Intelligent Transport System Life Cycle

Transport Roads & Maritime Services

Procedural Guideline | **ILC-ITS-TP0-001-G01**

Purpose

This document provides guidance on the development, implementation, finalisation and asset management (the life cycle) of Intelligent Transport System (hereinafter referred to as ITS).

This guideline is limited to the project activities that take place after a project is initiated. ITS project initiation is an outcome from network planning and management. It may be a response to government directives and be legislative, regulatory or policy related. Ultimately, the initiation of an ITS project is directed at improving network operations and management and/or road safety through variable messaging.

Scope

This document covers the processes employed for ITS development, implementation, finalisation and asset maintenance. It supports the ITS Pack procedures.

Overview

Infrastructure projects managed within Roads and Maritime Services are managed in accordance with either ProjectPack or MinorProject. Both management systems have a common basis, with the procedures of MinorProject applicable to relatively uncomplicated projects costing (nominally) less than $10 million. ProjectPack procedures are applicable to more costly and/or complex projects.

Typically, an ITS project will be delivered using the procedures of MinorProject. Given that both ProjectPack and MinorProject were developed for road construction projects, some of the processes will not be directly relevant to either Intelligent Transport Systems (ITS) projects in general or ITS projects specifically. To cover this situation, ITS Pack has been developed as a supplementary package of guidelines, procedures and other documents to cover the ITS-specific aspects of project management. ITS Pack is designed to work in conjunction with both MinorProject and ProjectPack to equip the Project Manager with the tools needed to effectively deliver ITS projects.

Note: For purposes of clarity, only those references directly pertaining to ITS policy and technology are listed within this document. General information on project management subjects is thoroughly covered by MinorProject and ProjectPack.

Click below to link to either suite:

