Reimagining the workforce: training for a future rolling stock workforce

Celeste Young, Roger Jones, Sidney Lung, Daniel Ooi, Neil Parry and Kumi Heenetigala
Institute of Sustainable Industries and Liveable Cities
Victoria University

VICTORIA UNIVERSITY | ISILC INSTITUTE OF SUSTAINABLE INDUSTRIES AND LIVEABLE CITIES
VICTORIA State Government | Department of Transport
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This report is one of a seven reports relating to the 'Reimagining the workforce: building smart, sustainable, safe public transport' research project. The complete suite of reports is as follows:
1. The Victorian rolling stock context. Literature review.
2. Community perceptions of careers working with rolling stock.
3. Organisational context assessment of inclusion and innovation in the Victorian rolling stock sector.
4. Training for a future rolling stock workforce.
5. The economics of rolling stock manufacturing, maintenance and operations for Victoria's public transport sector.
6. Building smart, sustainable and safe public transport. Workshop context paper.
7. Reimagining the workforce for public transport: interim action plan.

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Project summary

Reimagining the workforce: building smart, sustainable, safe public transport is a collaborative research project between the Department of Transport (DoT), the Rail Manufacturing Cooperative Research Centre (RMCRC), Victoria University (VU) and industry, which commenced on 1 July 2019 and will be completed by 30 June 2020. This research aims to provide a starting point for addressing the current knowledge gaps in the transport industry workforce, with a specific focus on above track rolling stock. Its purpose is to understand what practical steps might be taken to address critical skills shortages currently facing the sector, and what is needed to build a sustainable and resilient future workforce.

The project provides a systemic assessment case study of the Victorian public transport rolling stock sector from three perspectives: economic, organisational and community in the broader context of the public transport system. It undertakes a case study approach examining specific organisations across the rolling stock and public transport system in Victoria, and uses an 'end user-based research methodology', which is transdisciplinary and combines end user and academic knowledge. Findings from these assessments will be used to inform a workshop with industry in 2020 to identify key actions and develop an interim plan to support these actions.

Our key purpose is to understand:

- The current above track rolling stock workforce context.
- The barriers, needs, opportunities, benefits and existing strengths of organisations and their ability to respond to current recommendations and achieve a sustainable, inclusive and innovative future workforce.
- The economics of developing and growing capability within transport organisations' workforce as a result of the investment in training (Tiers 2 and 3) and potential economic opportunities for small to medium enterprises (SMEs) at a local level. This is being approached via the benefits and costs of local procurement.
- How the 18–30 year old cohort perceive and understand public transport as a potential employer and their expectations more generally in relation to work.

This research builds upon previous research undertaken by the Australian Rail Association and the RMCRC.

This report is Part B of the organisational review and economic analysis, and focuses on training and the economics associated with apprenticeships. As this report is part of an overall assessment of the rolling stock sector, it should be read in conjunction with *Reimagining the workforce: the economics of rolling stock manufacturing, maintenance and operations for Victoria's public transport sector* (Jones, et al., 2020), which addresses procurement issues, *Reimagining the workforce: community perceptions of careers working with rolling stock* (Ooi and Cormick, 2020), which examines the community, and *Reimagining the workforce: organisational context assessment of inclusion and innovation in the Victorian rolling stock sector* (Young, et al., 2020a), which focuses on the development of the inclusive and innovative culture needed to retain and build the future workforce, and provides the broader context for these findings.

Executive summary

'We need a new vision of what education is and can be in this sector.'

Training is the backbone of capability building, and for the public transport rolling stock sector, it is a core component of building a sustainable future workforce. The strong traditional approach to learning and training has served the sector well, but the system and context this was designed for has changed. Evolving technologies and social norms are driving new forms of education and educational needs. This requires rethinking what is useful, why it is useful and who it is useful for.

