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Transport Infrastructure Ireland

# TII Publications

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## Cost Management Manual

**PE-PMG-02044**  
December 2020

## About TII

Transport Infrastructure Ireland (TII) is responsible for managing and improving the country's national road and light rail networks.

## About TII Publications

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<b>TII Publication Number</b>	<i>PE-PMG-02044</i>

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## TII Publications




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<b>Activity:</b>	Planning & Evaluation (PE)
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## Contents

<b>1. Phase 0: Scope and Pre-Appraisal / Phase 1: Concept and Feasibility .....</b>	<b>7</b>
<b>2. Phase 2: Option Selection .....</b>	<b>10</b>
<b>3. Phase 3: Design and Environmental Evaluation Processes .....</b>	<b>13</b>
<b>4. Phase 4: Statutory Processes .....</b>	<b>17</b>
<b>5. Phase 5: Enabling and Procurement .....</b>	<b>20</b>
<b>6. Phase 6: Construction and Implementation .....</b>	<b>24</b>
<b>7. Phase 7: Close out and Review .....</b>	<b>28</b>
<b>8. References .....</b>	<b>31</b>
<b>Appendix A: .....</b>	<b>35</b>
Cost Management Requirements .....	35
<b>Appendix B: .....</b>	<b>50</b>
Risk Management Requirements.....	50
<b>Appendix C: .....</b>	<b>66</b>
Value Management.....	66
<b>Appendix D: .....</b>	<b>78</b>
Glossary of Terms .....	78

## Contents Table

<b>1. Phase 0: Scope and Pre-Appraisal / Phase 1: Concept and Feasibility</b> .....	<b>7</b>
1.1 Cost Management Requirements .....	7
1.2 Risk Management Requirements.....	8
1.3 Value Management Requirements .....	8
<b>2. Phase 2: Option Selection</b> .....	<b>10</b>
2.1 Cost Management Requirements .....	10
2.2 Risk Management Requirements.....	11
2.3 Value Management Requirements .....	11
<b>3. Phase 3: Design and Environmental Evaluation Processes</b> .....	<b>13</b>
3.1 Cost Management Requirements .....	13
3.2 Risk Management Requirements.....	14
3.3 Value Management Requirements .....	16
<b>4. Phase 4: Statutory Processes</b> .....	<b>17</b>
4.1 Cost Management Requirements .....	17
4.2 Risk Management Requirements.....	18
4.3 Value Management Requirements .....	19
<b>5. Phase 5: Enabling and Procurement</b> .....	<b>20</b>
5.1 Cost Management Requirements .....	20
5.2 Risk Management Requirements.....	22
5.3 Value Management Requirements .....	22
<b>6. Phase 6: Construction and Implementation</b> .....	<b>24</b>
6.1 Cost Management Requirements .....	24
6.2 Risk Management Requirements.....	26
6.3 Value Management Requirements .....	26
<b>7. Phase 7: Close out and Review</b> .....	<b>28</b>
7.1 Cost Management Requirements .....	28
7.2 Risk Management Requirements.....	29
7.3 Value Management Requirements .....	29
<b>8. References</b> .....	<b>31</b>
8.1 TII Publications (Standards) References .....	31
8.2 TII Publications (Technical) References .....	32
8.3 Other Miscellaneous References.....	34
<b>Appendix A:</b> .....	<b>35</b>
Cost Management Requirements .....	35

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<b>Appendix B:</b> .....	<b>50</b>
Risk Management Requirements.....	50
<b>Appendix C:</b> .....	<b>66</b>
Value Management.....	66
<b>Appendix D:</b> .....	<b>78</b>
Glossary of Terms .....	78

# Introduction

## Purpose

This Manual has been prepared to provide detail on the cost, risk, and **Value Management** processes and deliverables required during the development and delivery of National Road projects. Cost, risk, and **Value Management** processes will take account of the requirements of the Project Management Guidelines (PE-PMG-02041).

## Interaction of Cost Management Manual with other Guidelines

The Public Spending Code (PSC) is a set of rules and procedures to ensure that all Irish public bodies treat public funds with care to ensure that the best possible value-for-money is obtained whenever public money is being spent or invested. The Capital Works Management Framework (CWMF) is a structure that has been developed to deliver the Government's objectives in relation to public sector construction procurement reform. It consists of a suite of best practice guidance, standard contracts, and generic template documents.

This manual is compatible with the requirements of the PSC and the CWMF. Additional TII and other departmental guidelines of relevance include:

- TII Project Appraisal Guidelines for National Roads (PAG) available from the TII Publications website;
- TII Project Management Guidelines (PE-PMG-02041);
- TII Project Managers Manuals (PE-PMG-02042 & PE-PMG-02043);
- Common Appraisal Framework for Transport Projects and Programmes published by DoT.

## Application

This Manual is applicable to minor and major National Road projects which are funded through Transport Infrastructure Ireland (TII) and / or where TII is the Approving Authority, unless otherwise instructed by TII. This manual is to be utilised by Project Managers delivering National Road projects. In this manual where reference is made to the Project Manager, this refers to the person delivering the Project on behalf of the Sponsoring Agency <sup>1</sup>.

This Manual does not purport to be a full statement of the duties and statutory obligations of the Project Manager. Responsibility for ensuring that the Project is progressed in accordance with applicable legislation, standards, and guidelines remains with the Project Manager <sup>2</sup>.

TII, as Approving Authority, provides cost, risk, and **Value Management** processes which must be followed unless otherwise agreed with the TII Senior Engineering Inspector.

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<sup>1</sup> For the purposes of this Manual, the term "Project Manager" is used to describe the person or persons undertaking the functions of Project Coordinator and Project Manager as described in the *Project Management Guidelines (PE-PMG-02041)*.

<sup>2</sup> While this Manual identifies the Project Manager as the person responsible for the delivery of all aspects of the Project, it is anticipated that the Project Manager will rely heavily on the Design Team for assistance with this. The scope of work, and delegated responsibility to the Design Team (whether an internal design team within the Sponsoring Agency or external Technical Advisors) will be defined and recorded within the Project Execution Plan.

TII will be available to provide guidance and advice to the Sponsoring Agency, as appropriate, to ensure consistency of approach in the application of these processes with the aim of achieving the successful delivery of National Road projects. This Manual should be read in conjunction with the Project Management Guidelines (PE-PMG-02041).

Because projects vary in complexity and size, it is possible that projects may be identified where it is not appropriate to fully implement the requirements of the manual. In such circumstances, any deviation from the requirements of this manual must have prior approval from the TII Senior Engineering Inspector responsible for the Project and such deviation should be recorded within the Project Execution Plan.

## Interaction with TII

As a Project progresses, the Project Manager may desire to seek advice and support from various specialist sections within TII with respect to cost, risk, and value management. The primary interface between the Project Manager and TII is the TII Senior Engineering Inspector. The TII Senior Engineering Inspector will determine the appropriate process for seeking advice from the various specialist sections within TII as required.

The TII Senior Engineering Inspector will deal with all day to day issues on National Road projects on behalf of TII including payments to Sponsoring Agencies and ensuring that all Project Management Guidelines Approval Points, expenditure monitoring, and project reporting are in compliance with TII policies for National Road project delivery. The TII Senior Engineering Inspector is not responsible for checking, validating, or reviewing documentation prepared by the Sponsoring Agency. It is the responsibility of the Sponsoring Agency to ensure that deliverables are of a high quality and that the project is progressed in accordance with applicable legislation, standards, and guidelines. The TII Senior Engineering Inspector will be available to provide guidance and advice to the Sponsoring Agency, as appropriate, as to the form and content of deliverables required to ensure best practice and consistency of approach in the delivery of National Road projects.

## Manual Overview

The management of cost, risk, and value during project delivery and development is a continuous process. At each phase, cost, risk, and **Value Management** are interrelated. The outputs, decisions, and actions arising out of any one of these activities will feed into the other processes. Consequently, they will be considered and managed in an integrated manner.

This manual contains phase specific cost, risk, and **Value Management** processes and procedures. These will be adopted proportionately to whether the project is classified as 'Major' or 'Minor'. The Project Manager will detail the necessary cost, risk, and **Value Management** processes and procedures required during the delivery and development of the Project within the Project Execution Plan (PEP). The appendices of this manual outline how cost, risk, and **Value Management** processes and procedures will be implemented during project development and delivery.

## Structure of this Manual

The Project Management Guidelines divide the evolution and progression of a Project into an eight-phase process (Phase 0 to Phase 7 inclusive). Each phase is detailed within this Manual with the associated cost, risk, and **Value Management** processes and deliverables presented. Templates for key deliverables are included as appendices, as appropriate, or are referenced as available from TII upon request. The key processes and deliverables for each project phase are also summarised in **Figure 1**.

<b>Phase 0: Scope and Pre-Appraisal / Phase 1: Concept &amp; Feasibility</b>		
	<b>Major Projects</b>	<b>Minor Projects</b>
<b>Cost Management</b>	<ul style="list-style-type: none"> <li>Determine indicative range of costs involved.</li> </ul>	<ul style="list-style-type: none"> <li>Determine indicative range of costs involved.</li> </ul>
<b>Risk Management</b>	<ul style="list-style-type: none"> <li>Project Risk Register.</li> </ul>	<ul style="list-style-type: none"> <li>Project Risk Register.</li> </ul>
<b>Value Management</b>	<ul style="list-style-type: none"> <li>Determine project objectives and key value performance indicators.</li> </ul>	<ul style="list-style-type: none"> <li>Determine project objectives and key value performance indicators.</li> </ul>
<b>Phase 2: Option Selection</b>		
	<b>Major Projects</b>	<b>Minor Projects</b>
<b>Cost Management</b>	<ul style="list-style-type: none"> <li>Option Comparison Estimate</li> <li>Estimate Assumptions Sheet.</li> <li>Estimate Tracking Sheet.</li> </ul>	<ul style="list-style-type: none"> <li>Option comparison Estimate.</li> <li>Estimate Assumptions Sheet.</li> <li>Estimate Tracking Sheet.</li> </ul>
<b>Risk Management</b>	<ul style="list-style-type: none"> <li>Project Risk Register.</li> <li>Quarterly Risk Status Summary Reporting.</li> <li>Risk Assessment Report(s).</li> </ul>	<ul style="list-style-type: none"> <li>Project Risk Register.</li> <li>Quarterly Risk Status Summary Reporting.</li> <li>Risk Assessment Report(s).</li> </ul>
<b>Value Management</b>	<ul style="list-style-type: none"> <li>Quarterly Value Management Summary Reporting.</li> </ul>	<ul style="list-style-type: none"> <li>Quarterly Value Management Summary Reporting.</li> </ul>
<b>Phase 3: Design and Environmental Evaluation</b>		
	<b>Major Projects</b>	<b>Minor Projects</b>
<b>Cost Management</b>	<ul style="list-style-type: none"> <li>Target Cost 1 &amp; Total Scheme Budget.</li> <li>Estimate Assumptions Sheet.</li> <li>Estimate Tracking Sheet.</li> </ul>	<ul style="list-style-type: none"> <li>Minor Project Estimate (TC1).</li> <li>Estimate Assumptions Sheet.</li> <li>Estimate Tracking Sheet.</li> </ul>
<b>Change Management</b>	<ul style="list-style-type: none"> <li>Record within Project Risk Register.</li> </ul>	<ul style="list-style-type: none"> <li>Record within Project Risk Register.</li> </ul>
<b>Risk Management</b>	<ul style="list-style-type: none"> <li>Project Risk Register.</li> <li>Quantified Risk Analysis.</li> <li>Quarterly Risk Status Summary Reporting.</li> <li>Risk Assessment Report (s).</li> </ul>	<ul style="list-style-type: none"> <li>Project Risk Register.</li> <li>Quarterly Risk Status Summary Reporting.</li> <li>Risk Assessment Report (s).</li> </ul>
<b>Value Management</b>	<ul style="list-style-type: none"> <li>Quarterly Value Management Summary Reporting.</li> </ul>	<ul style="list-style-type: none"> <li>Quarterly Value Management Summary Reporting.</li> </ul>
<b>Phase 4: Statutory Processes</b>		
	<b>Major Projects</b>	<b>Minor Projects</b>
<b>Cost Management</b>	<ul style="list-style-type: none"> <li>Target Cost 2 &amp; Total Scheme Budget.</li> <li>Estimate Assumptions Sheet.</li> <li>Estimate Tracking Sheet.</li> </ul>	<ul style="list-style-type: none"> <li>Review of Minor Project Estimate (TC1).</li> <li>Estimate Assumptions Sheet.</li> <li>Estimate Tracking Sheet.</li> </ul>
<b>Change Management</b>	<ul style="list-style-type: none"> <li>Record within Project Risk Register.</li> </ul>	<ul style="list-style-type: none"> <li>Record within Project Risk Register.</li> </ul>
<b>Risk Management</b>	<ul style="list-style-type: none"> <li>Project Risk Register.</li> <li>Quarterly Risk Status Summary Reporting.</li> <li>Risk Assessment Report(s).</li> </ul>	<ul style="list-style-type: none"> <li>Project Risk Register.</li> <li>Quarterly Risk Status Summary Reporting.</li> <li>Risk Assessment Report(s).</li> </ul>
<b>Value Management</b>	<ul style="list-style-type: none"> <li>Quarterly Value Management Summary Reporting.</li> </ul>	<ul style="list-style-type: none"> <li>Quarterly Value Management Summary Reporting.</li> </ul>
<b>Phase 5: Enabling and Procurement</b>		
	<b>Major Projects</b>	<b>Minor Projects</b>
<b>Cost Management</b>	<ul style="list-style-type: none"> <li>Updated Target Cost 2 &amp; Total Scheme Budget</li> <li>Target Cost 3 &amp; Total Scheme Budget.</li> <li>Estimate Assumptions Sheet.</li> <li>Estimate Tracking Sheet.</li> </ul>	<ul style="list-style-type: none"> <li>Minor Project Estimate prior to Tender Issue (TC2).</li> <li>Minor Project Estimate at Tender Award (TC3).</li> <li>Estimate Assumptions Sheet.</li> <li>Estimate Tracking Sheet.</li> </ul>
<b>Change Management</b>	<ul style="list-style-type: none"> <li>Change Order Register.</li> </ul>	<ul style="list-style-type: none"> <li>Change Order Register.</li> </ul>
<b>Risk Management</b>	<ul style="list-style-type: none"> <li>Project Risk Register.</li> <li>Quantified Risk Analysis.</li> </ul>	<ul style="list-style-type: none"> <li>Project Risk Register.</li> </ul>

	<ul style="list-style-type: none"> <li>• Quarterly Risk Status Summary Reporting.</li> <li>• Risk Assessment Report(s).</li> </ul>	<ul style="list-style-type: none"> <li>• Quarterly Risk Status Summary Reporting.</li> <li>• Risk Assessment Report(s).</li> </ul>
<b>Value Management</b>	<ul style="list-style-type: none"> <li>• Translate Project objectives into Contract Documentation.</li> </ul>	<ul style="list-style-type: none"> <li>• Translate Project objectives into Contract Documentation.</li> </ul>
<b>Phase 6: Construction and Implementation</b>	<b>Major Projects</b>	<b>Minor Projects</b>
<b>Cost Management</b>	<ul style="list-style-type: none"> <li>• Outturn Cost (Target Cost 4 (TC4) and TSB).</li> <li>• Final Account Report.</li> </ul>	<ul style="list-style-type: none"> <li>• Outturn Cost (Target Cost 4 (TC4) and TSB).</li> <li>• Final Account Report.</li> </ul>
<b>Change Management</b>	<ul style="list-style-type: none"> <li>• Compensation Events Register.</li> </ul>	<ul style="list-style-type: none"> <li>• - Compensation Events Register.</li> </ul>
<b>Risk Management</b>	<ul style="list-style-type: none"> <li>• Project Risk Register.</li> <li>• Quarterly Risk Status Summary Reporting.</li> <li>• Risk Assessment Report(s).</li> </ul>	<ul style="list-style-type: none"> <li>• Project Risk Register.</li> <li>• Quarterly Risk Status Summary Reporting.</li> <li>• Risk Assessment Report(s).</li> </ul>
<b>Value Management</b>	<ul style="list-style-type: none"> <li>• Value Engineering Proposals Register.</li> </ul>	<ul style="list-style-type: none"> <li>• Value Engineering Proposals Register.</li> </ul>
<b>Phase 7: Closeout and Review</b>	<b>Major Projects</b>	<b>Minor Projects</b>
<b>Cost Management</b>	<ul style="list-style-type: none"> <li>• Final Outturn Cost (Target Cost 4 &amp; Total Scheme Budget).</li> <li>• Project Closeout Report.</li> </ul>	<ul style="list-style-type: none"> <li>• Final Outturn Cost.</li> <li>• Project Closeout Report.</li> </ul>
<b>Change Management</b>	<ul style="list-style-type: none"> <li>• Compensation Events Register.</li> </ul>	<ul style="list-style-type: none"> <li>• - Compensation Events Register.</li> </ul>
<b>Risk Management</b>	<ul style="list-style-type: none"> <li>• Project Risk Register.</li> <li>• Project Closeout Report.</li> </ul>	<ul style="list-style-type: none"> <li>• Project Risk Register.</li> <li>• Project Closeout Report.</li> </ul>
<b>Value Management</b>	<ul style="list-style-type: none"> <li>• Value Engineering Proposals Register</li> <li>• Project Closeout Report.</li> </ul>	<ul style="list-style-type: none"> <li>• Value Engineering Proposals Register.</li> <li>• Project Closeout Report.</li> </ul>

**Figure 1 Cost Management Manual – Deliverables**

## Overview of Cost, Risk, and Value Management

This manual requires that industry standard practice approaches be adopted. Note however, it is required that users of the manual apply their own professional judgement and experience at all times when determining **Project Cost** estimates, evaluating risk, and ensuring that Projects deliver value for money.

### Cost & Change Management

Estimates (cost and time) and budget figures used in public reports, indicated on project information boards, and used in compiling business cases should be produced and approved in line with this Cost Management Manual.

Reviews of estimates (Cost and Construction / Implementation Duration) will take account of, but are not limited to, the guidelines outlined within **Appendix A**. During Construction & Implementation contract administration will be undertaken in accordance with the applicable Conditions of Engagement.

#### Pre-Construction (Phases 0 – 5)

All pre-construction cost estimates remain 'work in progress' and subject to change as the Project scope and design information becomes more definitive. Amounts in the approved estimate templates will be utilised in any Project documentation (e.g. PAG, PMG) for the associated Phase. If as a result of any review or design amendment or receipt of additional information, changes are introduced in any one of these reports that affects the estimate, the estimate will be updated. Formal estimates TC1, 2, or 3 and the relevant TSB shall only be used in project documentation. All other intermediate estimates are for project team and TII information only.

During Phases 3 – 5, the Project Manager will prepare **Base Cost** estimates for the project being advanced. These will be issued and presented in the required format with the appropriate level of back-up, to the TII Senior Engineering Inspector at the appropriate stages. Guidelines for preparing cost estimates and presenting back up information are outlined within **Appendix A**. Preparing and presenting cost estimates will necessitate appropriate **Change Management**. **Appendix A** provides some additional guidelines on **Change Management** processes and procedures.

#### Construction & Implementation (Phases 6 – 7)

Contract Administration, including cost management, for the Main Contract will be undertaken in accordance with the Main Contract Conditions, the applicable Conditions of Engagement, the Project Management Guidelines, and this manual.

The Conditions of Contract shall outline how 'change' will be managed between the Contracting Authority and the Contractor. Project specific procedures will take account of the requirements of the Project Management Guidelines, this manual, and any other TII guidelines and/or procedures.

### Risk Management

The Project Manager, in consultation with the TII Senior Engineering Inspector, will identify a **Risk Manager** whose function will be to implement **Risk Management** processes and procedures on the Project, aided by relevant stakeholders as necessary. In the absence of a dedicated **Risk Manager** the Project Manager will fulfil all required responsibilities.

## Pre-Construction (Phases 0 – 5)

Pre-construction the Project Manager will maintain and regularly update a record – within the Project Risk Register - of all risks identified as potentially impacting upon successful project delivery. As noted within the Project Management Guidelines, risks may include delivery risks, statutory stakeholder risks, and third-party service provider risks among others.

In addition to maintaining a Project Risk Register in line with the requirements of the Project Management Guidelines, the Project Manager will qualitatively and quantitatively evaluate risks affecting cost and value. This will also include determining **Risk Contingency** with respect to the principal cost headings (refer to **Appendix B** for guidelines). When determining appropriate **Risk Contingency**, it is essential that the Project Manager ensures that estimated costs are reasonable and that risks are appropriately evaluated. Guidance regarding the determination of **Risk Contingency** is included within **Appendix B**.

**Risk Response Strategies** to counter risks identified as potentially impacting upon successful Project delivery will be determined and implemented throughout Project development.

## Construction & Implementation (Phases 6 – 7)

During construction & implementation the Project Manager will continue to maintain and regularly update the Project Risk Register.

In addition to maintaining a Project Risk Register in line with the requirements of the Project Management Guidelines, the Contracting Authority's Representative will maintain a **Construction Contract Risk Register**. The function of the **Construction Contract Risk Register** is set out within **Appendix B** — this includes the recording and management of potential compensation events, delay events, or events that may lead to Contract sum adjustments.

Contract Administration, including **Risk Management**, for the Main Contract will be undertaken in accordance with the Main Contract Conditions, the applicable Conditions of Engagement, the Project Management Guidelines, this manual, and any other TII guidelines and/or procedures.

## Value Management

It is necessary to ensure that national road projects achieve **Value-for-Money** in line with PSC requirements. From a value perspective, **Value Management** entails spending money to achieve the right objectives and spending money as efficiently as possible, avoiding waste.

The Project Manager will be responsible for implementing **Value Management** activities on their projects on an ongoing basis.

It is important to clearly differentiate between **Value Management** at a project level and **Value Management** at sub project level. At a project level, **Value Management** is carried out using the project appraisal processes identified in the TII Project Appraisal Guidelines. Objectives for the overall project, whole life cost for the project, etc. will all be developed in accordance with the Project Appraisal Guidelines.

Key value performance indicators will be deduced from the project objectives identified and set out within the Project Brief / Project Execution Plan. They will be evaluated throughout project development so as to ensure that **Value for Money** is being achieved. These indicators shall be used to monitor the delivery of value and benefits with respect to cost and **Risk Management** and to take steps to ensure that all impacts or outcomes are arising as planned.

