

INDUSTRY PROFILE

Rail



ANZSIC 4710 Rail Freight Transport
ANZSIC 4720 Rail Passenger Transport

Report Prepared July 2022

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Overview

- This industry profile covers the Rail sector of Transport, Postal and Warehousing. Relevant ANZSCO Industry Groups are:
 - 4710 Rail Freight Transport – in WA this is Heavy Haul rail moving, for example, iron ore, minerals and wheat.
 - 4720 Rail Passenger Transport – in WA this is the Public Transport Authority. This is characterised by METRONET with electric trains powered from overhead cables.
- The WA Rail sector is unique in Australia for three factors:
 - private companies own significant rail networks. For example FMG, BHP and Rio Tinto alone operate over 2000 kilometres of remote Heavy Haul Rail
 - newly constructed METRONET and remote Heavy Haul Rail make WA a world leader in autonomous trains and electronic signalling. This generates world leadership in infrastructure advances forming integrated logistics systems. For example integration now of Rail with Pilbara Ports and potentially road – rail – port integration at Westport, Kwinana.
 - WA Heavy Haul Rail makes a strategic contribution to Australia through the value of Iron ore exports to the Australian economy.

WA Rail and the global supply chain

- **Pilbara iron ore Rail.** Iron ore accounted for 89% of WA royalty revenue and 28% of general revenue in 2020-21. Over 60% of WA iron ore sales volume was exported from Port Hedland in 2020-21 followed by Cape Lambert (20%), Dampier (15%) and all other ports (5%). WA accounted for 39% of global iron ore supply in 2020. This strategic export is built on the operational efforts of the Rail workforce. For example FMG, BHP and Rio Tinto alone operate over 2000 kilometres of remote rail network in WA. Some Pilbara mines connect to port using state government-owned railways. These remote WA rail networks lead the world in autonomous train and automatic signalling technology. This creates demand for Rail workers with high level skills.
- **Location of rail workforce.** The geographic location of workforce is on the Rail network. Passenger Rail is concentrated in the Perth Metropolitan Area. Heavy Haul Freight Rail is concentrated in the Pilbara with Heavy Haul of wheat in the Wheatbelt.
- **Heavy Haul Freight Rail.** There is currently an estimated 2,639 route (track) kilometres of railway in the Pilbara region. This Heavy Haul Rail transports iron ore from mine to port. These privately owned rail networks are maintained, upgraded and expanded to connect new mine sites/projects as they come online. There is approximately 5,500 km of standard, narrow and dual-gauge rail infrastructure in the southern half of the state. This ranges from Midwest WA to the Goldfields and Yilgarn regions through to the South West and Great Southern.¹
- **Wheatbelt Rail.** Wheat is the major grain crop produced in WA making up 65% of annual grain production and generating A\$2-3 billion for the State economy each year. Wheat production occurs across the WA wheatbelt. WA generates about 50% of Australia's total wheat production with more than 95% of this exported predominantly to Asia and the Middle East.
- **February 2022 WA to East Coast Rail link breakdown.** The WA to East coast Rail supply chain breakdown of February and March 2022 illustrated the importance and profile of Freight Rail. Flooding destroyed 18 sections across a 300 km length of the WA to East coast rail link in remote areas. The logistics supply chain affected stock in shops. This was a high profile media event. Some large companies hired shipping. The repairs took three weeks.
- **Current and emerging trade opportunities (global supply chains).** Australia is subject to surges and declines in the world commodity markets. The war in Ukraine affects wheat and liquid natural gas production and supply. COVID-19 has affected Brazil Iron Ore. The March 2022 Chinese snap lockdown for zero-Covid policy has closed port of Shanghai. World events affect Australian exports.

WA Heavy Haul Rail and iron ore exports

- **Iron ore exports.** Three WA ports dominate Australian iron ore exports: Port Hedland, Dampier and Cape Lambert. Port Hedland is the largest bulk export port in the world. WA ore and mineral export is growing. The ports of Esperance and Geraldton are expanding iron ore exports. Growth requires infrastructure and efficient logistics chains. Expansion drives rail and port integration: additional jetties and berths for larger vessels, integrated rail-port yards for blending ore stocks, channel dredging, higher-capacity ship loader equipment, new railways and longer trains The upstream logistics chain to port is Heavy Haul Rail using high-volume dry bulk trains.

