both percentages to be applied.
	All	Queensland Rail	3 - 4% of the construction costs	
Contract administration	Typical	Transport and Main Roads	5.5 – 6.5% construction cost	Both percentages to be applied.
		Queensland Rail	3 – 4% construction costs	
	Complex	Transport and Main Roads	10% construction costs	Both percentages to be applied.
		Queensland Rail	5 - 7.5% construction costs	
Environmental management	Typical	Transport and Main Roads	1 – 4% of the project costs	Environmental cost can be highly variable and higher especially if a project triggers land contamination, extensive offsets, complex erosion control or extensive fauna mitigation is required.
		Queensland Rail	Needs to be determined	
	Complex	Transport and Main Roads	5% +-	
		Queensland Rail	Needs to be determined.	
Materials	All	Transport and Main Roads	Not applicable	Materials provided by Queensland Rail and costed to the project.
		Queensland Rail	Queensland Rail to provide sleepers and rail	
Enabling works	All	Transport and Main Roads	Not applicable	
		Queensland Rail	Scope of works to be determined & priced.	
WHS & PLSL	All	Transport and Main Roads	0.575% of the project total less resumptions plus GST.	Check WHS website for the current rate.
Principal arranged insurance	All	Transport and Main Roads	Refer to the Annexure F – Principal Arranged Insurance of this document	Contract works professional indemnity Public liability.
Project management	All	Transport and Main Roads	1% of the construction cost	Both percentages to be applied.
	All	Queensland Rail	1% of the construction costs	

11.1.4 Property acquisition (resumptions)

Rail project property resumption costs may include:

- actual areas acquired or utilised permanently for the project, including easements and acquisitions
- any land that permanently/temporarily required for compensatory habitats and contractor's work sites

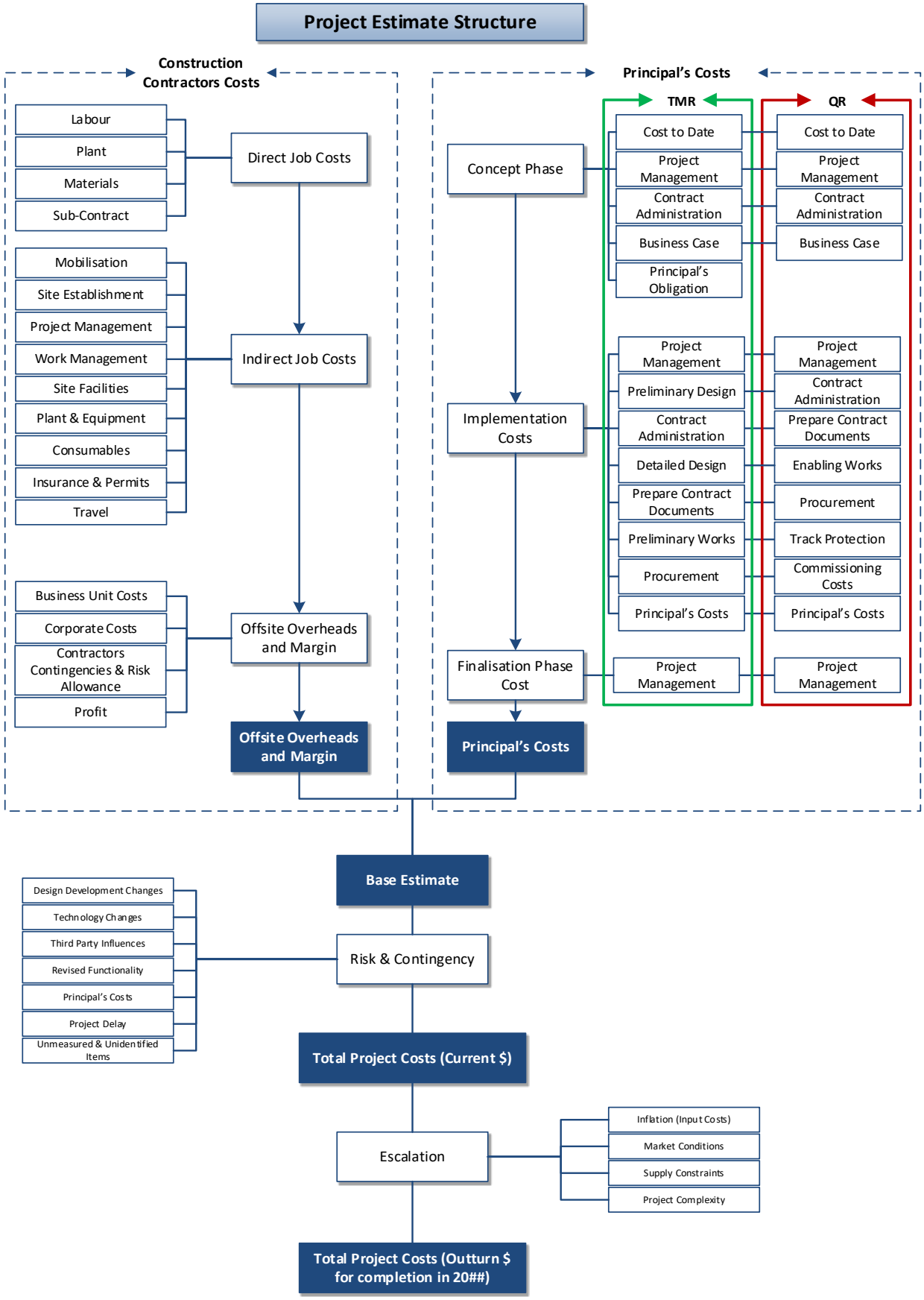
- the department and Queensland Rail site offices and facilities area (if separate from the contractors' site), and
- land required by the department and Queensland Rail, to be undertaken as part of the project.

