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EMU Deep Dive Report

Recommendation

That the Board:

i. Notes this report.

Executive summary

April 2014, when AT rolled out the first of the 57 new Electric Multiple Units (EMUs) on the Onehunga-Britomart Line, was the culmination of a programme begun in 2006. This report is not a full post-implementation review, in that patronage and reliability benefits will only be capable of measurement once the new units have been in operation for sufficient time to provide a reliable data set.

Nevertheless, the project has been delivered on time and to budget. The public/ customer feedback has been positive, with an immediate uplift in capacity on the Onehunga Line when the first units were rolled out. The project execution involved a complex set of relationships between CAF, AT, KiwiRail and Transdev and involved delivery of a depot with a training simulator and 57, three-car carriages plus spares and maintenance. Project and implementation risks have not been realised in any material fashion.

Inevitable teething issues have been swiftly addressed and provisional acceptance has occurred for all 57 units.

Background

ARTA's 2006 paper proposed $1.452 billion capex, of which $618 million was for the rolling stock and $68 million for the Rolling Stock Maintenance Depot and Stabling ($686 million total). ARTA's paper highlighted under used capacity in the existing rail corridors and made the case for urban rail as the *"most efficient people mover"* arguing that moving the 30,000 commuters forecast to make the journey into the city every day by 2030 by road would otherwise require some "*120 kms of extra arterial road".*

In 2006 rail patronage was growing and a monthly record of 545,000 had just been reached. Patronage had grown from just over one million in 1992 to five million in 2005 and the estimated maximum capacity was eight million. The ARTA paper proposed additional SA/SD carriages be purchased. This was done between 2006 and 2010, enabling the growth in rail patronage until delivery of the EMUs.

In 2009 AT offered a contract to build 57 EMUs to the Spanish company, Construcciones y Auxiliar de Ferrocarriles (CAF). The contract, along with the related depot was budgeted at $630 million. There were several expected benefits of the EMUs; greater capacity, high train reliability and availability, and short dwell times.

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Strategic context

EMUs were proposed as part of a $1.6 billion ($600 million DART, $500 million AEP and $600 million EMUs) package of works by the ARTA in 2006 in order to deliver *"a step change for Auckland"*. The social change of achieving widespread acceptance of public transport as a mode of travel had begun some time previously but needed to accelerate if Auckland was to avoid significant congestion. The environmental benefits of electricity over diesel were recognised along with the better customer experience afforded by electric units over diesel.

All five current Board strategic themes are relevant to the original EMU project.

Patronage

Whilst it is clear that the EMUs are a significantly better offering than the previous diesels in terms of quality of passenger experience, the measurable impact on passenger usage and other performance indicators linked to the new trains cannot yet be reliably evaluated. A full EMU service on all three lines, with the exception of Papakura to Pukekohe only began on 20 July 2015 so the data set is still too narrow. The project has enabled additional services to be run, as well as offering a better travelling experience.

The table below (Figure 2) shows that mode share for rail has been growing since before the roll-out of EMUs. During the past year to 30 September, when a mixed fleet was in operation for most of the time, rail patronage grew by 22.8% relative to 8.8% across all modes.

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Figure 1 - Metro Patronage - Rolling Annual Total Passenger Trips - All Modes