- **Pilbara Rail integrated logistics.** New Pilbara railways run with trains hauling up to 33000 tonnes of ore. Early Pilbara lines carry trains hauling around 9000 tonnes. These trains are 2.5 km long with the heaviest wagons in the world carrying at 130 tonnes of ore per wagon. Rio Tinto trains are autonomous driven by operators in control rooms in Perth. New railways, electronic signalling, new and longer passing loops, double and triple tracking have increased Heavy Haul Rail capacity. The major mining companies in the Pilbara aim for an integrated logistics chain from mine to port via rail. The mining companies control logistics to wharf side. At wharf side actions must be integrated with port users and the port authority.
- **Pilbara Rail network.** Virtually all Pilbara ore goes to port by train. The iron ore that passes through Port Hedland is mined predominantly by BHP Billiton and Fortescue. Mines are up to 425 kilometres from the port. The railways are owned by the mining companies or joint-venture companies who operate the trains directly or via subsidiaries. A summary of the Pilbara Rail network is:
 - BHP Billiton Goldsworthy railway from Yarrie and Newman railway from a range of mines including Mac and Newman Hub to Port Hedland.
 - Fortescue Christmas Creek railway and Fortescue Hamersley - Solomon railway to Port Hedland.
 - The proposed Hancock Roy Hill railway to Port Hedland has contracts let but construction is pending.
 - Rio Tinto Rail networks to Dampier and Cape Lambert.
- **Pilbara Rail network upgrades.** The landside logistics infrastructure has been upgraded to expand capacity. BHP Billiton has substantially double-tracked its Newman railway. Fortescue has double-tracked around 39 per cent of its Port Hedland – Christmas Creek railway. Atlas Iron has been exploring new rail construction with Aurizon plus use of the Fortescue railway network to replace road haulage from the Pardoo Mine 75 km east of the port and the Wodgina Mine 100 km south. Atlas uses the Port Hedland Utah Point common-user berth. Atlas shipped around 5.6 million tonnes of iron ore in 2011–12.
- **Port Dampier.** Rio Tinto Hamersley Iron moves iron ore by railway to Port Dampier from Paraburdoo. There are branches to other iron ore mines including Yandi, Hope Downs (a Rio Tinto joint venture with Hancock), Brockman No.4 mine, West Angelas and Mt Tom Price. The landside movement of the iron ore occurs entirely on the Rio Tinto Hamersley Iron Railway. Hamersley Iron railway trains are 2.5 km long. Each train carries around 26000 tonnes
- **Geraldton.** The rate of iron ore export from Geraldton is increasing. The Karara Iron Ore Project is a joint venture between Gindalbie Metals and Ansteel. A new port terminal rated at 16 million tonnes per annum was built at Geraldton to accommodate export traffic. The Karara project has involved constructing an 85 km railway between the existing Brookfield Rail network at Morawa and the mine site at Karara. That project underpinned the Brookfield Rail upgrade of the Midwest Railway between Morawa and the Geraldton.
- **Esperance.** Iron ore is exported through Esperance from the Koolyanobbing mining operations in the Yilgarn Region by Cliffs Asia Pacific Iron Ore. Current iron ore exports of 9 million tonnes per annum form three quarters of the port throughput. Iron ore is transported to the port by railway via the Koolyanobbing - Kalgoorlie (interstate - Eastern Goldfields) and Kalgoorlie - Esperance railways. Track renewals and additional passing loops have been undertaken. Train length has been increased from 126 wagons to 159 wagons. Rail infrastructure work has been undertaken around Esperance.²

- **Western Australia Iron Ore.** Western Australia Iron Ore (WAIO) is an example of an integrated BHP logistics system. There are four processing facilities and five mines connected by 1,000 kilometres of rail infrastructure. WAIO comprises a BHP 80 million tonnes per annum Pilbara iron ore mine called South Flank plus the neighbouring BHP Mining Area C. This forms the largest operating iron ore hub in the world producing 145 million tonnes of iron ore per year. Train drivers and rail infrastructure maintenance crews will be required to deliver iron ore from pit to port over a pit lifecycle of 25 years.³
- **Liquefied natural gas.** Liquefied natural gas (LNG) exports are increasing from reserves in WA. Rail carriage of LNG is minimal. Transfer is generally by pipeline with offshore processing.