Refer to Section 3.3.6.2 Property Acquisition (resumptions) for details.

11.1.5 Rail project estimate structure

Figure 11.1.5 illustrates the standard project estimate structure for a rail project.

Figure 11.1.5 - Rail project estimate structure



11.1.6 Time critical activities

The following time-critical activities should be considered when preparing cost estimates for rail projects:

- timeframes to access the corridor as per Scheduled Corridor Access System (SCAS), and
- ordering key material and/or equipment that is specific to rail such as custom-made turnouts, signalling equipment, points and so on.

11.1.7 Track closures

Track closures will be required to undertake maintenance and upgrade works on operating rail lines. There can be two types of track closures:

- night-time closures required for planned and corrective works on all asset types, and
- SCAS for major maintenance and construction works.

SCAS involves the closure of a section of track at planned times throughout the year and are broken down in to network zones. There are seven network zones across the network and generally there are four weekend shutdowns per network zone per year.

The following SCAS timeframes need to be considered from a time and cost perspective when developing cost estimates for rail projects:

- 12+ months prior - Initiation of a SCAS possession bid
- 10 to 6 weeks prior – Expression of interest
- 6 weeks prior – Planning and site meeting
- 6 to 4 weeks prior – SCAS approval process
- 30 days prior – SCAS application work changes cut-off date
- 4 to 2 weeks prior – Plotting of works
- 5 days prior – SCAS coordination package
- 3 days prior – Pre-SCAS meeting, and
- 0 days – SCAS closure.

11.1.8 Work breakdown structure for rail projects

The standard work breakdown structure for typical rail related activities of a typical green field rail project are provided in Annexure M.

11.1.9 Risk and contingency assessment

Based on the trends in cost data over the last 10 years, the categories of cost change for rail projects are:

- Rise and fall in material costs.
- Limited number of approved / qualified suppliers.
- Risk adverse contracting strategies.
- Increased demand for rail performance requirements.

- Additional rail safety requirements.
- New technology.
- Increased minimum design standards as below:
  - adoption of 6 m track centres
  - increased requirement for head hardened rail
  - increased axle loads
  - increased curve radius, and
  - adoption of Q100 flood immunity.

Figure 11.1.5 illustrates the standard project estimate structure for a rail project.

11.1.10 Escalation

Due to the bespoke nature of rail projects, escalation for rail projects will be considered separately on a case by case basis.

11.2 Marine infrastructure

11.2.1 Types of marine infrastructure

Marine infrastructure also has a unique set of challenges and costs that are not associated with land-based transport.

The department also delivers and maintains a variety of marine infrastructure projects such as:

- boat ramps
- barge ramps
- pontoons and floating walkways
- aids to navigations
- dredging
- beach nourishment
- breakwaters
- jetties
- berthing dolphins and fender piles, and
- ferry terminals.

11.2.2 Locality

The estimator must consider how remote the facility is, tide availability at the proposed time of construction, the accessibility of the facility and how this affects contractor establishment costs and the transportation of materials to site. The remoteness also affects the costs for administering the contract / witness.

