Smarter solutions:

network optimisation framework

June 2019

Queensland Government

Bus priority lanes, Brisbane

Contents

A new approach for infrastructure decision-making

Planning for infrastructure is critical to support Queensland's growing population and encourage economic development across the state.

With its significant geographical size and dispersed population, Queensland needs a transport network that supports the diverse and changing needs of our communities and industries, now and into the future.

Customers are increasingly embracing new technologies and expectations around how they want to interact with the transport network are changing. Technological advances are also driving innovation as we move toward greater automation of our roadways and vehicles.

Balancing growing demand and meeting customer expectations within a constrained funding envelope requires that the Department of Transport and Main Roads (TMR) find greater efficiencies and improved reliability from our existing infrastructure assets.

By changing the way we think about future transport requirements, we can identify opportunities to get the most out of our investments and use infrastructure smarter and more efficiently than before.

What does this mean for TMR?

In some cases, low-cost and non-infrastructure solutions that optimise our existing transport network generate similar outcomes to new infrastructure, reducing the need for significant capital expenditure and helping TMR to do more with less.

Recognising these opportunities, TMR has developed the *network optimisation framework* to help prioritise consideration of low-cost and non-infrastructure solutions – or network optimisation solutions – within our planning and investment process.

The framework will be embedded as standard practice across TMR's infrastructure planning process to help us do more with less while continuing to meet customer expectations.

Embedding the Network Optimisation Framework within our process

The framework takes an outcomes-based approach to prioritising consideration of lower cost and non-infrastructure solutions within our existing processes. It provides direction about what we should consider when making planning and investment decisions to ensure we are getting the most from our existing assets and using infrastructure smarter and more efficiently than before.

To support the framework, a *Smarter solutions reference guide* and *Smarter solutions multi-criteria analysis tool* have been developed to bridge key gaps in our current processes. The framework indicates when referring to these tools will be helpful and why.

Bus priority lane

Alignment to government policy direction

Ensuring network optimisation solutions are routinely considered in TMR's planning and investment process will ensure we design and delivery a best practice infrastructure program.

A transport network that is supported by robust consideration of network optimisation solutions is better positioned to deliver:

- improved returns from government investment
- reductions in travel time for passenger transport and private vehicle users
- improvements in travel time reliability for passenger transport and private vehicles
- improvements in the quality or amenity of customer experience
- reductions in vehicle operating costs
- eductions in vehicle emissions, accidents and other externalities.

Leveraging a range of network optimisation solutions to increase capacity and improve reliability will unlock opportunities for TMR to address a greater number of transport problems across the state and respond to strategic drivers that encourage the use of these smarter solutions to prevent or defer significant capital investment.

Figure 1 – Strategic direction of government investment policy

**refer to TMR processes and documents*

Changing infrastructure requirements

The landscape in which TMR operates is rapidly changing, with a constrained fiscal environment, growing infrastructure deficit and increasing uncertainty across the planning horizon shifting the way we think about the transport network.

With increasing infrastructure needs and a constrained funding environment, our decisions need to be smarter than ever before. Achieving these outcomes requires the effective management of existing infrastructure assets and a rigorous approach to new investment.

Challenge 1: Constrained fiscal environment

Public sector investment in Queensland's infrastructure has plateaued over the last three years in real terms. While transport infrastructure remains the largest driver of government expenditure, historical underinvestment relative to population growth and increasing demand is compounding existing capacity and reliability constraints across the network.

Around half of all road-related expenditure in Australia is made by state governments, with Queensland's road-based capital and operating expenditure the highest in the nation. TMR faces the challenge of planning, designing and delivering transport infrastructure that addresses current and future demand requirements, in light of budget consolidation across all levels of government.

Challenge 2: Leveraging technology

How Queenslanders use the transport network is changing, making it difficult to predict and plan for their future needs.

While population growth has traditionally been used as a predictor of future demand, the impact of new technology, fuel and parking costs and changing user preferences are playing an increasing role in changing travel behaviour.

Technology is a disruptive force that will fundamentally change future infrastructure requirements. The potential for autonomous vehicles and increasing ride-sharing, for example, may dramatically change the efficiency of the transport network and how people prefer to use it. A more flexible approach will also be needed to identify adaptable transport solutions which form part of a dynamic and responsive network.