- Minor Project
- ProjectPack

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1. Phases of an ITS project

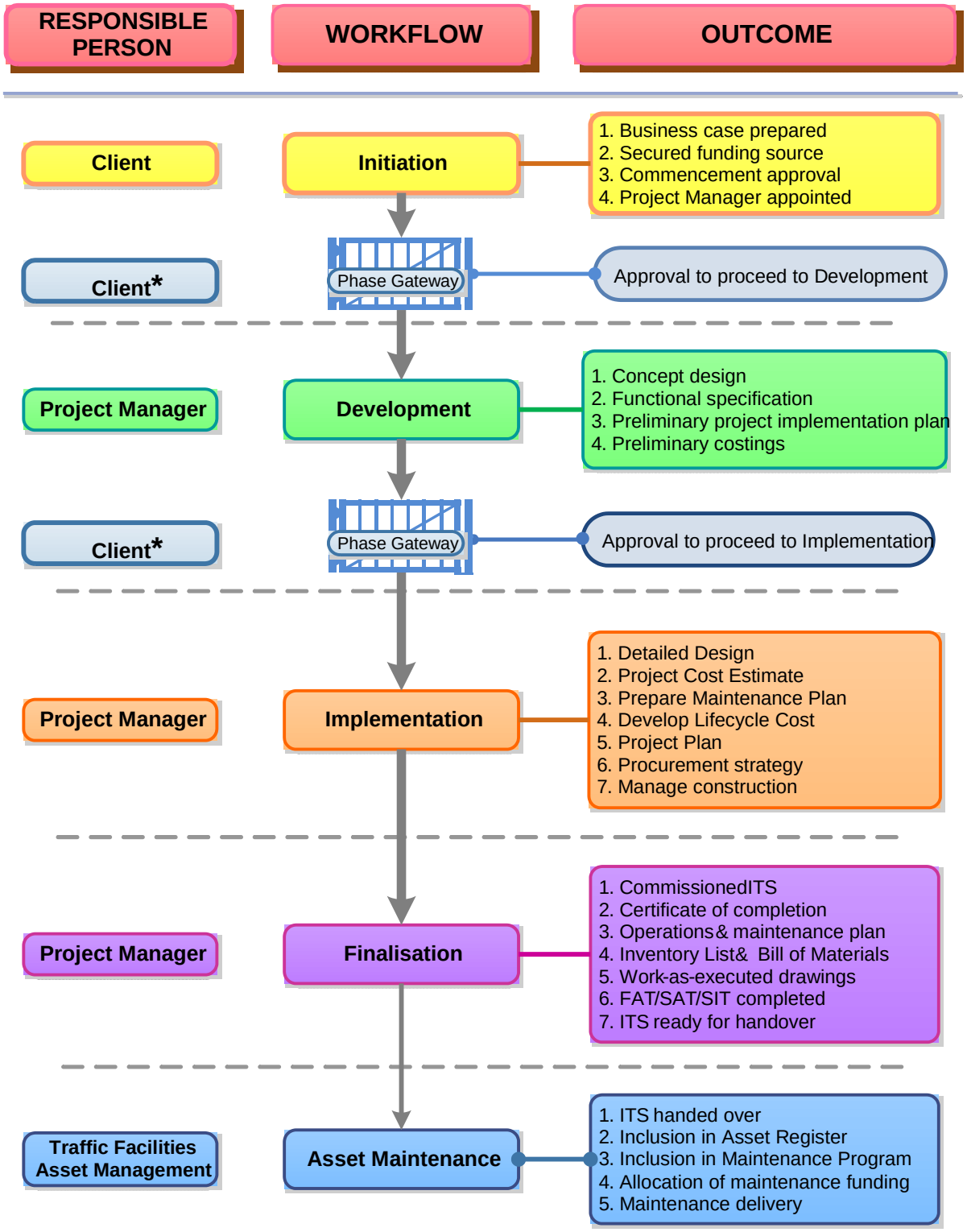

Figure 1. ITS Project Phases

*** Client to meet requirements of TfNSW Investment Gating and Assurance guidelines, for all Growth and Improvement projects**