11.2.3 Availability of site information

Depending on the nature of the work, the availability of site information affects costs (risk management). This typically includes geotechnical information, sediment sampling analysis, wave

climate information, wind climate, hydrographic bathymetry data, and land survey data. If these data sets are not available at the time of the cost estimate, then allowances must be made for the risks associated with the lack of available information. Undertaking of any site investigation / analysis tasks if required must be included in the cost estimate.

11.2.4 Risk and contingency allowance

There are several risks that are common to marine projects that should be assessed and used to determine a suitable contingency allowance. These risks include:

- Poor geotechnical properties affecting pile embedment depths and settlement, which may increase the rock volumes.
- Water levels impacting on construction timing and method - tidal and freshwater (flooding and weir levels).
- Existing users at the site that may need to be accommodated in the scope of works, design changes or timing of the works e.g. recreational boaties, commercial barges, commercial fishermen, etc.
- Limited number of experienced / suitable marine contractors particularly for dredging works and remote locations.
- Lack of alternative facilities, meaning an existing ramp cannot be fully closed during construction requiring extra traffic management, safety considerations, complex construction method and extended contract period. Alternatively, site works may only be allowable outside school holidays to avoid the peak usage time by boaties.
- Risk adverse contracting strategies (e.g. sole supplier).
- Marine park and Fish Habitat Area (FHA) and protected marine plants constraints – costly and time-consuming revocations may be required, and
- Land tenure – complexities involving the land tenure for the new or upgraded facility can greatly impact on delivery timing.

11.2.5 Statutory approvals required

For works that will require statutory approvals (for example, Development Approval, Tidal Works Approval, Marine Park Permits, Sea Dumping Permits, Environmental Authority), the estimator must price in the work required to prepare approval applications and associated fee payments.

Aids to navigation are typically exempt from tidal works approvals and Marine Park approvals.

11.2.6 Environmental management costs

Depending on the type of work, environmental management may add significant cost and potential time delays to the project and the estimator must consider what environmental management tasks may likely be required (for example, preparation of an environmental management plan, contractor's implementation of environmental management controls, third party water quality monitoring costs, obtaining permits from other agencies and so on).

Marine related-environmental approvals often have very detailed design requirements as a condition of the approval and thus early involvement of the administrating authority and incorporation of design requirements will prevent costs of rework and retrofitting to detailed design.

Cultural heritage management agreements or plans with Aboriginal or Torres Strait Islander Parties and historical heritage approvals can also contain strict management requirements such as onsite presence of observers and conditions that will have associated costs.

11.2.7 Complexity of design

For projects that are considered complex (that is, not routine, difficult site situations such as exposed to extreme weather events, unusual imposed load spectrum, or unprecedented design situations), the estimator must make allowance for the higher-level design development required.

11.3 Intelligent transport systems

Intelligent Transport Systems (ITS) are technologies intended to improve the efficiency, reliability and safety of existing or new transport infrastructure.

Examples of ITS include Managed Motorways (ramp metering, lane use management systems and variable speed limits), En-route Information Systems (such as variable message signs), traffic control (such as traffic signals), and vehicle detection, classification and monitoring (such as CCTV, loops, and so on).

ITS projects generally involve complex information technology systems, communication equipment and software. Changes to one component of an ITS project may have a significant impact on another area, for example, a change of communications hardware at one site may make it unable to transfer data back to the server.

ITS projects can be delivered either as stand-alone projects or delivered as part of an overall civil road infrastructure project.

Understanding the various disciplines required to implement ITS along with the iterative design and implementation process is required to maximise value and achieve the most cost efficient from the ITS solution.

Most typical ITS projects require civil works such as the installation of underground cabling or gantry structures on which to attach variable message signs.

Further information about ITS treatments can be found in *TMR's Smarter Solutions: Network Optimisation Framework*, which provides direction about what should be considered when making planning and investment decisions to ensure the department is getting the most from existing assets and using infrastructure smarter and more efficiently than before.

A concept of operations for the operation of new or existing infrastructure should be developed and agreed to prior to undertaking detailed design of any ITS equipment, so as to ensure appropriateness of any technology delivered.

11.3.1 Procurement

It is important that an ITS procurement strategy considers the volume of work, budget, reliability and maintainability and involves asset management and operations from the very start of the project.

Procurement planning needs to consider the most suitable delivery/works packaging as well as procurement / contract methods.