Advances in technology are able to alter transport supply and demand dynamics and to optimise the efficiency and use of current infrastructure. If managed effectively, automation of vehicles and transport systems can help to 'flatten' demand and decrease the urgency for critical transport infrastructure to manage excessive congestion.

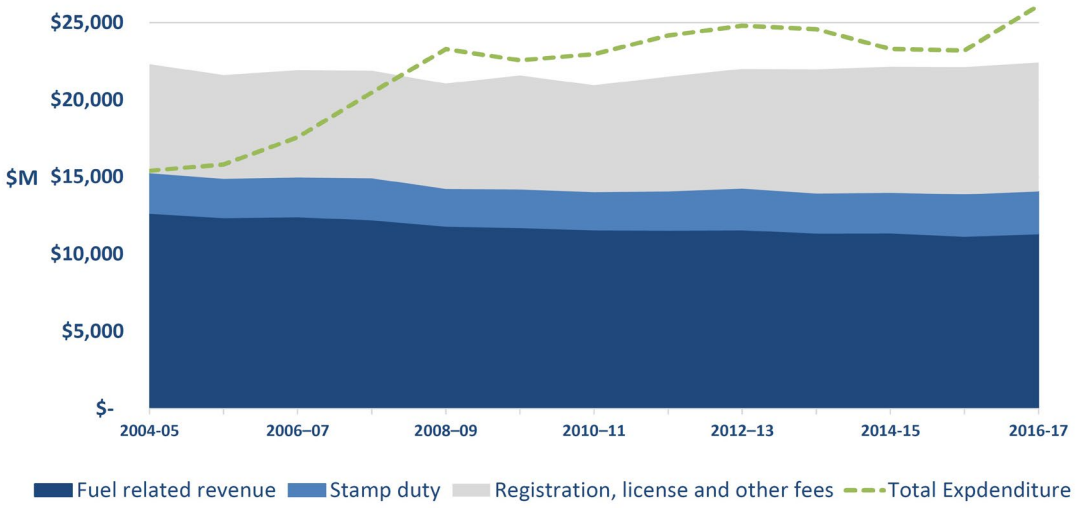


Figure 2 – Road-related revenue and expenditure 2004–05 to 2016–17 (all governments and the private sector, $ million real 2016–17)

Challenge 3: Peak car

Growth in private vehicle use has plateaued over the past decade and distances travelled per capita are showing signs of saturation and subsequent decline. However, the causes of the phenomenon known as 'peak car' and its potential impacts on future infrastructure requirements are not yet fully realised.

Falling vehicle kilometres per capita is linked to various interrelated causes including: urbanism; rising fuel prices; demographic shifts; changing preferences; growth in public transport usage and major macroeconomic events (e.g. Global Financial Crisis).

Queensland per capital car use peaked in 2004 and significantly declined following the global disruptions of 2008, but has partially recovered since 2011. Despite this, overall kilometres travelled by private vehicles has continued to increase as a result of population growth. Medium to long-term projections of future car use, therefore, often reflect population growth and result in an increase to the forecast total kilometres travelled, even where individual rates of driving are not increasing.

Queensland's per capita car use

PEAKED IN 2004

DECLINED IN 2008

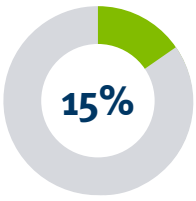
PARTIALLY RECOVERED IN 2011

Challenge 4: A growing freight task

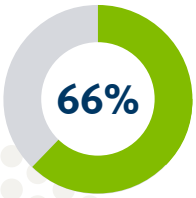
The volume of road freight in Queensland is projected to increase by 15 per cent between 2017 and 2024. Growth in the freight market has consistently contributed to reliability constraints (increasing travel time and reducing freight reliability), asset stress on road infrastructure, and increased safety risk at certain locations.

Currently, the road network supports the largest proportion of Queensland's domestic freight task, with 66 per cent of state's freight tonnage carried by road. Projections out to 2024 suggest this mode share will remain consistent over the short term.

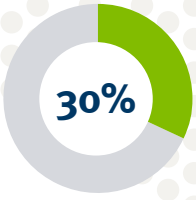
Potential absolute peak car trends, the uncertainty of future car use, and the growth in freight activity are important considerations when assessing long-term infrastructure requirements. Where appropriate, network optimisation solutions can help to ensure future investment decisions are well-informed and better reflect immediate and long-term trends.