2. Documents (and their hierarchy) relating to ITS projects

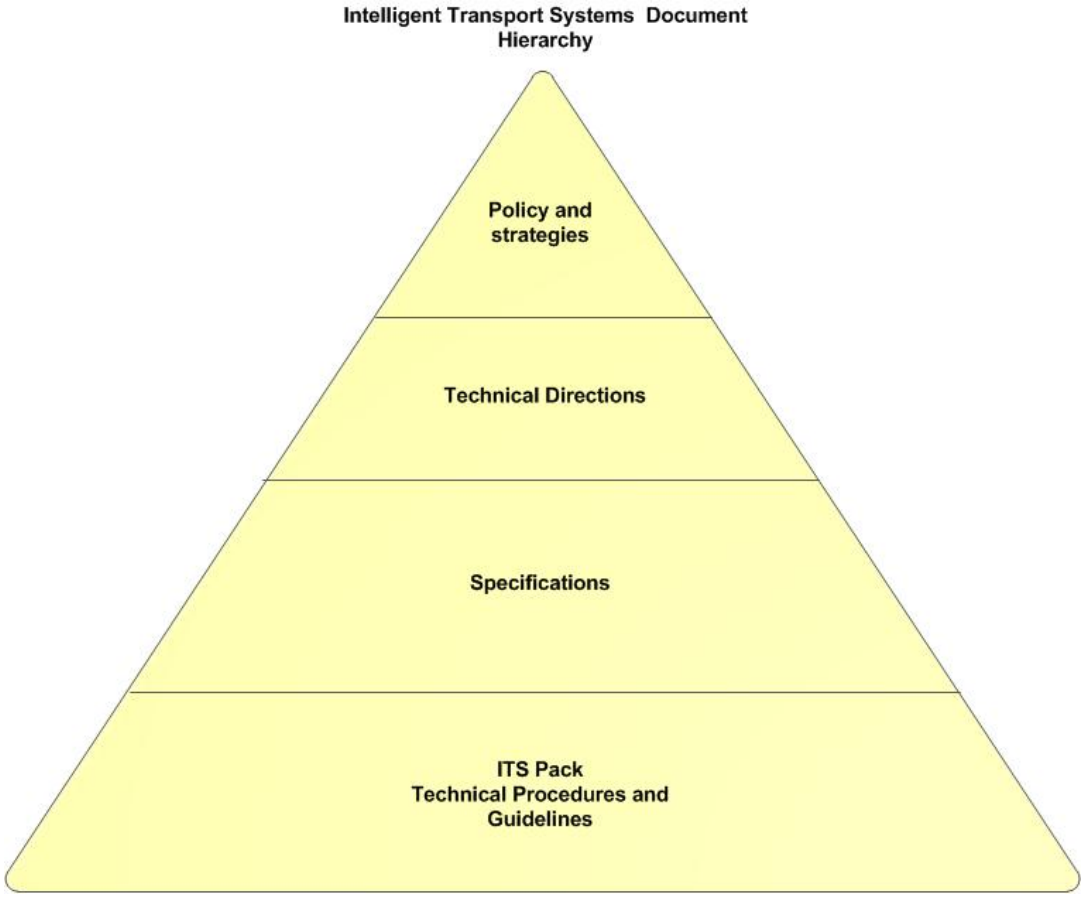

Figure 2. ITS Documents Hierarchy

3. The Initiation Phase

The Initiation Phase is the responsibility of the client. This is where the network is managed, where traffic and safety issues are evaluated and strategies considered. Ultimately, in response to Journey Management objectives and needs, a project strategy will be developed. A business case is prepared if the project falls under the TfNSW Growth and Improvement portfolio.

Given the rapidly evolving nature of ITS around the world, the Client must also remain abreast of new developments in the field, both in terms of technology and application. New products and systems are constantly being introduced to the market and it falls to the Client to determine the applicability of innovative ideas to the Roads and Maritime Services network.

From a project management perspective, the process begins with the Client gaining funding for a project proposal to enter the development phase. Development of a project allows closer evaluation of design options and costs prior to committing to implementation.

4. Development Phase

4.1 ITS Projects

In general, unlike road construction projects that employ well proven technologies and techniques, ITS projects are affected by the evolution of technology. The impact of changing technology can affect both performance and cost. There is a need for the Project Development Managers to work closely with Clients to ensure selection of appropriate and preferred options.

The Austroads Guide to Traffic Management series is the primary guide for NSW when assessing the requirements for traffic efficiency and safety. Other guides such as Roads and Maritime Technical Directions and specifications may be referred to in situations where specific guidance is not provided by Austroads.

4.2 Prerequisites for Development of a ITS Project

From the Initiation phase, it can be expected that:

- A Strategy or plan has been developed that determines the broad ITS locations considered.
- A business case (including problem definition, need analysis, operational objectives, proposed sites, economic evaluation) has been prepared.
- Approval to commence the Development phase has been gained.
- Funding for development has been secured.
- A Project Development Manager has been appointed.

4.3 Activities

The Project Development Manager (PDM) is responsible for all activities of the Development phase, including but not necessarily limited to:

- Ensuring that an agreed project brief has been prepared.
- The developing a concept design and functional specification.
- Confirming (in conjunction with the Client) that the likely project cost or complexity justifies managing the project as a minor project using MinorProject procedures (i.e.< $10 million / not complex).
- Commencing a Project Management Plan.
- Preparing a Concept Estimate of costs and negotiating with the Client on cost variations.
- Preparing a risk management plan.
- Preparing an assessment of environmental impact.
- Managing urban design.
- Preparing a WHS plan.
- Actioning a Road Safety audit.
- Commencing any property acquisition or adjustment process.
- Preparing a community involvement plan (as required).

4.4 Concept Design

The PDM has overall responsibility for the preparation of the:

- Concept Design
- Functional Specification
- Cost Estimate

Maintaining close liaison with the Client is important during this phase as decisions on location, technology and systems integration will impact on the budgeted cost.

The PDM is responsible for the preparation of a design management plan that identifies the deliverables, review requirements and hold points. During development and evaluation, the concept design must take into account the aspects listed in paragraphs 4.4.1 to 4.4.8 (following), as well as the Evaluation Criteria listed in 4.5 Table 1.