# 1. Phase 0: Scope and Pre-Appraisal / Phase 1: Concept and Feasibility

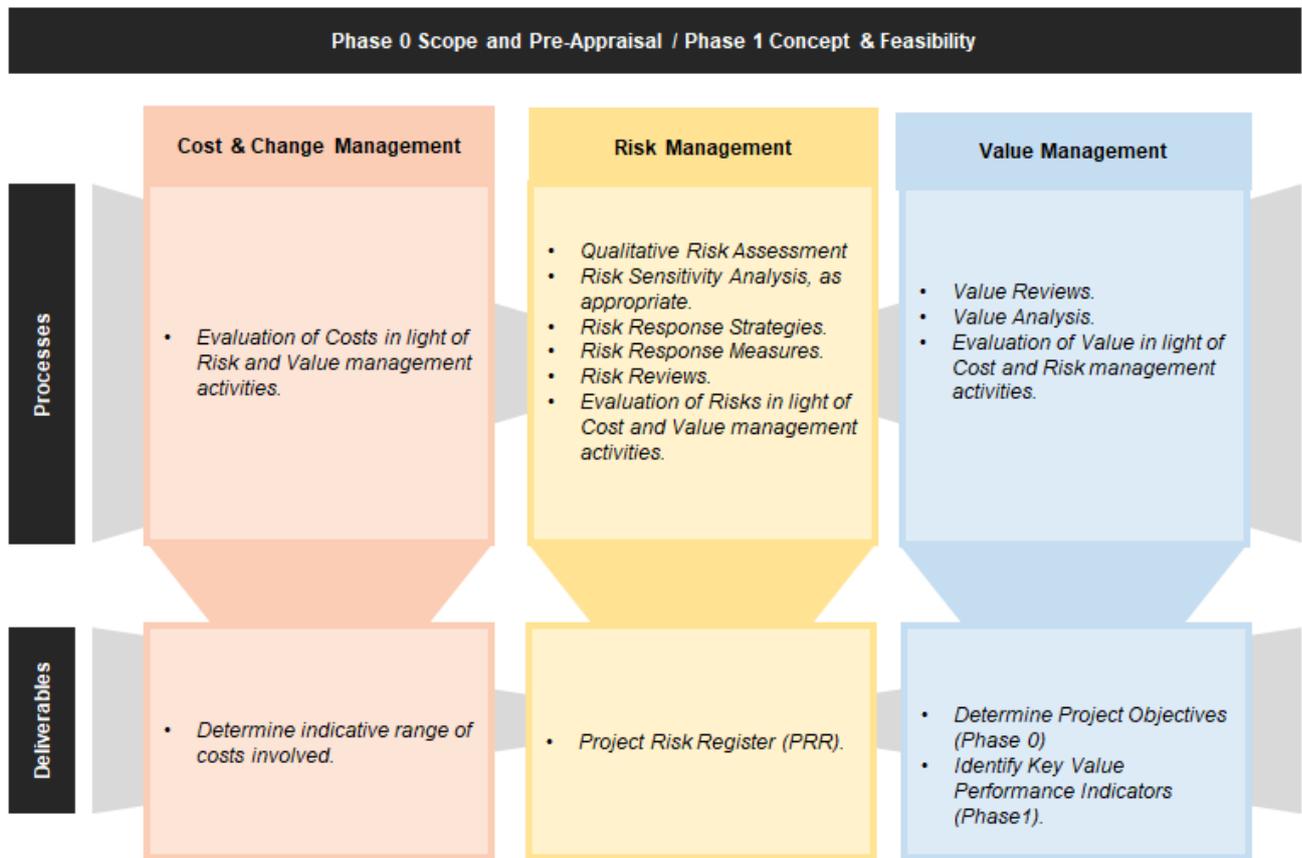


Figure 1.1 Phase 0 Scope and Pre-Appraisal / Phase 1 Concept & Feasibility – Processes & Deliverables

## 1.1 Cost Management Requirements

### 1.1.1 Project Cost Management: Phase 0

The Project Manager will evaluate whether the Project will likely be ‘Major’ or ‘Minor’ based on estimated ‘outturn cost’. This classification will determine the necessary appraisal to be undertaken in accordance with TII Project Appraisal Guidelines (PAG) requirements.

The Project classification, ‘Major’ or ‘Minor’, will be reported within the Project Information Sheet Note (PISN). The PISN is issued to TII by the Sponsoring Agency in consideration of advancing the development and delivery of the Project.

### 1.1.2 Project Cost Management: Phase 1

Necessary cost management processes and procedures will be determined by the Project Manager. These processes and procedures will be outlined within the Project Brief / Project Execution Plan.

The Project classification (‘Major’ or ‘Minor’) will guide the determination of necessary cost management processes and procedures. Estimated costs may be utilised to undertake cost benefit analysis, where required, in line with the requirements of PE-PAG-02010.

During Phase 1 anchoring around one option should be avoided. Notwithstanding, the Project Manager shall determine the range of potential costs associated with meeting the objectives and solving the identified problems. To the extent that costs are known they should be presented as indicative and subject to considerable variation as proposals are developed and progress through the stages of the lifecycle. Care must also be taken in communicating early estimates of **Project Costs** and the level of uncertainty attaching should be explicitly highlighted. **Appendix A** provides guidance on preparing cost estimates. Estimates will be benchmarked against appropriate comparable projects.

## 1.2 Risk Management Requirements

### 1.2.1 Project Risk Management: Phase 0

The Project Manager will identify and evaluate potential Project risks. Project particulars at Phase 0 will be limited and reference will be made to projects of a similar scale, complexity, or type when identifying and evaluating potential Project risks. This will include an evaluation of 'Lessons Learned' from previous projects.

### 1.2.2 Project Risk Management: Phase 1

Necessary **Risk Management** processes and procedures will be determined by the Project Manager. These processes and procedures will be outlined within the Project Brief / Project Execution Plan.

The Project Management Guidelines require that a Project Risk Register be prepared, maintained, and regularly updated during the life of a Project. This requirement applies equally to both Major and Minor projects. A template for a Project Risk Register is included within **Appendices B1** and **B4**.

The Project Manager will identify and analyse risks and prepare the Project Risk Register. Risk will be evaluated via **Qualitative Risk Analysis**. **Appendix B** provides guidance on undertaking **Qualitative Risk Analysis** and **Appendix B1** includes a proforma for undertaking **Qualitative Risk Analysis**. This analysis is undertaken to aid the development of the Project Risk Register. **Risk analysis** will be used to rank risks in order of potential impact and to determine **Risk Response Strategies** as part of ongoing **Risk Management**.

The Project Manager will prepare a quarterly Risk Status Summary Report incorporating an updated Project Risk Register detailing the current status of the **Risk Response Strategies** (specific action plans), and documenting progress made during the quarter with updated **Risk Analysis**. The Project Manager will issue Risk Status Summary Report to the Steering Group on Major Projects and to the Sponsoring Agency Management Group on Minor Projects. This report will include a listing and prioritisation ranking of the top ten key risks, as appropriate.

## 1.3 Value Management Requirements

### 1.3.1 Project Value Management: Phase 0

It is necessary to ensure that appropriate Project objectives are determined during Phase 0. This is necessary as **Value Management** entails spending money to achieve the right objectives and as efficiently as possible avoiding waste. From a technical perspective, the overarching purpose of **Value Management** is to achieve the best **Value for Money** via the optimum combination of price (including consideration of **Whole Life Cost**), and quality (including fitness for purpose) required to meet the users' requirements. Guidance on determining project objectives is included within PE-PAG-02012: PAG Unit 3.0 Project Brief.

### 1.3.2 Project Value Management: Phase 1

Necessary **Value Management** processes and procedures will be determined by the Project Manager. These processes and procedures will be outlined within the Project Brief / Project Execution Plan.

Key value performance indicators will be identified by the Project Manager. These key value performance indicators will be deduced from the project objectives identified and set out within the Project Brief / Project Execution Plan. They will be evaluated throughout project development so as to ensure that **Value for Money** is being achieved. These indicators shall be used to monitor the delivery of value and benefits with respect to cost and **Risk Management** and to take steps to ensure that all impacts or outcomes are arising as planned. It is imperative that such indicators are formulated such that **Value for Money** materialises. Consequently, they shall be specific, measurable, and capable of beneficially driving project development.

**Appendix C** provides guidance on undertaking value analysis.

## 2. Phase 2: Option Selection



Figure 2.1 Phase 2 Options Selection – Processes and Deliverables

### 2.1 Cost Management Requirements

#### 2.1.1 Project Cost Management

The Project Manager will review the implementation of cost management processes and procedures and update, as necessary, requirements for same outlined within the Project Brief / Project Execution Plan. Estimated costs will be utilised to undertake cost benefit analysis which will feed into the preparation of the preliminary business case in line with the requirements of PE-PAG-02010. **Appendix A** provides guidance on preparing cost estimates. Estimates will be benchmarked against appropriate comparable projects.

Land & Property Cost Estimates will be undertaken in accordance with the requirements of the TII Land & Property Section.

##### 2.1.1.1 Major & Minor Projects - Option Comparison Estimate (OCE)

The Project Manager will prepare an **Option Comparison Estimate** for each option being evaluated. Each **Option Comparison Estimate** will be reported using the Level 2 Estimate Summary and Back Up Template, included within **Appendix A2**.

The Level 2 Estimate Summary and Back Up Templates and an Estimate Assumptions Sheet (**Appendix A7**) will be issued to the TII Senior Engineering Inspector to compile and complete by including an allowance for inflation and for **TII Programme Risk**. An **Option Comparison Estimate** Template is included within **Appendix A5**.

**Option Comparison Estimates** at this phase will necessarily be determined elementally and on a unit rate basis (**Appendix A**). Consequently, they are only suitable for use as comparators between options and should not be taken as formal cost estimates. Care must also be taken in communicating estimates of **Project Costs** and the level of uncertainty attaching should be explicitly highlighted.

Estimates will also be accompanied by a completed Estimate Tracking Sheet (**Appendix A10**) which will record each change in the estimate as the project progresses through the various phases of development.

## 2.2 Risk Management Requirements

### 2.2.1 Project Risk Management

The Project Manager will review the implementation of **Risk Management** processes and procedures and update, as necessary, requirements for same outlined within the Project Brief / Project Execution Plan.

**Risk Management** will take account of the options being evaluated, ongoing environmental appraisal, design development, project appraisal, stakeholder consultation, Project objectives, etc. and their implications upon successful Project delivery.

### 2.2.2 Risk Management Reporting

The Project Manager will identify and evaluate Project risks and review and update the Project Risk Register.

Risk will be evaluated via **Qualitative Risk Analysis**. **Appendix B** provides guidance on undertaking **Qualitative Risk Analysis** and **Appendix B1** includes a proforma for undertaking **Qualitative Risk Analysis**. This is undertaken to aid the development of the Project Risk Register. This analysis will be used to assist in identifying and prioritising **Risk Response Strategies** as part of ongoing **Risk Management**. **Sensitivity Analysis** should be carried out, as appropriate, upon the revision of the Project Risk Register and risks ranked in order of potential impact. Detail of **Sensitivity Analysis** undertaken will be outlined within the Project Risk Register.

The Project Manager will prepare a quarterly, Risk Status Summary Report, incorporating an updated Project Risk Register detailing the current status of the **Risk Response Strategies** (specific action plans), and documenting progress made during the quarter with updated **Risk Analysis**. The Project Manager will issue Risk Status Summary Reports to the Steering Group on Major Projects and to the Sponsoring Agency Management Group on Minor Projects. This report will include a listing and prioritisation ranking of the top ten key risks, as appropriate.

The Project Manager will prepare a Risk Analysis Report during Phase 2, incorporating Preliminary **Risk Response Strategies** and **Sensitivity Analysis** (including inputs/outputs of **Qualitative Risk Analysis**), as appropriate. The Risk Analysis Report will be issued to the TII Senior Engineering Inspector. The Risk Analysis Report will also be issued to Peer Reviewers as part of the Option Selection Peer Review during Phase 2.

## 2.3 Value Management Requirements

### 2.3.1 Project Value Management

The Project Manager will review the implementation of **Value Management** processes and procedures and update, as necessary, requirements for same outlined within the Project Brief / Project Execution Plan.

**Value Management** will take account of the selection of the preferred option, ongoing environmental appraisal, design development, project appraisal, stakeholder consultation, the determination of the land acquisition boundary (if necessary), Project objectives, etc. and their implications upon successful project delivery.

### 2.3.2 Value Management Reporting

The Project Manager will review Project development against the Project objectives, taking cognisance of the identified key value performance indicators so as to ensure that **Value for Money** is being achieved. This review will evaluate the delivery of value and benefits with respect to cost and **Risk Management** and any steps taken to ensure that impacts or outcomes are advancing as planned.

The Project Manager will prepare a Quarterly **Value Management** Summary Report incorporating an evaluation as to how **Value for Money** is being achieved and documenting progress made on ensuring same during the quarter. The Project Manager will issue the **Value Management** Summary Report to the Steering Group on Major Projects and to the Sponsoring Agency Management Group on Minor Projects.

**Appendix C** provides guidance on undertaking value analysis.

**Value Management** activities will be reported within the Option Selection Report and Preliminary Business Case. This will include outlining and reporting **Value Management** techniques applied during option assessment - including benefits yielded and to whom, balance between stakeholder needs and resources, etc.

### 3. Phase 3: Design and Environmental Evaluation Processes

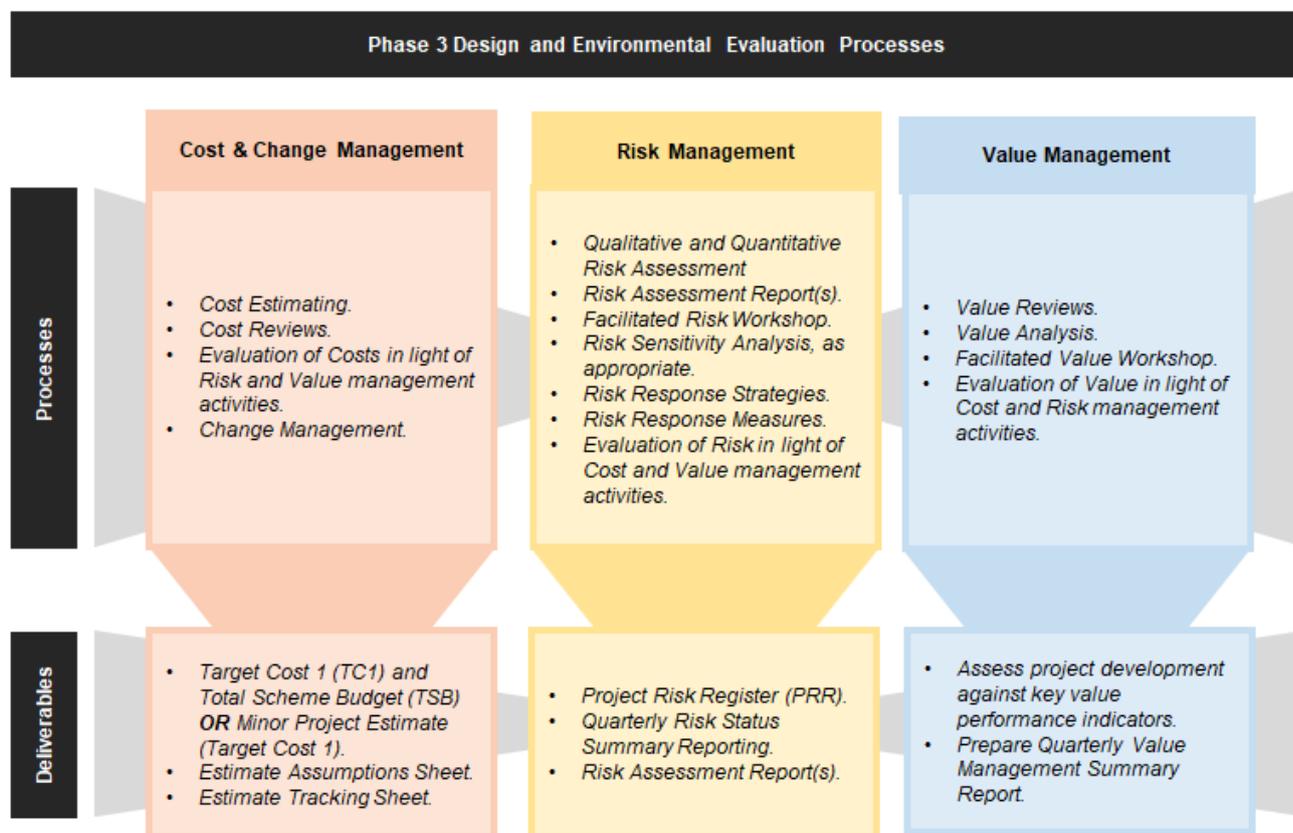


Figure 3.1 Phase 3 Design and Environmental Evaluation – Processes and Deliverables

### 3.1 Cost Management Requirements

#### 3.1.1 Project Cost Management

The Project Manager will review the implementation of cost management processes and procedures and update, as necessary, requirements for same outlined within the Project Brief / Project Execution Plan. Estimated costs will be utilised to undertake cost benefit analysis which will feed into the preparation of the traffic modelling report and detailed business case in line with the requirements of PE-PAG-02010. **Appendix A** provides guidance on preparing cost estimates. Estimates will be benchmarked against appropriate comparable projects.

Land & Property Cost Estimates will be undertaken in accordance with the requirements of the TII Land & Property Section.

Assumptions surrounding the date for commencement of construction and construction durations will be agreed with the TII Senior Engineering Inspector.

#### 3.1.2 Cost Management Reporting

##### 3.1.2.1 Major Projects - Target Cost 1 (TC1) and Total Scheme Budget (TSB)

For Major Projects, estimates from Phase 3 onwards will be presented as range estimates in the form of a **Target Cost (TC)** and a **Total Scheme Budget (TSB)**.

The Project Manager will prepare **Target Cost 1** (TC1). TC1 is produced in draft format (together with a draft TSB) during Phase 3 prior to the finalisation of the preparation of the land acquisition documentation. Final TC1 (together with TSB1) will be compiled during Phase 3 when the risk workshop has been undertaken, land acquisition requirements and costs are finalised, and prior to publication of development approval documentation.

TC1 will be reported using the Level 3 Estimate Summary and Back Up Template, included within **Appendix A3**.

The Level 3 Estimate Summary and Back Up Templates and an Estimate Assumptions Sheet (**Appendix A7**) will be issued to the TII Senior Engineering Inspector to compile and complete the **Total Scheme Budget** by including an allowance for inflation and **TII Programme Risk**. The **Target Cost** and **Total Scheme Budget** template is included within **Appendix A6**.

Any proposed change to TC1 in advance of its finalisation must first be approved by the TII Senior Engineering Inspector and will lead to an updated TSB template being compiled.

Estimates will also be accompanied by a completed Estimate Tracking Sheet (**Appendix A10**) which will record each change in the estimate as the project progresses through the various phases of development.

### 3.1.2.2 Minor Projects - Minor Project Estimate (Target Cost)

Project outturn forecasts from Phase 3 onwards on Minor Projects will be presented in the form of a **Target Cost** only.

The Project Manager will prepare a Minor Project Estimate (**Target Cost 1**). The Minor Project Estimate will be reported using the Minor Project Estimate and Back-up Template, included within **Appendix A4**.

The Minor Project Estimate (**Target Cost 1**) and an Estimate Assumptions Sheet (**Appendix A7**) will be issued to the TII Senior Engineering Inspector to complete the Minor Project Estimate (**Target Cost 1**) Template by including an allowance for inflation and for **TII Programme Risk**.

Estimates will also be accompanied by a completed Estimate Tracking Sheet (**Appendix A10**) which will record each change in the estimate as the project progresses through the various phases of development.

### 3.1.3 Project Change Management

The Project Manager will formulate **Change Management** processes and procedures and outline requirements for same within the Project Brief / Project Execution Plan. Change management processes will take account of the requirements of the Project Management Guidelines (PE-PMG-02041).

Following determination of TC 1 and TSB 1, proposed Project changes which result in changes thereto will be recorded. Pre-Construction, the Project Manager will record change management and control as part of the Project Risk Register.

## 3.2 Risk Management Requirements

### 3.2.1 Project Risk Management

The Project Manager will review the implementation of **Risk Management** processes and procedures and update, as necessary, requirements for same outlined within the Project Brief / Project Execution Plan.

**Risk Management** will take account of the selection of the preferred option, ongoing environmental appraisal, design development, project appraisal, stakeholder consultation, the determination of the land acquisition boundary (if necessary), Project objectives, etc. and their potential implications upon successful project delivery.

### 3.2.2 Risk Management Reporting

The Project Manager will identify and evaluate Project risks and review and update the Project Risk Register.

Risk will be evaluated via qualitative and **Quantitative Risk Analysis**. **Appendix B** provides guidance on undertaking **Qualitative** and **Quantitative Risk Analysis**. This is undertaken to aid the development of the Project Risk Register. **Risk Analysis** will be used to assist in identifying and prioritising **Risk Response Strategies** as part of ongoing **Risk Management** and in determining **Risk Contingency** for each of the principal cost headings. **Sensitivity Analysis** should be carried out, as appropriate, upon the revision of the Project Risk Register and risks ranked in order of potential impact. Detail of **Sensitivity Analysis** undertaken will be outlined within the Project Risk Register.

The Project Manager will prepare a quarterly Risk Status Summary Report incorporating an updated Project Risk Register detailing the current status of the **Risk Response Strategies** (specific action plans), and documenting progress made during the quarter with updated **Risk Analysis**. The Project Manager will issue Risk Status Summary Reports to the Steering Group on Major Projects and to the Sponsoring Agency Management Group on Minor Projects. This report will include a listing and prioritisation ranking of the top ten key risks, as appropriate.

The Project Manager will prepare a Risk Analysis Report, incorporating Detailed **Risk Response Strategies** and **Sensitivity Analysis** (including inputs/outputs of **Qualitative** and **Quantitative Risk Analysis**) as appropriate. The Risk Analysis Report will be issued to the TII Senior Engineering Inspector. The Risk Analysis Report will also be issued to Peer Reviewers as part of the Design Peer Review during Phase 3.

### 3.2.3 Risk Contingency

The determination of the **Risk Contingency** will be carried out by TII, taking account of both the **Quantitative Risk Analysis** and **Reference Class Forecasting** – as identified in **Appendix B**.

**Risk Contingency** will be determined via **Quantitative Risk Analysis** ('internal view') and via **Reference Class Forecasting** ('external view' - prepared by the TII Senior Engineering Inspector, refer **Appendix B** for information, including workshop requirements). When determining appropriate **Risk Contingency**, it is essential that the Project Manager ensures that estimated costs are reasonable and that risks are appropriately evaluated. Guidance regarding the determination of **Risk Contingency**, including appropriate confidence intervals, is included within **Appendix B**.

#### 3.2.3.1 Risk Contingency Workshop

A risk workshop will be convened during Phase 3, prior to the derivation of **Risk Contingency** for inclusion in the **Target Cost** (TC) and **Total Scheme Budget** (TSB), and post the undertaking of the Design Peer Review outlined within the Project Management Guidelines. Risk Workshop requirements and guidelines are outlined within **Appendix B2**. The key purpose of this risk workshop is to determine financial risks to the Project estimate such that the **Risk Contingency** can be determined.

The TII Senior Engineering Inspector will facilitate an evaluation of **Risk Analysis** outputs. Upon completion of the risk workshop, the Project Manager will update the **Risk Analysis** and **Risk Contingency** to take account of the outcomes.

## 3.3 Value Management Requirements

### 3.3.1 Project Value Management

The Project Manager will review the implementation of **Value Management** processes and procedures and update, as necessary, requirements for same outlined within the Project Brief / Project Execution Plan.

**Value Management** will take account of the development of the preferred option, ongoing environmental appraisal, design development, project appraisal, stakeholder consultation, the determination of the land acquisition boundary (if necessary), Project objectives, etc. and their implications upon successful project delivery.

### 3.3.2 Value Management Workshop

A **Value Management** workshop will be convened during Phase 3, prior to finalisation of the draft Design Report and Design Peer Review outlined within the Project Management Guidelines. Value Workshop requirements and guidelines are outlined within **Appendix C**.

An independent facilitator may be appointed for the main Value Workshop (coinciding with the Risk Workshop during Phase 3) to prepare, manage, and chair the workshops and produce the resultant report.

### 3.3.3 Value Management Reporting

The Project Manager will review Project development against the Project objectives, taking cognisance of the identified key value performance indicators so as to ensure that **Value for Money** is being achieved. This review will evaluate the delivery of value and benefits with respect to cost and **Risk Management** and any steps taken to ensure that impacts or outcomes are advancing as planned.

The Project Manager will prepare a Quarterly **Value Management** Summary Report incorporating an evaluation as to how **Value for Money** is being achieved and documenting progress made on ensuring same during the quarter. The Project Manager will issue the **Value Management** Summary Report to the Steering Group on Major Projects and to the Sponsoring Agency Management Group on Minor Projects.

**Appendix C** provides guidance on undertaking value analysis.

**Value Management** activities will be reported within the Design Report. This will include outlining and reporting **Value Management** techniques applied during design development - including benefits yielded and to whom, balance between stakeholder needs and resources, etc.