Volume of road freight projected to increase 15% by 2024



In 2014, 66% of Queensland's freight was carried by road



In 2014, 30% of Queensland's freight was carried by rail

Changing infrastructure requirements

Challenge 5: A diversifying economy

By 2031, over two-thirds of the world's middle class will live in Asia, creating economic opportunities for Queensland that have long-term infrastructure requirements – particularly related to the tourism sector.

China will be Australia's largest source of inbound visitor arrivals and expenditure by 2018, overtaking New Zealand as our most important tourism market. In fact, fuelled by increased connectivity and a growing middle class, Chinese tourists will account for over 60 per cent of all tourism-related expenditure in Australia by 2026.

Right now, the tourism sector is growing three times as fast as Australia's Gross Domestic Product (GDP) – providing a reliable driver of growth as our economy continues to transition out of the mining boom. Building on our natural advantage and investing in infrastructure that supports further growth in tourism is critical.

This means better linkages to airports, ports, visitor precincts and major attractions through efficient and reliable connections, often public and mass transport.

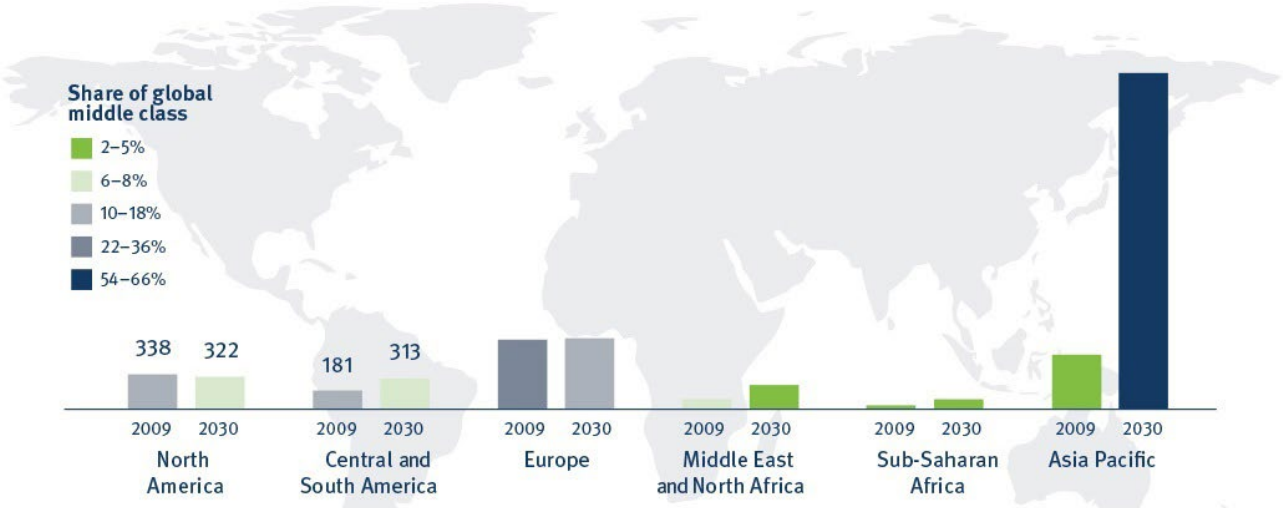


Figure 3 – Size of the global middle class (millions of persons)

En-route information system and variable speed limits

Challenge 6: Cost of urban congestion

Optimising our transport network to make smarter use of existing infrastructure when addressing growing urban congestion and unreliability is a key challenge for all levels of government in Australia.

As demand continues to increase, Queensland's urban transport networks will come under increasing pressure. Better managing this growth is key to preventing the total cost of urban congestion growing from $13.7 billion in 2011 to $53.3 billion by 2031.

