

# **A NOVEL APPROACH FOR AN INTEGRATED FRAMEWORK FOR ROAD SYSTEM MANAGEMENT IN AN AUSTRALIAN ROAD AGENCY**

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## **ABSTRACT**

This paper presents a "new way of doing business" for a large public sector road agency in Australia. The new approach involves an integrated framework for road system asset management, known in the Queensland Department of Main Roads (QDMR) as the Road System Manager (RSM) Framework.

The stewardship practices in QDMR, as a decentralized agency, have led over the years to inconsistencies in work practices and standards, funding allocations, and road system performance. Investment decisions were often based on local assessment of needs and priorities, and historical regional funding levels that did not necessarily reflect true needs.

This has led to real and potential inefficiencies in delivering its road system management achievements.

Responding to these systematic issues, QDMR has adopted radical improvements comprising integrated road system management, which is underpinned by the principle of sound forward planning of road system investments and delivery of system preservation and improvements according to a consistent state-wide approach to identifying and prioritising investment needs.

This new approach – the Road System Manager Framework – has required considerable organisational effort. The changes have necessitated considerable investment of time and costs into business process re-engineering, review of business system support arrangements, and management of cultural change.

## **1. INTRODUCTION**

This paper presents a "new way of doing business" for a large public sector road agency in Australia responsible for the stewardship of public infrastructure assets valued in 2006 at AUD30.4 billion. The new approach involves an integrated framework for road system asset management, known in the Queensland Department of Main Roads (QDMR) as the Road System Manager (RSM) Framework.

The state of Queensland occupies almost a quarter of the Australian continent, and has an estimated gross state product (2004-05) of AUD158 billion, 17.8% of Australia's gross domestic product. The state population is over 4 million. Approximately 20% of Australia's vehicle fleet is registered in Queensland[1].

The Queensland road system is 182,000km including state-controlled roads and local government roads. QDMR manages the state-controlled network of almost 34,000 km. Currently the planned investment in providing, maintaining and operating the state-

controlled road system over the next five years is \$11.5 billion, an increase of around 10% over the previous year's rolling forward program of works[4].

## 2. BACKGROUND

QDMR is a strongly decentralised road agency, with a corporate office based in the state capital, Brisbane, and 14 district offices across the state, managing regional delivery of the program of works and road system operations.

Historically, QDMR has operated within a road system planning and delivery framework with the following characteristics.

- *Future Vision* – The expectations of the Queensland community, the outlook for road infrastructure and operations services to be provided by QDMR, and the key outcome areas driving future road system planning are set out in a published, publicly available document Roads Connecting Queenslanders (RCQ)[2].
- *Road Network Planning* – For the last decade, the forward intentions for development and preservation of the State Controlled Network have been directed by a set of Road Network Investment Strategies (internal QDMR documents), complemented by other public documents: the Integrated Transport Planning Framework (ITPF)[3] and various integrated regional transport plans for specific regional economic areas.
- *Five Year Rolling Works Program* – The forward works program for road infrastructure and operations, the Roads Implementation Program (RIP)[4] is published in the public domain each year, and provides details of significant construction and maintenance projects, and other bulk works programs (mainly maintenance and transport operations) categorised by local government area across the state.
- *Project Delivery* – Management of delivery operations (design, construction, maintenance, network operations) occurs in 14 decentralised districts across the state. All work is delivered by contract, utilising a variety of contract forms (road construction contracts, design and construct contracts, alliance contracts, partnering contracts, build-own-operate franchise agreements, road maintenance performance contracts and others). The QDMR policy is to support three viable sectors in the road industry – private sector contractors, a QDMR commercial group RoadTek, and local authority workforces.
- *Performance Assessment* – The physical, operational and financial performance of road and bridge infrastructure are monitored on a regular periodic basis, using a variety of quantitative inspection, road condition survey, traffic and WIM survey and image survey techniques. System and organisation performance information is published for the Queensland community in the Main Roads Annual Report[1], Roads Implementation Program[4], and Ministerial Portfolio Statements (MPS)[5].