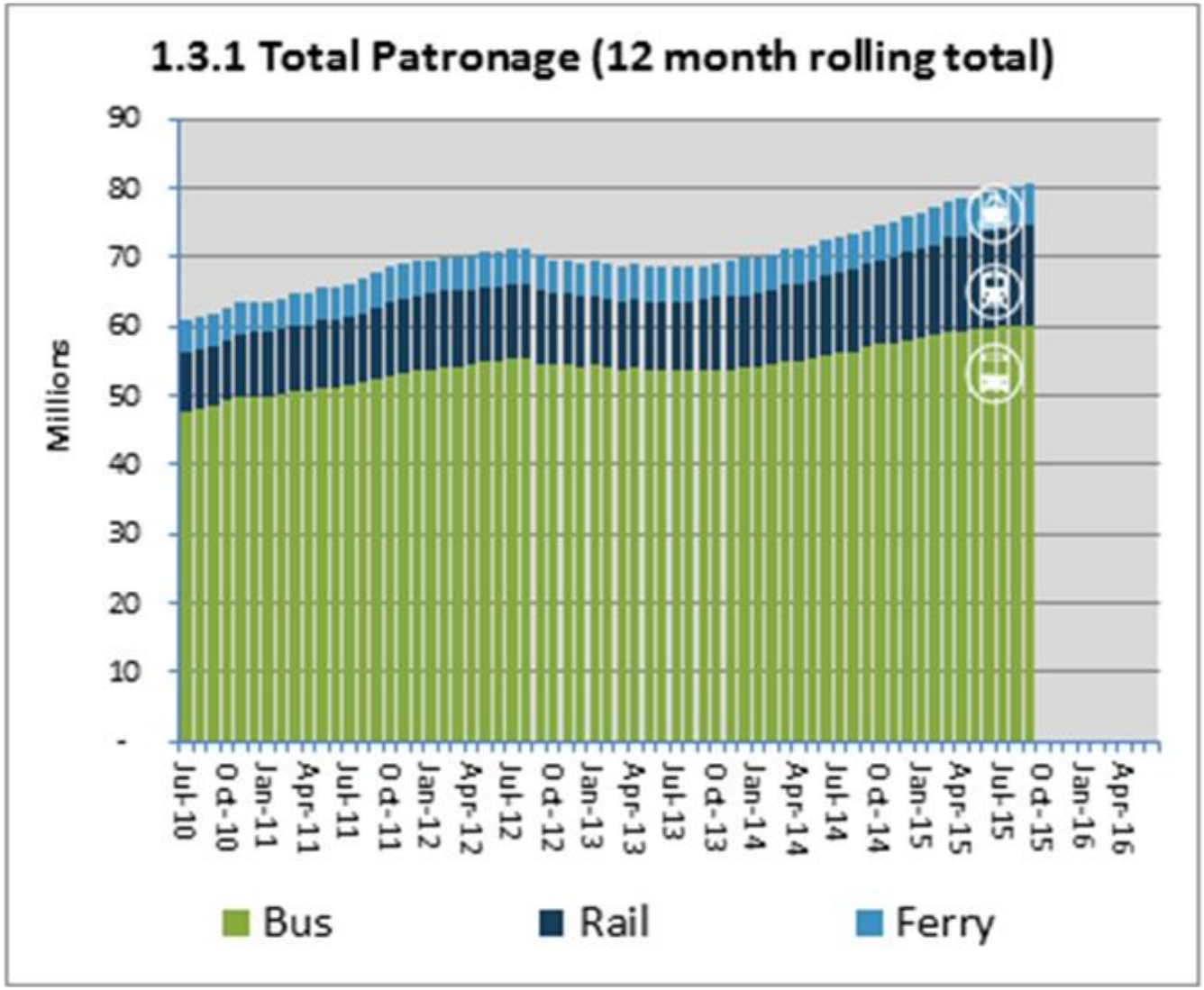

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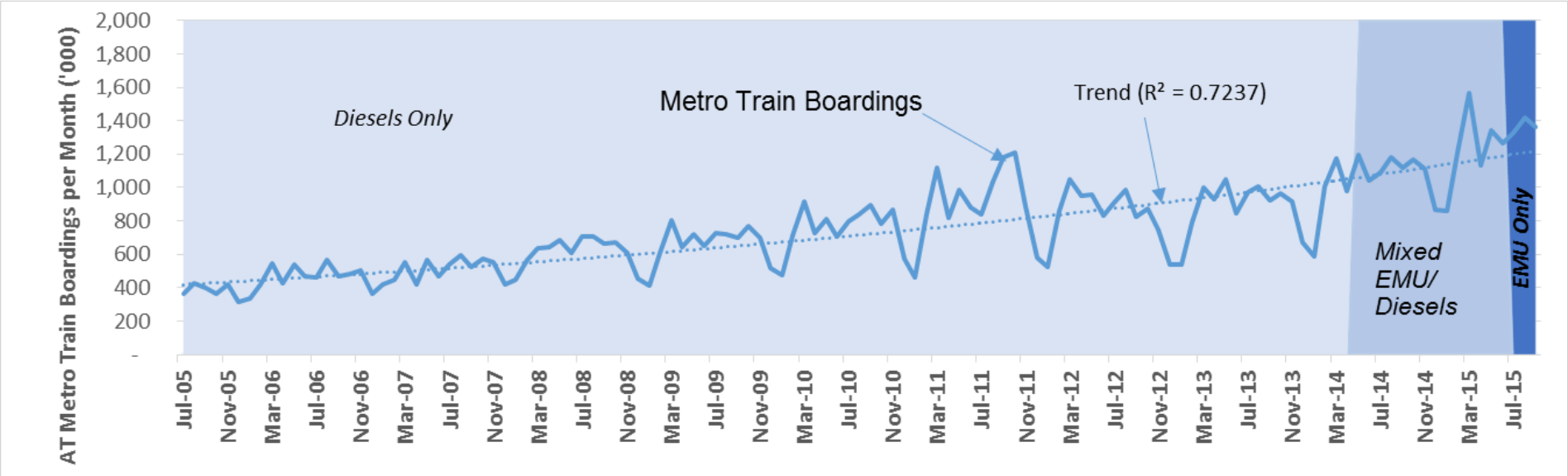
Figure 2 - AT Metro Train Boardings Trend (Source: AT Metro)