## 4. Phase 4: Statutory Processes

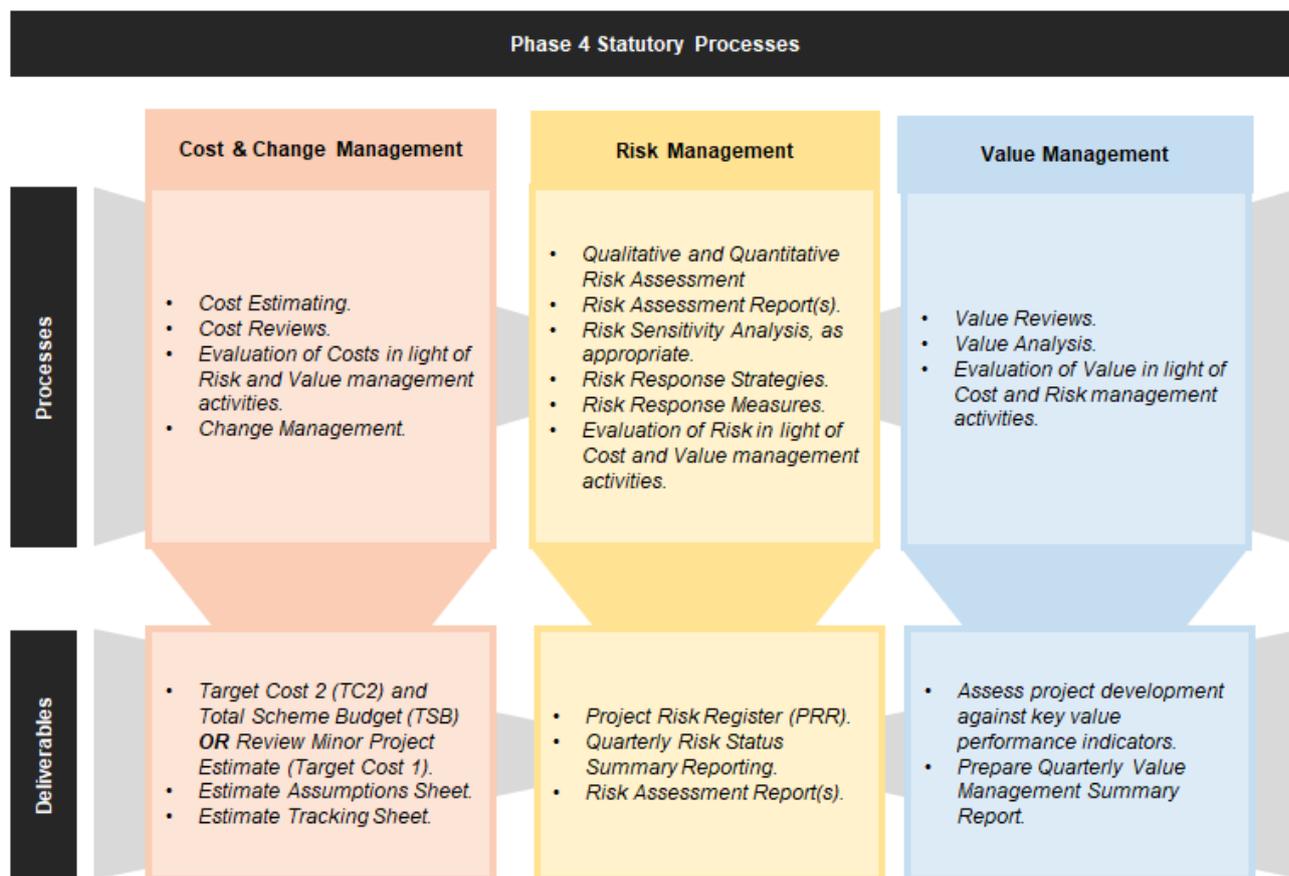


Figure 4.1 Phase 4 Statutory Processes – Processes and Deliverables

### 4.1 Cost Management Requirements

#### 4.1.1 Project Cost Management

The Project Manager will review the implementation of cost management processes and procedures and update, as necessary, requirements for same outlined within the Project Brief / Project Execution Plan. Estimated costs (where revised) will be utilised to update the Detailed Business Case (and components thereof) in line with the requirements of PE-PAG-02010. Estimates will be benchmarked against appropriate comparable projects.

Land & Property Cost Estimates will be undertaken in accordance with the requirements of the TII Land & Property Section.

Note, in instances where a Project has been paused for a period, thereby necessitating a re-evaluation of estimated costs, the preparation of an interim TC1 and TSB1 will be necessary.

#### 4.1.2 Cost Management Reporting

##### 4.1.2.1 Major Projects - Target Cost 2 (TC2) and Total Scheme Budget (TSB)

**Target Cost 2 (TC2)** will be prepared following the completion of the statutory processes. TC2 will take account of the finalised schedule of environmental commitments and development approval conditions, if any, as well as updates to inflation assumptions and risk requirements.

**Target Cost 2** and the updated Estimate Assumptions Sheet from Phase 3 will be issued to the TII Senior Engineering Inspector to compile and complete the **Total Scheme Budget** by including an allowance for inflation and **TII Programme Risk**. The **Target Cost** and **Total Scheme Budget** template is included within **Appendix A6**.

Estimates will also be accompanied by a completed Estimate Tracking Sheet (**Appendix A10**) which will record each change in the estimate as the project progresses through the various phases of development.

#### **4.1.2.2 Minor Projects – Updated Minor Project Estimate (Target Cost 1)**

The Minor Project Estimate (Target Cost) prepared during Phase 3 (TC1) will be reviewed, no formal budget is required. This review will take account of the finalised schedule of environmental commitments and development approval conditions, if any.

The findings of the review will be issued to the TII Senior Engineering Inspector.

#### **4.1.3 Project Change Management**

The Project Manager will review the implementation of **Change Management** processes and procedures and update, as necessary, requirements for same outlined within the Project Brief / Project Execution Plan.

As noted, Pre-Construction, the Project Manager will record change management and control as part of the Project Risk Register.

### **4.2 Risk Management Requirements**

#### **4.2.1 Project Risk Management**

The Project Manager will review the implementation of **Risk Management** processes and procedures and update, as necessary, requirements for same outlined within the Project Brief / Project Execution Plan.

**Risk Management** will take account of the completion of the statutory processes, the finalised schedule of environmental commitments, and development approval conditions, if any, and their implications upon successful Project delivery.

#### **4.2.2 Risk Management Reporting**

Risk will be evaluated via **Quantitative Risk Analysis**, if required. **Appendix B** provides guidance on undertaking **Qualitative** and **Quantitative Risk Analysis**. This analysis will be used to assist in identifying and prioritising **Risk Response Strategies** as part of ongoing **Risk Management** and in determining **Risk Contingency** for each of the principal cost headings. **Sensitivity Analysis** should be carried out, as appropriate, upon the revision of the Project Risk Register and risks ranked in order of potential impact. Detail of **Sensitivity Analysis** undertaken will be outlined within the Project Risk Register.

The Project Manager will prepare a quarterly Risk Status Summary Report incorporating an updated Project Risk Register detailing the current status of the **Risk Response Strategies** (specific action plans) and documenting progress made during the quarter with updated **Risk Analysis**. The Project Manager will issue Risk Status Summary Reports to the Steering Group on Major Projects and to the Sponsoring Agency Management Group on Minor Projects. This report will include a listing and prioritisation ranking of the top ten key risks, as appropriate.

The Project Manager will prepare a Risk Analysis Report during Phase 4, incorporating detailed **Risk Response Strategies** and **Sensitivity Analysis** (including inputs/outputs of **Qualitative** and **Quantitative Risk Analysis**) as appropriate. The Risk Analysis Report will be issued to the TII Senior Engineering Inspector.

### 4.2.3 Risk Contingency

**Risk Contingency** will be independently determined via **Quantitative Risk Analysis** ('internal view') and via **Reference Class Forecasting** ('external view') as outlined within Chapter 3 of this manual and **Appendix B**. The determined **Risk Contingency** value will be reported within the Risk Analysis Report and used in the development of the **Target Cost** and TSB, as appropriate.

## 4.3 Value Management Requirements

### 4.3.1 Project Value Management

The Project Manager will review the implementation of **Value Management** processes and procedures and update, as necessary, requirements for same outlined within the Project Brief / Project Execution Plan.

**Value Management** will take account of the completion of the statutory processes, the finalised schedule of environmental commitments, and development approval conditions, if any, and their implications upon successful project delivery. **Value Management** processes may also be used during the statutory process to assess the value of proposals to address landowner / stakeholder submissions to the Project.

### 4.3.2 Value Management Reporting

The Project Manager will review Project development against the Project objectives, taking cognisance of the identified key value performance indicators so as to ensure that **Value for Money** is being achieved. This review will evaluate the delivery of value and benefits with respect to cost and **Risk Management** and any steps taken to ensure that impacts or outcomes are advancing as planned.

The Project Manager will prepare a Quarterly **Value Management** Summary Report incorporating an evaluation as to how **Value for Money** is being achieved and documenting progress made on ensuring same during the quarter. The Project Manager will issue the **Value Management** Summary Report to the Steering Group on Major Projects and to the Sponsoring Agency Management Group on Minor Projects.

**Appendix C** provides guidance on undertaking value analysis.

## 5. Phase 5: Enabling and Procurement

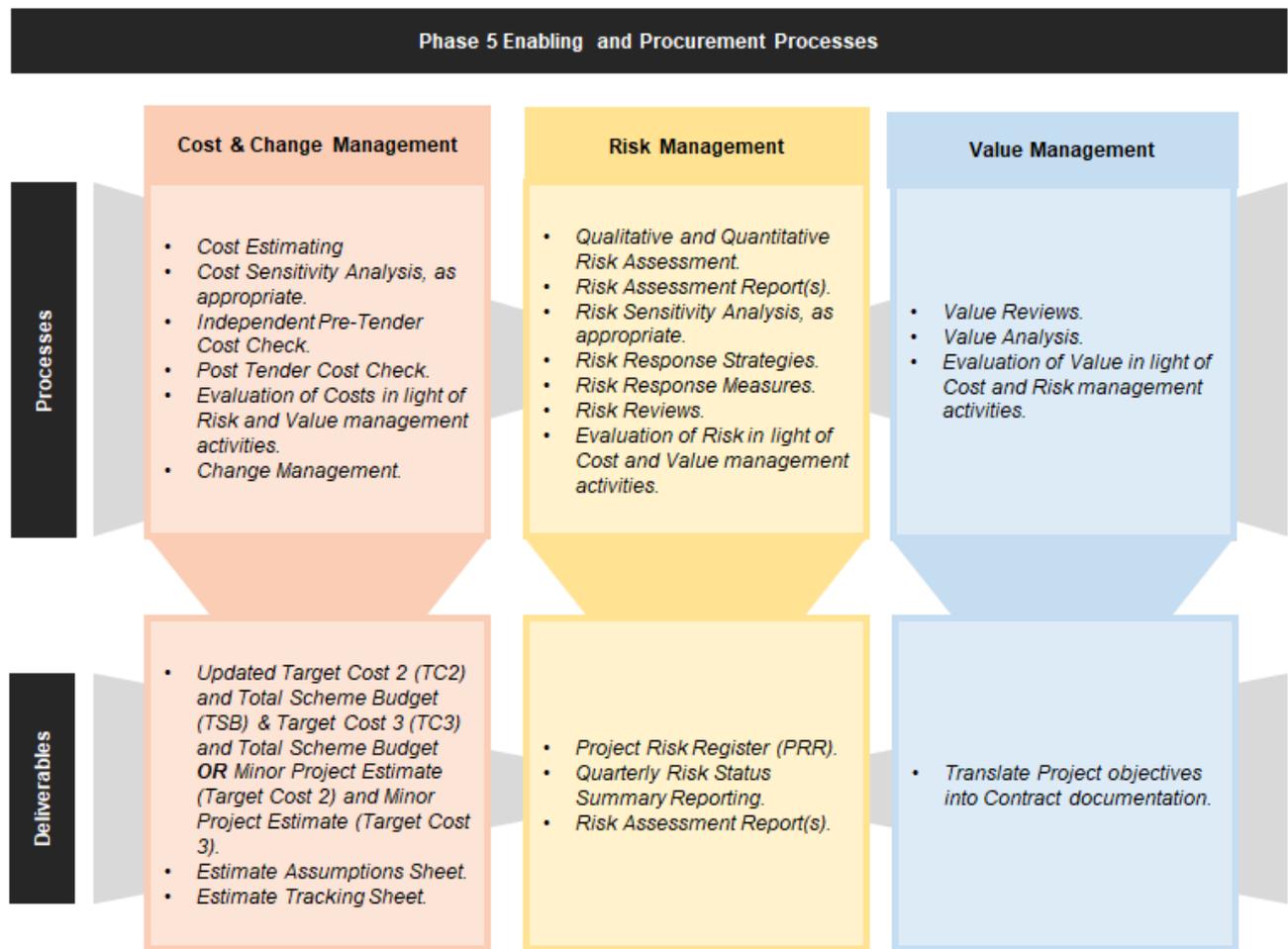


Figure 5.1 Phase 5 Statutory Processes – Enabling and Procurement

### 5.1 Cost Management Requirements

#### 5.1.1 Project Cost Management

The Project Manager will review the implementation of cost management processes and procedures and update, as necessary, requirements for same outlined within the Project Brief / Project Execution Plan. Estimated costs will be utilised to undertake cost benefit analysis which will feed into the preparation of the traffic modelling report and detailed business case in line with the requirements of PE-PAG-02010. Estimates will be benchmarked against appropriate comparable projects.

Land & Property Cost Estimates will be undertaken in accordance with the requirements of the TII Land & Property Section.

## 5.1.2 Cost Management Reporting

### 5.1.2.1 Major Projects - Updated Target Cost 2 (UTC2), Target Cost 3 (TC3), and Total Scheme Budget (TSB)

The **Updated Target Cost 2** (UTC2) is produced pre-tender (Pre-Tender Cost Estimate). The updated **Target Cost 2** and **Total Scheme Budget** will take account of the increased clarity in Project Scope (following preparation of tender documents, design, additional surveys, enabling works contracts, archaeological testing, etc.) and the transferring of risk within the proposed contract.

**Target Cost 3** (TC3) is produced post tender and prior to tender award.

UTC2 and TC3 will be reported using the Level 3 Estimate Summary and Back Up Template, included within **Appendix A3**.

The Level 3 Estimate Summary and Back Up Templates and an Estimate Assumptions Sheet (**Appendix A7**) will be issued to the TII Senior Engineering Inspector to compile and complete by including an allowance for inflation and for **TII Programme Risk**. The **Target Cost** and **Total Scheme Budget** template is included within **Appendix A6**.

Any proposed change to TC3 in advance of its finalisation must first be approved by the TII Senior Engineering Inspector and will lead to an updated TSB template being compiled.

Estimates will also be accompanied by a completed Estimate Tracking Sheet (**Appendix A10**) which will record each change in the estimate as the project progresses through the various phases of development.

### 5.1.2.2 Minor Projects - Minor Project Estimate (Target Cost 2 and Target Cost 3)

The Project Manager will prepare a Minor Project Estimate (Target Cost). The Minor Project Estimate will be reported using the Minor Project Estimate and Back-up Template, included within **Appendix A4**.

**Target Cost 2** (TC2) is produced prior to tender.

**Target Cost 3** (TC3) is produced post tender and prior to tender award.

The Minor Project Estimate (Target Cost) and an Estimate Assumptions Sheet (**Appendix A7**) will be issued to the TII Senior Engineering Inspector to complete the Minor Project Estimate (Target Cost) Template by including an allowance for inflation and for **TII Programme Risk**.

Estimates will also be accompanied by a completed Estimate Tracking Sheet (**Appendix A10**) which will record each change in the estimate as the project progresses through the various phases of development.

## 5.1.3 Project Change Management

The Project Manager will review the implementation of **Change Management** processes and procedures and update, as necessary, requirements for same outlined within the Project Brief / Project Execution Plan.

As noted, Pre-Construction, the Project Manager will record change management and control as part of the Project Risk Register.

## 5.2 Risk Management Requirements

### 5.2.1 Project Risk Management

The Project Manager will review the implementation of **Risk Management** processes and procedures and update, as necessary, requirements for same outlined within the Project Brief / Project Execution Plan.

**Risk Management** will take account of the completion of the statutory processes, the finalised schedule of environmental commitments, and development approval conditions, if any, and their implications upon successful project delivery. **Risk Management** will also take account of the increased clarity in Project Scope and the transferring of risk within the proposed contract. Where appropriate, for **Target Cost 3**, **Risk Management** will take account of the successful tenderer's tender price and pricing strategy.

### 5.2.2 Risk Management Reporting

Risk will be evaluated via **Qualitative** and **Quantitative Risk Analysis**, if required. **Appendix B** provides guidance on undertaking **Qualitative** and **Quantitative Risk Analysis**. This is undertaken to aid the development of the Project Risk Register. This analysis will be used to assist in identifying and prioritising **Risk Response Strategies** as part of ongoing **Risk Management** and in determining **Risk Contingency** for each of the principal cost headings. **Sensitivity Analysis** should be carried out, as appropriate, upon the revision of the Project Risk Register and risks must be ranked in order of potential impact. Detail of **Sensitivity Analysis** undertaken will be outlined within the Project Risk Register.

The Project Manager will prepare a quarterly, Risk Status Summary Report, incorporating an updated Project Risk Register detailing the current status of the **Risk Response Strategies** (specific action plans), and documenting progress made during the quarter with updated **Risk Analysis**. The Project Manager will issue Risk Status Summary Reports to the Steering Group on Major Projects and to the Sponsoring Agency Management Group on Minor Projects. This report will include a listing and prioritisation ranking of the top ten key risks, as appropriate.

The Project Manager will prepare a Risk Analysis Report, incorporating detailed **Risk Response Measures** and **Sensitivity Analysis** (including inputs/outputs of **Qualitative** and **Quantitative Risk Analysis**) as appropriate. The *Risk Analysis Report* will be issued to the TII Senior Engineering Inspector.

### 5.2.3 Risk Contingency

**Risk Contingency** will be independently determined via **Quantitative Risk Analysis** ('internal view') and via **Reference Class Forecasting** ('external view') as outlined within Chapter 3 of this manual and **Appendix B**. Determination of **Risk Contingency** will be reported within the Risk Analysis Report and used in the determination of the **Target Cost 2** (Minor), Updated **Target Cost 2** (Major), **TC3**, and **TSB**.

## 5.3 Value Management Requirements

### 5.3.1 Project Value Management

The Project Manager will review the implementation of **Value Management** processes and procedures and update, as necessary, requirements for same outlined within the Project Brief / Project Execution Plan.

**Value Management** will take account of the completion of the tender documents, any advance works undertaken, the tender process and the successful tender including variants, if any, and their implications upon successful project delivery.

The Project objectives will be translated for delivery via the contract documentation to ensure that money is spent as efficiently as possible, avoiding waste, to deliver the Project objectives. Translation may include setting performance obligations with respect to **Risk Management**, stakeholder management, or quality management, the encouragement of concerted **Value Management** techniques – such as ‘value engineering’ and ensuring that appropriate project governance structures are implemented so as to manage cost and change management, etc.

**Appendix C** provides guidance on undertaking value analysis.

## 6. Phase 6: Construction and Implementation

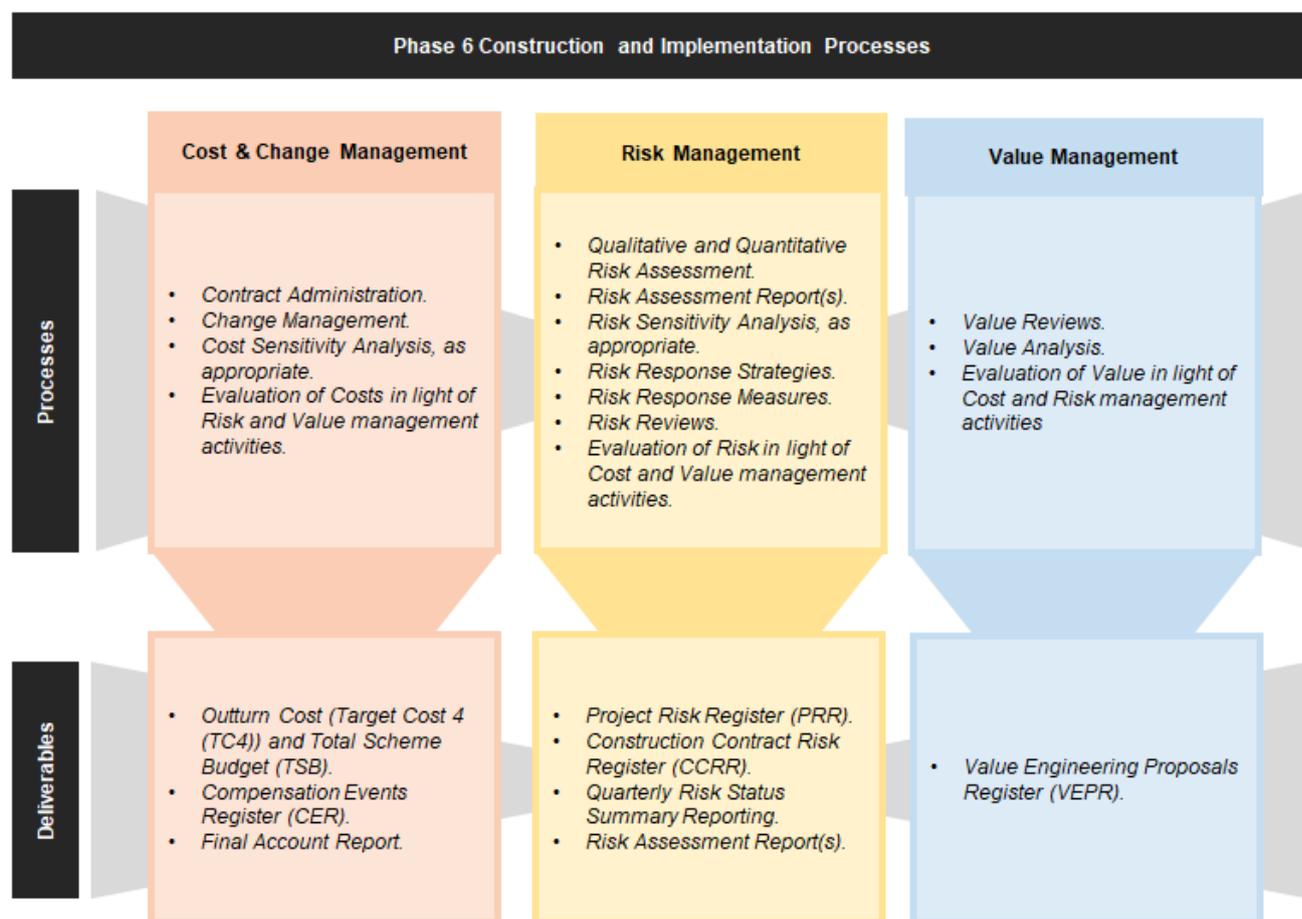


Figure 6.1 Phase 6 Construction and Implementation

### 6.1 Cost Management Requirements

#### 6.1.1 Contract Administration

Contract Administration for the Main Construction or Implementation Contract ('The Contract') will be undertaken in accordance with the Contract Conditions, the Project Management Guidelines, and this manual<sup>3</sup>.

Expenditure forecasts for each of the principal cost headings will be carried out on a monthly basis (Financial Report Summary Sheet template included within Project Management Guidelines) to take account of project progress, actual payments, and ongoing **Risk Management**. Project expenditure (outturn) forecasts should be continuously monitored against the **Base Cost** and associated risk allowances (**Target Cost 3**).

Land & Property Cost Estimates will be undertaken in accordance with the requirements of the TII Land & Property Section.

<sup>3</sup> All site staff grades and numbers should be agreed with the TII Senior Engineering Inspector based on need and budget.

### 6.1.2 Change Management

Change Management will be undertaken in accordance with the requirements of the Project Management Guidelines, the Contract Conditions, the applicable Conditions of Engagement, and this manual. **Appendix A** provides additional guidelines on **Change Management** processes and procedures – which are supplemental to those within the Project Management Guidelines and associated manuals.

The Project Manager shall maintain an up to date Change Orders Register in accordance with the requirements of this manual (see template in **Appendix A8**). This register will detail Change Orders and indicate the purpose and reason for the issuing of the Change Order.

The Contracting Authority's Representative will receive, acknowledge, and process claims for compensation, delay events, and other contractual claims and will maintain a Claims / Compensation Events Register (see template at **Appendix A11**) all in accordance with the Contract, the Project Management Guidelines, and the requirements of this manual. Note, the Change Order Register is subsumed within the Compensation Events Register per the Project Management Guidelines.

### 6.1.3 Final Account

Following the Substantial Completion of the Works, the Contractor will be obliged to submit a Final Statement of Account in accordance with the Conditions of Contract.