QDMR operates a relatively mature asset management system, founded on a sophisticated asset database (ARMIS). This asset data system integrates current and historical information on road and bridge inventory, traffic, condition, road accidents, maintenance activity and other data within a common reference system.

However, the stewardship practices in QDMR, as a decentralized agency, have led over the years to inconsistencies in work practices and standards, funding allocations, and road system performance. Investment decisions were often based on local assessment of needs and priorities, and historical regional funding levels that did not necessarily reflect true needs. Performance assessments have not effectively closed the feedback loop to the review of investment level, investment strategies, affordable performance targets and investment priorities linked to desired outcomes.

This has led to real and potential inefficiencies in delivering its road system management achievements.

Queensland is experiencing the fastest rates of population and economic growth in Australia. As in many countries, the high growth in demand on the road transport system is causing typical symptoms of strain on the network infrastructure and operational performance:

- Heavy vehicle loads continue to increase, the freight transport fleet comprises an increasingly complex mix of long combination vehicles and larger and heavier axle groups, and freight tyre pressures are increasing;
- The growth in congestion in urban areas is outpacing the rate of increase of road capacity;
- The ageing road infrastructure, much of it built in the 1950's to 1980's, and not designed for current and future vehicle loads and volumes, is showing increased rates of deterioration;
- Longer service lives are being demanded of ageing pavements, well in excess of the design and economic lives, before rehabilitation or reconstruction can be programmed;
- Large backlogs exist for road and bridge maintenance and rehabilitation.

### **3. ROAD SYSTEM MANAGEMENT FRAMEWORK**

QDMR's response to improving consistency in its practices and investment effectiveness has been to develop and implement the Road System Manager (RSM) Framework, consistent with Austroads guidelines[6].

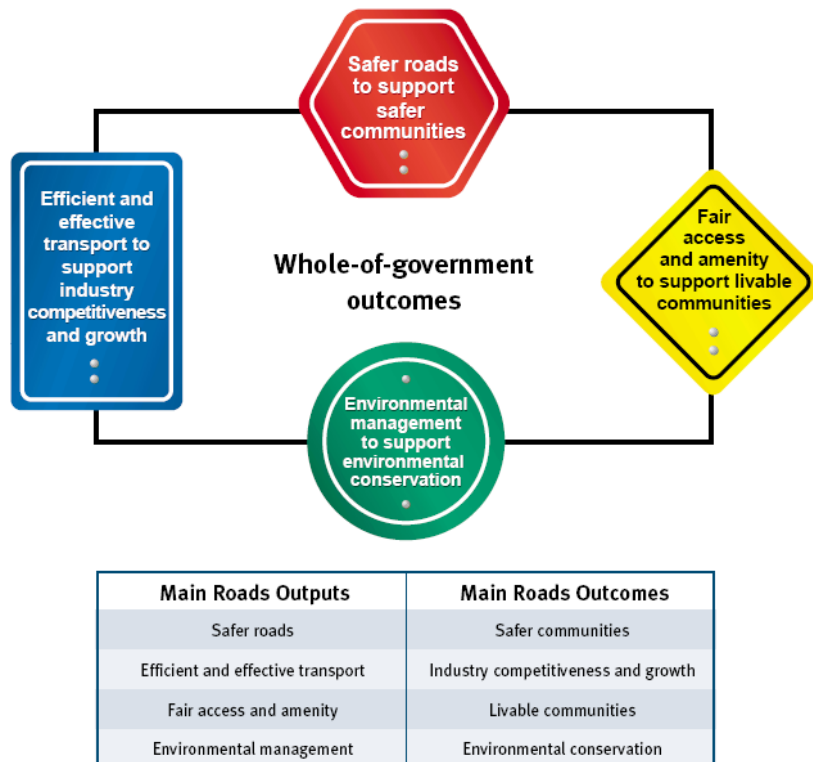
Implementation of the framework has required fundamental review of desired outputs and outcomes of the state road system, review of business processes and supporting information and decision support systems, restructure of the QDMR organisation, and substantial change management to assist the workforce to understand, assimilate and adapt to the widespread changes, including changes in behaviours, attitudes, roles, responsibilities and organisational cultural norms.