Reliability

The decision to purchase EMUs also referenced their reliability, relative to the diesels they replaced. Reliability is measured by Total Delay Minutes. Delay minutes will be influenced by the number of trains in operation, quality of rolling stock and other factors such as the state of the KiwiRail network. The graph below (Figure 4) shows that Total Delay Minutes peaked at almost 35,000 in June 2015. There has clearly been a deleterious impact of dual operations / the introduction period of the new units. These would be expected to settle to a reduced level once the fleet is in normal operations, and there does appear to be a step change from 20 July 2015 onwards – on-time and completed trips significantly increased, although now congestion points are being revealed, for example, Quay Park and Newmarket. However running more services, closer together, will also mean that a single failure may impact many services. Total delay per 100,000 service hours may be a more appropriate metric. This should be considered in a subsequent benefits realisation once a sufficient period of 'normal operation' is available for measurement.

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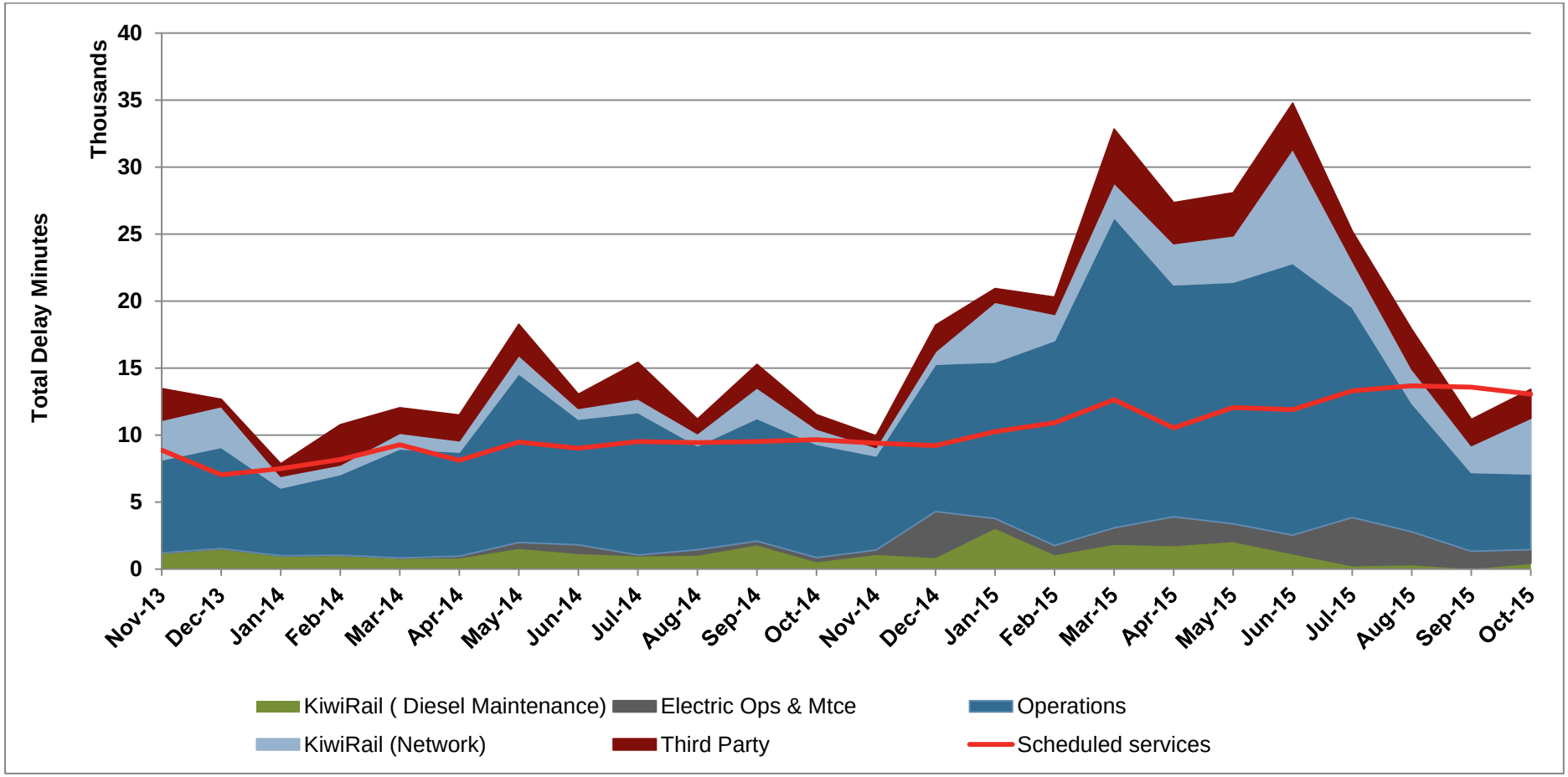
Figure 3: Total Delay (Minutes - '000s) Source: AT Metro



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Train operations

The previous diesel fleet was heterogeneous and drivers were not interchangeable. Train operations and maintenance are more easily managed with the new fleet.