In the event that a Final Statement of Account (or any part thereof) is referred to Alternative Dispute Resolution, the Project Manager will liaise with the TII Senior Engineering Inspector to confirm whether to engage experts and/or legal advisors to assist in preparing the Contracting Authority's case during dispute resolution proceedings. In such circumstances, the Project Manager should also agree the appropriate procurement process with the TII Senior Engineering Inspector.

Where the Final Outturn Cost as per the Final Statement of Account (as agreed or as determined during dispute proceedings) exceeds the Tender Sum, the Project Manager will be required to obtain the approval of TII to discharge the balance payable to the Contractor.

### 6.1.4 Final Account Report

Once the Final Outturn Cost as per the Final Statement of Account has been determined, The Project Manager, in conjunction with the Contracting Authority's Representative, will prepare a Final Account Report relating to the Main Contract.

The Final Account Report should include a statement of 'Lessons Learned' from the Main Contract. This should highlight both the positive and negative aspects of the Contract.

In many cases, the determination of the Final Statement of Account may be a protracted process, particularly in the event of a dispute. As a result, the Final Account Report may not be finalised until Phase 7. In such circumstances, and in the event that the Contracting Authority's Representative is no longer retained, the Project Manager should ensure that all information and records necessary to complete the Final Account Report have been retrieved from site.

A template outlining the items to be included in the Final Account Report is contained in the Project Management Guidelines.

## 6.2 Risk Management Requirements

### 6.2.1 Project Risk Management

The Project Manager will review the implementation of **Risk Management** processes and procedures and update, as necessary, requirements for same outlined within the Project Brief / Project Execution Plan. **Risk Management** will take account of scope evolution, enabling works contracts, the form of contract utilised, cost, and **Value Management** outputs.

### 6.2.2 Risk Management Reporting

The Project Manager will identify and evaluate Project risks and review and update the Project Risk Register.

**Appendix B3** includes a proforma for **Risk Analysis** during Construction / Implementation – the ‘**Construction Contract Risk Register**’ - which will be prepared and updated by the Project Manager. The function of the **Construction Contract Risk Register** includes the recording and management of potential compensation events, delay events, or events that may lead to Contract sum adjustments. Further information is available within **Appendix B**. Additionally, analysis is undertaken for the preparation of the Construction Contracts Risk Register and contributes to updating and maintaining the Project Risk Register. This analysis will be used to assist in identifying and prioritising **Risk Response Strategies** as part of ongoing **Risk Management**. **Sensitivity Analysis** should be carried out, as appropriate, upon the revision of the Project Risk Register and risks ranked in order of potential impact. Detail of **Sensitivity Analysis** undertaken will be outlined within the Project Risk Register.

The Project Manager will prepare a quarterly Risk Status Summary Report incorporating an updated Project Risk Register detailing the current status of the **Risk Response Strategies** (specific action plans), and documenting progress made during the quarter with updated **Risk Analysis**. The Project Manager will issue Risk Status Summary Reports to the Steering Group on Major Projects and to the Sponsoring Agency Management Group on Minor Projects. This report will include a listing and prioritisation ranking of the top ten key risks, as appropriate.

**Note:** The Contracting Authority’s Representative will report progress on **Risk Management**, incorporating an updated **Construction Contract Risk Register** within monthly construction progress reports.

## 6.3 Value Management Requirements

### 6.3.1 Project Value Management

The Project Manager will review the implementation of **Value Management** processes and procedures and update, as necessary, requirements for same outlined within the Project Brief / Project Execution Plan.

**Value Management** will take account of scope evolution, enabling works contracts, the form of contract utilised, Cost, and **Risk Management** outputs.

### 6.3.2 Value Management Reporting

Concerted **Value Management** will be promoted and undertaken, as appropriate, during Construction / Implementation so as to ensure that the Project achieves **Value for Money**. A **Value Engineering Proposals Register** will be prepared by the Contracting Authority’s Representative at the commencement of Phase 6 and maintained until the completion of the Main Construction Contract.

The Value Engineering Proposals Register will be prepared and maintained in accordance with the requirements of this Manual. The Contractor may, in accordance with the Contract, submit value engineering proposals on either the design or construction of the Project which may:

- i. Reduce the cost of the Contract.
- ii. Accelerate the time for completion of the Contract, or
- iii. Improve the quality of the end product.

At this phase, it is imperative that value engineering proposals do not adversely impact on the Scope of the Project (time, cost, or quality). Similarly, value engineering proposals must not lead to an increase in **Whole Life Cost**, or an additional maintenance liability, nor undermine the project objectives.

The Contractor shall be required to illustrate to the Contracting Authority that the changes / value engineering proposals are fully in compliance with development approval conditions and the Project objectives.

**Appendix C** provides guidance on undertaking value analysis.

## 7. Phase 7: Close out and Review

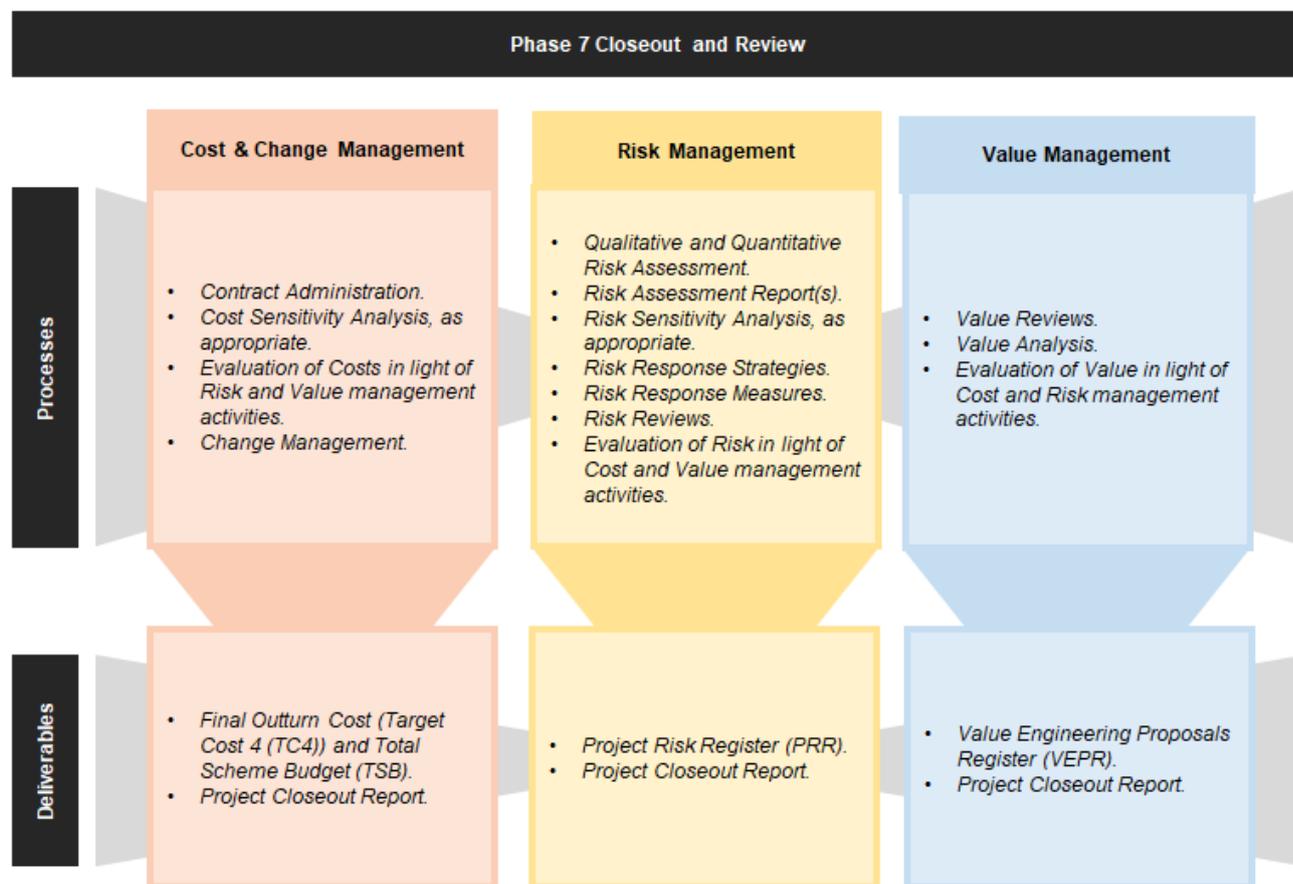


Figure 7.1 Phase 7 Closeout and Review

### 7.1 Cost Management Requirements

#### 7.1.1 Final Outturn Cost

As the Project nears completion, the Project final outturn costs for each of the principal cost headings will be compiled. All such costs should be inclusive of VAT. The Project **Final Outturn Cost** is the sum of all outturn costs from each principal cost heading in the TII PRS.

The Project Manager will compile the **Base Cost** elements - based on final outturn costs - of **Target Cost 4 (TC4)**. The TC4 **Base Cost** estimates will be issued to the TII Senior Engineering Inspector. It is not anticipated that there will be any change to the **Total Scheme Budget** at Phase 7. The Main Contract element of the Project **Base Cost** should be as determined in the Final Account Report and should be VAT inclusive.

The site supervision costs should include for direct costs of Local Authority personnel and/or Technical Advisor costs, including any retention monies due in accordance with the Technical Advisor's conditions of appointment.

The Archaeology costs should include for the costs of all works to date up to and including the publication of results. The Project Manager will ensure that all payments have been made and all archaeological contracts have been closed out. It is recommended that all archaeological reports be published as soon as possible after completion of the Main Contract to avoid delays at Project closeout. The Project Manager should follow up on any reports awaiting publication.

The enabling works contract costs should include for all enabling works contracts and should include for costs associated with the design and tender of these contracts.

Walking / Cycling / PT Connectivity / Asset Renewal costs should include, inter alia, for the costs of sign declassification, old road rehabilitation, and the 'Percent for Art' scheme and should also include for all other costs associated with closing out the Project.

Planning & design costs should include for NRO/PO Costs, Technical Advisor costs, and/or specialist advisor costs (e.g. legal, communications etc.).

## 7.1.2 Project Closeout Report

At the completion of any project, a Project Closeout Report must be prepared as per the TII Project Management Guidelines and Project Appraisal Guidelines. The Project Closeout Report verifies that all aspects of the project have been completed, confirms project budget information and discusses the issues that arose in project development, particularly those that have implications for future project planning and implementation. A template for a Project Closeout Report is contained in the Project Management Guidelines.

### 7.1.2.1 Land & Property

There may be a number of outstanding land acquisition cases carried forward to Phase 7 and it will be necessary to complete all land transactions (either by agreement or independent assessment). It may not be possible to do this prior to determining the **Final Outturn Cost**. If so, a list of outstanding claims will be appended to the closeout report with costings. As payments become due, potentially over a number of years, these will be discharged based on the property owner being listed on the schedule of outstanding payments. Property owners not included on the schedule of outstanding payments shall not be paid without the specific and prior approval of the TII Senior Engineering Inspector.

It will be necessary to ensure that all compensation payments are made to, or identified for, affected property owners so that the Land and Property cost can be determined and reported within the Final Outturn Cost.

Land & Property Cost Estimates and reporting will be undertaken in accordance with the requirements of the TII Land & Property Section.

## 7.2 Risk Management Requirements

### 7.2.1 Construction Contract Risk Register

**Risk Management** processes will be closed out during Phase 7. The Project Manager will identify and evaluate Project risks and close out the Project Risk Register. Remaining items within the **Construction Contract Risk Register** will also be closed out by the Project Manager.

Closing out risks in Phase 7 is related to preparing the **Project Closeout Report**, and, if outstanding, the **Final Account Report**. Within this report, the Project Manager will outline how risks were handled, identify and review lessons learned, and indicate whether there are any outstanding issues and how these will be resolved.

## 7.3 Value Management Requirements

### 7.3.1 Value Management Processes and Procedures

The Project Manager will review the implementation of **Value Management** processes.

In reviewing the implementation of **Value Management** processes and procedures the Project Manager will take cognisance of scope evolution, enabling works contracts, the form of contract utilised, and cost, change, and **Risk Management** outputs.

### **7.3.2 Value Engineering Proposals Register.**

The Project Manager will update and finalise the Value Engineering Proposals Register.

## 8. References

### 8.1 TII Publications (Standards) References

CC-CMG-04001 - Preparation and Delivery Requirements for As-Built Records.

CC-RMP-00010 – Introduction to the Requirements for Measuring and Pricing

CC-RMP-00100 - Requirements for Measuring and Pricing Preliminaries

CC-RMP-00200 – Requirements for Measuring and Pricing of Site Clearance

CC-RMP-00300 – Requirements for Measuring and Pricing of Fencing and Environmental Noise Barriers

CC-RMP-00400 – Requirements for Measuring and Pricing of Road Restraint Systems (Vehicle and Pedestrian)

CC-RMP-00500 – Requirements for Measuring and Pricing of Drainage and Service Ducts

CC-RMP-00600 – Requirements for Measuring and Pricing of Earthworks

CC-RMP-00700 - Requirements for Measuring and Pricing of Pavements

CC-RMP-01100 - Requirements for Measuring and Pricing of Kerbs, Footways and Paved Areas

CC-RMP-01200 - Requirements for Measuring and Pricing of Traffic Signs and Road Markings

CC-RMP-01300 – Requirements for Measuring and Pricing of Road Lighting Columns and Brackets

CC-RMP-01400 - Requirements for Measuring and Pricing of Electrical Work for Road Lighting and Traffic Signs

CC-RMP-01500 – Requirements for Measuring and Pricing of Motorway Communications

CC-RMP-01600 – Requirements for Measuring and Pricing of Piling and Embedded Retaining Walls

CC-RMP-01700 – Requirements for Measuring and Pricing of Structural Concrete

CC-RMP-01800 - Requirements for Measuring and Pricing of Structural Steelwork

CC-RMP-01900 - Requirements for Measuring and Pricing of Protection of Steelwork Against Corrosion

CC-RMP-02000 - Requirements for Measuring and Pricing of Waterproofing for Structures

CC-RMP-02100 – Requirements for Measuring and Pricing of Bridge Bearings

CC-RMP-02300 - Requirements for Measuring and Pricing of Bridge Expansion Joints and Sealing of Gaps

CC-RMP-02400 – Requirements for Measuring and Pricing of Brickwork, Blockwork and Stonework

CC-RMP-02500 - Requirements for Measuring and Pricing of Special Structures

CC-RMP-02700 – Requirements for Measuring and Pricing of Watermains, Utilities and Accommodation Works

CC-RMP-02800 - Requirements for Measuring and Pricing of Trenchless Installation of Road Drainage and Service Ducts

CC-RMP-02900 - Requirements for Measuring and Pricing of CCTV Survey of Road Drainage Systems

## 8.2 TII Publications (Technical) References

PE-PAG-02009 - Project Appraisal Guidelines for National Roads Unit 1.0 – Introduction.

PE-PAG-02010 - Project Appraisal Guidelines for National Roads Unit 2.0 - Project Appraisal Deliverables.

PE-PAG-02011 - Project Appraisal Guidelines for National Roads Unit 2.1 - Project Appraisal Plan.

PE-PAG-02012 - Project Appraisal Guidelines for National Roads Unit 3.0 - Project Brief.

PE-PAG-02013 – Project Appraisal Guidelines for National Roads Unit 4.0 – Consideration of Alternatives and Options.

PE-PAG-02014 - Project Appraisal Guidelines for National Roads Unit 5.0 - Transport Modelling Overview.

PE-PAG-02015 – Project Appraisal Guidelines for National Roads Unit 5.1 – Construction of Transport Models.

PE-PAG-02016 - Project Appraisal Guidelines for National Roads Unit 5.2 - Data Collection

PE-PAG-02017 - Project Appraisal Guidelines for National Roads Unit 5.3 - Travel Demand Projections.

PE-PAG-02018 – Project Appraisal Guidelines for National Roads Unit 5.4 – Transport Modelling Report.

PE-PAG-02019 - Project Appraisal Guidelines for National Roads Unit 6.0 - Cost Benefit Analysis Overview.

PE-PAG-02020 – Project Appraisal Guidelines for National Roads Unit 6.1 – Guidance on conducting CBA.

PE-PAG-02021 - Project Appraisal Guidelines for National Roads Unit 6.2 - Preparation of Scheme Costs.

PE-PAG-02022 - Project Appraisal Guidelines for National Roads Unit 6.3 - Guidance on using TUBA.

PE-PAG-02023 - Project Appraisal Guidelines for National Roads Unit 6.4 - Guidance on using COBALT.

PE-PAG-02024 – Project Appraisal Guidelines for National Roads Unit 6.5 – TUBA and COBALT Sample Input Files.

PE-PAG-02025 - Project Appraisal Guidelines for National Roads Unit 6.6 - CBA Audit Checklist.

PE-PAG-02026 – Project Appraisal Guidelines for National Roads Unit 6.7 – CBA Report.

PE-PAG-02027 - Project Appraisal Guidelines for National Roads Unit 6.8 - Appraisal of Motorway Service Areas.

PE-PAG-02028 – Project Appraisal Guidelines for National Roads Unit 6.9 – Wider Impacts.

PE-PAG-02029 - Project Appraisal Guidelines for National Roads Unit 6.10 - Reliability and Quality.

PE-PAG-02030 - Project Appraisal Guidelines for National Roads Unit 6.11 - National Parameter Values Sheet.

PE-PAG-02031 – Project Appraisal Guidelines for National Roads Unit 7.0 – Multi Criteria Analysis.

PE-PAG-02032 - Project Appraisal Guidelines for National Roads Unit 7.1 - Project Appraisal Balance Sheet.

PE-PAG-02033 - Project Appraisal Guidelines for National Roads Unit 8.0 - Business Case.

PE-PAG-02034 - Project Appraisal Guidelines for National Roads Unit 9.0 - Post Project Review.

PE-PAG-02044 - Project Appraisal Guidelines for National Roads Unit 11.0 - Financial Appraisal.

PE-PAG-02035 – Project Appraisal Guidelines for National Roads Unit 12.0 – Minor Projects (5m to 20m).

PE-PAG-02036 - Project Appraisal Guidelines for National Roads Unit 13.0 - Pedestrian and Cyclist Facilities.

PE-PAG-02037 – Project Appraisal Guidelines for National Roads Unit 14.0 – Minor Projects (0.5m to 5m).

PE-PAG-02038 - Project Appraisal Guidelines for National Roads Unit 16.0 - Estimating AADT on National Roads.

PE-PAG-02039 – Project Appraisal Guidelines for National Roads Unit 16.1 – Expansion Factors for Short Period Traffic Counts.

PE-PMG-02041 - Project Management Guidelines.

PE-PMG-02042 - Project Manager's Manual for Major National Road Projects.

Reference Class Forecasting: Guidelines for Use in connection with National Roads Projects.

### **8.3 Other Miscellaneous References**

The Public Spending Code – Government of Ireland.

The Capital Works Management Framework – Government of Ireland.

Common Appraisal Framework - Department of Transport.

## **Appendix A:** Cost Management Requirements

## A0.1 Cost Estimating and Management

### A0.1.1 Overview

Cost management is the overall planning, estimation, co-ordination, controlling, and reporting of costs from a Project's conception to the completion of all cost-bearing activities.

Transport Infrastructure Ireland (TII) seeks to promote international best practice in cost management on all its programmes of work and on individual projects to:

- Optimise investments in different programmes and individual projects.
- Aid decision making and promote desirable project outcomes.
- Benchmark and optimise design solutions to achieve **Value for Money**.

Cost management guidelines applicable to TII Projects are outlined within this Appendix.

When progressing a PPP project through Phases 1 - 4, the estimating processes in this manual will generally apply. TII will provide guidance on a case by case basis on the cost management processes to be applied during Phases 5 – 7.

## A1.1 Estimate Scope

### A1.1.1 Definition of Project Cost

**Project Cost** consists of the **Base Cost**, inflation, and **Risk Contingency** allowances required to plan, deliver, and closeout the planned work activities.

Project costs should be inclusive of VAT, taxes, statutory payments, compliance with safety, health and welfare requirements, environmental protection requirements, etc. Estimates will also include provisions for **Risk** and inflation. Estimates should be prepared in such a way that provisions for VAT, **Risk**, and inflation can be easily identified. Project costs exclude TII's 'head office' costs.

#### Note:

1. Provisions for operation, maintenance, and capital interventions required during the operational life of a Project and which are not provided as part of the Contract are not generally included for within the estimates referred to within this manual. However, the Project Manager will take account of **Whole Life Cost** factors when optimising design. Note, operation and maintenance costs are dealt with in a different way on PPP Projects.
2. All costs allocated to any of the principal cost headings must be eligible in accordance with eligibility and audit requirements listed in the TII Chargeability of Expenditure to National Road Grants.

### A1.1.2 Breakdown of Project Cost – Principal Cost Headings

Project costs are to be allocated to one of the following principal cost headings:

1. Main Construction Contract.
2. Land and Property.
3. Planning and Design.

4. Archaeology.
5. Advance Works and Other Contracts.
6. Main Contract Supervision (Contracting Authority's Costs)<sup>4</sup>.
7. Walking / Cycling / PT Connectivity / Asset Renewal<sup>5</sup>.

The principal cost headings remain constant throughout project development and delivery. Additional headings may be specified for PPP Projects.

When estimating costs under the Archaeology heading, the Project Manager shall liaise with the TII Project Archaeologist to identify the appropriate means of determining costs – which may be dependent upon the Project phase. Methods may include, but are not limited to, estimation via percentage of the Main Construction Cost, estimation via cost per hectare of land acquisition, estimation via interpretation of testing, etc.

When preparing the project costs, the Project Manager will ensure that all costs associated with the provision of active travel and public transport infrastructure (including the relevant proportions of planning & design, supervision, etc costs) can be clearly identified.

### **A1.1.3 Principal Cost Headings Item Coverage**

**Appendix A0** outlines the scope of works and services typically included under each principal cost heading at each project phase.

The 'Main Construction Contract' (the Contract) cost heading covers all works to be completed at Phase 6 which will be specified in the construction / implementation contract.

## **A1.2 Estimating Methodology**

It is expected that two main estimating methodologies will be adopted to produce **Project Cost** estimates:

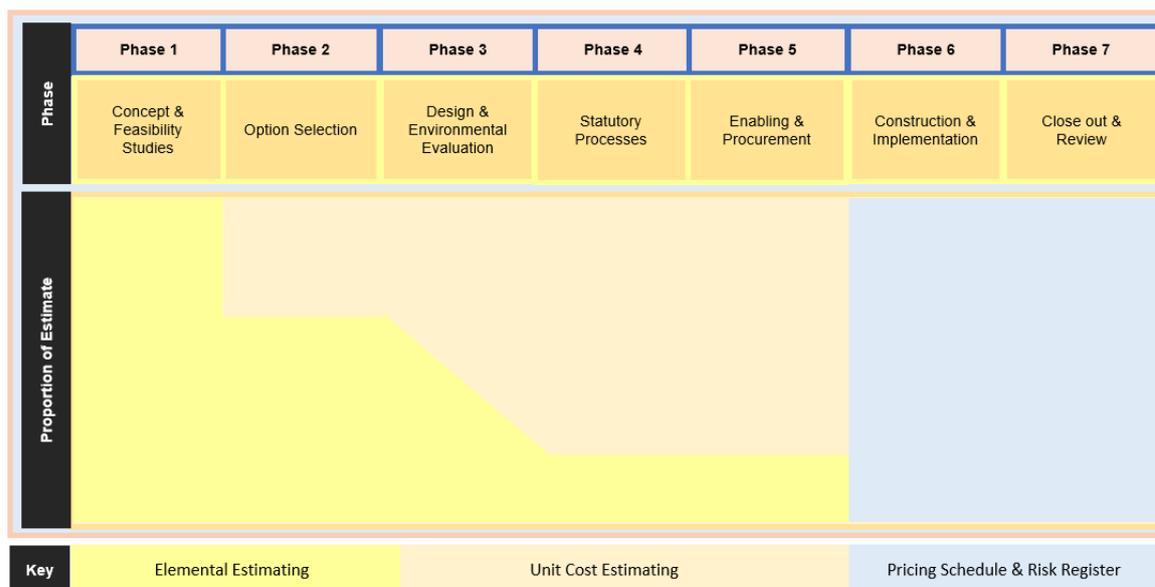
- **Elemental Estimating**; and
- **Unit Cost estimating**.