The PDM is responsible for managing the nomination of an appropriate discipline champion for each area of the concept design. For example, Road Safety aspects must be approved by a Road Safety representative, ITS Technical requirements must be approved by the ITS Principal in consultation with the Client and ITS asset life cycle requirements by an Asset Strategy representative.

4.4.1 Location and Equipment Type

When preparing the concept design, the location and type of the proposed ITS and other aspects of particular concern during implementation must be properly assessed and selected, in particular:

- The concept design must be in accordance with the specification TSI-SP-035 – General Requirements for Variable Message Signs.
- The location must meet the requirements outlined in the 'Austroads Guide to Traffic Management Part
- 10: Traffic Control and Communications Devices'
  The design must satisfy the primary traffic management function.
- When selecting the ITS type; approach speed and legibility distance requirement must be taken into account.

Note: For ITS projects; the location and placement assessment should be undertaken by the regional Road Safety & Traffic Management section.

4.4.2 Cyclist and Pedestrian Safety

The Concept Design should, as far as possible, ensure that any adverse impacts are minimised, on existing pedestrian and cycling facilities or other public amenity located near the proposed ITS location. Flexible design and implementation processes may be employed to allow for unusual ITS site conditions.

As an example, the ITS installation must consider the recommended lateral clearance widths detailed in 'Cycling Aspects of Austroads Guides'.

4.4.3 Environmental Factors

A Review of Environmental Factors (for minor projects) or an Environmental Assessment (for major projects) of the proposed ITS site must be carried out in accordance with Roads and Maritime environmental guidelines. The assessment must examine all matters affecting or likely to affect the environment surrounding the proposed ITS development.

The outcome of the environmental assessment may affect the site selection and require consideration of an alternative location for the proposed ITS.

4.4.4 Economic Evaluation

Economic evaluation of ITS projects carried out by the PDM in cooperation with the Client must be conducted in accordance with the 'Economic Analysis Manual'. It must cover (but not be limited to) the following parameters:

- Capital Expenditure (CAPEX)
- Operational and maintenance Expenditure (OPEX)

An economic evaluation report must be prepared detailing the project Benefit Cost Ratio (BCR) and Net Present Value (NPV). The technical direction "Economic Analysis of Variable Message Signs" outlines the economic evaluation procedure. A 'Sensitivity Analysis' must be conducted to assess the impact of uncertainties in the above estimations.

4.4.5 Options

Roads and Maritime is committed to analysing a full range of options to achieve the optimum value-for-money solution. Alternative options should be considered during the Development Phase particularly in respect of design consistency across urban, rural and regional Australia.

4.4.6 Cost Estimation

Cost estimation must be carried out in accordance with the Project Estimating Manual. For value management information refer to the Roads and Maritime Value Management Guidelines.

4.4.7 Life Cycle Costing (LCC)

A LCC must be calculated for each ITS project in accordance with the Life Cycle Costing Guidelines.

4.4.8 Road Safety Audits

Road safety audits are an integral component of the safe system approach. A road safety audit must be conducted for each ITS site and undertaken in accordance with the Policy for road safety audits of construction and reconstruction projects. The PDM is responsible for ensuring that any Corrective Actions Requests raised during the audit process are closed out at each stage of the project.

