Australian Government | Infrastructure Australia

Project business case evaluation summary

METRONET: High Capacity Signalling System

Location
Perth, Western Australia

Geography
Fast-growing cities

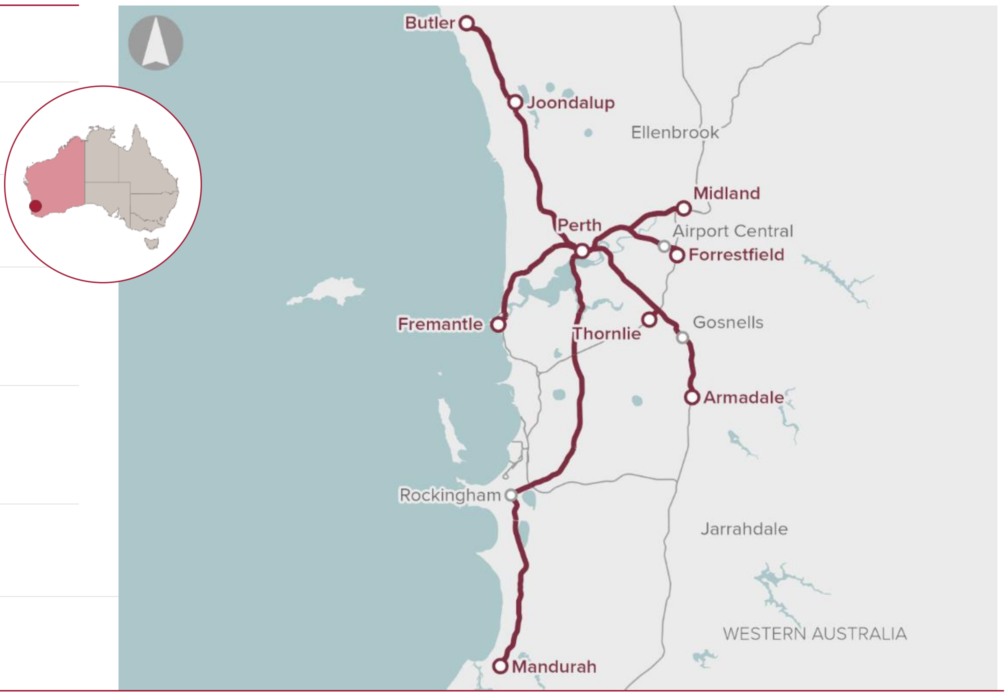
Category
National Connectivity

Capital cost
$1,232 million (P90, nominal, undiscounted)

Indicative timeframe
Construction Start: 2021
Project completion by: 2030

Proponent
WA Government

Evaluation date
7 April 2020



1. Evaluation Summary

The **METRONET High Capacity Signalling Project** has been added to the Infrastructure Priority List as a **Priority Project**.

Perth’s existing signalling and train control systems include ageing assets that are in some instances approaching life expiry and/or obsolescence. The WA Government has also identified that the signalling and train control systems will have insufficient capacity to support the additional rail services needed to meet future passenger growth. The proposed project will replace the existing signalling and train control systems with a new Automatic Train Control system based on Communications-Based Train Control technology.

Infrastructure Australia’s evaluation found that the project has a strong strategic case, as the project would make better use of existing assets and use technology to improve the performance of the rail network. The business case shows that the preferred option would have a benefit-cost ratio (BCR) of 2.6, with a net present value (NPV) of $688 million when using a 7% discount rate and P50 cost estimate.

Infrastructure Australia found that several opportunities discussed in the business case could have been quantified as benefits in the economic appraisal, such as safer and more efficient operations and lower whole-of-life costs. We also found that the business case may have overestimated some benefit items and underestimated some costs. Further, the economic appraisal assumed the existing systems would be fully replaced with an equivalent modern solution in the base case. The appraisal therefore considers the incremental benefits of higher capacity solutions rather than the benefits of addressing the underlying problem.

Comparing the performance of potential solutions against the performance of the rail network without a significant investment would have enabled a clear understanding of the economic, social and environmental value of the options, and would have been likely to demonstrate the critical nature of signalling and train control systems in operating metropolitan train networks. On balance, Infrastructure Australia considers the project benefits would exceed its costs.