Pipeline of major State Government projects

- **METRONET.** The 15 METRONET passenger rail projects form the single largest investment in WA public transport. Statistics include 72 km of new passenger rail and 22 new stations with 8000 hectares of land developed around new stations. Workforce shortages have been acute. Rail stakeholders agree that the training window in WA for railway construction has passed. Experts concur that WA training and migration should focus on the maintenance and operations occupations that will exist over the next 10 to 15 years to service the lifecycle of the 15 METRONET projects beyond construction.
- **Forrestfield-Airport Link.** An example of one METRONET project is the Forrestfield-Airport Link or Airport Line opening 9 October 2022. The \$1.86 billion Forrestfield-Airport Link is jointly funded by the Australian and WA governments. The new rail service to the eastern suburbs will have three new stations at Redcliffe, Airport Central and High Wycombe. The \$625 million contract for the Byford Rail Extension has been awarded to MetCONNX Alliance. This will create better transport connections for Serpentine Jarrahdale. The \$701 million Victoria Park-Canning Level Crossing Removal contract has been awarded to the Armadale Line Upgrade Alliance (Acciona Construction, BMD Constructions, WSP and AECOM). Other projects include the Thornlie to Cockburn spur line, the Yanchep rail extension and the Ellenbrook line.
- **WA Railcar Program.** See below
- **Rail Trade Training Centre.** See below
- **Henderson region developments.** The WA Government has projects in the Henderson region that will require integrated rail freight links. Four projects include
 - **Westport.** Westport is the proposed container port in Kwinana with integrated road and rail networks.
 - **Shipping and Supply Chain Taskforce.** The McGowan Government Shipping and Supply Chain Taskforce will need to analyse integrated rail links when reporting in 2022 on the resilience of Australia's shipping industry and vital supply chains.
 - **Defence West support to the Naval Shipbuilding Plan.** Defence West planning will need to include Rail integration in the Defence supply chain for construction, operation and maintenance in the Naval Shipbuilding plan.
 - **Australian Marine Complex dry dock development.** Rail integration will need consideration in the Defence supply chain for dry dock development at the Australian Marine Complex, Henderson and related to growth of HMAS Stirling as a Royal Australian Navy regional maintenance hub.

Rail skills shortage

- **National Rail Action Plan.** In 2020 State and Federal transport Ministers agreed to implement the National Rail Action Plan. Strategically \$155 Billion has been allocated. Planning has made the Government aware that there is no trained workforce to build \$155 Billion of rail infrastructure nor the trainers to train them. Ministers approved the formation of a *National Rail Skills Hub to co-ordinate between state academies and industry initiatives to improve access and pathways to current and future rail skills needed to build and operate the national rail network*. The proposed Rail Skills Academy is part of this National Rail Skills Hub. The National Rail Action Plan aims for Rail harmonisation and standardisation across Australia. It is important to note that WA is a leader in automation and does not have the legacy mechanical signalling systems that will influence the national harmonisation decisions.
- **National Rail skills shortage.** The Australasian Railways Association is investigating a national approach to alleviate the skills shortage and mobility constraints. The acute Rail skills shortages faced by WA are national. The 2021 Infrastructure Market Capacity report has a Public Infrastructure Workforce Supply Dashboard.⁴ The report forecasts that over the next three years the labour shortages will peak at a shortfall of 93000 workers in 2023. At this peak demand for skilled workers will be 48% higher than supply. The rail sector was already facing workforce shortages for infrastructure and maintenance roles prior to COVID-19 to cope with the Commonwealth and State investment in rail. Ref <https://www.ntc.gov.au/sites/default/files/assets/files/National-Rail-Action-Plan.pdf>⁵
- The Australian Railways Association (ARA) identified an acute shortage in the following rail occupational groups ARA-Skills-Capability-Study.pdf WA stakeholders would add the two occupations Track Protection Officer and Train Controller. Noting that Train Controller traditionally develops from the occupations Train Driver and Track Protection Officer.⁶
 - Track Inspectors
 - Train Drivers
 - Track Workers
 - Electrical Technicians
 - Signal Technicians
 - Rail Engineers (Electrical, Mechanical, Signalling)
 - Network Controllers
 - Telecommunications Trades