The current organisational and economic context of training in the rolling stock industry is fragmented, competitive and diffuse. Analyses of extensive discussions with, and a survey of, industry participants revealed the following challenges:

- There is a lack of cohesion and defined pathways between rolling stock industry, the educational sector and the community.
- There is no cohesive understanding as to how new technologies and social changes in society will manifest throughout the industry in the next 10 years.
- There is a lack of workforce profiles that can be used to support strategic planning of future training needs.
- Responses to training issues in rolling stock have been predominantly reactive and organisationally-based, having little impact on the longer-term workforce issues affecting the sector.

However, these challenges also offer a unique opportunity to build a new model with educational partners that provides short and long-term solutions that are industry and trainee-centric.

'It is really hard to find time to do training, everything is so busy.'

The current expansion of the sector has brought to light large variations in supply chain capability and training needs. These can be separated into short and long-term challenges and opportunities. Many small to medium enterprises (SMEs) are resource-constrained. If they are to realise the potential offered by increases in local content and social procurement, SMEs will require specific support to enable effective development and uptake of training. Study participants also raised the need for a more proactive approach to training that anticipates changing skills requirements, so that a technologically adept workforce is available as new technologies are rolled out across the sector.

The more immediate need, to provide an employment pipeline of diverse, skilled employees, particularly in the trades and technical areas, is acknowledged in all areas of the sector. Opportunities raised by participants included:

- Upskilling and reskilling of potential workforce entrants who may be the 'right people for the job', but may not have all the right skills for the jobs.
- Training to support more effective attraction and retention of employees.
- Exposure to the rolling stock sector by embedding specific modules in current training and higher educational programs.
- The need to rethink apprenticeships and design programs that reflect what employees will be doing in 5–10 years, not just what they do today.

'There is no point in having a brilliant technology or idea if you can't communicate it to other people. Clients need to understand what you're offering and employees need to understand what is on offer. Ultimately, it is all about building relationships and trust.'

Social and technological changes are transforming the sector, which finds itself in the uncomfortable position of having strong traditions that are not well suited to the future it faces. Training in soft skills is critical if leadership and management are to support the development and uptake of social and technological innovation. People-based skills were included in some of the training packages reviewed, but mostly as electives. Social and technological change also results in new types of risk emerging, which will need skills such as adaptability and foresighting to manage. Training packages may need to have their content re-evaluated to address these gaps.

Training needs across the sector are diverse, and much of the knowledge needed to address these already exists within organisations. As a result, mechanisms and resources to support broad, bottom-up and industry-led collaboration are needed for programs to be effective.

Key findings are as follows:

- Formal education, such as degrees and apprenticeships, are the foundation upon which skills are built. This review has indicated a need for more diverse skill sets associated with apprenticeships, and the need for additional modules in current training and tertiary education.
- Ongoing learning is now required for the sector to remain competitive in the face of rapidly evolving technologies and changing social norms. A multi-tiered, diversified approach to training is needed – one that bridges formal and informal training, ranging from short courses to full degrees.
- SMEs were found to have lower capability in some areas, with more resource and capital constraints than larger organisations. There is an urgent need to understand what specific training they need to build capability, what is likely to be most effective, and what mechanisms will best support these initiatives.
- The majority of training undertaken was reported as taking place in-house, revealing the need to build capability in the provision of this training – particularly between older and younger employees. Many of the critical training needs emerging are related to people-based soft skills, which are mainly optional in training packages. This indicates a gap in current training and a need to re-evaluate core competencies in training packages.