Delivering a new signalling and train control system will require complex coordination with multiple other programs, including the procurement of new trains, the construction of new rail lines and the upgrade of technology and communications systems. These interface risks will need to be carefully managed through an efficient governance system to minimise delivery risks.

2. Context

In 1992, the Perth rail network was the first Australian urban railway network to introduce Automatic Train Protection as a safety measure to prevent trains from over-running red signals or travelling at excessive speeds. The Automatic Train Protection system is now one of the most outdated technologies on the Perth network and is based on a system design from the late 1970s.

Over the next 30 years, Perth is forecast to be home to a population of 3.5 million people making over 1.4 million public transport trips per day. To accommodate this growth and encourage more people to take public transport, the WA Government's METRONET Stage 1 program plans to expand the length of the existing Perth network by nearly 40%. Through a program of new and extended railway lines and new stations, METRONET will expand Perth's rail network from 178 kilometres with 71 stations, to 250 kilometres with 89 stations.

The capacity and service frequency of the rail network will also need to be increased to accommodate future population growth and the expanded rail network.

Consequently, several critical interdependent projects are being implemented to upgrade and make better use of the rail network. These include the procurement of additional trains, replacement of WA Public Transport Authority (PTA)'s current radio system with the new Long Term Evolution (LTE) digital radio system, and network improvements.

3. Problem (and opportunity) description

As the rail network expands and population increases, the following challenges are likely to be exacerbated unless the existing signalling and control systems are upgraded:

- Safety and serviceability – existing signalling and control systems include assets which are ageing and, in some instance, approaching life expiry and/or obsolescence, requiring costly maintenance and reducing the systems' reliability, availability and safety.
- Capacity – the existing signalling system is unable to support the increase in rail services needed to meet predicted future patronage demand.
- Reliability and resilience – higher patronage and more frequent train services will mean train operations become less resilient and increasingly prone to disruptions from delays and/or technical failures under the existing system.

The replacement of the existing signalling and train control system with new contemporary technology offers significant opportunities to improve the way the rail system is operated and maintained. The business case identifies four key opportunities:

1. Safer operations – Automatic Train Control systems can improve track worker safety by reducing the amount of trackside equipment requiring maintenance. Train operational safety can also be improved through reduced reliance on human interventions and new train safety functions based on fail-safe design principles.
2. More efficient operations – modern Automatic Train Control systems can improve operational efficiency by accurately determining train location, speed, and operational status.
3. Improved services – modern Automatic Train Control systems can facilitate a range of service improvements such as schedule and headway optimisations, turn-up-and-go service frequencies, real-time passenger information, faster recovery from operational disruptions, and regulation of train traffic at network pinch points.
4. Future proofing – transitioning to a moving block in-cab signalling system with Automatic Train Operation presents opportunities to increase rail service capacity by reducing inter-train spacing by 50% or more.

4. Options identification and assessment

A wide range of solutions were identified to address the problems, including different technologies and approaches. These included:

- Asset life extension
- Conventional signalling options
- New signalling technology
- Rail infrastructure options
- Rail operations options
- Road-based options.

The resulting long-list contained 13 project options and nine technology sub-options for new signalling technology. The long-list of 22 options were filtered using a multi-criteria analysis with four evaluation criteria based on the project objectives:

- Ability to provide customers with safer and more reliable public transport services
- Ability to build network capacity to enable an increase in rail services to meet predicted future patronage demand
- Ability to maximise value for money and optimise operational and whole of life costs
- Minimising delivery risk.

Five options (plus a base case) were selected from this process. These were:

- Option 1 – Asset life extension with moderate signalling modifications (Base Case)
- Option 3 – Asset life extension with conversion from existing three-aspect signalling to four-aspect signalling
- Option 4E – New signalling technology / European Train Control System (ETCS) Level 2
- Option 4F – New signalling technology / ETCS Level 2+ with Automatic Train Operation
- Option 4B – New signalling technology / Communications-Based Train Control; and
- Option 4J – New signalling technology only on those sections of the network requiring high capacity signalling and maintaining legacy signalling in sections of the network where high capacity signalling is not required.

The five short-listed options were subsequently assessed against the short-list decision criteria to identify a preferred option. These criteria included: addressing project problems/realising project opportunities; delivering project outcomes, including integration of the new system with PTA's new LTE Digital Radio System; and an economic appraisal.