#### **3.1. Objective**

The objective of the RSM Framework is to enable the effective and consistent planning, programming, delivery and review of priority responses in the road system, according to need.

### 3.2. Key Outcomes

Queensland's RCQ document[7] defines the key outcomes required of the state controlled network (Figure 1).



**Figure 1 - QDMR Outcomes and Outputs for Roads**

The activities and outputs within the phases of the RSM Framework are strongly aligned to the delivery of these system outcomes.

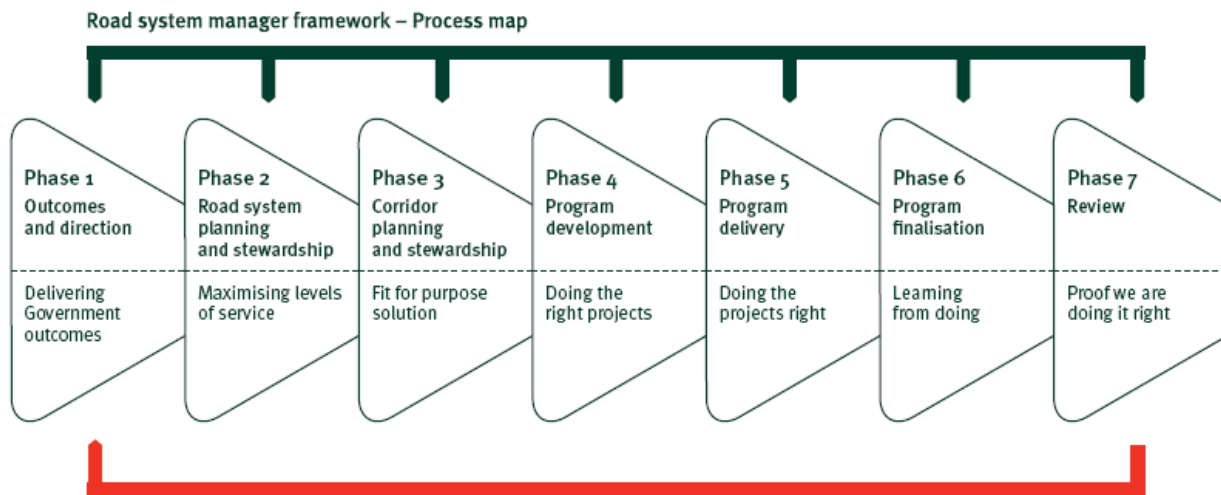
### 3.3. Framework Characteristics

The important characteristics of the framework are:

- a needs-based approach to investment prioritisation planned over a long time frame;
- needs identified by comparing future targets for system performance against comprehensive asset inventory and performance data, at both the network and corridor levels;
- work elements for network enhancement, asset maintenance and preservation, and road operations, and including infrastructure and non-infrastructure responses;
- an organisation structure for QDMR strongly aligned to the framework;
- highly integrated planning and delivery processes, and underlying decision support systems, with consistent data structures.

## 4. ROAD SYSTEM MANAGEMENT PHASES

The RSM Framework is designed in seven phases, reflecting a typical asset management cycle of state-wide and corridor planning, programming, delivering, monitoring and reviewing performance. The framework concept is shown in Figure 2.



**Figure 2 - Road System Manager Framework Concept**

This conceptual inter-relationship of phases is drawn from, but is also a variation from that proposed by Austroads[6].

#### 4.1. Phase descriptions

The RSM phases, their descriptions, dependencies and outputs, are presented in Appendix 1.

#### 4.2. Information flows and dependencies

In overall concept, the phases of the RSM Framework flow sequentially from Phase 1 through to Phase 7, with feedback from the review phase returning to prior phases. However, detailed phase processes and information flows are much more complex than a simple sequential model. These details are not included in this paper. However, as shown in Appendix 1, there are internal dependencies between adjacent phases, which result in process interactions and extensive needs for shared information between phases.