- **The Seamless Future Rail Skills project.** On 29 Mar 22 the Australian Industry Standards launched the Seamless Future Rail Skills project. This has 30 Rail training pathways open for public consultation www.futureraislskills.org.au⁷:
 - Railway Track Plant Operator
 - Track Vehicle Machine Operator
 - Rolling Stock Maintainer
 - Cable Jointer
 - Cable Jointer (Underground)
 - Tramway Track Worker
 - Possession Protection Officer
 - Protection Officer Level 2/3
 - Protection Officer Level 4
 - Rail Infrastructure Worker
 - Rail Safety Officer
- **Rail Industry Worker program.** The Rail Industry Worker Program (RIW) is a national competency management framework for rail worker compliance. The RIW is owned by the Australian Railways Association (ARA). Participant organisations have visibility of the regulatory and compliance requirements of workers moving between projects.
- **Ageing workforce.** The WA cohorts of ANZSCO 731311 Train Drivers and Rail Trainers and Assessors (ANZSCO 242211 Vocational Education Teacher) are aging out.
- **Rail Trainers and Assessors (ANZSCO 242211 Vocational Education Teacher).** In WA all companies are aware of the acute shortage of trainers to replace the current trainer cohort that is aging out over the next two to seven years. Stakeholders realise the reality that there is no training pathway without trainers. There is a limited number of RTOs in WA that provide Rail training. Trainers and Assessors are recruited in house but take-up is weak. The TAE40116 Certificate IV Training and Assessment is seen as an obstacle. During COVID-19 border restrictions some companies put their trainers back on Rail operations due to staff shortages. Organisations have reported a minimum of three and a half years to find a competent Trainer in Perth welding. Two large Statewide companies stated they have only one suitably experienced Rail Trainer - Assessor.
- **Attraction and retention of workers.** In the competition for skilled rail labour a merry-go-round has developed in WA as workers rotate between companies. Companies with in-house training blame the companies without training. The solution is to address the overarching skills shortage

- **Non market factors.** Non market factors affect recruitment for Heavy Haul Rail in the Pilbara. Factors are a lack of affordable housing, housing shortages, remoteness and lack of childcare services. Efforts by WA regions are well-documented. Metropolitan lifestyle naturally gives mature professionals access to housing, childcare and tertiary education options that match their income. This creates FIFO. State Government efforts to support regional day-care and housing are acknowledged but the pros and cons of FIFO are well known. One Rail company reported housing issues in Northam as a barrier.
- **Under-utilised or latent capacity.** Large enterprises in the Pilbara conduct successful local recruitment campaigns for rail workers. Companies are aware of the value of local workforce for stability and value in contrast to FIFO. Companies have targeted Indigenous groups, females, schools and under-utilised groups as entry level Rail Shunters. For example in 2021 BHP launched a three year program to qualify 200 Train Drivers with entry as Rail Shunter.
- **Transition of Defence veterans.** The Logistics and Defence Skills Council is collecting detail of developments in WA regarding employment of Defence veterans. A key point is that WA does not have a high-level of transitioning service personnel compared with regions that have large Defence formations like Queensland or the Northern Territory. BHP have established an engagement program with Defence in WA for expansion to Queensland.

Rail Training

- **WA Railcar Program.** The WA Railcar Program was identified as a [Strategic Project](#) under the WA Jobs Act 2017. Alstom Australia will manufacture 102 new railcars (17 six-car trains) at the Bellevue Railcar Manufacturing and Assembly Facility. Construction of the \$46 million METRONET Bellevue rail car manufacturing facility commenced in March 2020.⁸
- **Rail Trade Training Centre.** North Metro TAFE is the approved/preferred training provider for The WA Railcar Program with industry partner Alstom Australia at the METRONET Bellevue rail car manufacturing facility. Development includes the METRONET Trade Training Centre at North Metro TAFE Midland Campus. The intent is to link the Bellevue Railcar Facility with a Rail Trade Training Centre run by North Metropolitan TAFE for apprenticeship and traineeships.
- **Stage 1.** Stage 1 works completed in October 2020 by M/Construction built rail signalling workshops for electrical rail signalling qualifications. A pilot group of employees from Rio Tinto, John Holland Group and Hitachi commenced a Certificate IV in Electrical Rail Signalling in Semester 1 of 2021. Holders of a WA electrical licence will be able to undertake a Certificate IV in Electrical Rail Signalling from Semester 2 of 2021.
- **Stage 2.** The \$5.6 million Stage 2 development includes construction of a dual-track level crossing, a maintenance track and crossover, a standalone Signalling Equipment Room to enable hands-on training in signal equipment and a section of line for training in rail maintenance.⁹
- **Proposed WA Rail Skills Academy.** The Australasian Railways Association (ARA) is liaising with the WA Government on potential for the Trade Training Centre to relate to the WA Rail Skills Academy nested in Metro North TAFE and Pilbara TAFE. The intent of the National Rail Action Plan is that WA will pilot a Rail Skills Academy. It is acknowledged that that private providers have an essential role in WA Rail industry training. An Industry Advisory Board will guide the WA Rail Skills Academy.