4.5 Development Evaluation Criteria and Deliverable Documentation

Table 1. Evaluation Criteria for Development outcomes

Criterion	Considerations	Benchmark
Community Engagement	Refer to community engagement and consultation policy PN 095P	Impacts eliminated or minimised so far as reasonably practical
Environmental Impacts	Refer 'EIA-P05-2' Environmental assessment procedure – Project review of environmental factors.	Impacts eliminated or minimised so far as reasonably practical
Traffic and Safety Management	Optimal location of the ITS, maximising traffic efficiency and safety	Refer to Austroads Guide to Traffic Management Part 10, Austroads Report: Freeway Design Parameters for Fully Managed Operations (AP- R341/09)
	Access changes (public and Roads and Maritime staff)	Impacts eliminated or minimised so far as reasonably practical
Safety	WHS	Road users are not subject to elevated risk from placement or use of the ITS
	Road safety	Road Safety Audits undertaken and CARs are closed out
Services Adjustment	Associated cost of adjustment to Roads and Maritime and other utilities' underground or aboveground services	Less than 7% of CAPEX
Cost Estimation	CAPEX and OPEX	P 90 Probabilistic Cost
Power Supply	Establishment cost Reliability	Less than 5% of CAPEX. Reticulated mains power supply, preferred
Communications	Establishment cost	Less than 3% of CAPEX
Economic Evaluation	Benefit Cost Ratio.	BCR >1
	Net Present Value	NPV Positive
	Sensitivity Analysis	Varying key variables by ± 20% to get the best and worst case results
	CAPEX and OPEX forecasts	OPEX/CAPEX < 0.1

Note: If the evaluation indicates that one or more of the criteria is not met, the Project Manager must contact the Manager Asset Strategy, Network Optimization Journey Management Division and seek direction.

Hold Point: Approval of the 'Concept Development Report' is considered a Hold Point. The PDM will proceed to the next phase once the Concept Development Report is approved and funding has been secured for the Implementation Phase.

Table 2. Deliverable documentation from the Development phase

Accountable Person	Document/Activity
Project Development Manager	Concept Development Report; Summarises all key undertakings including the criteria listed in Table 1, (considered options, preferred option(s), risk assessment, concept of design/general site layout, costs, reliability & maintainability, research reports, reasoning and recommendations)
Client	Approval of the Concept Development Report and funding profile for the program/project
Project Development Manager	All project artefacts as evidence of delivery from this phase, retained in accordance with organisational policy
Journey Management	ITS location and Type Selection report
Environment Section	Review of Environmental Factors (REF)
PM in consultation with Finance	Economic and Financial Evaluation/Capex and Opex
Road Safety Auditor	Road Safety Audit report(s)
PM	Work Health & Safety plan & report(s)
PM	Site Safety: Motorist, Pedestrian, Cyclist report(s)
PM in consultation with Infrastructure Communication	Community Engagement plan and report(s)
PM	Utility assessment and relocations report(s)
PM	Geo Technical Assessments and report(s)
PM in consultation with TFAM	Life Cycle Costing of delivered assets
TFAM	Maintainability report of delivered assets.

4.6 References Covering Development

Austroads Guides:

Roads and Maritime Services References - General
TSI-SP-008 – General Requirements for VMS'
TDT 2011/05 – Approval process for alternative/new technologies for traffic assets
PMO-EST-UG-001 – Project Estimating manual
RMS Economic Analysis Manual
TD2003/RS03 – Policy for road safety audits of construction and reconstruction projects
TAM04-10 – Life Cycle Costing Guideline' http://www.treasury.nsw.gov.au/__data/assets/pdf_file/0005/5099/life_cycle_costings.pdf
'EIA-P05-2' Environmental Assessment Procedure – Project Review of Environmental Factors'
ILC-GEN-TP0-901 : Asset Acceptance

5. Implementation Phase

5.1 Prerequisites

The PM (Implementation) must ensure all Development phase requirements have been met prior to commencing Implementation activity.

5.2 Activities

The PM (Implementation) must complete the Implementation phase tasks following:

- Action the detailed design
- Update the project plan
- Commence property acquisition or adjustment (if required)
- Develop and manage any necessary utility adjustments Review Life Cycle Costing
- Carry out the procurement process
- Manage WHS requirements
- Conduct any required community management/engagement
- Manage construction
- Prepare a maintenance plan including test specifications in conjunction with TFAM and the Client
- Manage the integration of the project into traffic management and control systems
- Manage the Acceptance Testing regime (FAT, SAT, SIT)
- Ensure operational readiness.

5.3 Detailed Design

The detailed design is based on a selected option from the concept design package that was agreed with the Client.