Consequently, in order to efficiently achieve the desired goals of the RSM Framework of consistency and integration, attention to strong integration is required between business systems supporting information access and decision support.

#### 4.3. Phase outputs

Each phase produces primary outputs (listed in Appendix 1), which may be published documents, internal data sets, or delivery activities. In most cases, the primary outputs provide input to the next phase, as well as being the source of feedback to prior phases.

## 5. WORK ELEMENTS

The *Road System Performance Plan* (the primary output of Phase 2) outlines future priorities for road investment to deliver the Queensland Government’s desired outcomes for the State-Controlled Road system. The plan has a 20 year planning horizon with 10 and 5 year milestones, and provides a prioritised list of state-wide responses to needs or deficiencies on the SCR network, together with the forward funding requirements to manage those needs. These needs and funding demands are categorised by work

elements, which identify the different work activities that warrant a consistent state-wide approach to their management.

### 5.1. Work element definition

A work element is a work activity, responsibility or system management issue driving the need for delivery of network enhancement works, maintenance and preservation works, and road system operations. A work element requires significant investment allocation or action and prioritisation over the long term. A work element also requires a consistent, defensible state-wide management approach, based on identified needs against performance targets.

### 5.2. Element management plans

The work elements provide a category of detail within the overall road system management task for which the management processes, data, outputs and performance can be managed consistently across the state, and across all phases of the RSM Framework. Each work element has an *Element Management Plan*, which documents the phase processes for the element, and the current performance targets, deficiencies (the needs identified as the gap between current state or condition and the performance target), the program level funding required to deal with the needs, and past and current performance.

The element management plan is structured in two parts, with content as shown in Table 1.

**Table 1 - Content Structure of Element Management Plans**

Part	Content
Part 1 – Process Description	Objectives Data and systems State-wide needs analysis Program development Program / project delivery Performance analysis and reporting
Part 2 – Element Performance	Performance targets Funding requirements Element performance

Part 1 of the plan remains relatively stable over time, only changing when process improvements are implemented. Part 2 of the plan may be updated with changes to performance targets and/or funding requirements every 2 to 3 years, and is updated with performance data each year.

### 5.3. Element details

Work elements have been identified within a hierarchical structure given in Table 2. Each element is related to a Key Outcome Area, to which it has a primary affinity in terms of outcome achievement. In reality, many work elements contribute to more than one Key Outcome Area.

**Table 2 - Hierarchy of Element Identification**

Key Outcome Area	Element Category	No. of Elements
Environmental Sustainability	Environmental Rehabilitation	3
	Environmental & Heritage Management	5
Safer Roads for Safer Communities	Treating Crash Sites	5
	Risk Reduction	8
	Maintaining Safe Road Conditions	2
	Providing Road User Guidance	3
Efficient & Effective Transport	Maintaining Road Surfaces	1
	Maintaining Pavement Service Life	1
	Maintaining Structures	1
	Providing Enhanced Capacity	8
	Managing Road Use	6
Fair Access & Amenity	Sealing Roads Serving Remote Communities	1

Currently, a total of 44 work elements are managed, comprising 34 *Maintenance, Preservation and Operations* elements, and 10 *Network Enhancement* elements. A full list of the work elements is given in Appendix 2.

#### 5.4. Element manager roles and responsibilities

The execution of element management processes usually is performed by many people across the QDMR organisation, depending to which RSM phase any particular element process belongs. The purpose of Part 1 of an Element Management Plan is to provide guidance to the various organisation units having process responsibility for each phase.