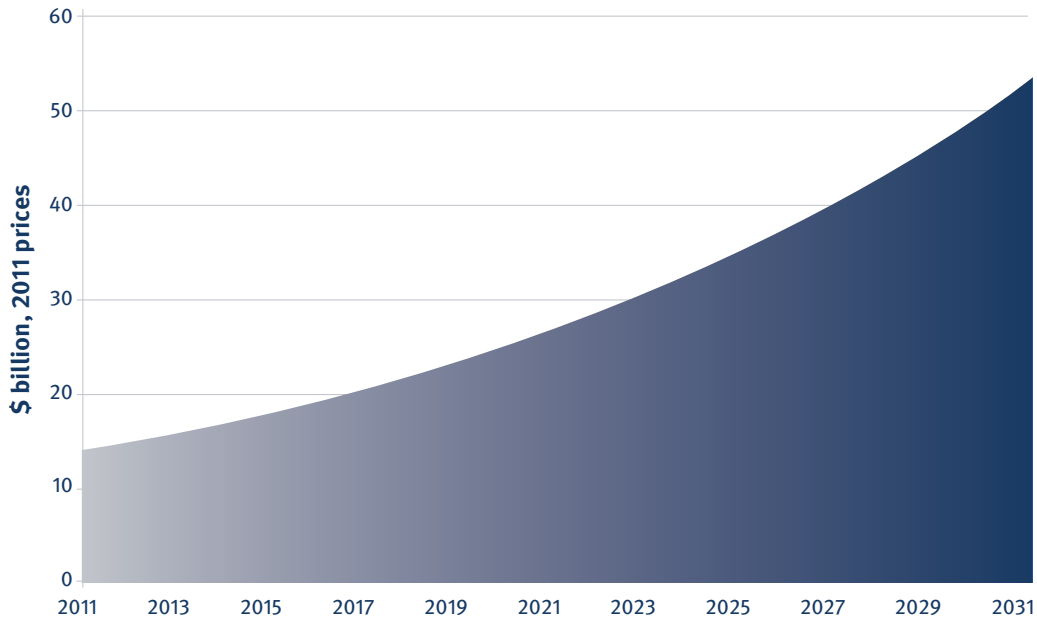


Figure 4 – Annual congestion cost in Australia's six largest cities

How can TMR respond?

Responding to these challenges will require a shift in the way TMR currently makes decisions.

Delivering the right infrastructure at the right time requires that our infrastructure planning process prevents or defers large capital investments when viable alternatives exist. Ensuring we consider low cost and non-infrastructure solutions that optimise the existing network is key to achieving these outcomes.

Park 'n' ride facilities

Network optimisation solutions

Network optimisation solutions are initiatives that can improve the functioning of the existing transport network, without delivering new infrastructure.

TMR's network optimisation framework includes a range of low-cost and non-infrastructure solutions which are designed to address particular transport problems.

These solutions improve performance by increasing the capacity of, or demand for, elements of our current transport network. Network optimisation solutions can address the supply-side and/or the demand-side of the transport network:

Supply-side interventions include those solutions which change the supply of network capacity, for example, the improved management of corridors or intersections.

Demand-side measures aim to influence the overall demand for transport resources, by encouraging users to shift from congested modes and routes to more efficient alternatives. These can include 'carrot' and 'stick' policies; encouraging or enabling some behaviours while disincentivising others.

There are significant benefits to be gained through the implementation of network optmisation solutions as they allow for large-scale capital expenditure to be deferred, while improving the performance of our existing network.

Road Transport

- HOV lanes
- Truck restrictions
- Hard shoulder running
- Reversible lane
- Turning lanes
- Parking management

Intelligent Transport Solutions

- Incident management systems
- En-route information system
- Variable speed limits
- Signal optimisation
- Lane use management system
- Ramp metering

Public Transport

- Bus priority lanes
- Public transport jump lanes
- Transit signal priority
- Park 'n' ride facilities
- Board all doors

Regulation and Policy

- Education campaigns

Figure 5 – Network optimisation solutions (not exhaustive list)

Investment outcomes of network optimisation solutions

Network optimisation solutions extend the life of existing assets by improving their performance. Implementing these 'smarter solutions' and deferring large capital expenditure can produce significant savings for TMR, helping us do more with less.

Any solution to a transport problem carries with it a financial cost, whether for the construction or acquisition of new assets, expansion to or extension of existing assets or the introduction of new policies and education campaigns – nothing is achieved without investment.

Investment costs associated with network optimisation solutions are no different – while these are often referred to as low-cost solutions, they are seldom free. Typically, in transport appraisal techniques, the incremental cost, either capital or operational are the most important considerations to government in making investment decisions. These include capital expenditure, and lifecycle and maintenance costs.