The economic framework for assessing the costs and benefits of investing in apprenticeships presented here can serve as a sampler for the economic analysis of other forms of training – such as reskilling and upskilling. Due to the lack of data that can be used to gauge the economic efficiency and return on investment for many types of training being delivered to the rolling stock industry, quantifying these benefits specifically for the rolling stock industry is currently not possible. However, the following general conclusions can be made:

- Compared to other forms of training, apprenticeships tend to recruit younger workers (particularly in trades). Younger workers tend to have a longer working life, providing greater returns to employers for their investment if they can be retained.
- Ongoing investment in apprenticeship training is needed to ensure a pipeline of skilled workers to sustain economic returns.
- The dual structure of on and off-the-job training reduces the need for government investment compared to other forms of solely off-the-job training (such as university degrees or TAFE diplomas).
- Further investigation is needed to understand the economic context of costs and benefits across the full spectrum of training discussed in this report.

With billions of dollars to be spent in Victoria on new rolling stock (trains, trams and buses) over the next decade, an approach combining longer-term collaborative planning between the educational and rolling stock sector is needed. These findings reinforce the previous findings from Young, et al. (2020a), that there is a key need to undertake a stocktake of current and emerging industry skills, and develop profiles that reflect the industry as it is and what it is becoming, to provide a basis for planning training that addresses industry needs.

The future of training in rolling stock is complex and reaches beyond the sector into the education system that surrounds it. The current lack of structure in both sectors offers a window of opportunity to pilot a sector-led collaborative approach to developing training from the bottom-up, to support renewal and resilience-building across the sector. If this is to be successful, organisations will need to form long-term working relationships with each other and key educational stakeholders. They will also need to be strategic, systematic and systemic in their design and implementation, and to ensure resources and funding for the longer term. But most importantly, they will need to embrace the transformation process they are part of, and reimagine the concept of learning if they are to fully unleash its potential.

Methodology

This report uses a mixed methodology approach for assessment, and has four areas of investigation:

1. A series of in-depth interviews with industry representatives on training needs and a description of the initiatives being taken.
2. A phone survey exploring training activities in 25 sector organisations.
3. A collation of skills elicited during the organisational review and the survey from the industry perspective and analysis of these in relation to the literature.
4. An assessment of the economics of training apprentices at the individual, firm and industry scale, with special regards being paid to SMEs.

Its aim is not to describe key aspects of the context, but to provide a starting point for stakeholders in the rolling stock and training sectors to build solutions upon.

Synthesis of key findings and data collected that pertained to training from the organisational review

This combines findings and key themes from:

- The literature review (Young, et al., 2020b) of the current status of training in rail, and building inclusive and innovative organisational cultures.
- Findings from 63 semi-structured interviews with stakeholders from across the rolling stock sector. These interviews were undertaken as part of an organisational review to ascertain challenges, needs, opportunities and influences related to innovation, inclusion and organisational culture. The interviewees were of diverse ages and performed a variety of roles in relation in the rolling stock sector. (See Appendix 2 for details.)
- An assessment of the SMEs' sectorial context through two focus groups conducted with industry representatives, targeted interviews with those who work with SMEs in the supply chain, and one case study to ascertain their specific contexts and needs.
- Additional targeted review of the literature in relation to specific training organisations, strategies and the educational sector in Australia.

The full methodology and questions can be found in Young, et al. (2020a).

Phone survey of 25 sector organisations: The survey was conducted with representatives of companies (the majority of whom were managers), who are currently part of the rolling stock sector in relation to current training arrangements and needs. Twenty-five companies participated (drawn from a target sample list of 51 companies supplied by the Victorian Department of Transport), and their responses were synthesised using thematic and basic statistical analysis. (The survey questions are provided as Appendix 3.)

Training needs mapping: Training needs elicited during the organisational review and findings from the survey were collated and mapped into thematic areas and usage to provide a perspective of current and future training needs.

Economic assessment of the context for apprenticeships: This assessment conducted an economic survey on the literature of the costs and benefits associated with apprenticeships. The role of apprenticeship training in SMEs was a particular focus. An econometric analysis of the effect of training policy and the economy on traineeship and apprenticeship with reference to the rolling stock industry was also undertaken. (See Appendices 7 and 8 for details.)