However, there are specific *Element Manager* roles and responsibilities assigned to technical specialists who provide expert advice and services to the whole organisation in relation to their element specialty. The generic element manager roles and responsibilities are as follows:

- Prepare and maintain the Element Management Plan
- Manage element analysis processes
- Manage element data and systems
- Set performance targets and identify technical standards
- Measure and report on element performance
- Engage stakeholders
- Lead innovation through research and development
- Review compliance with governance requirements
- Business and resource planning

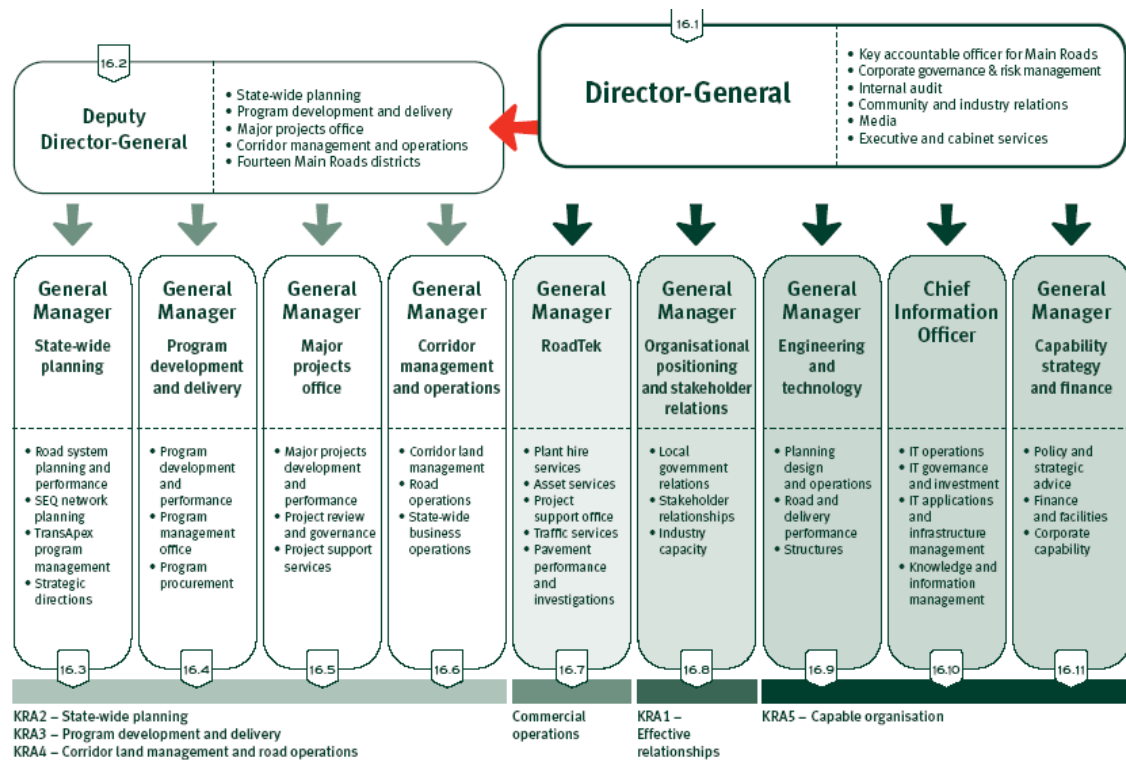
In QDMR, 15 element managers cover the technical requirements of the 44 work elements.

## 6. ORGANISATIONAL IMPACTS

Implementation of the RSM Framework has led to substantial restructure of the QDMR organisation. The new organisation structure aligns strongly to the phase functions of the framework and to the new roles and accountabilities that have developed within each phase.

### 6.1. New organisational structure

The new organisation retains the characteristics of having a strong, decentralised connection to the community with district management structures (14 districts). It also retains central corporate management and support, and specialist technical / engineering functions, and introduces new organisation groups that provide state-wide consistency and integration in the planning, delivery, operations and management of the state controlled network.



**Figure 3 - Senior Management Roles and Accountability**

Senior management roles are outlined in Figure 3.

The new state-wide functions cover:

- State-wide planning
- Program development and delivery
- Corridor management and operations
- Major projects office

Greater detail on the structure is available in the QDMR Annual Report[8].

The district structures have also been re-aligned to reflect the operational functions within the RSM Framework.