- **Industry career pathways.** WA Rail stakeholders acknowledge a misfit of WA TAFE training to the industry career pathways and the weaknesses of the Apprenticeship - Traineeship system in the WA context. WA Rail training needs coordination. WA Rail stakeholders look forward to developments in the Trade Training Centre and WA Rail Skills Academy.
- **Induction skillset.** There is potential for a short course to support WA industry practice. A central location could teach foundation skills and enterprise knowledge before trainees move to different areas via FIFO work. For example there could be training including:
 - FIFO health and wellbeing
 - risk management and safety tools
 - radio communications
 - compliance training
 - rail maintenance and mechanical appreciation
 - industry concepts of mine to market, supply chain/value chain
 - industry context, values, pathways and performance management
 - induction / area specific inductions
 - fatigue management
- **Contractor Rail skillset.** The acute Rail workforce shortage means that companies are utilising civil contractors for Rail construction with no Rail experience eg METRONET construction. There is a particular need for a short course relating to the legal requirements for Rail Track Protection Officer and Possession Protection Officer to protect construction workers on a Rail network. Companies are hiring separate mechanical and electric contractors from the heavy vehicle / heavy industry sector for Rolling Stock Fitting and Maintenance. The traditional Rail workshop trades that combined Mechanical and Electrical Fitting are not available. These contractors have no rolling stock experience. Stakeholders work on a minimum of 12 months to develop skills for the rail environment before electrical or mechanical fitters can be utilised as rolling stock engineers (passenger), wagon maintainers or diesel mechanics (freight).
- **Apprenticeship - Traineeships.** Rail stakeholders support maintenance of the Apprenticeship - Traineeships:
 - TLI27121 - Certificate II in Rail Infrastructure¹⁰
 - TLI37121 - Certificate III in Rail Infrastructure
 - TLI40921 - Certificate IV in Rail Network Control
 - TLI42621 - Certificate IV in Train Driving
- **Industry safety regulator.** The Office of the National Rail Safety Regulator (ONRSR) is the independent body corporate established under the Rail Safety National Law to enforce safe rail operations, promote and improve national rail safety.¹¹

Establish industry partnerships with education, training and university

- **Industry and education.** Rail training requires a track, rolling stock and locomotives. Rail training therefore requires partnerships to share infrastructure. The Naval Shipbuilding Plan, METRONET and the construction of remote railways for resource Heavy Haul Rail are creating competition for a small graduation of Engineers and supporting technicians. There needs to be a coordinated training plan to generate the Engineers and related Technicians required by Rail, shipbuilding in the Defence Industries, Maritime, Civil construction and the Heavy haul Rail in the WA resources sector. Naturally migration must be considered as a short term fix. A long term training plan may include
 - Engineering career pathway information
 - Partnerships with industry and university
 - Internships
- **Training and university.** The acute shortage of engineers within the rail industry suggests it would be beneficial to influence the course structure at the Rail Trade Training Centre and the proposed WA Rail Skills Academy nested in Metro North TAFE and Pilbara TAFE to develop Level 2 course options. This should be synchronised with Higher Education Engineering courses for a Level 1 pathway. WA is a world leader in remote Heavy Haul Rail with autonomous trains and electronic signalling. There is an opportunity to develop a Rail specialisation for existing Engineer courses plus a short course option for upgrades of existing Rail Engineers or transition of qualified engineers from other fields.
- **Perception of the industry.** Rail engineering needs to be seen as a genuine career alternative to the mines. WA should utilise its position as a world leader in autonomous and digital rail technology derived from development of the supply chain for the resource sector in the Pilbara. The Rail industry is poorly branded. In WA the Heavy Haul Rail sector can be easily assumed to be part of 'the mines'. This can affect political policy and funding. Neither Passenger nor Heavy Haul Rail are articulated as career options in Schools, TAFE and Universities.