Technical compliance of the detailed design must be assessed and approved by the ITS Principal in consultation with Manager Traffic facilities Assets.

The ITS structural design and site installation drawings will be developed by the Bridge & Structural Engineering Section /external Engineering consultants and will be approved by the Principal Bridge & Structures Engineer. The design for the site civil works including the maintenance bays will be approved by Principal Road Design Engineer.

5.3.1 Maintenance Plan and Specifications

The PM must prepare a maintenance plan, in consultation with Traffic Facilities Maintenance Planner, (TFMP) that includes:

- Factory test plans
- Field level tests
- Maintenance specifications.
- Routine (preventative) maintenance activities. Refer R300 for Routine maintenance specifications on various types of ITS.

Maintenance planning must use standard analysis/test methodologies such as Reliability Centred Maintenance – Failure Modes Effects and Criticality Analysis (FMECA).

5.3.2 Utilities Adjustment

Impacts on existing utilities in the ITS vicinity must be identified and action plans developed.

It is imperative that all utilities adjustments or new service establishment be addressed early in the development phase to avoid delays and unforeseen costs during the ITS implementation.

5.3.3 Integration into the Traffic management and control system

To maximise the value of a ITS provision, the ITS are typically integrated into traffic management control systems such as the Central Management Computer System (CMCS) used by the Transport Management Centre or equivalent. This functionality must be verified by the Project Manager.

5.3.4 Updating the Project Plan

The preliminary project plan must be updated with the following:

- Scope of work
- Project schedule and allocated resources
- Risk management plan
- Work Health & Safety Plan
- Commissioning, handover Asset acceptance requirements
- Detailed Cost Estimation for Capex/Opex to P90 (±10% of Development Phase cost).

Hold Point: If the estimated cost of the project deviates from ±10% of Development Phase cost then the Project Manager must report to the Client and seek direction.

5.4 Project Implementation Report

A ITS's final layout and design including maintenance (where required), power and communications must be approved in consultation with the Network Optimization branch, Journey Management.

Maintenance specifications must be prepared in consultation with TFAM once the detailed design has been finalised. Asset acceptance requirements are to be specified for compliance.

The project implementation report must be approved by the Client and the location(s) concurred with by the Regional Traffic Manager to:

- Ensure consistency of the design, installation and maintenance methods
- Apply experience gained from previous projects
- Ensure it is incorporated into operational plans, where appropriate.

The Regional Network & Safety Managers in regions approve locations.

Hold Point: Approval of the 'Project Implementation Report' is considered a Hold Point. The PM may only proceed to 'Procurement' once the Project Implementation Report is approved.

5.5 Procurement

The procurement of ITS devices must be managed in accordance with the principles defined by the Roads and Maritime Engineering Contracts Manual. A procurement strategy should be selected in consideration of the past performance of service providers, installers and contractors relative to the functional compliance required of the proposed system. Refer to the listed references for guidance.

5.6 Operational readiness

Once an approximate delivery date is known, the PM must notify the relevant regional "Roads and Maritime Services Traffic Manager" and the Manager Traffic Operations, TMC, and Manager TMC Systems to enable planning for network operations when commissioned.

Table 3. Deliverable documentation for the Implementation phase

Accountable Person	Document/Activity
Project Manager	Project Implementation Report: Summary of all deliverables in Implementation Phase
Client	Approves the Project Implementation Report and funds the project
Project Manager	All project artefacts from this phase (including maintenance & test plans and specifications, FMECA, utility adjustment action plan), kept in accordance with organisational policy
Principal Structures Engineer	Structural Design for ITS structure
Design Manager (Road)	Civil Works including Maintenance Bays

5.7 References covering Implementation

General Roads and Maritime Services References:
RMS Engineering Contracts Manual Sections 5 and 6
RMS Delegations Manual
NSW and RMS Purchasing Delegations
01PR0720 IM&IT Procurement Process – Assessment of Tenders
01PR0725 IM&IT Procurement Process – Methodology for Evaluating Contract Compliance
RMS Evaluation of Tenders Template
ILC-GEN-TP0-901: Asset Acceptance
TSI-SP-035 General Requirements for Design, Installation, Commissioning and Maintenance of VMS.