## 6.2. RSM roles in the new organisation

The processes required to produce the outputs from each RSM Phase generally need involvement from more than one organisational group. Process design needs to take into account the role responsibilities within different groups. Any phase, or process within a phase, will have one group nominated as taking the lead role, and is therefore accountable for the output. Other groups may take a major role, or a supporting role in contributing to the output. Figure 4 shows the relationships of lead groups to the RSM phases.

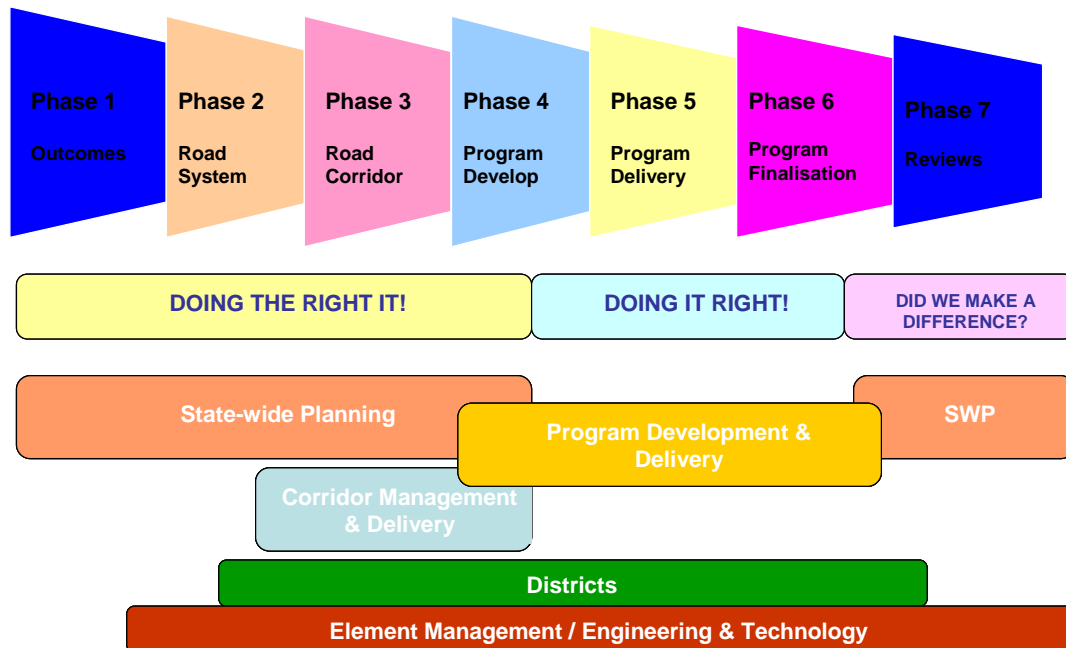


Figure 4 - RSM Phase Relationships with Organisation Groups

## 6.3. Impacts on organisational culture and behaviours

The juxtaposition of RSM phases and organisation groups demands a "matrix" management approach, in which business units and individuals have line management reporting, but also multiple customers of their project activities.

Confusion in roles and responsibilities can easily arise, so continuing attention is needed to nurturing a culture of collaboration and empowerment within project teams. Tensions often exist between behaviours showing empowerment to act within consistent corporate standards, and behaviours demanding flexibility to move outside the standards to "get the job done" within time and cost constraints.

## 7. COMMUNITY IMPACTS

The impacts of the substantial change agenda embodied in implementing the RSM Framework have been predominantly impacts on the organisation and business processes for QDMR, with an overall objective of achieving greater efficiency and effectiveness for the outcomes delivered by the state road system for the Queensland community. Nevertheless, there are real and potential impacts to the Queensland community as well. These impacts will have both positive and negative effects.

- The road user community enjoys the benefits of greater consistency of road standards (e.g. acceptable asset conditions, maintaining safe road conditions,

maintaining visibility, signage and road delineation, maintaining environmental protection) and of consistency of performance expectations, for roads in similar operating conditions anywhere in the state.

