Patrick Terminals Fremantle – Battery Electric Terminal Trucks

Lessons Learned Report No. 1

30 May 2024

Organisation	**Patrick Terminals** www.patrick.com.au
Project Name	**Patrick Terminals - BEV Terminal Trucks at the Port of Fremantle**
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Contents

List of Figures

List of Tables

1 Project Background

1.1 Project Summary

Patrick Terminals (Patrick) will deploy 9 battery electric vehicle (BEV) terminal trucks (TTs), associated fast charging infrastructure and a fleet power management system to replace 8 diesel equivalents at the Port of Fremantle Port in Western Australia (WA). (The Project)

Figure 1: Patrick Terminals Fremantle

1.2 Background Information

Patrick is one of Australia's largest container terminal operators with operations at four strategically located container ports nationally and handling c.40% of container volumes at its port locations. It has a decarbonisation plan which focuses on three key priority areas of fleet modernisation, a transition to renewable energy and influencing intermodal (rail and road capacity and efficiency).

The Project represents the first heavy BEV deployment for 24/7 container terminal operations in Australia. It is a foundation project under Patrick's decarbonisation plan and represents a 'proof of concept' for the deployment of heavy vehicle BEV technology in a 24/7 operating environment.

Port operations have seen limited deployment of heavy BEVs, due to the higher upfront costs of BEVs compared to diesel equivalents, the incremental costs of enabling infrastructure and the current perception that BEVs are unable to perform in a 24-hour environment.

The Project aims to demonstrate the suitability of heavy BEVs in this operating environment, gain insights on the key considerations and risks and drive the availability and uptake of a new BEV model in the Australian market.

The Project comprises of 9 x 350kWh Battery Electric TTs along with 2 x 260kW dual-port DC fast chargers, communication and fleet power management systems, and associated site, civil and electrical works at Patrick's Fremantle terminal in WA. The BEV TTs will be deployed to transfer cargo between quay cranes and stacking areas within the terminal.

Figure 2: BEV- TT Commissioning operations at Patrick Terminals Fremantle

1.3 Project Objectives

The objectives for the Project will be achieved through the following outcomes:

1. Demonstrating that BEVs can be integrated as a significant percentage of the TT fleet in 24/7 container terminal operations.
2. Analysing the impact on charging loads and patterns to inform the case for alternative energy pricing models.
3. Operating of the TT fleet to help address key barriers to adoption, such as vehicle purchase and infrastructure costs, vehicle running costs, and operational flexibility.
4. Building the market confidence around the reliability of the new technology, energy costs and other operating metrics through knowledge sharing activities.

1.4 How this report fits into the project schedule

The Project commenced in November 2023 and as such this report represents the key lessons learned for the first six months of the project. The major achievements in this reporting period include:

1. 9 x BEV-TTs - purchase, on-site delivery, commissioning and preliminary acceptance.
2. 2 x 260kW dual gun chargers - purchase, on-site delivery, commissioning and preliminary acceptance .
3. Charger installation complete including: development application, enabling works including network connectivity via copper/fibre optic.
4. Fleet Power Management Test System operational including: vehicle communication to each TT to collect State of Charge (SoC), Open Charge Point Protocol (OCPP) based server to

manage and monitor the chargers and graphical user interfaces/devices for TT drivers and central users.