6. Finalisation Phase

In accordance with the test plan developed at the detailed design stage, at least the following tests/audits must be carried out.

- Factory Acceptance Tests (FAT) – Hold point to be cleared.
- Site Acceptance Tests (SAT) – Hold point to be cleared.
- System Integration Tests (SIT) – Hold point to be cleared; after integration into Traffic management and control systems such as CMCS is carried out successfully.
- Road Safety Audit – Hold point to be cleared.
- Asset acceptance requirements – Hold point to be cleared.

Project Manager represents the Client and will organize and schedule the FAT, SAT and SIT.

Representative of Traffic Systems Application (TSA) will be responsible for witnessing the FAT at the OEM facility. Any defects will be rectified prior to FAT sign–off. A FAT sign-off will allow the device/system to leave the facility for installation at site. TSA will release the hold-point.

After installation, a SAT is performed at site to determine that the devices(s)/system(s) are performing as specified. The SAT will be witnessed by representatives of the PM, TSA and Traffic Facilities Maintenance Planner (TFMP). Discrepancies if any will be noted and will be rectified by the manufacturer within the defect's liability period of the device/system, which is normally one year. TFMP & TSA will release the hold-point.

A SIT is not required if the device/system is not to be integrated into a TMC system. A SIT is required to integrate the device/system with the TMC or any other parent management system and will be witnessed by a TSA, TMC and PM representative. A list of discrepancies from SIT should be added to the list of SAT discrepancies. After analysis and rectification, TSA, TMC and PM will clear the device/system for operation on the road network, if remaining discrepancies do not affect operations and the safety audit does not find the device/system unsafe.

Once the device/system is cleared for operations it will be deemed commissioned. The date of commissioning will be the start date of the defects liability period (DLP) and subsequent maintenance.

Responsibility matrix for FAT, SAT and SIT is given below;

Table 4. Responsibility Matrix for testing in the Finalisation phase

Test	Test Set-up	Test Carried out by	Test Witnessed by	Hold point cleared by	Inform
FAT	OEM/ PM	OEM and TSA	PM and TSA	TSA	PM, OEM, TFMP
SAT	PM	OEM and Project Team	PM, TFMP and TSA	TSA in consultation with TFMP	PM, OEM, TFMP
SIT	PM	TSA, TMC (if applicable)	PM, TSA, TMC	TSA in consultation with TMC	PM, TFMP, TMC

The PM is responsible to clear all residual discrepancies within 3 months of the date of commissioning and start of DLP.

To provide opportunities for improvement in the procurement and deployment of ITSs, records of specific problems, issues and resolutions encountered during the project must shared as 'Lessons Learnt', as a project review.

The PM shall provide all artefacts such as; bill of materials, maintenance plans, WAE plans, functional and electrical drawings, structural drawings, site layout drawings, cable plans, test results, certifications, approvals and audits. These artefacts and others specifically required for the project are to be handed over to the Traffic Facilities Maintenance Planner (TFMP) as part of the handover process for the ITS. The Handover process must be completed in accordance with Asset Acceptance Requirements.

Table 5. Deliverable documentation for the Finalisation phase

Accountable Person	Document/Activity
Project Manager	All project handover artefacts from this phase are kept in accordance with organisational policy. A copy of handover artefacts will be provided to the TFMP at the time of commissioning.
ITS TEST Engineer, TSA	Signed-off FAT report
ITS TEST Engineer, TSA	Signed-off SAT report
ITS TEST Engineer, TSA	Signed-off SIT report
Road Safety Auditor	Cleared Audit Report

6.1 References covering Implementation

Documents:
Asset Acceptance : ILC-GEN-TP0-901

7. Asset Maintenance

In addition to the Maintenance Plan and maintenance specifications developed during the detailed design phase, the Project Manager is expected to include the following:

- Funding scenarios and the funder/maintainer identified.
- Guidance on cost associated with maintenance tasks.
- Reference to manufacturer's literature.