COVID-19 impact

- **Workforce constraints due to COVID-19 border restrictions.** Note that the COVID-19 border restrictions affected international, interstate and intrastate FIFO for Rail professionals and technicians. For example COVID-19 dislocated the traditional movement of construction phase workforce who move between national and international Rail construction sites. This caused a recalibration of the METRONET construction timeline. This workforce availability will re-adjust. The situation is dynamic.
- **Labour movement.** Before COVID-19 rail contractors were able to move their workforce to where the projects were located. Interstate FIFO was standard industry practice. National companies transfer workers from one project to another across the construction, operation and maintenance phases. Employers have concerns over the ability to meet current and future contractual obligations in WA when unable to access experienced workers due to border closures. Rail sector work is often in isolated and remote regions. For example construction of new track in the North West and South West of WA has relied on project-based FIFO work.

- **Diminished rail labour pool.** COVID-19 has diminished the rail labour pool in WA. WA Rail companies have re-deployed trainers and assessors back into operational roles to mitigate capacity constraints. Training programs have been suspended. There is a high profile shortage of Train Drivers. The shortfalls in trainers and assessors is a National and State issue across all roles in infrastructure, maintenance and rail driving operations.
- **Heavy Haul Rail.** Bulk and rail freight operations continued to operate during COVID-19. Factors include increased grain harvests, increased world grain demand, the high price of iron ore and minerals. WA resource companies have increased production in response to global market demand. This requires a larger workforce to freight products by rail.
- **Passenger Rail.** A shift towards working and studying from home contributed to a fall in industry revenue in 2019-20 for passenger transport. This contributed to a lower profit in 2019-20 with gradual recovery in 2020-21 as COVID-19 restrictions eased. IBISworld predicts that the COVID-19 pandemic is likely to encourage commuters to avoid public transport and opt for private vehicles. The Rail Passenger industry is still projected to continue growing over the next five years due to government investment in new supply and the return of consumer demand.

Training and migration strategy

- **Rail skills shortage.** The Rail industry requires specific skills. The skills range from professional Level 1 Engineers to Technician through to entry level Rail Worker. The skills required in the rail construction phase are different to the operations and maintenance phases. WA is in a construction phase and has an acute shortage of Rail workforce. Therefore stakeholders use temporary, permanent interstate and overseas migration short term but acknowledge the need for training in WA for operations and maintenance long term.
- **Rail Construction phase.** It is important to emphasise that the construction phases of the 15 METRONET projects and the current construction of remote freight rail networks for iron ore export require specific rail construction occupations that move between railway construction sites. These occupations are mobile. These higher level Rail engineers cannot be trained in WA. The required occupations will change as these projects mature from construction into the maintenance and operations phases of the 15 year project life cycle.
- **DIDO – FIFO and Migration.** The Rail industry uses workforce that is Drive-In-Drive-Out (DIDO) and Fly-In-Fly-Out (FIFO) plus permanent interstate and overseas migration. Factors include the location of remote Heavy Haul Rail networks in the Pilbara and the specific needs of workforce in the Rail construction phase compared with operations and maintenance. Migration options used by the rail sector include:
 - temporary DIDO
 - temporary FIFO (WA)
 - temporary FIFO (interstate)
 - temporary FIFO (international)
 - permanent interstate migration
 - overseas migration with particular reference to engineers
 - State Nomination Migration Program (through Department of Training and Workforce Development (DTWD))

- Engagement with the Commonwealth Government (through DTWD)
- Global Talent visa (through Department of Jobs, Tourism, Science and Innovation)
- The inability to bring in international and interstate skilled workers for specialised roles continues to be an issue faced by rail employers across multiple disciplines including engineering, signal operators, train drivers and train controllers. The average age of rail workers in WA continues to rise. Skilled workers are retained for longer due to lack of replacements. This retention may be subject to the COVID-19 retirement wave. Although industry is looking at ways to engage and retain a younger cohort through traineeships there is a long lead time for these new entrants to become competent.
- **Migration and training strategy.** Rail workforce shortage is acute. WA Rail stakeholders agree policy must relate to:
 - Long term development of Rail training including the WA Rail Skills Academy under negotiation between the State Government and Fiona Love of the Australasian Rail Association
 - Short term inclusion of Rail sector occupations in the two migration streams General and Graduate.