**Figure A1** shows that estimates prepared at Phase 1 will be predominantly based on **Elemental Estimating** while estimates from Phases 2 to 5 will be arrived at using a combination of both estimating approaches. There is increased usage of **Unit Cost Estimating** as project information availability increases.

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<sup>4</sup> All site staff grades and numbers should be agreed with the TII Senior Engineering Inspector based on need and budget.

<sup>5</sup> The Project Manager will identify relevant works for inclusion under this item and seek agreement from the TII Senior Engineering Inspector before including the works in the estimate.



**Figure A1 'Main Construction Contract' (the Contract) Estimating Methodology**

### A1.2.1 Elemental Estimating

**Elemental Estimating** is an approach to estimating where a project is broken down into key high-level elements of work. **Project Cost** is arrived at by multiplying quantities of elements by monetary rates with lump sum provisions for some elements.

The extent of work breakdown in elemental estimates will vary from simply the extent (e.g. length, scale) of a project and possible number of interchanges to having a selection of key project elements presented in the form of a works schedule.

Where sufficient information exists, key project elements can be quantified. This may lead to the use of quantities such as structures deck area, approximate cut and fill volumes, and pavement area. Provisions for other elements such as, for example, landscaping and fencing may be limited to lump sums.

Refer Level 1 Estimate Summary and Back-up Template within **Appendix A1**.

### A1.2.2 Unit Cost Estimating

**Unit Cost Estimating** is based on breaking down project elements into various works activities and then multiplying the resultant quantities for each activity by unit costs appropriate to the scope and nature of the works. The presentation of such an estimate typically ranges from an abridged bill of quantities to a full bill of quantities.

Refer Level 1 Estimate Summary and Back-up Template as per **Appendix A1**.

**Note:**

1. The TII Requirements for Measuring and Pricing is a useful reference for the purposes of clarifying the type of items that should be quantified and costed. The focus should be to quantify the 20% of items that typically capture 80% of the cost. Remaining items can be provided for using elemental costing and lump sum provisions.
2. The Project Manager is responsible for the selection of appropriate rates when preparing estimates.

3. Where rates are obtained from TII, these should be used solely for benchmarking purposes as the rates would not relate to any particular project. The Project Manager must satisfy themselves that the rates used in their Project estimates are adapted for the particulars of their Project.
4. Typically rates and prices used for **Elemental Estimating** of the **Base Cost** will be based on historical final outturn costs. Where these historical costs are final outturn costs as opposed to tendered unit cost rates, this may need to be reflected in lower levels of **Risk Contingency** being applied on top of the **Base Cost**, as appropriate.

### A1.2.3 Base Cost Estimate

Whether compiled using elemental or **Unit Cost Estimating** methodologies - or a combination of both, the **Base Cost** estimate will consist of a point estimate in current values for each of the principal cost headings. Rates used should be adjusted as necessary to account for project variables such as environment, terrain, scale and complexity of works, envisaged construction methods, ground conditions, etc.

The **Base Cost** estimate represents the best estimate of the project's outturn cost were the project to be constructed now with no provision for **Risk** or inflation. Provision for **Risk** and inflation will be identified and provided for separately.

### A1.2.4 Land and Property

Estimating costs associated with land and property will be undertaken in accordance with the TII Land and Property Section requirements. Information is available upon request from TII.

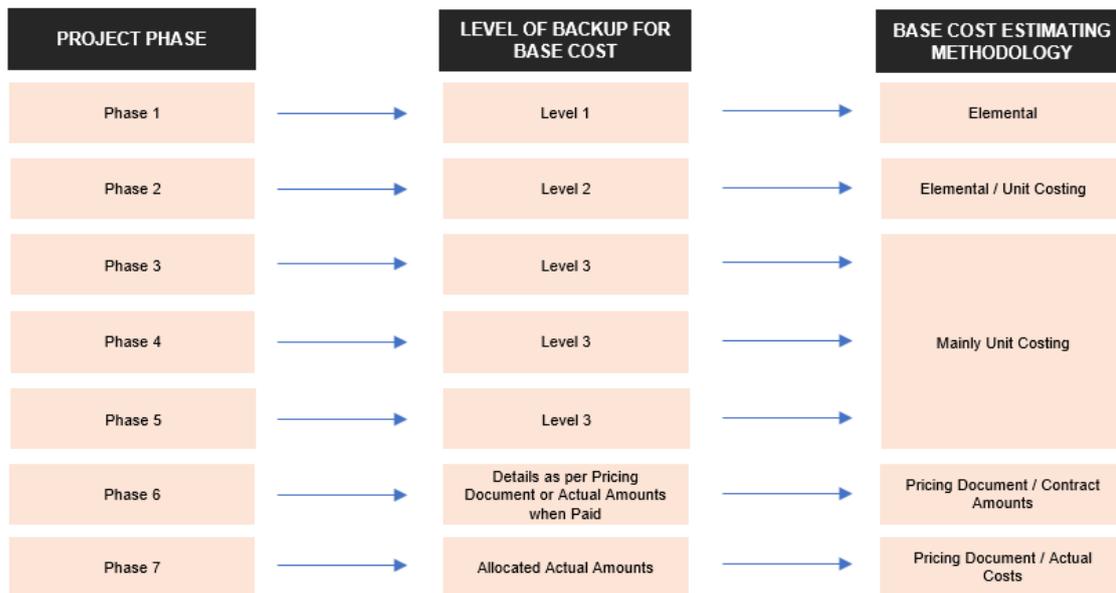
### A1.2.5 Estimate Composition - Levels of Supporting Detail

Due to the varying levels of information available as projects progress through different Project phases, estimates prepared at different phases will be accompanied by varying levels of back-up and will be presented to varying degrees of detail.

For the purpose of preparing estimates on TII projects, three levels of estimating detail have been identified. The three levels of **Base Cost** supporting detail, depending on project phase, are indicated in **Figure A2** and are defined below:

- Level 1 - where scope and design information are limited - for example - to mainline and major link road lengths; section type; number of structures and possible grade separated junctions or interchanges. **Appendix A1** gives an example of an acceptable format and backup detail for the summary of a Level 1 estimate. Level 1 estimates do not form part of the formal TII cost estimation processes, but may be useful for Project Managers if cost estimates are required during early project phases to support initial capital investment decisions.
- Level 2 - where additional key scope parameters including – for example - cut and fill volumes, structures deck areas, area of pavement, key risks are known, etc. **Appendix A2** gives an example of an acceptable format for the summary of a Level 2 Estimate Summary and Back-up Template.
- Level 3 - where design information of an appropriate degree is available to facilitate the preparation of a detailed schedule of works using a bill of quantities (BOQ) format including key quantities for all works elements. Refer **Appendix A3** for the level of detail required in support of a Level 3 estimate. The format used to derive estimates should be capable of being summarised as per the Level 3 breakdown outlined in **Appendix A3**.

The detail required in support of estimates prepared in accordance with each of the above levels is outlined in **Appendix A0**.



**Figure A2** Base Cost Estimating at Phases 1 to 7

### A1.2.6 Compiling Project Estimates from Base Costs at Different Phases

Total cost provision at any particular phase is made up of the **Base Cost**, inflation, and **Risk Contingency** provisions. The process of establishing project costs at all phases is illustrated in **Figure A3**. This figure shows how the **Base Cost**, **Risk Contingency**, inflation, and **TII Programme Risk** are incorporated into an overall estimate at different phases. Different terminology is used to describe estimate provisions at different phases as following:

**Major Projects:**

- Phase 2 **Option Comparison Estimates**
- Phases 3 to 7 **Target Cost and Total Scheme Budget**

**Minor Projects:**

- Phase 2 **Option Comparison Estimate**
- Phase 3 - 7 **Minor Project Estimate (Target Cost) and Outturn Cost**

Templates for compiling these estimates are included in **Appendices A4, A5, A6** and **A7**.

Care will be taken to ensure that **Project Cost** estimates at all phases are neither excessively conservative (over provision) nor too optimistic (under provision). To mitigate such tendencies, **Risk Contingency** will be determined via **Quantitative Risk Analysis** ('internal view') and via **Reference Class Forecasting** ('external view') for estimates at Phase 3 and subsequent phases.

### A1.2.7 Option Comparison Estimate (OCE) – Phase 2

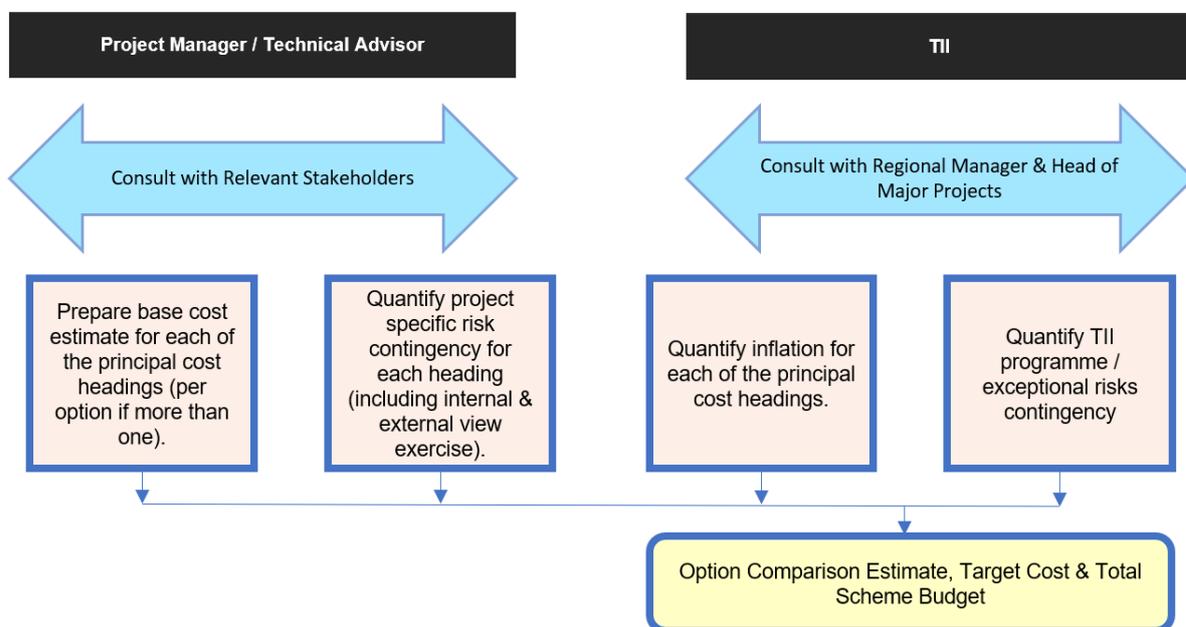
The process leading to the compilation of the **Option Comparison Estimate** Template is depicted in **Figure A3**.

The Estimate Assumptions Sheet is to be a summary of the key scope, issues, **Risks**, and programming assumptions that informed the determined estimate. See **Appendix A7** for a template Estimate Assumptions Sheet.

**Base Cost** estimates and contingencies are derived for each proposed option. The **Option Comparison Estimate** Template is included in **Appendix A5**.

The TII Project Appraisal Guidelines outline a multi-stage approach to option selection. At all stages of option selection, the **Base Cost** for the various options under consideration should be compiled as ‘Level 2’ estimates. Estimates should be prepared in a consistent and comparable manner, in particular each **Option Comparison Estimate** should be estimated with an equivalent level of detail.

Note: Amounts in the approved **Option Comparison Estimate** Template should be used in any cost reporting, business case report, the option selection report, etc. If, on foot of any review or analysis, changes are introduced in any one of these reports that affects the **Option Comparison Estimate**, the estimate compilation process in **Figure A3** is repeated so that an updated **Option Comparison Estimate** is arrived at and included in all reports.



**Figure A3 Project Cost Estimate Roles at All Phases**

### A1.2.8 Major Project Target Cost (TC) and Total Scheme Budget (TSB) – Phases 3 to 7

Project outturn forecasts from Phase 3 onwards on Major Projects will be presented as range estimates in the form of a **Target Cost** and a **Total Scheme Budget**.

With respect to Major Projects, the **Target Cost** and **Total Scheme Budget** can be interpreted as following:

- **Target Cost** is the projected project final outturn cost achievable if realistic **Risks** (i.e. those that have a 50% probability of being exceeded (P50)) and inflation materialise (i.e. 50% of estimates exceed the P50 estimate).

- The **Total Scheme Budget** is potential project final outturn cost achievable where **Exceptional Risks** (which have only a 20% probability of being exceeded (P80)) and **TII Programme Risk** materialises (i.e. the probability of the final outturn cost being less than P80 is 80%).

**Note:**

1. The production of the **Risk Contingency** for inclusion in the **Target Cost** and **Total Scheme Budget** requires a Risk workshop at Phase 3.
2. The Project Manager will consult with TII regarding inflation provisions.
3. While in the majority of cases the P80 **Risk Contingency** is appropriate for the **Total Scheme Budget**, there may be occasional cases where a higher level of certainty (and lower risk) is required to evaluate the affordability and judge whether a project could negatively impact on the ability to deliver other projects or programmes. In these cases, which must be agreed with TII, a higher **Risk Contingency** may be appropriate.

The Project Manager in consultation with the TII Senior Engineering Inspector will use the agreed **Base Cost** estimates, inflation forecasts, and **Risk Contingency** to compile the **Target Cost** and **Total Scheme Budget** using the template outlined in **Appendix A6**.

The Estimate Assumptions Sheet (**Appendix A7**) should be updated to accompany the compiled **Total Scheme Budget** template.

**Note:**

1. The approved (signed off) **Total Scheme Budget** is the amount that will be communicated (when required) as TII's overall position for the project at this stage.
2. The approved **Target Cost** and **Total Scheme Budget** will be used in all project documentation.

The **Target Cost** will be post-fixed by the numbers 1, 2 or 3 as follows:

- **Target Cost 1** is initially produced in draft format (together with a draft **Total Scheme Budget**) at Phase 3 prior to the finalisation of the development approval documentation. Final **Target Cost 1** and **Total Scheme Budget** will be compiled at Phase 3 when the **Risk** workshop has been undertaken; land acquisition requirements and costs are finalised just before publication of development approval documentation.
- **Target Cost 2** is produced at the end of Phase 4 after Competent Authority conditions or agreed variations to the Schedule of Environmental Commitments are known. An Updated **Target Cost 2** is prepared, if necessary, during Phase 5, prior to commencement of the tender process, to take account of the increased clarity in Project Scope (following preparation of tender documents, design, additional surveys, advance works contracts, archaeological testing, etc) and the transferring of **Risk** within the proposed contract.
- **Target Cost 3** is prepared at Phase 5 post tender and prior to tender award to take account of the developed final tender documents, the preferred tenderer's tender design offering and the preferred tenderer's tender sum, although care must always be taken to ensure that the forecast is not influenced by the lowest tenderer's pricing strategy.

**Note:**

1. When compiling **Target Cost 3** it is particularly important that **Risk Contingency** is reviewed to take account of **Risks** transferred in the Contract and those retained by the Contracting Authority. Hyperinflation provisions, etc. will generally be addressed by the TII Senior Engineering Inspector.
2. The format of the Tender Estimate will follow the format of the **Pricing Document** to be included in the tender documents.
3. The Tender Estimate and its backup will also be utilised for the Detailed Cost Check (to be carried out Pre-Tender per Project Management Guidelines).
4. The **Pricing Document**, used when a full Bill of Quantities is not required, may follow the format of the typical document included in **Appendix A9**. Additional headings should be included for specialised works such as, for example, tunnelling and signature structures.
5. Where there are options for alternative design solutions, separate estimates, including priced schedules of works, will be produced to establish and substantiate any decisions taken in arriving at what is deemed as the most economically viable option.

### **A1.2.9 Minor Project Estimate (Target Cost) – Phases 3 to 5**

Project outturn forecasts from Phase 3 onwards on Minor Projects will be presented in the form of a **Target Cost** only.

With respect to Minor Projects, the Target Cost can be interpreted as following:

- **Target Cost** is the projected project final outturn cost achievable if realistic **Risks** (i.e. those that have a 50% probability of being exceeded (P50)) and inflation materialise (i.e. 50% of estimates exceed the P50 estimate).

Due to their lower value, there is not a requirement for a **Total Scheme Budget** with higher **Risk Contingency** for Minor Projects as the effect on TII's overall budget of higher than anticipated **Risk** materialisation is much less significant for Minor Projects as compared to Major Projects.

The Project Manager in consultation with the TII Senior Engineering Inspector will use the agreed **Base Cost** estimates, inflation forecasts, and **Risk Contingency** to compile the **Target Cost** using the template outlined in **Appendix A4**.

The Estimate Assumptions Sheet (**Appendix A7**) should be updated to accompany the compiled **Target Cost** template.

The **Target Cost** will be post-fixed by the numbers 1, 2 or 3 and developed at the same Phases as for Major Projects. The exception to this is that TC2 will be prepared prior to tender issue. TC1 shall be reviewed at the end of Phase 4 but no formal budget is required at Phase 4.

## **A1.3 Review of Estimates**

### **A1.3.1 Publication of Project Estimates (Cost and Duration)**

While there is not normally a requirement to publish cost estimates in the public domain, where their publication is unavoidable, only information reflected on the latest TII approved template sheets will be published. Cost estimates will be published as a cost range rather than as a point estimate.

Assumptions surrounding construction commencements and durations will be agreed with the TII Senior Engineering Inspector before they are used for estimating purposes or indicated on any project information boards or included in any public documentation.

### A1.3.2 Intermediate Review of Estimates

During the - often extended - period between decision gates, it may become evident that an estimate needs to be updated.

In these circumstances - rather than waiting until the next decision gate to update the Project Cost estimate - an intermediate project estimate should be prepared. This applies to Major Projects only: Intermediate project estimates should only be created if it is considered by the Steering Group and/or TII that the last project estimate is no longer suitable and that it needs to be refreshed. This may arise in circumstances such as:

- There have been unexpected increases in inflation (e.g. land prices, construction costs, labour costs);
- New information has come to light during the design process which has a material impact on the cost of the project;
- There is an internal requirement for an up to date project estimate (e.g. for cashflow planning purposes); or
- There has been a considerable delay to the project since the last project estimate was approved.

Otherwise, it is expected that the project estimate prepared at the last decision gate should provide sufficiently accurate cost data for the project until an updated project estimate is prepared at the next decision gate.

Intermediate estimates shall be used for internal decision making, cashflow analysis, etc within the Sponsoring Agency and/or TII only. Under no circumstances shall intermediate estimates be published or used in any documents prepared for parties outside the Sponsoring Agency or TII.

### A1.3.3 TII Review of Estimates

Estimates at all levels presented to the TII Senior Engineering Inspector will be accompanied by the previous estimate (where a previous estimate had been prepared) accompanied by a brief reconciliation highlighting any changes to the estimate and the reasons for same. Estimates will also be accompanied by a completed Estimate Tracking Sheet (**Appendix A10**) which will record each change in the estimate as the project progresses through the various phases of development.

#### Note:

1. During construction / implementation at Phase 6, outturn forecasts for each of the principal cost headings will be carried out on a quarterly basis to take account of project progress, actual payments and developments in the Project Risk Register (incorporating the Construction Contract Risk Register - CCRR). Project outturn forecasts should be continuously monitored against **Target Cost 3**.

While the construction outturn cost can be prepared once the final account is agreed at Phase 6/7, the Project Outturn Cost can only be prepared when payments on all the principal cost headings have been mainly discharged. At this stage final payments on any remaining minor expenditure can be forecast with a high degree of certainty.

## A1.4 Future Proofing - Application of Inflation/Deflation to Estimates

Once the **Base Cost** in current values and **Risk Contingency** is determined, reviewed, and agreed as per the requirements of this Manual, the Project Manager will send details of these agreed estimates to the TII Senior Engineering Inspector.

The TII Senior Engineering Inspector will apply appropriate inflation rates to cost estimates.

### Note:

1. Project Managers and their Property Valuation Advisors may be required to provide an inflation rate deemed appropriate for land estimates taking into account land value trends in the area.
2. The TII Senior Engineering Inspector may consult with the Project Manager on the levels of inflation proposed for use in future proofing estimates.

## A1.5 Change Management

### A1.5.1 Change Management Overview

At any stage, a project can be said to have a known or agreed scope, schedule, cost and status (project circumstances). Change is defined as any alteration to a project's known circumstances. Causes for change can be internal or external to the project or implementing agencies – including Competent Authority requirements, environmental constraints, etc. Whatever the cause, the effect on the project is likely to be changes in one or more of the following:

- Scope
- Programme
- Specification/functional requirements
- Approach /methodology
- Objectives
- Underlying assumptions/ known information
- Cost

Such changes can affect the business case on which the authorisation for the project was based. It is, therefore, critical that mechanisms are in place for recognising, assessing, recording and managing drivers for change.

At any stage in the project a change may be identified which impacts on the project rationale, project objectives or the strategic alignment of the project. Changes such as these have the potential to materially affect the grounds upon which approvals were given by the Approving Authority in accordance with the Public Spending Code. Changes such as these shall be brought to the attention of the Steering Group and/or TII at the earliest opportunity.

Other than changes to project rationale, objectives, or strategic alignment, changes during Phases 1, 2 & 3 will primarily be considered as design development. The majority of these changes can typically be deemed to be foreseeable insofar as they arise as project information becomes more detailed.

Any change order that arises on foot of a contract agreement under any of the principal cost headings will be recorded by the Project Manager in the Project Procurement File (refer Project Management Guidelines) together with all requests, approvals, and supporting documentation relating to the change order.

## **A1.5.2 Pre-Construction Change Control (end of Phase 3 to the end of Phase 5)**

### **A1.5.2.1 Change Management Procedures: Pre-Construction Triggers**

Changes which occur post the preparation of the **Base Cost** and **Risk Contingency** at the end of Phase 3 shall generally be captured and recorded as risks to the cost estimate.

When risks that were anticipated become issues, they should be managed through the appropriate risk register and money transferred from the appropriate risk register to the **Base Cost**.

There could be changes however, which were not foreseeable and which may be of sufficient magnitude to merit a review of the **Base Cost** estimate. In such circumstances, the **Change Management** process in **Figure A5** will apply.

Change will also take account of Sponsoring Agency's specific change control approval procedures or thresholds / triggers, as necessary.

### **A1.5.2.2 Change Management and Control**

Measures should be taken prior to the construction phase to minimise the potential for change. Such measures could include:

- Introducing scope freeze points at key stages during the development of the project and in particular prior to the preparation of tender documentation or documenting agreed project status/circumstances.
- Considering targeted concentration of resources on problem areas such as scoping service diversions.
- Increasing the scope of enabling works contracts where feasible to improve the initial efficiency of the Contract and where appropriate deal with high **Risk** items.
- Early engagement with all stakeholders likely to have requirements that would instigate changes.
- Ensuring the **Project Cost** estimates and the Project Risk Register both take full account of current information.

Pre-Construction, the Project Manager will record change management and control as part of the Project Risk Register.

## **A1.5.3 Construction and Implementation Stage (Phases 6 & 7) Change Control**

From the main construction / implementation contract onwards; the conditions of contract deal with how changes will be managed between the Contracting Authority and the Contractor by way of value proposals and change orders. Change management processes during these phases will take account of the requirements of the Project Management Guidelines (PE-PMG-02041).

### **A1.5.3.1 Change Orders**

Any changes to the Main Construction Contract involving a change to the scope of works and a change to the contract value require approval from TII in accordance with the relevant procedures and thresholds prevalent.

In some instances, the Contracting Authority's Representative may approve Change Orders to a threshold amount specified in the Contract. The TII Senior Engineering Inspector will provide guidance as to the relevant procedures and thresholds and these shall be recorded in the Change Management Plans / Strategies (Cost, Risk, Value) included with the PEP.

The Project Manager, in conjunction with the Contracting Authority's Representative, will prepare a justification Report for each Change Order in accordance with the requirements of this manual and the Project Management Guidelines.

As outlined within the Project Management Guidelines, and associated manuals, the Contracting Authority's Representative shall maintain an up to date Change Order Register. This register shall indicate instructions that the Contracting Authority's Representative considers to be Change Orders and shall indicate the purpose and reason for the issuing of the Change Order.