Apart from the LTE Digital Radio System, the interface between the project options and the various critical interdependent infrastructure projects was not directly considered as part of the option evaluation process. However, the option assessment process appears to have been rigorous and aligns with guidance provided in the Infrastructure Australia Assessment Framework.

The preferred option was consistently the highest scoring throughout the option assessment process, receiving the highest score under both the long-list and short-list criteria.

5. Proposal

The business case recommends the implementation of an Automatic Train Control system using modern, radio-based, high-capacity Communications-Based Train Control technology on all three line-groups of the Perth metropolitan railway network (Option 4B).

A Communications-Based Train Control system is a continuous Automatic Train Control system which:

- determines a trains location via in-cab signalling, allowing for the removal of most of the existing track-side signals and Automatic Train Operation
- enables 'moving-block' functionality, minimising the distance between trains and maximising line capacity

- provides the foundation infrastructure, in the form of train-borne and wayside processors, to enable the implementation of Automatic Train Protection functions, as well as supplementary Automatic Train Operations and Automatic Train Supervision functions.

The scope of the project includes:

- The provision of a 'moving-block' Communications Based Train Control system to replace the existing 'fixed-block' signalling system, for safe operation of trains at shorter intervals enabling capacity increases of up to 150 per cent
- Replacement of the PTA's life-expired Automatic Train Protection system to maintain safety of train operations
- Automatic Train Operation supporting drivers to achieve consistent and on time train running
- Automatic Train Supervision and Regulation to replace the existing Train Control System with higher levels of efficiency and automation
- Simplified secondary signalling for operation of Automatic Train Operation-unfitted third-party trains (e.g. Indian Pacific, freight trains)
- A reduction of field signalling equipment for higher reliability and a reduced maintenance requirement, for example the provision of 'moving-blocks' will enable the removal of the existing track circuits, eliminating a major source of signalling system failure, boosting the overall signalling system availability
- A new purpose-built Rail Operations Control Centre which will accommodate a new Train Control Centre for highly integrated traffic management, service planning and incident response. The centre will also accommodate a new Centralised Signalling Equipment Room
- A new Backup Signalling Equipment Room to be located in a geographically diverse location, adjacent to Burswood railway station
- An upgrade of the existing Alternate Train Control facility to accommodate Automatic Train Control.

6. Strategic fit

The proposed project aligns with relevant state planning policies and plans, including:

- Perth and Peel @ 3.5 million
- Transport @ 3.5 million
- Public Transport Plan
- Public Transport Authority Strategic Asset Plan 2017-18.

Furthermore, the project has a strong alignment with Infrastructure Australia's recommendations to improve the performance of urban rail networks in our capital cities by making better use of existing networks using technology.

The proposed project has strong strategic merit as it will replace Perth's existing signalling and train control systems with new contemporary technology which offers significant opportunities to improve the way the rail system is operated and maintained.

Furthermore, the new signalling and train control system will enable a more efficient use of the rail network enabling PTA to meet future service demands. The new high capacity signalling system would also enable the opportunities discussed in Section 3 to be realised.

7. Economic, social and environmental value

The proponent undertook an economic cost-benefit analysis of the short-listed options, evaluating a 30-year benefit stream against the construction and operating costs of the project. All costs and benefits were discounted into present value terms using a discount rate of 7%.

The total discounted capital cost of the preferred option (Option 4B) under the capped capacity scenario (with frequencies capped at 18 trains per hour to avoid costly grade separations on the Heritage Lines), compared with the base case, is $432 million. The preferred option has a stated BCR of 2.6 and a NPV of $688 million.

The economic appraisal assumed the existing systems would be fully replaced with an equivalent modern solution in the base case. The appraisal therefore considers the incremental benefits of higher capacity solutions rather than the benefits of addressing the underlying problem. Better specification of the base case would have strengthened the economic results.

Infrastructure Australia's review also found that the narrative developed in the business case did not have a strong alignment with the scope of the economic analysis. Specifically, the narrative in the business case identifies four main opportunities that are unlocked by the project (see page 2). However, the economic analysis focussed on just two of these opportunities – improved services and future-proofing.