Rail innovations

- **Carbon neutral trains.** International resource companies are under market pressure to move to carbon neutral practices. The large companies in Heavy Haul Rail in the resources sector are moving to battery-powered solar-charged locomotives and alternate fuels.
- **Battery-powered solar-charged locomotives.** Battery-powered solar-charged locomotives are under consideration for remote rail in the Pilbara. Note that remote electric Rail requires different engineering to metropolitan electric passenger Rail. For example there is no overhead power cable. Solar charging will require new infrastructure and maintenance routines.
- **Alternate fuels.** Alternate fuels hydrogen and ammonia are under development. Trials of hydrogen for Heavy Haul road vehicles are progressing in the Northwest.
- **Mechatronics.** The integration of mechanical, electronic and electrical engineering systems as 'mechatronics' is creating crossover in the traditional mechanical and electrical occupations from Level 1 Engineering through to supporting Technician occupations. For example Rail Electronic signalling is advancing to a point where the occupations are close to 263311 Telecommunications Engineer and 342414 Telecommunications Technician.
- **Autonomous trains.** Autonomous Heavy Haul trains are operating in the Pilbara controlled from screens in Perth. At a micro level these autonomous trains require three back up communication systems for safe operation: GPS/satellite, Data and Broadband. The Train Controllers in Perth require maintenance and fault finding systems. For example flying a drone 5 km out and back along a halted 2.5 km iron ore train to inspect the air brake hoses. Then despatching a manual repair team. Autonomous trains will affect the rail occupations for operators, drivers, shunters, maintainers, network controllers and train controllers. As in all areas of automation there will be developments regarding legal safety procedures for rail operations. These legal developments will affect all suppliers in the integrated logistics chain.

- **Transition to electronic signals.** The move to automation will be a transition for occupations and technology. The investment in supporting infrastructure makes immediate full automation expensive. An example at micro level is Heavy Haul locomotives with drivers are transitioning from signal lights on the track to signals on the dashboard in the cab. This saves outdoor signal maintenance costs in remote areas but requires investment in electronic signalling technology. This communications based train control (CBTC) signalling will affect the rail occupations for operators, drivers, shunters and maintainers. Electronic signalling will extend to initial fault assessment and call out of fault repair teams. Control room coordination of signalling will influence Train Scheduling.
- **Cyber security.** Rail companies are moving to automation, digitisation and 'systems thinking'. Examples are electronic signalling and autonomous trains. Iron ore accounted for 89% of State government royalty revenue and 28% of general revenue in 2020-21. Over 60% of WA iron ore sales volume was exported from Port Hedland in 2020-21 followed by Cape Lambert (20%), and Dampier (15%). WA accounted for 39% of global iron ore supply in 2020. Private companies FMG, BHP and Rio Tinto alone operate over 2000 kilometres of remote rail network in WA. This automatic rail network is a cyber target. WA is responsible for 40% of Australian wheat exports. The electronic systems that support these commodities are Cyber targets. The risks are criminal manipulation of the share price or state actor grey zone warfare. These systems are of strategic value and require cyber defence coordinated at Commonwealth level.
- **Systems thinking.** There is global pressure from international export companies to deploy 'systems thinking' at macro level across an integrated logistics system. Theoretically autonomous machines mine and load ore onto autonomous trains. The ore is automatically loaded onto an unmanned ship at port. The ore is automatically unloaded at an automated steel plant. Systems thinking involves an automatic maintenance cycle, fault finding and emergency response. Scandinavian companies are trialling automated unmanned shipping with automated load and unload. Functioning forms of automation technology in Australia are Port Botany, NSW and Victoria International Container Terminal, VIC. The concept is that a Cargo Movement Coordinating Centre controls the loading and unloading of the shipping, road and train network strategically to create an integrated logistics system. Operationally sensors control vehicle and container movement.
- **Big Data analysis.** Systems will generate short and long term data. Data analytics will provide predictive information. For example to plan train, vessel and vehicle marshalling, scheduling, routing and maintenance. The Advanced Train Management System (ATMS) is a functioning example of progress to systems thinking and big data analysis.
- **Infrastructure Diagnostic Vehicle.** The WA Public Transport Authority operate a \$14.3 million Infrastructure Diagnostic Vehicle (IDV). The IDV travels the network replacing visual inspections. The IDV operators monitor data in the IDV Vehicle to predict failures and target repairs. The operators role is an example of data and technology skills moving into the occupation 821611 Railway Track Worker.

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