Where necessary, the Contracting Authority's Representative shall maintain a separate record of directions given to the Contractor to comply with the Contract.

**Note:** The contents of the Change Order Register shall be incorporated into the Compensation Events Register. Alternatively, one register can be maintained recording all Compensation events, Claims and Change Orders, once Change Orders are labelled as such. A template for a Claims / Compensation Events Register is included within **Appendix A11**.

### A1.5.3.2 Relationship Between Contract and Change Management Registers

The relationship between the Contract Management Registers (deriving from the Project Management Guidelines, and associated manuals, and this manual) is presented in **Figure A4**.

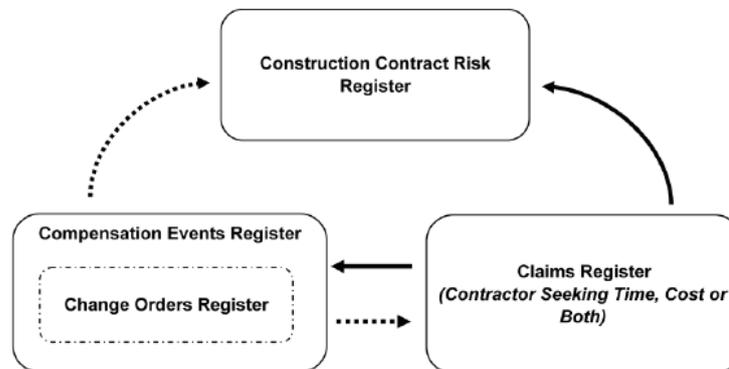
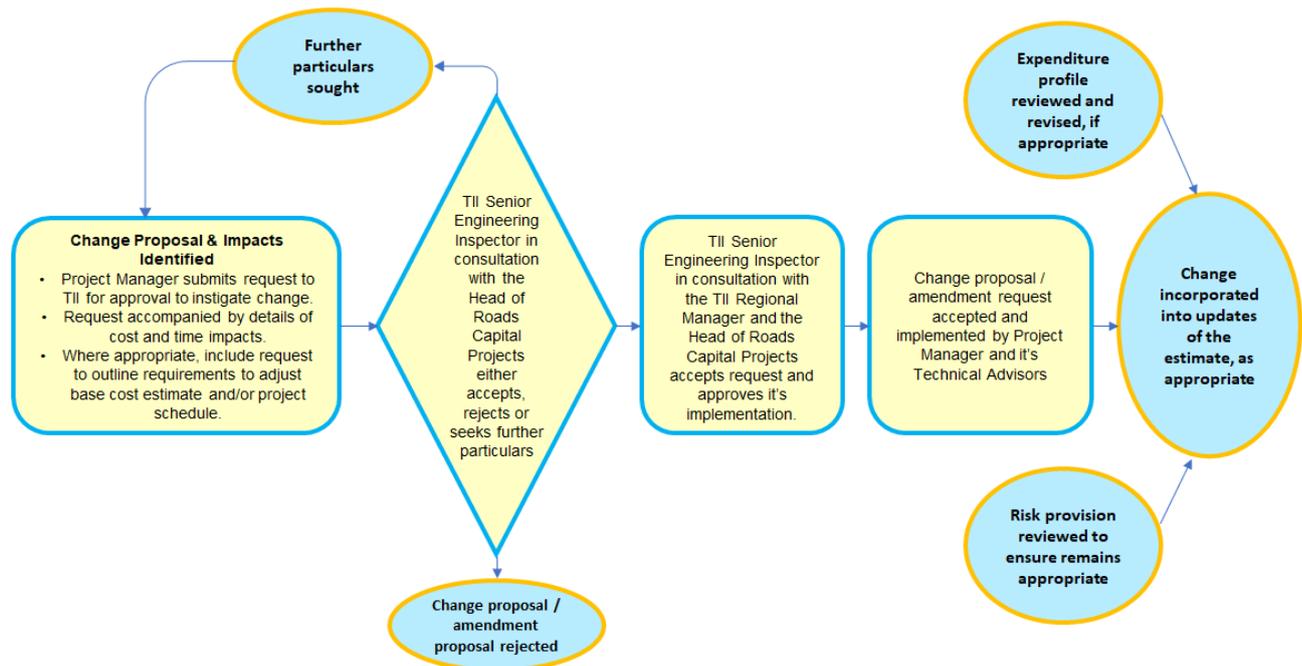


Figure A4 Relationship Between Contract and Change Management Registers

### A1.5.3.3 Revisions to Estimates

Following the approval of a change each updated **Base Cost** estimate and **Risk Contingency** or contract sum will be reconciled with the previous estimate to clearly illustrate where the change has been incorporated into the revised estimate.

In the event of a change which results in a cost reduction, these procedures will similarly apply albeit with the possibility of leading ultimately to a downward adjustment of the **Project Cost** estimate or contract sum.



POTENTIAL CHANGE WHICH MAY HAVE A COST IMPACT ON PROJECT BASE COST ESTIMATE AND/OR CONTINGENCY LEVELS

Key:   Activities      Decision      Beginning or End

Figure A5 Change Proposal Procedure

## A1.6 Cost Allocation to Cost Headings - Capturing and Reporting Costs in PRS

When transferring eligible costs from Agresso - or other accounting packages - Project Managers should ensure that chargeable costs are assigned to one of the principal cost headings. Additional cost headings could be available for PPP projects and proper assignment of costs should be done.

Supporting information should be recorded and retained in a manner that can be easily audited when required.

The TII Senior Engineering Inspector and the Project Manager will work in conjunction with their respective finance sections to ensure that the assignment and recording of costs is accurate and timely.

The monthly reporting of costs and claims for reimbursements by the Project Manager will be carried out in accordance with the provisions of all relevant TII and Sponsoring Agency administrative procedures.

## Appendices

Electronic appendix templates are available, as required and necessary, upon request from TII.

- **Appendix A0:** Cost headings and Level of Estimate Detail at Project Phases.
- **Appendix A1:** Level 1 Estimate Summary and Back-up Template.
- **Appendix A2:** Level 2 Estimate Summary and Back-up Template.
- **Appendix A3:** Level 3 Estimate Summary and Back-up Template.
- **Appendix A4:** Minor Project Estimate (Target Cost) and back-up Template.
- **Appendix A5:** Option Comparison Estimate Template.
- **Appendix A6:** Target Cost and Total Scheme Budget Template.
- **Appendix A7:** Estimate Assumptions Sheet.
- **Appendix A8:** Change Order Register.
- **Appendix A9:** Typical Pricing Document.
- **Appendix A10:** Estimate Tracking Sheet.
- **Appendix A11:** Claims / Compensation Events Register Template.

## **Appendix B:** Risk Management Requirements

## B1.1 Risk Management

### B1.1.1 Overview

Projects do not happen in entirely controlled environments and are subjected to the effects of uncertainty. To counter the impact of negative threats, and promote the occurrence of opportunities, **Risk Management** will be an integral part of project management processes visibly supported by the Project Manager.

### B1.1.2 Status of Risk Management Documentation

**Risk Management** documents represent work in progress and are subject to change on a continuous basis as concerns are investigated, addressed, or reflected in contract documents. They are snapshots of a project's **Risk** profile at a particular point in time used solely for the Sponsoring Agency's own planning, design, and cost management purposes. Therefore, these documents are not meant for general circulation.

### B1.1.3 Key Deliverables and Objectives per Phase

Key requirements, deliverables and objectives for **Risk Management** on a phase by phase basis are presented in the Manual. Note, the management of **Risk** and these deliverables is a continuous exercise.

### B1.1.4 Risk Management and Implementation

#### B1.1.4.1 Risk Management

**Risk Management** processes and procedures will be determined for all projects at the outset during Phase 1 by the Project Manager. These processes and procedures will be outlined within the within the Project Execution Plan.

#### B1.1.4.2 Implementing Risk Management

Typically, **Risk Management** will be implemented via:

- A series of **Risk Management** meetings and/or workshops.
- The production, review and updating of a Project Risk Register.
- The establishment and dynamic management of **Risk Contingency**.
- The active implementation of **Risk Response Strategies**.
- Referral of Programme, Strategic, or **Exceptional Risks** to TII.
- Review of **Base Costs** and estimates.
- Making **Risk Management** an item on the agenda of appropriate progress/financial meetings and Steering Meetings.

#### A1.1.4.3 Risk Management Process

A structured and systematic approach to the implementation of **Risk Management** is required. This continuous process, which is iterative and applicable at all project phases, is outlined in **Figure B1**.

**Note:**

1. The various meetings that take place where key stakeholders are in attendance over the course of a project are a key part of effective **Risk Management**. As such **Risk** will be an item on the agenda of the various meetings held during the course of the project (see Project Management Guidelines for meeting types and timing).
2. Emphasis on process activities will vary as the project develops. During early phases, there is emphasis on **Risk Identification** and analysis. In later phases, there will be more emphasis on the management of **Risk Response Strategies**.

#### **B1.1.4.4 Pre-Planning: Risk Management Process**

Advance-planning in the pre-planning process will assist in establishing a context, focus, and approach to an upcoming **Risk** review. It helps identify relevant stakeholders, key issues, and analysis methodologies to be employed. It also marks the initiation of the **Risk Management** process and offers an opportunity to review overall **Risk Management**.

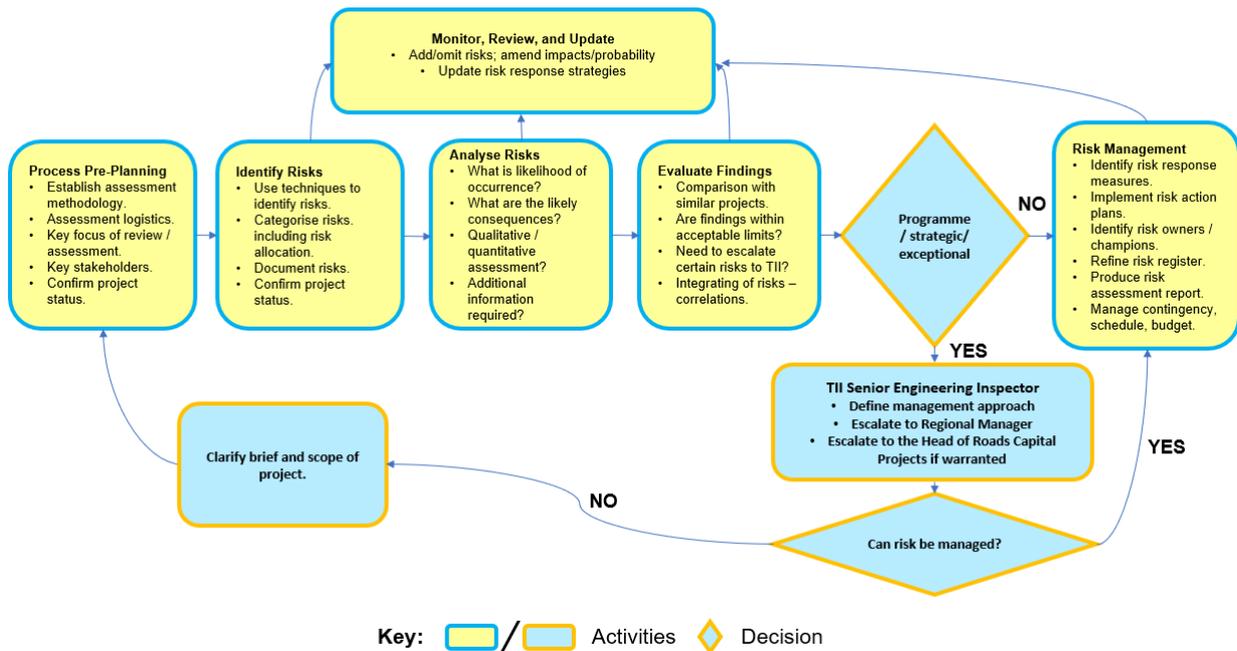
### **B1.1.5 Risk Identification and Categorisation**

#### **B1.1.5.1 Identification and Recording**

After establishing context, the next step in the **Risk Management** process is to identify potential **Risks**. Techniques for **Risk Identification** vary and include the following:

- Use of standard checklists (common **Risks** checking).
- Review of lessons learned from previous projects.
- Using a questionnaire to solicit views (Delphi Technique).
- Challenging assumptions and proposed design solutions.
- Objectives-based **Risk Identification** – identify what endangers project objectives.
- Scenario-based **Risk Identification** – exploring events that may trigger undesirable scenarios.
- Review possible sources of **Risks** and problem areas using techniques such as source analysis and problem analysis.
- Using diagramming techniques such as cause-and-effect (Ishikawa) diagrams, process flow charts and influence diagrams.
- Strengths, weaknesses, opportunities, and threats (SWOT) analysis.
- Documentation Review.

Most techniques above are best applied in a in a meeting or workshop setting.



**Figure B1 Risk Management Process**

Once **Risks** have been identified, they are recorded in a **Risk** register. **Appendix B1** gives an example of a **Risk** register for recording and undertaking both **Qualitative Risk Analysis** and **Quantitative Risk Analysis**. This risk register will be utilised as the Project Risk Register (matrix included per Project Management Guidelines requirements). **Risks** will be transferred from this register in later phases to the Construction Contract Risk Register.

**Note:**

1. When identifying and categorising **Risks**, reference will be made to the Works Contract, in particular with regard to **Risks** remaining with the Contracting Authority during Phase 6. These **Risks** together with any other retained **Risks** as defined in the contract (e.g. Hyperinflation) will form the basis of any contingency for the main construction contract for Phases 6 and 7. This review will therefore, be carried out ahead of compiling **Target Cost 3**.
2. Upon the commencement of Phase 6, it will be necessary to compile and maintain the Construction Contract Risk Register.

**B1.1.5.2 Categorisation**

When entered in the register, **Risks** will be categorised. This can be done using a number of different criteria such as:

- Whether **Risks** are **TII Programme Risk** or ‘ordinary’ **Risks**.
- Whether risks are reputational, strategic, political, etc.
- Whether risks are political, economic, social, technological, legal, and environmental (PESTLE).
- Timing or phase of project when **Risks** are envisaged.
- Whether **Risk** will eventually be allocated to the Contracting Authority or Contractor.
- Applicable Work element / activity.

- Applicable **Project Cost** heading (one of the principal cost headings).
- Proportion of **Risk** transferred through the contract if applicable.

**Risks** will also be allocated an owner and the name of the party responsible for implementing the **Risk Response Strategy** for that **Risk** will be included in the Project Risk Register.

**Note: Programme Risks** (referred to as **TII Programme Risk**) include strategic and **Exceptional Risks**. These will be identified but will not be quantified in the **Risk** registers and will be referred to TII.

## B1.1.6 Risk Analysis

Once **Risks** have been identified, they will then be assessed as to their probability of occurrence and severity of impacts using a 5x5 matrix. **Risk Analysis** can be qualitative or quantitative and the approach depends on the availability of information and the purpose of the analysis.

### B1.1.6.1 Qualitative Risk Analysis (Q<sub>L</sub>RA)

Whenever a Risk is added to the Risk Register, a **Qualitative Risk Analysis** will be carried out for the Risk. The key aim of **Qualitative Risk Analysis** will be to identify the overall risk rating using the 5x5 risk matrix, ascertain what controls need to be put in place to reduce the likelihood of the Risk occurring and identify whether or not the consequence of the **Risk** occurring can be mitigated and the measures that will be employed to mitigate same.

### B1.1.6.2 Quantitative Risk Analysis (Q<sub>T</sub>RA)

**Quantitative Risk Analysis** will be carried out throughout the delivery of a project to coincide with the review of **Project Cost** estimates, risk workshops, and ongoing review of the Project Risk Register. Full **Quantitative Risk Analysis** will be done from Phase 3 onwards. **Quantitative Risk Analysis** will be carried out on those Risks which may impact on the **Project Cost** but which have not been specifically included in the **Base Cost** estimate. Not all Risks in the Project Risk Register may need to be put through a **Quantitative Risk Analysis** e.g. Political or Reputational Risks, while important, may not have an impact on the overall project cost.

Unless otherwise agreed with the Project Manager, **Quantitative Risk Analysis** will be carried out using specialist software application. The resulting report will contain a range of possible **Risk** cost outcomes at various confidence levels including 50%, 80%, and 90% as shown in **Figure B2**. This information will also be presented in tabular format. The confidence level refers to the long-term success rate of the analysis, that is, how often the analysis will accurately capture the projected **Risk** (e.g. a 90% confidence level accounts for all the **Risk** 90% of the time whereas a 50% confidence level captures all of the **Risk** only 50% of the time). As such, higher value projects with greater **Risk** will often require a higher confidence level to inform cost and Risk estimates.

### B1.1.6.3 Sensitivity Analysis

**Sensitivity Analysis** will be carried out upon the preparation and subsequent revision of the Project Risk Register and **Risks** ranked in order of impact based on the output of the QRA. This analysis will be used to assist in identifying and prioritising **Risk Response Strategies** as part of ongoing **Risk Management**.

**Sensitivity Analysis** will be undertaken to identify how one parameter value influences a separate, but related or influenced, variable under a given set of assumptions.

It is not possible to prescriptively outline what **Sensitivity Analysis** will entail – this will be determined by the Project Manager taking cognisance of Project specific conditions such as the influence of ground condition interpretations on bridge design, the influence of hydrological conditions on geometric design and vice versa, the influence of stakeholder engagement on project advancement, etc.

#### **B1.1.6.4 Evaluation of Risk Analysis Outputs & Actions Arising**

A sanity check will be carried out on **Quantitative Risk Analysis** outputs. In the event that it is considered that the percentage is significant/excessive as a proportion of the **Base Cost** estimate, the Project Manager will examine the reasons for this and, if appropriate, seek to reduce the level of the **Risk Analysis** outputs to more realistic levels by exploring further controls or mitigation to allow the reduction of **Risk** impacts. An increase in the level of the **Base Cost** estimate may also be appropriate if certain Risks have a high likelihood of occurrence.

#### **B1.1.7 Risk Response Strategies (Treatment Options)**

Once **Risks** have been identified and assessed, all techniques for managing **Risks** fall into one or more of these major categories:

- **Impact Mitigation** – measures are taken to minimise the consequences of **Risks**. This may include taking out insurance against the **Risk**.
- **Risk acceptance** – accept that the risk exists and cannot be avoided or transferred. Identify controls that can be put in place to reduce the likelihood of the risk occurring and mitigation actions that should be carried out to reduce the consequences of the risk.
- **Risk avoidance** – project design is altered to avoid identified **Risk**
- **Risk transfer** – **Risk** is transferred to another party who is better placed to manage it. Sharing of **Risks** may be a sub-option of this approach. The following will be considered when transferring **Risks**:
  - The cost of retaining the **Risk** versus the cost of transferring the **Risk**.
  - The party best placed to manage the **Risk**.
  - The appropriate **Risk** transfer mechanism.
  - A fair price for transfer of the **Risk**.

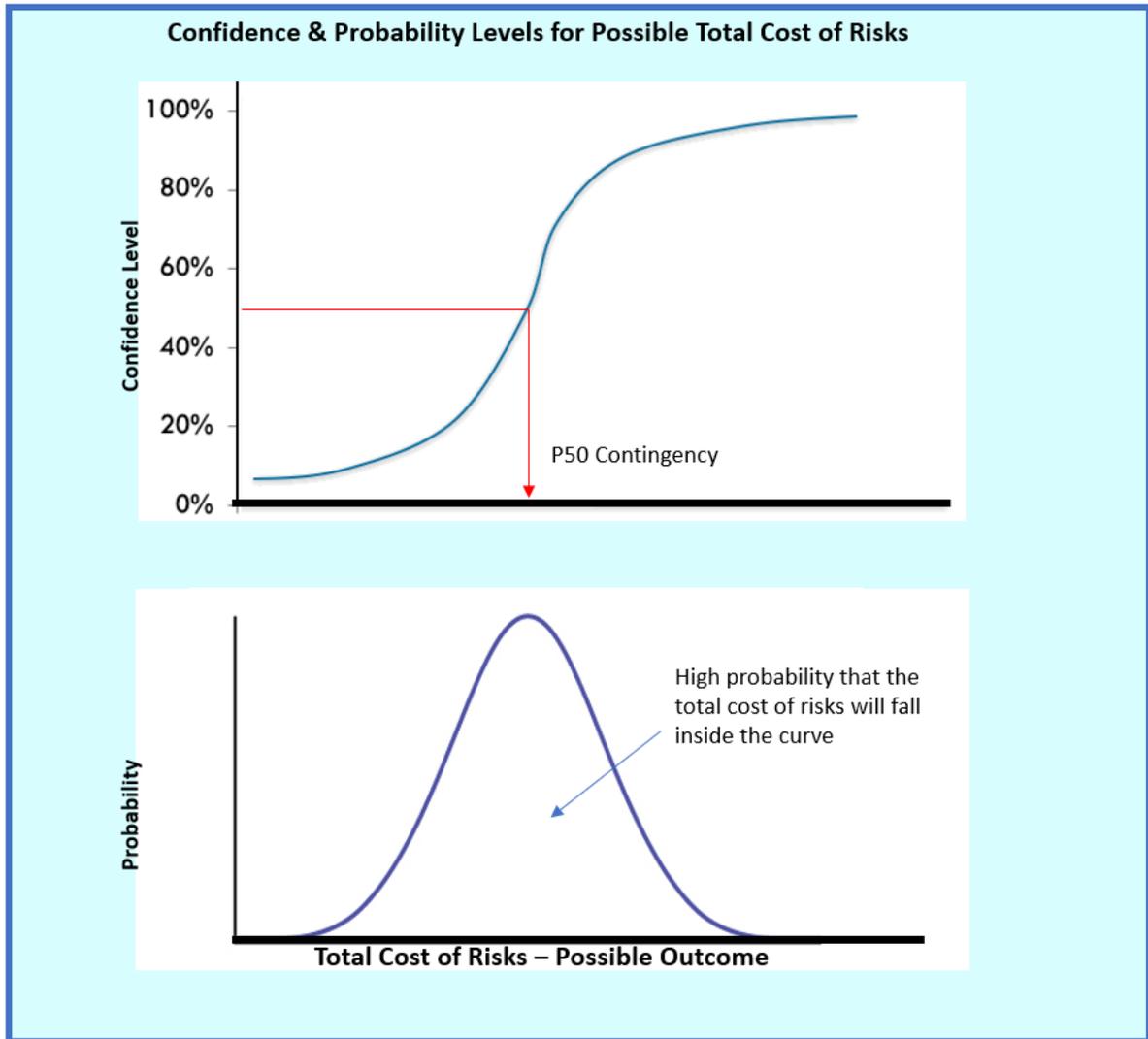


Figure B2 Quantitative Risk Analysis - Outcome Distribution

### B1.1.8 Practical Risk Response Measures (Treatment Options)

Practical **Risk Response Strategies** may include (but are not limited to):

- Additional ground investigation or environmental studies.
- Design workshops – issue specific.
- Identification of advance works packages.
- Amendments to contract terms (e.g. delayed possession of site provisions).

**Note:**

**Risk Management** efforts will be value driven. Focus will be on the 20% of **Risks** that typically are responsible for 80% of the potential impact on project deliverables ('Pareto Principle'). If **Risks** are improperly identified, assessed and prioritised, time can be wasted in dealing with **Risks** that are unlikely to occur.

Each **Risk** / action will be allocated to a **Risk** owner in the Project Risk Register. **Risk** response actions will be time framed and those that require imminent implementation will also be highlighted.

During each **Risk Management** workshop or review **Risk Response Strategies** will be identified, **Risk Response Strategies** already in place will be reviewed and mitigation efforts will be documented.

Actions will be duly implemented and monitored during the day to day management of the project and will be amended to take account of current information as the project progresses.

**Note:**

1. When drafting tender documents for the main construction contract, the Project Manager will ensure that the contents of the Project Risk Register are reviewed to ensure that opportunities to manage **Risk** by transfer via the main construction contract are optimised.
2. **Risks** that can be clearly identified (e.g. existence of contaminated material) will be included as background information in the relevant background information documentation when preparing tender documents.