The economic analysis did not fully consider benefits associated with safer and more efficient operations, and lower whole-of-life costs. It is likely that realising these opportunities could lead to better safety for rail workers, fewer track possessions, maintenance savings, and reduced energy consumption. Infrastructure Australia also identified several opportunities to strengthen the cost-benefit analysis. These include:

- Refining the passenger demand projections – the transport and land use demand projections underpinning the analysis use historical land use projections that are likely to overestimate patronage. Furthermore, the analysis used a fixed-matrix rail demand, which does not consider induced demand and is likely to overstate the benefits of the project.
- Refining the treatment of displaced passengers – the assessment methodology is likely to have significantly overstated benefits for passengers who would otherwise have not been able to use the rail network because of capacity constraints.
- Treatment of rolling stock costs – the assessment could have included the opportunity cost of the 41 trains included in the base case.
- Treatment of escalation – the analysis applied a real value of travel time escalation to some benefits, while project costs were not escalated in real terms.

The following table presents a breakdown of the benefits and costs stated in the business case. These represent the incremental benefits and costs compared to the 'Do Minimum' base case.

Benefits and costs breakdown

Proponent's stated benefits and costs	Present value ($m,2018/19) @ 7% real discount rate		% of total
Public transport user benefits	**$941**		
Reduced crowding on trains	$363		32%
Reduced station wait time	$132		12%
Improved punctuality	$26		2%
Preferred travel time	$212		19%
Increase farebox revenue (resource correction)	$145		13%
Health benefit (a form of positive externality)	$64		6%
Road user benefits	**$177**		
Reduced vehicle operating cost (resource correction)	$75		7%
Reduced crashes	$58		5%
Reduced environmental externalities	$44		4%
For infrastructure owner (PTA)	**$1**		
Improved operational safety (e.g. wayside safety)	$0		0%
Asset residual value (incl. critically interdependent assets)	$1		0%
Total Benefits[1]	**$1,120**	(A)	**100%**
Total capital costs (P50)	$383		89%

Proponent's stated benefits and costs	Present value ($m,2018/19) @ 7% real discount rate		% of total
Operating costs	$48		11%
Total Costs[1]	**$432**	(B)	**100%**
Net benefits - Net present value (NPV)[2]	**$688**		n/a
Benefit-cost ratio (BCR)[3]	**2.6**		n/a

Source: Proponent's business case

(1) Totals may not sum due to rounding.
(2) The net present value is calculated as the present value of total benefits less the present value of total costs (A – B).
(3) The benefit–cost ratio is calculated as the present value of total benefits divided by the present value of total costs (A ÷ B).

The proponent's reported capital costs and funding is presented in the following table.

Capital costs and funding	
Total capital cost	$1,157 million (P50, undiscounted, nominal) $1,232 million (P90, undiscounted, nominal)
Australian Government funding contribution	$986 million (80% of the P90 capital cost)
Other funding	The remaining capital costs would be funded by the WA Government

8. Deliverability

The proposed project will require complex interface management with other investment programs, including procuring new rolling stock, deploying infrastructure in existing and new rail lines, and a significant organisational change management process, as the technology will require wide-ranging changes to major parts of the PTA's organisation, including its systems, its processes and its people.

The proponent has undertaken rigorous risk analysis to identify operational and technical risks associated with the Automatic Train Control project. This risk analysis was conducted via risk workshops and continuously updated through the project evaluation phase. A risk management strategy has been developed to mitigate the project's key risks. Infrastructure Australia considers that managing interface risks, including the interface with other projects and programs, will be essential to achieve the project objectives. We strongly recommend that an appropriate governance model is implemented to manage these risks.

The business case states that PTA will engage a single contractor to design, build and maintain an Automatic Train Control system across the entire PTA network and train fleet.

The proponent considered network capacity, the staging of the system roll-out, asset life expiry and/or obsolescence of the existing signalling system, and minimising disruption to rail operations in developing the recommended delivery strategy. Based on these operational considerations the business case recommends deploying the Automatic Train Control system sequentially on all three line groups, commencing with either:

- The North-South line group by 2026 where there has been a commitment, prior to PTA engaging the Automatic Train Control system contractor, to complete the necessary infrastructure improvements to enable 6 car operations on the heritage lines by 2026; or
- The South-East line group by 2026, where no such commitment has been made.

The business case provides a summary of the benefits realisation plan, including the anticipated benefits and the proposed evaluation methods. However, a full Post Completion Review Plan has not been submitted to Infrastructure Australia. We recommend the proponent undertakes a full Post Completion Review and makes this information available to inform future projects.