When determining work packages for a project, thought should be given to:

- the full range of risks, not just coordination between contractors on a site

- the entire sequence of delivering quality data (which many systems rely on)
- existing departmental technical specifications for ITS equipment and processes
- whether any ITS, in particular performance monitoring devices, should be deployed prior to civil works so as to allow project monitoring.

11.3.2 Resources

Human resources involved in ITS projects include:

- project management
- contract management
- electrical trades
- electrical engineering
- civil engineering
- structural engineering
- telecommunications experts
- information technology / computer science engineering, and
- traffic / transport engineering.

It is important that continuity of key technical staff to support the project are maintained throughout the process, including the finalisation and handover stages.

11.3.3 Principal's costs

For ITS projects, principal's costs will include the costs incurred by department throughout the project life cycle. Further to that mentioned in the previous sections of this document, serious consideration also needs to be given to:

- commissioning costs
- ongoing operations
- asset management, and
- system compatibility.

11.4 Busways and tunnels

A typical busway or tunnel project will incorporate pavements, mechanical and electrical systems, structures, and ITS features. Thorough planning is required to ensure that all systems are integrated correctly. Estimation of these projects should consider the following items:

- fire, life and safety devices
- heating ventilation air conditioning
- ITS
- hydraulics (such as stormwater pumps)
- closed-circuit television and other communication systems
- emergency gates

- traffic control systems and software
- dynamic signs
- encoders, sensors, switch boards
- electrical systems, and
- station, tunnel and road lighting systems.

After construction is complete, the department is expected to develop a routine maintenance regime for handover to the applicable maintenance contractor.

The estimates and budgets for these systems should consider costs associated with intensive planning, design by specialist staff, preparation of maintenance regimes and contracts and also developing asset management systems.

12 Glossary of terms

Term	Definition
Accountability	The final responsibility for completion of tasks and achievement of results within delegated authority and to established performance standards.
Activity	An element of work performed during the course of a project. An activity normally has an expected duration, cost and resource requirement. Activities can be subdivided into tasks.
Actual cost	The final outturn dollar expenditure on a project.
Anticipated final cost	The sum of expenditure to date, plus the forecast expenditure, in outturn dollars, to complete the project.
Approved Project Delivery Value (APDV)	Approved Project Value is the revised project budget at contract award.
Base estimate	The base estimate is the estimator's best prediction in terms of the quantities and current rates which are likely to be associated with the delivery of a given scope of work prior to the addition of inherent and contingent risk values or escalation allowances.
Benchmarking	Gathering, collating, and analysing historical data and storing it for future use.
Budget	The budget is the approved amount of funding for a project. This may be different to the estimates throughout the project life cycle.
Business case estimate	An estimate prepared during the concept phase to support the project's business case.
Candidate project	A body of work identified in TSM Phase 3 that with approval may become a project.
Cashflow	Cash flow is the project base estimate plus contingency amount expenditure profile across the financial years the funds are expected to be spent.
Component	A definable part of a project, including stages of planning, design and construction that contribute to the total project cost.
Concurrence review	An independent third-party review of a project estimates where the estimator, sponsor and reviewer agree regarding the estimate metrics.
Construction estimate	An estimate produced after acceptance of the successful tenderer just prior to the implementation phase.
Confidence Index	Data/information which captures in broad terms the project scope maturity, data available and time provided to produce the estimate.
Contingency	A financial reserve included in the project's estimate to offset uncertain or unpredictable factors relating to the delivery of project objectives. The amount of funds, budget or time needed above the estimate to reduce the risk of overruns of project objectives to a level acceptable to the organisation. Budget within the cost baseline or performance measurement baseline that is allocated for identified risks that are accepted and for which contingent or mitigating responses are developed.
Correlation	Correlation is the parameter (or statistic) used to describe the degree to which two variables are related - or the degree to which one variable's probability distribution is related to another.