- The road user community and the wider community of residents, industry and visitors to Queensland enjoy the benefits of balanced investments across the key outcome areas, driven by the government's desired priorities for the mix of key outcomes.
- The community is informed about planned road system performance targets into the medium to long term future (up to 20 years), and is informed about the forward level of investment needed in the road system to achieve those performance targets.
- Particular sectors of the community (eg local government) have been accustomed to relying on state commitments of funding into their local areas to support local employment, by committing to projects in each local area over the five year works program. In the past, this would occur largely by historical precedent, whether or not a project was addressing the highest priority need from the state perspective. While the commitment to supporting local employment in rural areas will be maintained, local workforces may have to be more flexible, to take on the high priority types of work, to work collaboratively across regional areas, and to be prepared to move work teams to where the priority work needs exist.
- The backlogs of unmet investment needs are known to be substantially more than the known available supply of funds. In order to get critical investment backlogs under control, the state government will need to consider a range of alternative funding methods to achieve the required level of funding for the road system. This may impact the community through diverting funds away from other sectors of government activity to the roads sector, by increasing government borrowings, or by adopting "user pays" solutions in partnership with the private sector.

## **8. BENEFITS OF THE NEW APPROACH**

Development of the concept for the RSM Framework commenced about six years ago, and active development and implementation of some framework processes and outputs has been in progress for approximately three years. The QDMR implementation is still relatively immature, and requires sustained attention to bedding down the organisational, cultural and process changes. However, at this still early stage, substantial benefits of the change initiatives are now apparent.

- QDMR has identified a sound approach to managing road system priorities through needs assessment against system performance targets;
- It can articulate current investment needs (including backlogs) across a comprehensive range of work elements.
- QDMR has achieved significant organisational redesign, with changed roles and accountabilities, to align with the RSM framework.
- Senior management are able to reassess priorities in strategic investments on the road system, and have set new key strategic objectives – to deliver a substantially larger program of works; to improve safety outcomes for the road system; and to address the maintenance backlogs.
- It has achieved a modest initial shift in the balance of funding priorities towards maintenance and rehabilitation works.

- Armed with more reliable information on investment needs, QDMR has achieved soundly based submissions to government for substantial additional funding for asset maintenance and rehabilitation in future.
- The framework has enabled sound business cases for improving investment in element data and decision support systems.
- Community benefits include consistency in the standard of road system outputs, which means a better road system requiring less recurrent investment in maintenance, and better value for money for the community.

## 9. CONCLUSION

The Queensland state road agency, the Queensland Department of Main Roads, carries responsibility for the planning and stewardship of a large road network servicing a widely dispersed population and industry sectors. Continuing strong economic and population growth is creating increasing strain on the road system, leading to investment demands that are exceeding government and community affordability.

QDMR has adopted a new approach to integrated road system management, which is underpinned by the principle of sound forward planning of road system investments and delivery of system preservation and improvements according to a consistent state-wide approach to identifying and prioritising investment needs.

This new approach – the Road System Manager Framework – has required considerable organisational effort involving:

- Defining business processes for work elements to be identified, prioritised and managed through the cyclic framework phases;
- Defining state-wide investment planning processes based on prioritised investment needs against affordable performance targets;
- Developing a revised forward program of works that addresses the prioritised needs;
- Major restructure of the QDMR organisation to align with the framework.

As these changes are bedded down, clear benefits are already apparent, enabling QDMR to have a defensible position in addressing community expectations for system performance, balanced against available funding, and also to have a defensible position when negotiating for funding requirements.

The changes have necessitated considerable investment of time and costs into business process re-engineering, review of business system support arrangements, and management of cultural change.

The changes have proven to be necessary and successful in enabling QDMR to meet the challenges of a rapidly growing work program for enhancing, preserving and operating the state road system.

## 10. ACKNOWLEDGEMENTS

The concepts and developments described in this paper are the result of a considerable body of work undertaken in QDMR over the past six years at least, and still continuing. The work includes the contributions and efforts of many people working within the organisation, too numerous to name here. The author gratefully acknowledges these collective efforts, and as documenter of this overview, takes full responsibility for any errors or omissions made.