## **B1.1.9 Monitoring and Reviewing the Risk Management Process**

### **B1.1.9.1 Risk Review Frequency**

In addition to the formal workshops / **Risk** meetings planned at key milestones during project delivery, the Project Manager will undertake continuous **Risk Management** reviews during the lifecycle of the project and update the Project Risk Register accordingly.

In any event, the Project Risk Register and **Risk Response Strategies** will be reviewed and revised whenever any of the following occurs:

- The cost estimate is reviewed.
- A **Value Management** exercise takes place.
- A **Risk Response Strategy** is implemented.
- A **Risk** materialises and its impact is reviewed.
- Or as directed by the Project Manager.

### **B1.1.9.2 Interim Reporting / Documentation**

The following interim reports will be prepared for the TII Senior Engineering Inspector by the Project Manager:

- A quarterly 'Risks Status Summary Report' incorporating an updated project risk register detailing the current status of the response strategies (specific action plans) as well as documentation of progress made during the quarter with updated **Risk** analysis. This report will include a listing and prioritisation ranking of key **Risks** (e.g. 1 to n).
- In addition to the periodic reporting specified above, the Risks Status Summary Report or other specified **Risk Management** reports will be prepared whenever requested.

### **B1.1.9.3 Final Risk Management Reporting**

At Phase 7, the **Risk Management** process will be concluded as follows:

The Project Manager will, as part of the Final Account Report preparation, carry out the following in relation to the Construction Contract Risk Register.

- Outline significant **Risks** that occurred and how they were managed.
- Outline how management actions lead to the non-occurrence of certain **Risks**.
- Tabulate amounts paid to the contractor for Contracting Authority **Risks** on the project.
- Indicate any outstanding issues and proposals for dealing with same.
- Lessons learnt from implementation of **Risk Management** on the project including lessons from managing specific construction **Risks** on the project.
- At this stage, all **Risks** that did not materialise will have a probability of occurrence of zero.

The Project Manager will update the Project Risk Register by taking into account **Risk Management** information from site, land acquisition, and other principal cost headings. They will incorporate this information in the Project Closeout Report. The commentary on **Risk Management** lessons and outcomes for the whole project should address the same topics as those specified above for the main construction **Risks**.

### B1.1.10 Risk Contingency

While one of the primary purposes of **Risk Management** is the provision of a framework within which uncertainty can be managed, it also provides a mechanism for determining monetary and time provisions (contingency) for envisaged **Risks**. **Risk Contingency** will be determined and provided for key **Risks** and for programme related **Risks** as outlined in this Appendix.

#### B1.1.10.1 Reference Class Forecasting

**Reference Class Forecasting** is an established method to address the root causes of cost and schedule overrun in projects. These root causes, including optimism bias and strategic misrepresentation, can lead to underestimation of projects' costs, benefits, and schedules, which can manifest itself in cost overruns at later phases of the project.

Within TII, **Reference Class Forecasting** is used in the determination of **Target Costs** and **Total Scheme Budgets** and is used in parallel with the QTRA process discussed earlier. This is shown in **Figure B3** below.

For Minor Projects, **Reference Class Forecasting** may be used as a standalone process to identify appropriate risk allowances for inclusion with the Project Estimates at Appraisal and Contract Award.

Full details of the theory behind **Reference Class Forecasting**, the development of the reference classes for national road **Schemes** and how **Reference Class Forecasting** is to be applied to national road **Schemes**, can be found in the document *Reference Class Forecasting : Guidelines for Use in connection with National Roads Projects* available from TII. The process for implementing **Reference Class Forecasting** for national roads projects is as follows:

- The uninflated **Base Cost** forecast, without contingency, is prepared by the Project Manager in accordance with the guidance given in the TII Cost Management Manual.
- A Quantified Risk Assessment is carried out to identify the appropriate risk allowance for both **Target Cost** (usually P50) and **Total Scheme Budget** (usually P80).

- In parallel with this, the equivalent risk allowances are identified from the reference class curves.
- Separate uninflated **Target Cost** forecasts are prepared using the QRA data and the reference class data.
- TII hold a structured workshop to use expert judgement to consider both **Target Cost** figures and record any specific project factors that may exist that would lead to the project being either more or less risky than the reference class. Attendees at this structured workshop will be the TII Senior Engineering Inspector, the TII Regional Manager, and the TII Head of Project Services. The Project Manager and other members of the project team may be invited at the discretion of the TII Senior Engineering Inspector.
- The attendees at the structured workshop above decide, based on the above analysis, on the appropriate **Target Cost** figure to be used for the project and record the reasons for this decision.
- The final budget sheet is prepared and approved.

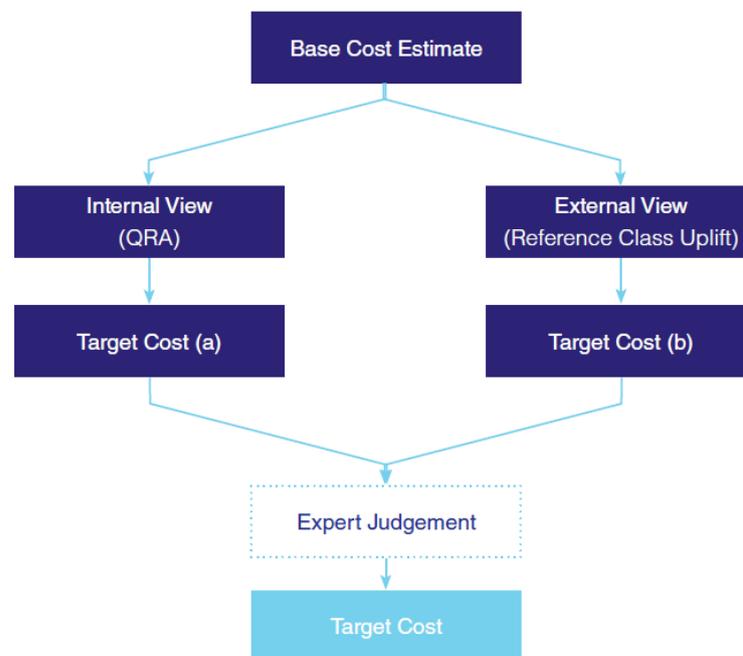


Figure B3 Application of Reference Class Forecasting

### B1.1.10.2 Phase 2

When draft **Option Comparison Estimates** produced at Phase 2 are submitted to the TII Senior Engineering Inspector, they will be accompanied by:

- a draft list of unique project features and how the influence of these on a Project's cost have been incorporated in **Option Comparison Estimates (Appendix A7: Estimate Assumptions Sheet)**.
- a draft Project Risk Register (preliminary **Qualitative Risk Analysis** of the **Risk** likelihood of occurrence and their impact).

The Project Manager will review the information and communicate with the TII Senior Engineering Inspector until the submissions are finalised for a particular phase or review. The interaction and finalisation of these submissions is depicted in **Figure B4**.

Once the Project Manager’s submissions are reviewed by TII, the Project Manager will facilitate the establishment of the **TII Programme Risk** and the compilation of the relevant estimate template.

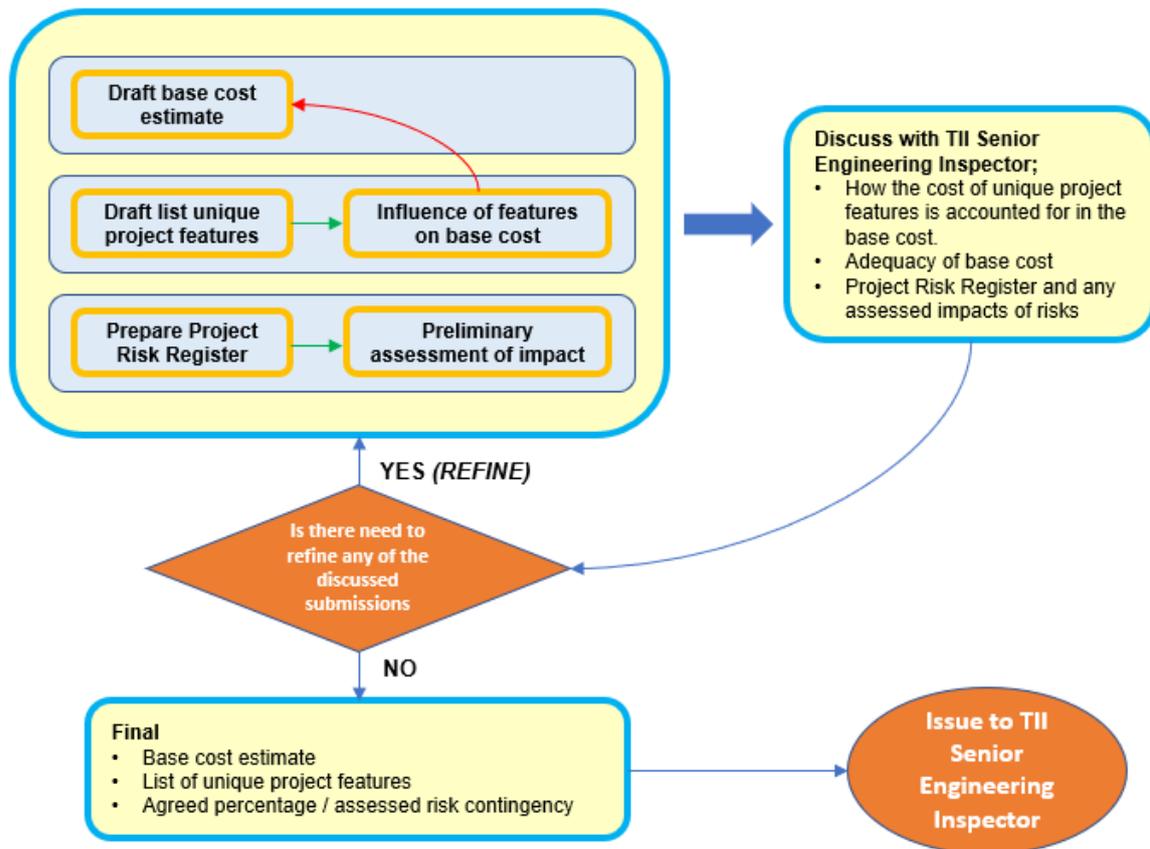


Figure B4 Establishing Risk Contingency Phase 2

### B1.1.10.3 Phases 3 & 4

Upon the conclusion of the **Quantitative Risk Analysis** and **Reference Class Forecasting** exercise, and their comparison and amelioration, at Phase 3 outputs representing **Risk Contingency** covering a range of confidence levels are produced. Under normal circumstances, the 50% confidence level **Risk Contingency** is incorporated, together with allocated inflation allowances, into the **Target Cost** and an 80% confidence level **Risk Contingency** is incorporated into the **Total Scheme Budget**. The TII Senior Engineering Inspector may require that contingency of a different confidence level be used where appropriate circumstances exist.

Once the **Risk Contingency** and **Base Cost** estimates are finalised by the Project Manager, the TII Senior Engineering Inspector will facilitate the establishment of the **TII Programme Risk** as outlined in this appendix and the compilation of the relevant estimate template.

### B1.1.10.4 Phase 5

During the phases preceding Phase 5, and early stages of Phase 5 itself, **Risks** initially identified will have been the subject of **Risk Response Strategies** (e.g. Site Investigation). The purpose of these strategies is generally to improve the level of information available to the Contracting Authority in relation to the site and the extent of the works required to complete the project. These strategies may often be influenced or directed by undertaking **Sensitivity Analysis**.

At tender stage, site information, project constraints, and other information will be reflected in the relevant background Information or tender documents.

**Risks** retained by the Contracting Authority will be those not expressly or otherwise transferred via the Contract.

The Project Risk Register will therefore, be revised during Phase 5 pre-tender to reflect the **Risk** transfer to be achieved via the main construction contract and to take account of pre-tender **Risks** that would have been dealt with or Risks that would no longer apply post-tender. The resulting **Quantitative Risk Analysis** based on the revised Project Risk Register will form the basis of the **Risk Contingency** to be included within **Target Cost 3** which would have been initially prepared as outlined within **Appendix A**.

## **B1.1.10.5 Phase 6**

### **B1.1.10.5.1 Contract Risk Management**

**Risk** monitoring and management will be discussed during Steering Group and Sponsoring Agency Management Group meetings. The Project Manager will review and update the Risk Status Summary Report and Project Risk Register to take account of any changes resulting from value, **Risk**, or contract administration activities. This report will detail how **Risks** will be managed during construction and or implementation. The Contracting Authority's Representative will prepare and maintain a Construction Contract Risk Register.

### **B1.1.10.5.2 Construction Contract Risk Register**

The following key points will be considered when identifying **Risks** for inclusion within the Construction Contract Risk Register:

- **Risks** will only be included on the basis that there is a possibility that at a later date, they may constitute compensation events, delay events, or lead to other adjustments to the contract sum allowable under the Contract.
- Claims issues recorded in the Claims Register are automatically transferred into the Construction Contract Risk Register by the Project Manager where they consider that there is a **Risk**, under the Contract, associated with the Claim.
- The settlement of compensation events will include for the full effects of the compensation event. However, the Project Manager may consider that there is a residual **Risk** associated with a Compensation Event and may deem it appropriate to include an item for the residual **Risk** within the Construction Contract Risk Register.
- The Construction Contract Risk Register will not include for compensation events that have occurred where their full impact has been agreed as these will have been transferred to the Compensation Events Register. The Construction Contract Risk Register only includes for issues which might occur and have the potential to result in either delay to the works or additional cost for which the Contracting Authority may have a liability under the Contract.

### **B1.1.10.6 Reviewing and Updating the Risk Contingency**

The Project Risk Register remains a live document throughout the Project Development Phases / lifecycle. As such it is subject to ongoing reviews with the **Risk Contingency** being amended as appropriate to reflect:

- The level of information available.
- The effect of approved changes.
- The impact of any new **Risks** which might arise during the course of the project.
- The completion of various aspects of the project.
- **Risk** transfer through the contract.
- **Risk Management**/mitigation efforts on the project.
- Actual cost and time impacts (especially during construction).
- Final account agreement.

This dynamic management of **Risks** and contingency may lead to a need to review **Base Costs** and where necessary, overall estimates.

As projects progress through different phases, envisaged **Risks** may become issues and their monetary impact materialise, leading to it being incorporated in the **Base Cost**. Similarly, actual inflation, if it happens, will be incorporated into the **Base Cost**. This approach leads to the progressive decrease in **Risk Contingency** and inflation and a corresponding increase in the **Base Cost**. In addition, there is a decrease in uncertainty and an increase in the degree of cost certainty as estimates are refined and are replaced by actual expenditure. This transfer of costs is illustrated in **Figure B5**.

**Note:**

The projection of the final outturn cost as per the scenario depicted in **Figure B5** is a complex process and there is also potential for Scenarios  $X_1$  and  $X_3$  which are described as follows:

- Project Outturn  $X_1$  – this could arise due to underestimation of **Base Cost**, inflation, **Risk Contingency** or some unforeseen occurrence which could potentially result in the outturn cost being higher than an overall figure envisaged at the beginning of the project. This would indicate that underestimation has occurred and is to be avoided
- Project Outturn  $X_2$  depicts an outturn cost that is consistent with envisaged **Risks**, **Base Costs** and inflation provision. Note it is unlikely that all **Risks** will materialise as envisaged
- Project Outturn  $X_3$  shows an outturn cost that is lower than originally estimated. While this outcome is preferable to Project Outturn  $X_1$ , this may mean that there has been overestimation of **Base Cost**, Inflation, **Risk Contingency**, or some combination of these. This is not ideal, as consistent overestimation of project costs on a portfolio basis may mean that available funding is not fully utilised.

Well estimated outturn costs should lie between  $X_2$  and  $X_3$  but should be as close as possible to  $X_2$

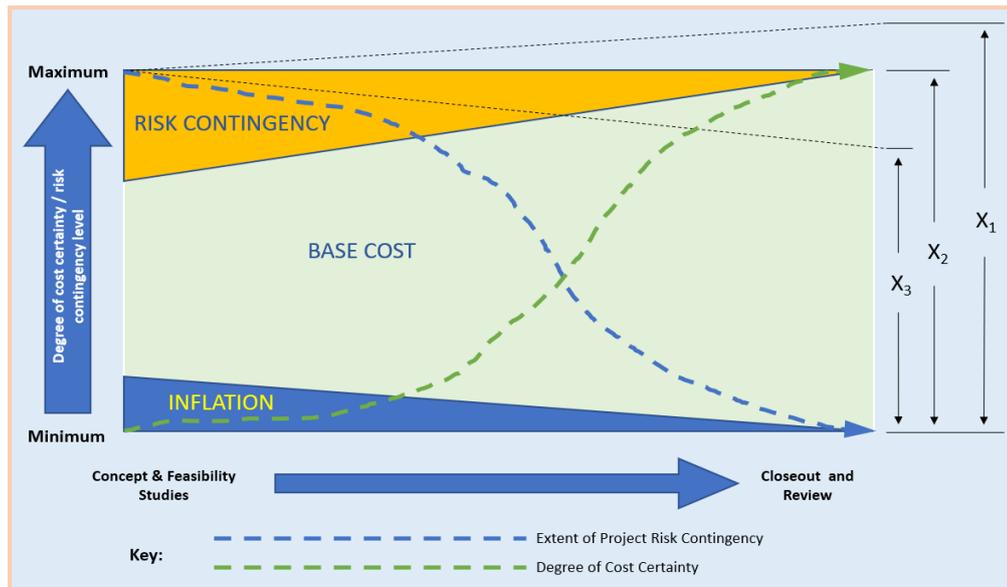


Figure B5 Relationship between Cost Certainty & Project Contingency

### B1.1.11 TII Programme Risk

Where a **Risk** is identified that could be considered as **TII Programme Risk**, the Project Manager will immediately advise the TII Senior Engineering Inspector detailing the nature of the issue and the potential impacts in terms of cost and time. **TII Programme Risk** also referred to as 'TII Risk' includes **Programme Risks**, **Strategic Risks**, **Reputational Risk**, 'PESTLE' style risks, and **Exceptional Risks**.

### B1.1.12 Risk Workshops

Dedicated risk workshops or meetings are the recommended means of identifying, documenting, categorising, and quantifying **Risks**, devising **Risk Response Strategies**, and establishing the Project Risk Register.

Other meetings specified in the TII Project Management Guidelines will take up **Risk Management** as an item on their agenda, as appropriate.

Risk workshops will be attended by the following stakeholders or their representatives:

- Project Manager.
- Sponsoring Agency/NRDO Senior Engineer.
- TII Senior Engineering Inspector and / or Regional Manager.
- Technical Advisors where appointed including specialists in relation to Structures; Highways including Bulk Earthworks; Geotechnics; Ecology, and Cost Estimating.
- Property Valuation Advisors.
- TII Archaeology Unit.
- TII Environmental Engineers, where deemed necessary.
- TII Project Services.
- Others as deemed appropriate by the Project Manager.
- Independent facilitator, where deemed necessary.

The process for undertaking a risk workshop at Phase 3 is outlined in **Appendix B2**. This process can be adapted for use at other Phases.

### **B1.1.12.1 Facilitation of Risk Workshops**

If a full structured workshop is required, an independent facilitator may be used. These could be individuals from external organisations, individuals from TII, or individuals from the technical advisor's organisation who do not have a day to day involvement on the project. All independent facilitators will be proposed by the Project Manager in consultation with the TII Senior Engineering Inspector. TII retains the discretion to directly appoint facilitators.

Regular risk review meetings can be facilitated by the Project Manager.

### **B1.1.12.2 Risk Workshop Stages**

The risk workshop can be broken down into three core stages namely pre-workshop, workshop, and post workshop. These stages and key activities for each stage together with a typical workshop structure and agenda are described in **Appendix B2**.

### **B1.1.13 Combined Approach to Risk and Value Management**

This appendix outlines requirements for **Risk Management** while **Appendix C** outlines **Value Management** requirements.

While these processes are presented as two separate requirements, from a practical implementation perspective it makes sense to integrate where possible the application of value and **Risk Management** as the two disciplines are complimentary. Whilst these procedures call for the appointment of a value manager and a **Risk Manager**, it may be considered appropriate that these roles are carried out by the same individual. In any event, it is envisaged that those responsible for **Risk** and **Value Management** will work together as part of the project team.

There are three major advantages to be gained from the integration of value and **Risk Management**:

- Integration allows value and **Risk** issues to be considered together. From inception it assists decision-makers to develop an understanding of opportunities and of uncertainties
- Integration allows a more efficient discussion process (greater depth and quality) and a lesser number of meetings / workshops are needed
- Use of the integrated process approach promotes a common team understanding and enables a coordinated effort to achieve the Project objectives

To this end, **Value Management** activities undertaken early in the project development stages (Phases 1 to 2 inclusive) will include the identification and analysis of **Risk** associated with options.

As the project moves through its development phases then value engineering can be applied in Phases 3 to 5 with risk workshops forming part of these reviews or alternatively separate risk workshops being undertaken at the same time.

Key value decisions taken or opportunities identified as well as main **Risks** that materialised will be included in the final account report and any project closeout reports / project post review reports.

## Appendices

Electronic appendix templates are available, as required and necessary, upon request from TII.

- **Appendix B1:** Typical Risk Register (Qualitative & Quantitative).
- **Appendix B2:** Risk Workshop Guidelines.
- **Appendix B3:** Construction Contract Risk Register.
- **Appendix B4:** Project Risk Register Template.

## **Appendix C:** Value Management

## C1.1 Appendix Overview

This Appendix gives guidance on the approach to and implementation of **Value Management** on TII projects.

The overall framework that informs TII's value enhancing strategies is briefly outlined. The Appendix then highlights the need and approach for systematically identifying, assessing, exploiting, and documenting value opportunities on individual projects as they progress through various project phases.

## C1.2 Responsibility for Value Management

The Project Manager will be responsible for ensuring **Value Management** activities are implemented on an ongoing basis. The Project Manager will be responsible for implementing **Value Management** activities on their projects on an ongoing basis.

It is important to clearly differentiate between **Value Management** at a project level and **Value Management** at sub project level. At a project level, **Value Management** is carried out using the project appraisal processes identified in the TII Project Appraisal Guidelines. Objectives for the overall project, **Whole Life Cost** for the project, etc will all be developed in accordance with the Project Appraisal Guidelines.

This Appendix should be used primarily for guidance on **Value Management** at a sub project level. Examples of this may include the consideration of a suitable junction type, consideration of earthworks management, consideration of appropriate structural form for a significant bridge structure, etc.

## C1.3 The Concept of Value and Value for Money

### C1.3.1 The Concept of Value

IS EN 12973:2020 describes the concept of value as being based on the relationship between satisfying needs and expectations and the resources required to achieve them. The needs relate to **Whole Life Costs**, quality, and other engineering and non-engineering requirements. The fewer resources used or the greater the satisfaction of needs for example, the greater the value. Depending on the phase the enhancement of value can therefore, be achieved by one or more of the following:

- Increase function with a lesser degree of cost increase.
- Increase function with no change in cost.
- Increase function at reduced cost.
- No change in function at reduced cost.
- Decrease function with a greater degree of cost reduction.