Term	Definition
Cost estimating	The process of estimating the cost of the resources needed to complete project activities.
Development Phase Stage 1 Design estimate (S1D)	The estimate of all components of a project prepared based on advanced design. It provides a check of the alignment between the project estimate and the approved scope/budget. It occurs immediately prior to the S2D and is expressed in outturn dollars. (Formerly preliminary design).
Development Phase Stage 2 Design estimate (S2D)	The estimate of all components of a project prepared prior to calling of tenders for construction, and based on final designs, construction specifications and project documentation. It is expressed in outturn dollars. (Formerly detailed design).
Detailed design estimate	See Development Phase Stage 2 design estimate.
Enrich Investment	Refers to the 'enrichment' – or 'the required activities' required when new investment is drafted in OPPM, and the project 'shell' is created in Unifier (that is, - 1. Adding the Project Manager to the Project Controller Group, - 2. Adding the Project Manager to the Project Information Form, - 3. creating the Primary Work Location and, - 4. Creating the Enrich Investment Form).
Escalation	The anticipated increase in project costs over time as a result of various factors such as inflation, market conditions, supply constraints and project complexity.
Estimate	A document recording the calculated cost prediction to undertake a specific amount of work. It is prepared in a systematic manner appropriate to the size and complexity of the work, and to a level of accuracy commensurate with the available information and the intended use of the information developed. It may include some prior expenditure.
Estimated final cost	See anticipated final cost.
Estimate for Comparison with Tenders (EFCT)	The estimate prepared at the tender stage to assess tenders' bids. This estimate only considers contract scope, not the whole project.
Estimate Probability	Ensuring that estimates have been prepared as prescribed and in accordance with the requirements and appropriate ranges for the different project phases and stages – either P50, P75 or P90.
Estimated total project cost	The total project cost is the sum of the base estimate plus contingency plus escalation, expressed in P90 values. This is also referred to as the total outturn cost. See also total project cost.
Expert Estimation	Department's preferred application to compile first principle estimates.
Estimate report	A report containing the estimate and details of the estimating processes, assumptions, inputs and so on.
First principles (basic cost) estimating	A detailed estimating method based on a detailed work breakdown structure, work methods, production rates and resource requirements. The estimate is structured to provide details of direct costs, on-site overheads, off-site overheads, contractor contingencies and margin.
Global estimating	A very approximate estimating method based on an all-inclusive unit rate, such as $/km of road. Also known as order of magnitude estimating.

Term	Definition
Indirect costs	These are costs not directly attributable to work items. For construction activities these costs include on-site overheads (such as site supervision) and off-site overheads (contractor's corporate / business costs). They are exclusive of contractor's contingency and profit.
Inflation	An allowance for the rising cost of the project due to rise and fall factors external to the project definition.
Management reserve	Management reserves are budgets reserved for unplanned changes to project scope and cost. The project manager will be required to obtain approval before obligating or spending management reserve Management reserve is administered at the program level.
Margin (contractor)	An allowance that includes the contractor's corporate overheads and profit.
Memoranda of understanding	A memorandum of understanding is a document describing a bilateral or multilateral agreement between parties. It expresses a convergence of will between the parties, indicating an intended common line of action. It most often is used in cases where parties either do not imply a legal commitment or in situations where the parties cannot create a legally enforceable agreement.
OnQ	Department's project management framework that provides direction and guidance for effective management and delivery of projects.
Optimism bias	The tendency for people to be overly optimistic regarding project costs and planned durations.
Oracle Primavera Portfolio Management (OPPM)	Management software used for Investment Prioritisation and Portfolio related activities including funding and planning of investment programs, evaluating Portfolio performance, QTRIP and Portfolio Reporting.
Oracle Primavera Unifier (referred to as 'Unifier')	It is a project and contract management system used to enable a large proportion of delivery functionality, and also to deliver Project, Contract and Delivery Program Management functionality. It is an integrated platform that optimizes business processes and creates visibility which enables users to manage all the information required to successfully manage a project throughout its life cycle – whilst providing real-time visibility across multiple projects.
Oracle Primavera P6	It is an integrated project management and work scheduling solution, used to deliver capability that will enable integrated planning, project schedule and resource management across the solution.
(Oracle Primavera) 3PCM	Portfolio, Program, Project and Contract Management (3PCM) is the system used by the department and is based on the Oracle Primavera suite of products, which incorporates Oracle Primavera Portfolio Management (OPPM), Oracle Primavera Unifier (Unifier) and Oracle Primavera P6 - EPPM (P6).
P50 estimate	An estimate with a 50% confidence of not being exceeded at project completion, while not being overly conservative.
P90 estimate	An estimate with a 90% confidence of not being exceeded at project completion, while not being overly conservative.
Pareto principle	Pareto principle, also known as the 80/20 rule, is a theory maintaining that 80% of the output from a given situation or system is determined by 20% of the input.
Peer review	A review of the project estimates by an independent, experienced estimator from within Transport and Main Roads.