7.1 Response times

The Maintenance Plan must include a Fault Management procedure that identifies persons and numbers to be contacted in case of failure.

Relevant ITS Maintenance Specifications under R300 (ITS Maintenance Services-General Requirements) must be followed for callout response times.

7.2 Upgrade / Renewal

TFMP determines ITS upgrades, refurbishment, disposal or end of life renewal or replacement by referring to the ITS Asset Database for historical data of ITS faults and upgrades. Considerations for upgrade or renewal include, but may not be limited to:

- Nearing end of design life
- Physical condition has deteriorated
- Device lacks performance and has chronic faults
- Spares support for service life is doubtful
- Change is due to operational priorities
- Maintenance and power costs are high
- End of economic life.
- No further purpose served.

Authorisation to modify existing ITS units on public and private roads shall be obtained from TFAM.

Table 6. Deliverable documentation for the Asset Maintenance phase

Accountable Person	Document/Activity
Project Manager	All project artefacts from this phase (including maintenance plan and maintenance specifications). A copy of these documents will be provided to TFMP
Traffic Facilities Maintenance Planner	ITS taken over and all documents pertaining to taking over kept in accordance with organisational policy
Traffic Facilities Maintenance Planner	ITS listed on maintenance register and maintenance program for on going callouts and routine maintenance
Traffic Facilities Maintenance Planner	Develop ITS Upgrade and Replacement Plan

8. Definitions

Term	Definitions
BCR	Cost Benefit Ratio
CAR	Corrective Action Request
Client	The entity for whom project managers are delivering a ITS installation. Generally the Traffic Facilities Asset Management section
Client's Representative	A delegated officer of the project funder. May also include officer(s) from Traffic Management or Road Safety having an authorising interest in the project.
CMCS	Central Management Computer System
EIA	Environmental Impact Assessment
Factory	Premises occupied by the equipment supplier for the manufacture, integration and/or testing of the equipment to be installed
FAT	Factory Acceptance tests
ILC	Infrastructure Life Cycle
ITS	Intelligent Transport System
LCC	Life Cycle Cost
NPV	Net Present Value
PDM	Project Development Manager (see PM)
PIM	Project Implementation Manager (see PM)
PM	Project Manager
PIP	Project Implementation Plan; this is analogous to Project Plan

Term	Definitions
REF	Review of Environmental Factors
RMS	Roads and Maritime Services
SAT	Site Acceptance Tests
SIT	System Integration Tests
IST	ITS Standards and Technologies
ITS	Intelligent Transport System
TFAM	Traffic Facility Asset Management
TFMP	Traffic Facilities Maintenance Planner
TMC	Transport Management Centre
TMCS	Traffic Management Control System
VMS	Permanent Variable Message Sign
WHS	Work Health and Safety
WAE	Work as executed

9. About this release

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Issue 4	February 2015	Reviewed and updated to reflect organisational changes, document number changed from ILC-ITS-M-001-G01 to ILC-ITS-TP0-001-G01
Issue 3	November 2013	Updated title and added policy number
Issue 2	September 2013	Updated Pyramid Graph
Issue 1	July 2013	Initial Release

Note: The issue date is normally considered to be the date on which a document is authorised or signed off. Under the ILC Management System, authorisation is indicated by the signature of the authorising manager on the document register. For simplicity then, the date of writing or revising a document is used as the issue date.

This document is published under the Infrastructure Life Cycle Management System and is subject to review and continual improvement. The current version of this procedure is that published on the Roads and Maritime Services intranet.

Note: The Infrastructure Lifecycle Management System complies with the requirements of the ISO9001 standard. This standard is revised every four years (2008, 2012, 2016). While system procedures within the ILC Management System are revised as necessary, to meet any changed requirements of the standard, references within the procedures refer only to ISO9001.

It should be confidently assumed by users that the term ISO9001 within a procedure refers to the most current version of the standard.

HAVE YOUR SAY!

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