Another characteristic justifying the EMUs was their higher top speed, 110 km per hour – EMU maximum speed is higher but the network maximum is 110 km per hour. However, this speed is only reached on at one point on the network, Southern Line and then only briefly. This is largely a network issue which is being worked on with KiwiRail.

Project execution

A feature of this project is the multiple stakeholders. AT managed the EMU part of the project, taking over from KiwiRail in 2010. The necessary predecessor projects to the EMUs, Network Electrification, dual tracking of the Western Line and signalling improvements, trackwork were done by KiwiRail. The electrification required interfacing with Transpower, the electricity utility, although the contract for supplying the network is between KiwiRail and Transpower. KiwiRail controls the track access and any units operating on KiwiRail lines must be compliant with their specifications. Maintenance of the diesels was undertaken by KiwiRail meaning the project had implications for their employees. Track, signals and platform work was required by KiwiRail to enable the EMUs to operate.

The units themselves are operated by a contractor, TransDev, (formerly Veolia) who provide the train-drivers and the train managers. The maintenance of the EMUs is undertaken by CAF. Co-ordinating these multiple interfaces presented both a project and on-going challenge. Any train modifications, for example, require consultation and agreement by all parties prior to implementation.

Project delivery required interaction with a foreign supplier over the many years of delivery.

Roll Out Technical Challenges

Two issues arose during roll-out:

- **Harmonics** – The interrelationship between the 25kV AC electrical supply and the overhead system and the active control devices of the EMU traction system mean resonance can occur when the network natural frequencies coincide with EMU's control system frequencies. These vary until the number of transformers, line length, number of EMUs and the network disposition and EMU operation condition (power, brakes and idle at station) coincide. When this occurs, the safety controls trigger and the EMU shuts down, as happened in July 2014 during testing. The solution required modifying software filters as this was cheaper than modifying the two different substation power supply systems.

  The organisational complexities required AT having to act through KiwiRail to the electricity supplier presented challenges.

- **European Train Control System (ETCS)** – A strong safety characteristic of the new trains is they have a Level 1 capable signalling network in the ETCS. The automatic system has a sophisticated series of programmable controls that limits train speeds in specific areas, a tight corner, for example or the approach to a station. The system, if triggered and no control action taken, overrides the driver control to bring the EMU to a stop or triggers alarms to warn train drivers of the proximity of a danger.

  ETCS presents a step change in safety building on the previous simpler train control mechanism operated on the diesels. Implementing the ETCS presented a challenge, limiting the ability to deliver the full benefit faster and more reliable network services. Fine tuning to minimise restrictions to safe minimums is ongoing.

Finance

Financing and financially managing a project of this size and complexity presented some challenges. Funding a project of this size and strategic importance meant additional funding from the Crown was required. The core contract for the delivery of the trains was denominated in USD ($299 million) and managing the forex and interest rate risk was critical.

The Capital Estimate at Completion (EAC) is $638 million against a budget of $630 million. The project has remained within budget if the original budget is adjusted for exchange rate differences.

Funding

The project was funded as follows:

Figure 4 – Summary of AT's Funding Sources

Funding	$M (NZD)	Repayment Terms	Notes
Govt. Loan	400	35 yrs	Interest paid by AT & NZTA claimable
Govt. Loan	100	50 yrs	Interest paid by AT & NZTA claimable
	500		
Govt.	90	Grant	
	590		
AC	40	35 yrs	Interest paid by AT and NZ Transport Agency claimable
	630		

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Next steps

Final acceptance is still required for three units and spares delivery is not yet complete. Once the full 57 units have been in use for sufficient time to allow conclusions to be drawn around reliability of services and impact on patronage, a full benefits realisation can be assessed. At this stage a complex project has been delivered successfully and is now operating as business as usual.

Once this stage is finished and the driver pool stable, a transition to Driver Only Operation, part of the original business case, will be progressed to give further operating efficiencies.

Document ownership

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Glossary

Acronym	Description
ARTA	Auckland Regional Transport Authority
CAF	Construcciones y Auxiliar de Ferrocarriles
EMU	Electric Multiple Units
ETCS	European Train Control System
MoT	Ministry of Transport