Capital expenditure

Capital costs of any transport initiative are always project dependent. Costs vary due to many technical considerations including engineering and environmental characteristics. The costs of network optimisation solutions therefore will also vary considerably due the individual nature of the type, scale and geographical application of each solution.

Lifecycle and maintenance

Lifecycle and maintenance costs relate to the recurrent and whole of life investment required to maintain network optimisation solutions over their useful life. Like capital expenditure, operating costs are dependent on characteristics of the solution itself and the environment in which they are implemented. The combination of both capital and operating/maintenance costs are equally important to decision makers in understanding the whole of life financial implications of their decisions.

Cost savings from investment deferral

Implementing network optimisation solutions, and subsequent deferral of capital expenditure in physical infrastructure, can generate significant capital savings in present value terms. This cost reduction can improve the benefit cost ratio of an investment option, and critically provide significant cost savings to government. The estimated value of these avoided costs are highlighted in Table 1 (below).

Table 1 – Capital savings matrix (estimated capital expenditure savings, $'000)

Capital Expenditure ($m)	1	2	3	4	5	6	7	8	9	10
500	22,828	44,615	65,406	85,248	104,184	122,256	139,503	155,962	171,670	186,660
100	4,566	8,923	13,081	17,050	20,837	24,451	27,901	31,192	34,334	37,332
10	457	892	1,308	1,705	2,084	2,445	2,790	3,119	3,433	3,733
5	228	446	654	853	1,042	1,223	1,395	1,560	1,717	1,867
2	91	179	262	341	417	489	558	624	687	747
1	46	89	131	171	208	245	279	312	343	373

Years deferred

Note: figures based on a real price escalation rate of 2.11% and present value of savings at a real 7% discount rate.

Network optimisation framework

Network optimisation solutions have a vital role to play in TMR's delivery of infrastructure. Recognising this, the Network Optimisation Framework is designed to inform TMR's existing planning and investment process – from infrastructure policy and regional planning, through to investment programming.

The framework will guide TMR's delivery of infrastructure, ensuring that the following investment principles continue to be embedded within our decision-making:

1. Run the system – Sufficient funding will be provided to operate infrastructure and services to ensure an appropriate level of access and safety.
2. Maintain the system – Maintain existing assets, focussing on repair or rehabilitation of networks, rather than replacement, where this reduces the whole-of-life costs of transport infrastructure.
3. Build and expand the system – After sufficient funding has been allocated to run and maintain the system, investments to expand the system and improve services will be balanced to meet growing demand.

Including network optimisation solutions within our decision-making

The framework is not intended to be applied independently of TMR's existing infrastructure planning and investment process. Rather, it provides direction and assurance that TMR prioritises low-cost and non-infrastructure solutions when responding to a range of transport problems.

The framework will be embedded as standard practice to ensure TMR is getting the most from our existing investment and using infrastructure smarter and more efficiently than before.

Smarter solutions reference guide

The *Smarter solutions reference guide* is a starting point for TMR's consideration of low cost and non-infrastructure solutions – providing information about the benefits and costs of 18 ready-to-implement solutions relevant to Queensland's transport network.

Case studies, including where the solutions have previously been implemented across Australia and the world, are included to illustrate the opportunities and challenges associated with network optimisation solutions.

Smarter solutions multi-criteria analysis tool

The network optimisation framework introduces a *Smarter solutions multi-criteria analysis tool* to TMR's infrastructure planning and investment process.

The tool provides assurance to TMR's infrastructure decision making bodies, such as the Infrastructure Investment Committee and Regional Planning Coordination Groups, that our consideration of low cost and non-infrastructure solutions aligns to the government policy direction for investment decision making.

Designed to supplement existing processes, such as the Project Assessment Framework (PAF) and OnQ, the tool provides a clear line-of-sight between the infrastructure policy, planning and investment decisions that occur across TMR – documenting consideration of network optimisation solutions from the initial stages of strategic planning through to the investment decisions and project approval.