Figure 3: Delivery of 9 x BEV-TTs at Patrick Terminals Fremantle

Figure 4: Installation of 260kW Dual Port Charger at Patrick Terminals Fremantle

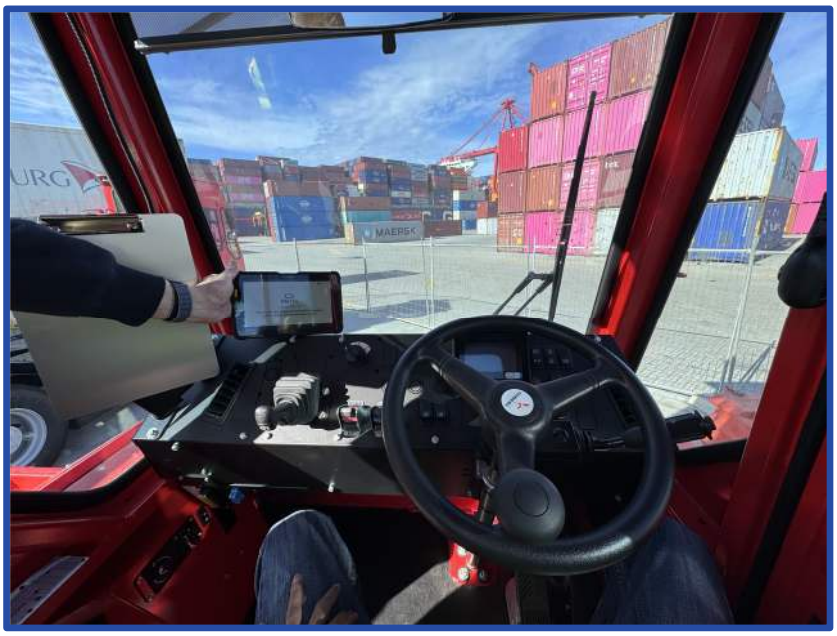

Figure 5: Prototyping driver interface screen as part of the Fleet Power Management System

The next steps of the project include the full operational deployment of the BEV-TTs and Chargers and the commencement of data collection/analysis. It is anticipated that both of those milestones will be achieved in the next reporting period.

2 Executive Summary

The key lessons learned in this reporting period can be summarised as follows:

1. **Procurement Strategy** – Key to mitigating project risk is developing and executing a procurement strategy that includes:
    - Fulsome vendor due-diligence;
    - Development of a performance specification and contractual framework to govern the delivery; and
    - Utilising a single supplier to manage integration between critical components.
2. **Stakeholder Acceptance** - Involving the end user at key points in the schedule is critical for managing change and gaining stakeholder acceptance.
3. **Cross-Functional Project Delivery Team** - Rapidly building a cross functional project delivery team with the appropriately skilled and experienced resources is required to maintain project schedule. Key skills include electrical infrastructure design and delivery, equipment procurement and operational integration along with structured project management.
4. **Supply Chain Issues for ICT Components** - Supply chain disruption/challenges in obtaining ICT components remain and need to be factored into future project schedules.

This report describes in detail the lessons learnt over the first six months of the Patrick Terminals Battery Electric Terminal Truck Project.

3 Key Learnings

3.1 Key Learning 1: Procurement Strategy

Category	Commercial
Lessons Learned Title	Procurement strategy is key to reducing project risk, specifically: 1. Vendor due-diligence; 2. Development of a performance specification and contractual framework to govern the delivery; 3. Utilising a single supplier to manage integration between critical components.

Table 1: Key Learning 1 Summary:

Detail:

Given that the Project constitutes Patrick's first investment in heavy vehicle BEV technology, Patrick made a tactical decision at the commencement of the Project to invest in a robust procurement framework to minimise project risk. The framework consisted of 3 key pillars:

1. Fulsome vendor due-diligence;
2. Development of a performance specification and contractual framework to govern the delivery;
3. Utilising a single supplier to manage technical integration between critical components.

This strategy was proven to be a success when it came to delivering to the Project schedule.

Firstly, the multi-criteria assessment that Patrick utilized to select the vendor was able to identify the maturity of the technology (a 3rd generation BEV was selected) and capacity of the vendor to deliver. The assessment included gathering extensive technical and operational data on BEV Terminal Trucks (TTs) deployed globally through extensive engagement with suppliers as well as validation through interviews with overseas terminal operators currently utilising the various prospective BEV-TTs in their terminal operations. This process ensured the delivery risk and technical risk of the TTs was minimised prior to project commencement.

Secondly, Patrick followed the adage "what you write, is what you get" by developing a comprehensive performance specification and a contractual framework based on the Australian standard which was used to govern the project delivery and formal relationship with the TT supplier. This was a key tool to manager delivery risk, minimise misunderstanding and ensuring timely delivery.

Lastly, given the relative novelty of the Project, Patrick decided early on to use a single supplier to deliver all technical integration between the critical components with the important integration interfaces being the interface between the Charger and the TT, as well as between the TT and the fleet power management system. This outsourced all integration delivery risk to the TT vendor: assessed by Patrick to be the optimal party to manage this.

Implication for future projects

The procurement framework Patrick followed for this project was assessed to be largely successful in minimizing both technical risk and project delivery risk. While it's self-evident that each project will have their own procurement process, the lesson from the Project is that vendor

selection, contractual framework and integration risk are key lessons that must be adopted into any such process.