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## Appendix 1 - Functional Phases of the Road System Manager Framework

Phase	Phase Title	Phase Description	Dependent on	Primary Phase Output
1	Outcomes & direction	This phase senses and interprets the external environment to provide tangible direction for Main Roads outcomes and high level outputs.	Government policy ITPF Phase 2 Phase 7	Roads Connecting Queenslanders [2]
2	Road system planning & stewardship	This phase translates the broad strategic choices and priorities identified under phase 1 into plans of action for improving the state-wide road network. It involves the setting of visionary targets, funding and implementation strategies for a 15-20 year period, categorised by work element.	Phase 1 Phase 3 Phase 4 Phase 7 EMPs	Road System Performance Plan
3	Corridor planning & stewardship	This phase concentrates on forward plans and road investment strategies at the corridor level which are consistent with the statewide approach defined under Phase 2.	Phase 2 Phase 4 EMPs	Link Strategies
4	Program Development	The aim of this phase is to produce a prioritised list of investment candidates and 5 year program funding (the RIP) across and within the work element categories that make up maintenance, operations and enhancement of the network.	Phase 2 Phase 3 Phase 5 Phase 6 EMPs	Roads Implementation Program[4]
5	Program Delivery	The aim of this phase is to deliver the RIP so that the infrastructure is in operational use and meets the needs identified in earlier phases. It includes the preliminary and detailed design, construction and maintenance of the infrastructure and management operations within road corridors.	Phase 4 EMPs	Construction & maintenance works Network operations
6	Program Finalisation	This phase evaluates the project and program performance against targets set in the RIP Business Rules and other departmental policies and directions.	Phase 5 EMPs	Project & program finalisation reports As-constructed records
7	Review	This phase measures actual outcomes against the desired outcomes identified in Phases 1 and 2. The purpose of the phase is to produce performance results and analysis that will inform decision-making back at Phase 1 and 2.	Phase 1 Phase 2 Phase 4 Phase 6 EMPs	Work element performance Program delivery performance QDMR Annual Report[1] Ministerial Portfolio Statement[5]

## Appendix 2 - Road System Manager Work Elements

Key Outcome Area	Element Category	Work Element	Element Type
Environmental Sustainability	Environmental Rehabilitation	Contaminated Areas Nature conservation Degraded areas	Maintenance Preservation Preservation
	Environmental & Heritage Management	Heritage preservation Declared pest species Fire risk management Roadside landscape Road traffic noise management	Preservation Maintenance Preservation Preservation Operations
Fair Access & Amenity	Sealing Roads Serving Remote Communities	Sealing roads to serve remote communities	Enhancement
Safer Roads for Safer Communities	Treating Crash Sites	Bicycle facilities Pedestrian facilities Intersections with high crash frequencies Hazards close to roads Driver fatigue management	Maintenance Maintenance Maintenance Maintenance Operations
	Risk Reduction	Management of animals on roads Performance of rail crossings Road and environment safety Hazardous grades Roadside barrier management Batter slope management Caging of overpasses Skid resistance management	Maintenance Maintenance Maintenance Maintenance Maintenance Maintenance Maintenance Maintenance
	Maintaining Safe Road Conditions	Routine maintenance (sealed) Routine maintenance (unsealed)	Maintenance Maintenance
	Providing Road User Guidance	Roadside signing Roadside and surface delineation Route lighting	Maintenance Maintenance Maintenance
	Maintaining Road Surfaces	Surfacing treatments	Maintenance
Effectiveness & Efficiency	Maintaining Pavement Service Life	Pavement rehabilitation	Maintenance
	Maintaining Structures	Bridge and culvert rehabilitation	Maintenance
	Providing Enhanced Capacity	Widening sealed roads Realigning sealed roads Providing additional lanes Constructing at-grade dual carriageways Grade separating to motorway standard Constructing intersections to increase capacity Constructing bridges to increased standards Improving flood immunity	Enhancement
			Enhancement
			Enhancement
			Enhancement
Managing Road Use	Overload management Provision for emergency vehicles Incident management Traffic management Traveller information Other transport initiatives	Enhancement	
		Enhancement	