Infrastructure planning and investment process	Network Optimisation Framework outcomes	Further information available
Regional Transport Plans and network planning		
› Outline objectives for a region's transport network that reflect a multi-modal and customer-centric approach. › Identify strategic challenges, short-term actions and future opportunities consistent with the region's transport objectives and government policy direction.	› Consider a range of funding mechanisms for delivering the region's transport objectives, including likely current and future government funding sources, the ability to stage investments and alternative financing models such as Public Private Partnerships (PPP).	**State Infrastructure Plan** for strategic approach to infrastructure funding. **Queensland Treasury** for PPP supporting guidelines.
Corridor and area planning		
› Assess whether the current and future performance of a corridor or area meets the desired transport objectives. › Identify transport challenges that can be resolved through short-term actions.	› Provide clear guidance on the relative priority of investments, including the type and mix of infrastructure and network optimisation solutions.	**Smarter Solutions Reference Guide** for data about the magnitude of expected benefits and costs for network optimisation solutions.
Route and link planning		
› Define the future function of a route or link, supported by intervention priorities that reflect local needs and the transport objectives identified in upstream planning.	› Include information about the expected impacts, benefits, outcome timeframes, alignment with transport objectives and estimated costs for all solutions proposed.	**Smarter Solutions Reference Guide** for data about the magnitude of expected benefits and costs for network optimisation solutions.
Transport System Planning Program (TSPP)		
TSPP nomination forms seeking to undertake PAF and OnQ planning will show clear evidence that projects: › reflect regional transport objectives and TMR's investment principles, particularly extending the life of existing assets through maintaining desired performance outcomes › are well-defined and reflect the scale, causes and effects of the strategic challenges they are trying to solve (short-term actions and future opportunities) › are the result of planning which has considered the capital and whole-of-life costs of solutions relative to the magnitude of any potential benefits.		
Strategic Assessment of Service Requirements (PAF) and Concept Development/Project Proposal (OnQ)		
› Determine whether a response is required to address an identified service need or strategic challenge, clearly articulating the outcomes sought to match against potential solutions.	› Consider a broad range of infrastructure and network optimisation solutions based on the magnitude of potential benefits, costs and outcome timeframes.	**Smarter Solutions Reference Guide** for data about the magnitude of expected benefits and costs for network optimisation solutions.
Preliminary Evaluation (PAF) and Options Analysis (OnQ)		
› Facilitates an assessment of the priority and affordability of potential solutions to an identified service need. › Guides decision makers on whether it is appropriate to proceed to a detailed Business Case.	› Incorporate unique criteria specific to network optimisation solutions within evaluation, ensuring they are assessed equitably with infrastructure-based solutions.	**Smarter Solutions Multi-Criteria Analysis (MCA) Tool** for criteria that must be used in evaluations of network optimisation solutions.
Business Case (PAF and OnQ)		
› Undertake a detailed comparative analysis of shortlisted solutions to identify the option most likely to meet the identified service need and provide value-for-money investment outcomes.	› Metrics used to evaluate solutions incorporate specific criteria that reflect the impact and benefits of network optimisation solutions.	**Smarter Solutions MCA Tool** for criteria that must be used in evaluations of network optimisation solutions.
PAF and OnQ Gate 3		
Projects that have passed through Gates 1–3 and proceed to procurement will show clear evidence that they: › have been optimally scoped to incorporate network optimisation solutions where appropriate › are appropriately timed to be triggered only after the network has been optimised and the desired performance outcomes of current infrastructure has been maximised through network optimisation solutions › support government policy direction for investment decision making by considering solutions that provide TMR with the opportunity to defer significant investments until they are required.		

Figure 6 – TMR's network optimisation framework

Where next?

TMR has committed to prioritising consideration of network optimisation solutions through the framework and associated tools. Moving forward, TMR business areas will be expected to explore low cost and non-infrastructure solutions as a matter of course, identifying key outcomes at relevant stages of our infrastructure planning and investment process.

To assist, 18 ready-to-implement network optimisation solutions have been identified in the *Smarter solutions reference guide*. These solutions should not be viewed as a complete and final list; TMR encourages innovation in exploring other viable solutions that will contribute to a better functioning, more reliable and efficient transport network.

The *Smarter solutions multi-criteria analysis tool* will provide a clear line-of-sight across TMR's infrastructure planning and investment process, providing assurance that the framework's outcomes are embedded in our decision-making and we are fostering a culture of delivering adaptable and innovative transport solutions that help us to do more with less.

Bus priority lanes

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