3.2 Key Learning 2: Stakeholder Acceptance

Category	Change management
Lessons Learned Title	Involving the end user at key points in the schedule is critical for managing change and gaining stakeholder acceptance

Table 2: Key Learning 2 Summary

Detail:

Patrick is an organization with a proven track record of delivering complex automation and operational improvement projects. As such it has been Patrick's experience that involving all stakeholders, and in particular front-line operational staff, at key points within the Project lifecycle is critical for managing change and gaining stakeholder acceptance.

Key members of the workforce were involved in the factory acceptance testing and on-site vehicle commissioning. This has enabled Patrick's HR and HSE functions to utilize this knowledge in the development and delivery of comprehensive training packages.

All of this has resulted in a positive reception of the technology by Patrick's operational team and workforce. This has been aided by the natural benefits that come with driving (quieter, smoother) and maintaining (cheaper, easier) a BEV compared to an internal combustion engine (ICE) vehicle.

Implication for future projects

Patrick's experience is that stakeholder involvement, and in particular front-line operational staff, at key points within the Project lifecycle is critical for managing change and gaining stakeholder acceptance. This "operations first" lesson from this Project is that this is something that should be factored into both the project schedule and project culture for any future project.

3.3 Key Learning 3: Cross-Functional Project Delivery Team

Category	Project delivery
Lessons Learned Title	Rapidly building a cross functional project delivery team with the appropriately skilled and experienced resources is required to maintain project schedule. Key skills include electrical infrastructure design and delivery, equipment procurement and operational integration along with structured project management.

Table 3: Key Learning 3 Summary

Detail:

In comparison to a project aimed at delivering only ICE equipment, the delivery of BEV heavy vehicles has more elements, requires more components and hence requires a broader range of project skills and experience. This project delivery team is cross functional and must not only

include equipment procurement specialists but also electrical engineers, construction management, operational staff and ICT specialists.

Maintaining project schedule, means that this cross functional team must be rapidly assembled and hence prior to commencement, there needs to be consideration to appropriately skilled and experienced resource recruitment/procurement.

An important lesson from the Project was procuring competent resources for the delivery of the electrical infrastructure including leading the development agreement process with the grid operator, electrical design and transformer procurement. The Project was able to maintain project schedule for this scope of activities largely through the assembly of an experienced team of specialists who were able to efficiently work through the required set of tasks to enable charger installation.

Implication for future projects

Prior to commencing BEV heavy vehicle projects, consideration should be given to recruiting or procuring skilled and experienced resources for the various disciplines required for project delivery. The quality of the resources can be a key determining factor in how well project schedule can be maintained particularly in relation to the delivery of the electrical infrastructure.

3.4 Key Learning 4: Supply Chain Issues for ICT Components

Category	Logistical/Project Delivery
Lessons Learned Title	Supply chain disruption/challenges in obtaining ICT components remain and need to be factored into future project schedules.

Table 4: Key Learning 4 Summary

Detail:

BEV heavy vehicle projects likely require software and information communication technology (ICT) components to function. Usually this comes with more emphasis compared to equivalent ICE delivery projects.

The Project requires a Fleet Power Management system which consisted of telemetry and communication devices on the vehicle (see for example Figure 5 for an example), connected Chargers and centralized server based software platform that can direct the operators of the fleet of TTs to undertake charging jobs/vehicle swapping.

A lesson from the Project was that the lead time to obtain certain ICT components is longer than what was initially anticipated largely because of a disrupted supply chain post pandemic.

Implication for future projects

Future projects need to take care to understand the dependencies and likely lead times for all components required to deliver the project. While often focus is given to the major pieces: vehicles, chargers etc - smaller components such as transformers and ICT items also need to be delivered and integrated..

4 Conclusion

While the first six months of the Project realized several achievements including the successful delivery of the BEV-TTs and chargers, installation of chargers and development of the Fleet Power Management system, there have also been key lessons learnt that are helpful for future projects. These include:

1. Developing and executing a **Procurement Strategy**
2. End user involvement to maximise **Stakeholder Acceptance**
3. Rapidly building a **Cross-Functional Project Delivery Team**
4. Factoring in **Supply Chain Issues for ICT Components**

The next phase of the Project is focused on the full operational deployment of the BEV-TTs and Chargers and the commencement of data collection/analysis. This phase will offer the opportunity to further validate/refine the above lessons particularly in relation to procurement strategy and stakeholder acceptance as well as learn about the 24-7 operational deployment of BEV-TTs in line with the Project Objectives.