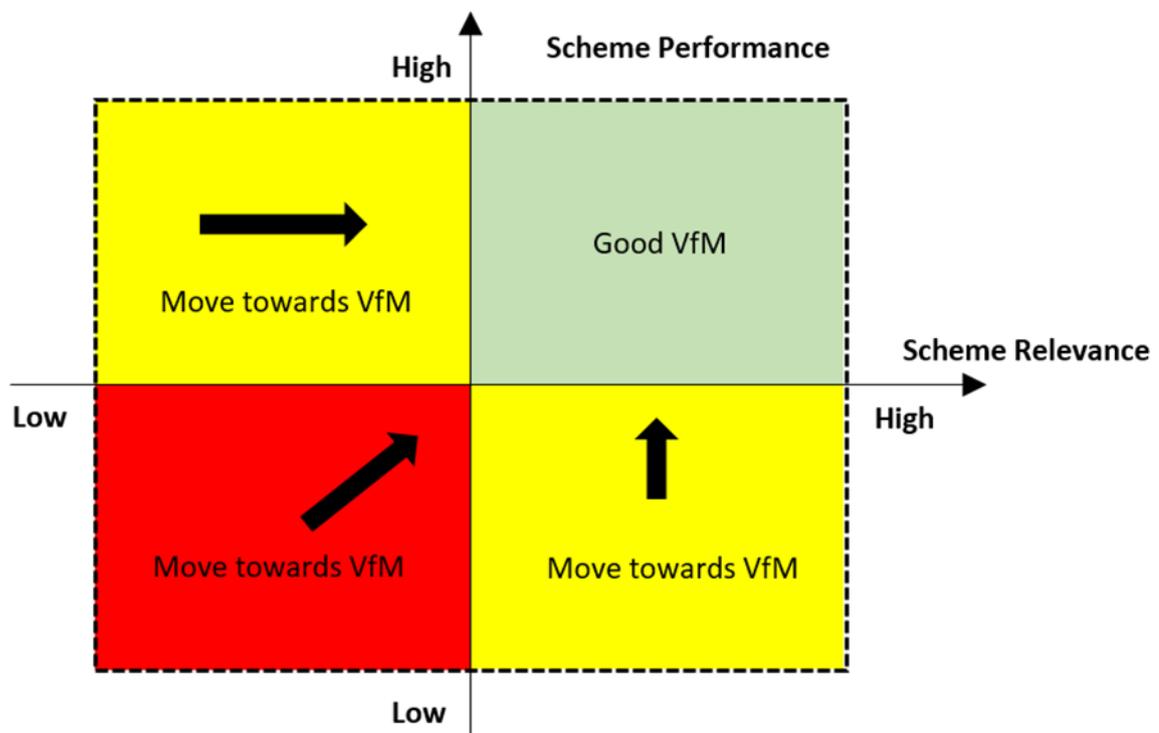
### C1.3.2 The Concept of Value for Money

Value for money (VfM) is a term used to assess whether or not an organisation has obtained the maximum benefit from programmes, projects, or services within the resources available to it.

VfM can be measured using a mix of quality, cost, resource use, fitness for purpose, timeliness, satisfaction of objectives, satisfaction with approved value performance indicators and convenience to judge whether or not, together, they constitute good value for money.

The achievement of value for money may be assessed by considering the following (see **Figure C1**):

- Project Relevance:
  - Express the need for the Project (business objectives).
  - Explain the appropriateness of the Project (location, scope, and design).
- Show consistency of the Project with current government and TII priorities.
- Project performance (Achieving the three Es) .
- **Economy** - careful use and assessment of resources to save expense, time, or effort and adopting management practices that promote economy.
- **Efficiency** - delivering the same level of service, quality and operational requirements for less cost, time, or effort and benchmarking capital costs, cost drivers, and management standards.
- **Effectiveness** - delivering better service, quality, and operational requirements or getting a better return for the same amount of expense, time, or effort and benchmarking outturn costs with targets.



**Figure C1 Assessment of Value for Money**

**Note** Careful judgment is required when assessing whether VfM will be, or was, achieved as at times some of the VfM elements may be subjective, difficult to measure, intangible, and misunderstood.

A Project whose need is clearly stated; satisfies objectives; is in the right location with an optimised design; and is delivered using best practice within **Target Cost**, time and specified performance will generally be accepted as providing VfM.

The CWMF describes Value for Money' as 'the optimum combination of **Whole Life Costs**, quality and affordability that meets the Sponsoring Agency's requirements'.

The above and below approach for assessing VfM is consistent with the CWMF approach for measuring Project success by reviewing whether business objectives, technical requirements and key indicators of cost, time, and quality have been met.

## C1.4 Value Management

Project Managers will manage value on their projects. The recommended approach to **Value Management** can be thought of as having three components as following.

- Value Planning — the incorporation of value enhancing strategies in planned or recommended deliverables and processes at all Project phases.
- Value Engineering – the technical considerations of proposed design solutions with a view to seeking options that enhance value.
- Value Review / Study — an analysis of outputs, performance, and delivery processes to determine whether value was or will be realised. A post-ante review would also involve possible areas for future improvements.

## C1.5 Value Management – Key Value Performance Indicators

To be effective, the identification, assessment and, where appropriate, implementation of value enhancing activities must be carried out in a systematic and structured manner. To this end, key value performance indicators must be documented and monitored consistently to ensure value for money is being achieved throughout the development of the Project.

Key value performance indicators will include the following:

- How value opportunities will be identified and assessed including the identification of the right fora for **Value Management**.
- How value enhancing decisions will be incorporated into the Project.
- Timing of **Value Management** events and Value Engineering Assessments (i.e. meetings; workshops; reviews).
- Rolling schedule of potential issues to be focused upon at each workshop and at each strategic point.

Key value performance indicators (e.g. relating, but not limited, to cost, time, and quality) must be identified for all projects at the outset of Phase 1 and updated as part of the gate review process or when deemed necessary. Preparation of the value performance indicators will be the responsibility of the Project Manager in consultation with the relevant TII Senior Engineering Inspector.

## C1.6 Undertaking Value Management - Practical Application

Project Managers should at all phases utilise all components of **Value Management** (i.e. Value Planning, Value Engineering and Value process review) in their pursuit of achieving Value for Money while meeting required standards, specifications, and regulations.

Their approach should be systematic, documented, and provide a basis for continuously verifying value enhancing decisions taken on the Project.

Key requirements of Project Manager's **Value Management** efforts include:

- Ensuring clarity in the key value performance indicators at different Project phases.

- Ensure that the right fora for planning, assessing, discussing, reviewing, proposing, and managing value are established and utilised.
- Ensuring that the right tools and techniques are proposed and used for carrying out **Value Management** activities.
- Ensuring that **Value Management** is central to all activities or works related to the planning, designing, procurement, construction, and closeout of the Project.

To achieve the maximum benefit from **Value Management**, it should be implemented from the very early stages of Project development, not simply when problems arise.

The following are practical steps for implementing **Value Management** during the course of a Project.

- **Understand the problem** – It is essential that those who are involved in the **Value Management** process understand the scenario being studied and the objective of the **Value Management** process. It is also vital that those involved in the process know and understand the overall project objectives as **Value Management** proposals which undermine the ability to achieve the overall project objectives should not be adopted. The output of this step is a description of what constitutes success for the **Value Management** process. This will be recorded in the Quarterly **Value Management** Summary Reporting. Frequently, workshops may be the best way to collect this information or in the case of value engineering smaller projects, desk studies may suffice.
- **Identify different solutions** - Identifying different solutions to provide the necessary functionality or meet the objectives of the **Value Management** process require creativity and open thinking. Many different techniques can be implemented to achieve this. Whichever technique is used, the emphasis is on generating as many ideas and potential solutions as possible without critiquing or reviewing them at this point. This step normally requires a workshop approach.
- **Evaluate the different solutions** - This takes each of the technical ideas generated and assesses them against the objectives of the **Value Management** process to draw up a shortlist. In some cases, eliminating unsuitable solutions on grounds of cost or feasibility may be very straightforward; other solutions may require more investigation before they can be assessed. The output from this step is a shortlist of potential solutions along with documented evidence for their inclusion or exclusion from the shortlist.
- **Develop the shortlisted solutions in more detail** – At this point the shortlisted solutions are examined in more detail. Typically, this requires additional analysis to understand the pros and cons of each. It should be noted that it would not be an efficient use of resources to analyse all the solutions in this great detail, and it may be that several iterations of shortlisting and more detailed analysis are required.
- **Identify the best solution and make recommendations** - The identified solutions are gradually whittled down to a preferred solution, through one or more rounds of shortlisting. The outcome of this step and of the study as a whole is the description of the preferred solution or solutions.

This will usually be in the form of a report forming part of the Quarterly **Value Management** Summary Reporting that documents the whole **Value Management** process and which may also be recorded in the Option Selection Report and Design Report.

The steps above may be run concurrently as part of a **Value Management** workshop for smaller scale proposals.

The above steps (modified as appropriate) may also be used to assess value engineering proposals submitted during Phase 6 by the Contractor. It is essential that value engineering proposals submitted by the Contractor be measured against the project objectives.

## C1.7 Whole Life Cost

**Whole Life Costing** is the consideration of **Whole Life Costs** and benefits over the period of analysis. Simply put, it assesses the total costs of a project element over its whole life, taking account of the initial capital cost, as well as operational, maintenance, repair, upgrade, social, and environmental costs (sustainability issues), and eventual disposal or recycling cost of the asset. It is necessary to consider **Whole Life Costing** when developing and evaluating different **Value Management** solutions. For example, a solution may satisfy all design criteria at a low capital cost but may have high associated costs in operation / maintenance / etc.

## C1.8 Value Management Tools and Techniques

Various tools and techniques can be used during value planning, value engineering, and value review exercises. Some key tools and techniques for **Value Management** are outlined in this section. These techniques could be categorised as Value Planning, Value Engineering, or Value Review/Study. Project Managers are required to use their broad experience and best practice in conjunction with these tools and techniques to ensure appropriate **Value Management** on their projects.

The following techniques may be adopted to encourage creativity and open thinking, in order to identify different solutions to provide the required functionality, and ultimately achieve the best value. The Project Manager should encourage Project wide team participation in developing and assessing value opportunities. These techniques may be used for the optimisation of design elements and are not a substitute for the formal project appraisal process as set out in the TII Project Appraisal Guidelines. Typical techniques include, but are not limited to:

- Simple brain storming.
- Functional analysis.
- Function analysis system technique (FAST).
- SMART methodology.
- Total Cost Minimisation Functions.
- **Whole Life Cost.**
- Successive Refinement.
- Earthworks Optimisation.
- Value Profiling.
- SCAMPER Technique.
- Departures & Relaxations.
- Technical Meetings.
- **Value Management** Workshops.

### C1.8.1 Functional Analysis

Functional Analysis is a tool used for Value Engineering. It relies on the intended functions of a design element being identified, clarified, understood, and specified.

It then seeks to find options that can satisfy the same function for minimum costs. The primary objective should be to improve quality, performance, reliability, safety, and **Whole Life Costs**.

The search for options should not merely be based on the past and the well trodden path of 'what we have done before'. Design teams should think differently, penetratingly, courageously, and outwards to arrive at design options that satisfy the same primary function at minimum **Whole Life Cost**.

### C1.8.2 Function Analysis System Technique (FAST)

Function Analysis System Technique is a technique to develop a graphical representation showing the logical relationships between the functions of a design element based on the questions "How" and "Why". FAST aids in thinking about the problem objectively and in identifying the scope of the design element by showing the logical relationships between functions. The organisation of the functions into a function-logic, FAST diagram enables participants to identify of all the required functions. The FAST diagram can be used to verify if, and illustrate how, a proposed solution achieves the needs of the design element, and to identify unnecessary, duplicated or missing functions.

### C1.8.3 Simple Multi- Attribute Rating Technique (SMART Methodology)

The technique is widely used to as an aid in design element options selection. The technique has broad application in engineering options decision making. Table C1 gives an example of the Multi-Attribute Rating Technique being used to select a form of earth retaining structure available.

**Table C1 Simple Multi-Attribute Rating Technique for Earth Support Structures**

Criteria	Weighting	Option							
		A - RC wall		B - Bored Pile		C - Sheet Pile		D - Gabions	
		Rank	Weighted Rank	Rank	Weighted Rank	Rank	Weighted Rank	Rank	Weighted Rank
Cost (Most Economical)	8	5	40	2	16	7	56	10	80
Health and Safety	10	4	40	10	100	8	80	4	40
Buildability	4	10	40	7	28	5	20	9	36
Aesthetics	2	10	20	7	14	5	10	8	16
Traffic Disruption	4	2	8	10	40	8	32	2	8
Programme	8	4	32	10	80	8	64	3	24
Score			180		278		262		204

### C1.8.4 Successive Refinement

Design teams should use Successive Refinement, as a value engineering process, to ensure that before decisions that are hard to undo are made, all options that can drive down costs while meeting Project objectives have been carefully considered.

Successive Refinement ensures that design concepts emerge from an iterative process of creating concepts, realising constraints, doing trade-offs, creating possible alternative solutions, increasing clarity (resolution) and choosing optimum solutions.

This approach ensures that design concepts and elements are developed, modified, reassessed, and compared against competing alternatives in a closed loop process that seeks the best choices available.

For example, various highway design concepts and elements can be optimised. Table C2 outlines some parameters or elements that may be considered for optimisation.

**Table C2 Key Value Engineering Opportunities**

Phase	Key Value Engineering Objective	Examples: Particular Value Opportunities
2	Optimum study area identified Optimum option selected.	Study Area (location and extent). Minimise impact on environment & settlements, and Location dependent costs.
2 to 4	Optimised design	Design concept and cross-section Horizontal alignment Location dependent costs. Implications to vertical alignment. Material reusability. Vertical alignment Earthworks balance. Minimise haulage. Structures Size, type, number and skew. Future maintenance requirements. Location dependent costs. Junction strategy Size, type, and number. Location dependent costs. Farm Underpasses Number Required & Location Drainage Size, type, and extent Pavement Pavement type Total area Land take Optimise land take through design To be 'necessary, suitable, and sufficient' Tunnels. Optimise size / type. Length required. Location dependent costs.

Phase	Key Value Engineering Objective	Examples: Particular Value Opportunities
		Safety & Environmental Fences. Optimise need. Buildability. Design for maintenance.
5	Optimised Works requirements Advance works contracts Works proposals	Optimise works requirements. Design for maintenance. Construction commencement timing.
6	Optimum contract administration	Value engineering proposals. Value review of change orders.

**Note:** Cost reductions due to the optimisation of the horizontal alignment are usually significant due to costs associated with land costs which are dependent on land usage, vertical alignment, construction costs, and socioeconomic costs.

### C1.8.5 Earthworks Optimisation

Earthworks optimisation can offer exceptional opportunity for Value Engineering. As earthworks tend to be dominating and sensitive in cost functions, techniques should be developed for optimising earthworks. Earthworks are primarily optimised in order to:

- Work towards cut — fill balancing and minimisation of borrow.
- Minimise haulage (within works and for disposal).

It is important that the Project Manager takes a ‘design process’ approach that seeks to simultaneously optimise vertical and horizontal alignments by considering the implications to earthworks balancing of proposed options. Focusing on cut-fill balance when an option is already fixed offers less flexibility for earthworks management and optimisation.

### C1.8.6 Value Profiling

This technique uses defined assessment criteria to measure improvements in value, including improvements in specified value for money indices. The key value performance indicators can be based on non-monetary benefits such as aesthetics and user satisfaction.

Value profiling is used to help Project Managers define value. The pursuit of value is geared towards the satisfaction of the ‘Client’s’ objectives. This enables the making of value-driven option selection decisions. A ‘Client’ can, for example, place high value on ‘a signature structure’ that may be relatively expensive but is aesthetically pleasing.

Other broad value objectives / indicators could be to reduce traffic conflict/accidents on a junction by achieving where possible a free flow configuration.

The objectives hierarchy for example, which uses diagrams to identify value objectives in a hierarchical manner, is a method of value profiling.

### C1.8.7 Departures & Relaxations

Departures from and relaxations to current standards may be approved by TII where compliance with current TII Publications requirements would result in significant economic cost that would far outweigh the benefits associated with complying with the standards. While the approval of these is discretionary, they may offer an opportunity for value enhancement.

### C1.8.8 Technical Design Review Meetings

Meetings such as Technical Advisors internal design review meetings, Project Supervisor design process review meetings, Client Technical Review meetings, Environmental Review meetings, and Risk Workshops provide additional platforms for **Value Management**.

### C1.8.9 SCAMPER Technique

This technique can be used by Project Managers as an aid to Value Engineering. It relies on focusing on answering questions which have the acronym SCAMPER in a structured way. The questioning or idea generation process is indicated in **Table C5**.

**Table C5 SCAMPER Technique**

S	Substitute	What Project elements can be substituted by something else?
C	Combine	Can two or more elements, ideas or processes be combined to produce a better option?
A	Adapt	How can the nature of an element be changed?
M	Modify	Can the current design or process be modified to produce a better one? If what looks to be a perfect idea is distorted out of shape can new ideas emerge?
P	Put to other purposes	Can more functions or use be assigned to an element?
E	Eliminate	Can parts of the design or elements be eliminated to reduce cost?
R	Rearrange/Reverse	Can the design or process be more effective if done in another way round?

### C1.8.10 Value Management Workshops (Value Analysis / Studies)

Value Analysis Studies and some elements of the **Value Management** tools and techniques outlined in this Appendix can be undertaken in a meeting or workshop set up. Value review/analysis meetings or workshops should be carried out on a continuous basis.

Representation at value review/analysis meetings/workshops should cover the key specialist areas involved in the Project to enable realistic identification of value enhancing opportunities. Core representation will comprise of Sponsoring Agency personnel supported by their Technical Advisors (e.g. covering engineering, property valuation, and archaeology), the TII Regional Manager and Senior Engineering Inspector for the Project, and the Project Manager.

Agendas for workshops shall be tailored to suit the particular phase of a project.

Representation at all **Value Management** workshops should include a degree of independence from the existing Project team involved to enable the effective challenging of the existing approach, objectives, and design.

It is also recommended that an Independent Facilitator be appointed for the main Value Workshop (coinciding with the Risk Workshop during Phase 3) to prepare, manage, and chair the workshops and produce the resultant report. The facilitator could be an individual from an organisation involved at the time with the Project but not involved in day to day management of the Project or a candidate with no connection with the Project.

Key objectives value review meetings/workshops will be to:

- Carry out value analysis/ review of specified components of the Project.
- Identify additional value enhancing opportunities to be explored.

The Project Manager will take on board agreed feasible value enhancing opportunities. Post workshop/meeting the Project Manager should ensure that identified opportunities are fully explored and all feasible ones adopted as necessary. After each meeting/workshop the Project Manager should also ensure that a short report is produced which includes summarised details of the following items:

- How accepted opportunities were/ will be incorporated into the design.
- Additional opportunities to be explored.

**Note:** Value Analysis Study vs. Peer Review

Peer review is a distinct process. Peer review is undertaken to ensure and enhance the adequacy, soundness, completeness, consistency, accuracy, and quality of proposed program and Project phase deliverables. It seeks to solicit senior and specialist input and sometimes to identify better approaches and procedures.

On the other hand, Value Analysis Studies seek to determine or to apply Value Planning, Engineering, or Review to ensure the satisfaction of functional, quality, and specified requirements while optimising resources used. It seeks to generate new ideas, compare and rank options and provide a sound decision basis for adopted options. It is also used to confirm the application of Value Engineering on a project.

### **C1.8.11 Other Techniques Related to Project Management**

- Other techniques available to project teams to enhance value are more generic project management processes identified below:
- Excursion Process — this is a powerful idea generation process that takes team members on an excursion (journey) by making them move away from current solutions to a place where new ideas can be explored.
- Process Mapping — this is used to plot out a process (e.g. design process) so that omissions or overdesign can be eliminated
- SWOT Analysis — identifying the strength, weaknesses, Opportunities and Threats available in a proposed design solution.
- Stakeholder Analysis — identifying stakeholders likely to add value to the project or those likely to have requirements that would reduce value.
- Ishikawa (Fishbone Analysis) — this is a cause and effect diagram that can be used to look at design aspects and issues that would contribute to the non-achievement of value.

- Specification Approach — where possible, seek to avoid very prescriptive specifications and focus on stipulating appropriate performance standards to enable tenderers to consider and identify best value solutions.

## **Appendix D:** Glossary of Terms

**Base Cost (Base Construction Cost)** – The best estimate of the outturn cost of the construction of a project in the form of a point estimate priced at current rates (thus exclusive of inflation provision) and excluding risk contingency. This will typically be based on an Employer design approach with design costs (Employer and Contractor) being accounted for elsewhere.

**Elemental Estimating** – The use of a schedule of works elements to compile a cost estimate using historical rates and prices.

**Exceptional Risk** – A project specific risk that is so significant that if it occurs, it could prevent the achievement of Project Objectives.

**Option Comparison Estimate** – The Option Comparison Estimate or OCE is the total provision at Phase 2 of project delivery inclusive of base cost, project specific risk contingency, TII Programme Risk contingency and Inflation.

**Pricing Document** – The document included within the tender documents prescribing how the tender sum is to be broken down.

**Programme Risk** – See TII Programme Risk.

**Project Specific Risk Contingency** – See Risk Contingency. This term can be used to emphasise that the contingency in question is related to a specific project.

**Qualitative Risk Analysis** (as opposed to Assessment) – Non-quantitative identification, categorising and ranking of risks using a simple probability-impact (Pxl) matrix resulting in risk identification and an understanding of the likely consequences of occurrence.

**Quantitative Risk Analysis** – Risk identification and quantification of the likely impacts on cost and time including a numerical analysis of the overall effect of risk on project objectives leading to the identification of the likely costs associated with risks identified (i.e. the Project Specific Risk Contingency). A quantified probability impact (Pxl) matrix may be utilised for this task.

**Reference Class Forecasting** - Reference Class Forecasting is an established method to address the root causes of cost and schedule overrun in projects. These root causes, including optimism bias and strategic misrepresentation, can lead to underestimations of projects' costs, benefits and schedules, which later results in overruns.

**Risk** – Risk is the possibility of an uncertain event or condition occurring which, if it occurs, will have a discernible effect on one or more defined project objectives.

**Risk Analysis** – Risk analysis is the identification and assessment of factors that have the possibility to affect the achievement of project objectives.

**Risk Contingency** – Risk Contingency is an allowance for risk specific to a particular project. The allowance is typically monetary but can also deal with delay. Project Specific Risk Contingency excludes Programme Risk.

**Risk Identification** – Risk identification is the discovery, describing, documenting and communicating of project risks.

**Risk Management** – A systematic approach to risk identification; analysis; response formulation; monitoring and control through all phases of project development aimed at managing and minimising exposure to risk in a controlled fashion.

**Risk Management Strategy (RMS)** – A pre-determined, well defined and documented systematic approach to risk management to apply at all phases of project development. The strategy toward Risk Management is to be detailed within the Project Execution Plan.

**Risk Response Strategies** – Risk response strategies are the approaches that can be adopted to deal with a risk once identified. The response strategy whether mitigation, acceptance, avoidance or transfer will be dictated by the tolerance of the organisation to accept and manage the risk.

**Project** – The construction of a section of TII funded roads infrastructure at all stages of project delivery from Phase 1 to Phase 7.

**Project Cost** – Project cost is the base cost plus contingency and inflation allowances required to plan, manage and deliver a section of TII funded roads infrastructure.

**Sensitivity Analysis** – The analysis of project risks to compare the potential impact of a range of variables (i.e. risks) on project objectives thus assisting in the identification and prioritisation of risk response strategies.

**Strategic Risk** – Risk that is not project specific and does not constitute a Programme or Exceptional Risk.

**Target Cost** – The Target Cost or TC is the provision from Phases 3 to 7 of project delivery inclusive of base cost and project specific risk contingency only.

**TII Programme Risk** – TII Programme Risk or 'TII Risk' is risk that would affect a portfolio of projects (programme) if it occurs. They are generally high value, low probability risks and are excluded when quantifying project specific risk contingency. Provision for TII Programme Risk is assessed and included for in the total provisions by TII. TII Risk also includes Strategic and Exceptional Risks.

**Total Scheme Budget** – The Total Scheme Budget or TSB is the total provision from phases 3 to 7 of project delivery inclusive of base cost, project specific risk contingency, TII Programme Risk contingency and Inflation.

**Unit Cost Estimating** – As a project progresses through the phases of development, additional information is produced which allows the breakdown of work elements into their constituent works items and the identification of the quantities of these items required to construct the works element. Unit Rates are applied to these quantities to produce the base cost estimate.

**Value Management** – A systematic approach to the identification; assessment and where appropriate implementation of value enhancement activities and opportunities through all phases of project development aimed at increasing value for money and improving organisational learning.

It is important to clearly differentiate between **Value Management** at a project level and **Value Management** at sub project level. At a project level, **Value Management** is carried out using the project appraisal processes identified in the TII Project Appraisal Guidelines. Objectives for the overall project, whole life cost for the project, etc. will all be developed in accordance with the Project Appraisal Guidelines.

**Value Management Strategy** – A pre-determined, well defined and documented systematic approach to value management to apply at all phases of project development. The strategy toward Value Management is to be detailed within the Project Execution Plan.

**Whole Life Costs** – The total cost of delivering a project including the capital cost of constructing the project (including all ancillary costs) and the costs of operating and maintaining the project over its useful life.





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