Term	Definition
Portable Long Service Leave (PLSL)	As the building and construction industry is project driven, it would be impossible for most workers to accrue enough service with one employer to be eligible for long service leave. Portable long service leave provides long service leave entitlements to workers in the building and construction industry as they move between projects.
Portable long service leave levy	This levy is collected solely to fund the building and construction industry Portable Long Service Leave Scheme. If the work is being done for a local government or non-Queensland Government entity, the local government or entity is responsible for payment of the levies and fee.
Preliminary design estimate	See development phase stage 1 design estimate.
Principal Arranged Insurance (PAI)	Principal arranged insurance is insurance arranged by an agency representing a principal to cover the agency, principal, contractors and subcontractors and other service providers in respect of risks under contracts let by the principal. The premiums may be paid by the agency or by each contractor to the principal.
Principal's costs	Principal's costs are those costs which the department incurs to conceptualise, develop, deliver and finalise a project. These may include community consultation, environmental assessment, design planning, services relocation, resumptions, accommodation, site investigations, and principal supplied material and so on.
Probabilistic estimating	A method of generating estimates which takes into consideration that quantities measured (or allowed for) can change, rates assumed can vary and risk with a probable outcome can materialise.
Program	A group of related projects managed in a coordinated way in order to obtain benefits and control not available from managing them individually.
Program management framework	The department's operational model for qualifying, selecting and managing projects through their life cycles.
Program manager	The person responsible for leading and managing a group of projects. The program manager interacts with each project manager to provide support and guidance on individual projects.
Program of works	The planned durations for performing activities and the planned dates for reaching milestones.
Project	A temporary endeavour undertaken to create a unique product, service or result. It has a clearly defined scope, start and end time, a structured set of activities and tasks, a budget and a specified business case.
Project manager	The person responsible for managing a project and achieving its objectives. Manages all activities necessary to deliver the project or services to the required quality standard and within the time and cost constraints.
Project life cycle	All of the activities necessary for a project throughout its life, from beginning to end, normally dissected into a number of sequential phases. The generic project life cycle has four stages: concept, development, implementation and finalisation.
Project schedule	A listing of a projects works activities and their associated costs.
Provisional items	Items included in an estimate which cannot be accurately quantified.
Public Utility Plant (PUP)	Public Utility Plant includes, but is not limited to, infrastructure related to the distribution of communications, electricity, water, sewerage, gas and so on.

Term	Definition
Qualitative risk analysis	The process of prioritising risk for subsequent analysis or action by assessing and combining probability of likelihood and impact. In regard to estimating and risk assessment, this approach draws upon the softer skills such as past experience, asking stakeholders the right questions, decision making, problem solving and common-sense review by appropriate personnel and is more reliant on the project team's experience.
Quantitative risk analysis	The process of numerically analysing the effect on project objectives of identified risk. In regard to estimating and risk assessment, this approach draws upon the use of tools, techniques, templates, software, and the use of specialist risk estimating software, such as @Risk.
Queensland Transport and Roads Investment Program (QTRIP)	The QTRIP is the program of works the department produces and plans to deliver over the upcoming four years.
Range estimate	An estimate which reports the pessimistic, optimistic and most likely values.
Reality check	The action of comparing an estimate and/or its items to previous benchmarked values.
Risk	A project risk is the effect of uncertainty on project objectives; the chance of something happening that will have an impact upon project objectives. Risk is measured in terms of consequences and likelihood.
Schedule of rates	The list of all envisaged project work activity items, quantities and rates, whether the rates have been entered or not.
Scope	The scope is the work that must be undertaken to deliver a product, service or result with the specified features and functions.
Scope creep	Increase in project scope not anticipated at the start of the project.
SmartCost	SmartCost is a library of resource costs used by the department for developing first principle's cost estimates. It is used by the Expert Estimation tool in the preparation of project estimates.
Stage	A logical construct to describe the division of work within a project phase.
Strategic estimate	A high-level estimate prepared to support the department's strategic road network planning processes, presented in current dollars.
Total project cost (current dollars)	The estimated total completion cost.
Total project cost (outturn dollars for completion in 20XX).	Total project cost in outturn dollars is used for planning and budgeting purposes and relates to the period in which the work will be performed. Estimates prepared at a particular date can be converted to outturn dollars by applying the appropriate escalation rates to the project's planned cash flow.
Uncertainty	Uncertainty represents unknown or ill-defined variables causing a loss or profit. The point is that the agency causing the loss or profit cannot be named.
Variation	Approved change to the scope of work.

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