Due to sector-wide sensitivities, interviewees and participating organisations have been kept anonymous unless the material used is publicly available or consent has been obtained from the organisations.

Constraints

The views represented are indicative only of the sector, as it has only been possible in the time available to undertake limited formal sampling. Interviewees, survey participants and organisations participated on an opt-in basis, so our findings represent the views of those who chose to engage. The majority of interviewees were Victoria-based, and those who were interviewed from other states were from organisations who participate in the Victorian sector.

Introduction

This report describes the training, skills, challenges and needs required for Victoria's public transport rolling stock industry to renew and transform its workforce. It is part of an organisational analysis of the sector, and brings together the organisational and economic context for training with a particular focus on SMEs and their capability needs and apprenticeships.

The sector has been through a period of contraction, which has left the industry with an ageing workforce and skills gaps. The sector is also transforming in response to increased investment, and social, economic and environmental changes, which includes Industry 4.0. The challenge now facing the sector is how to build a differently skilled workforce and strengthen areas of the supply chain to meet the increasing demand for all types of rolling stock assets, and the delivery of a service that is networked, reliable, and suitable for every type of passenger. Effective training is central to this challenge.

Since 2006, a number of reports have raised the issue of training needs in the sector (Young, et al., 2020b). Actions to address these issues have, for the most part, been reactive and fragmented, and reflect deeper issues in the broader education system. The Ai Group report *Realising potential: solving Australia's tertiary education challenge* (2019), reviewed the changing nature of Australian tertiary education, and identified the need for a more 'coherent and cohesive' system:

> Despite this impressive growth in recent decades, the sectors are beset with a range of challenges. Chief among these is the development of a binary system characterised by seriously unbalanced participation between the sectors. The recent dramatic falls in [Vocational Education and Training] VET participation have also been accompanied by declining funding levels which seriously jeopardise the sector. (Ai Group, 2019, p3)

The main aspect of training involved in our report is through VET, but all types of training are discussed, including formal and informal, on-the-job, external training and education at high secondary and tertiary levels, and the dual training model that defines apprenticeships. Training issues addressed include:

- The impact of differing workforce cultures which shape approaches to learning and the needs that arise from this particularly in areas of inclusion, innovation and transformation. Many of the training models that can support this are rudimentary and not well-defined.
- Workforce renewal is important for SMEs who face economic pressure in providing training that benefits trainees and trainers.
- Training needs to be considered for a range of people and purposes, including new entrants into the industry, reskilling people in the industry to meet changing needs, and upskilling people to offer attractive career pathways that meet industry needs.

The existing, widely-identified skills shortages have short- and long-term aspects, including the need to:

- Build capability in SMEs and support more active participation in the manufacturing and maintenance supply chains, and local content and social procurement requirements in contracts.
- Establish educational pathways that support the immediate and ongoing need to develop a diverse and skilled workforce.
- Identify the need for industry-specific training tailored to bridge existing gaps in the current rolling stock workforce.

The organisational context for training

A number of factors shape the current context in relation to training in organisations, including:

- A lack of clarity in relation to how the Industry 4.0 revolution that is driving the need to transform aspects of the sector will manifest in the rolling stock sector, and what the skills needs are as a result of this.
- The lack of workforce profiles (encompassing current skills that need to be retained and future skills) restricts strategic planning across the sector in relation to training.
- The fragmentation of educational and career pathways in relation to the rolling stock sector.

Young, et al. (2020a) found that in large organisations and SMEs, the most common form of training was in-house and peer-to-peer learning. Many large organisations had apprenticeship programs and graduate programs for new entrants and leadership training for identified individuals. Young, et al. (2020b) also found that mediums currently used in rail to deliver training are diversifying, and include e-learning, mentoring, in-class training, and on-the-job training. Many larger organisations offer apprenticeships, traineeships, internships/cadetships and professional graduate recruitment programs. They also offer study assistance programs to encourage their staff to undertake additional study or further training (Young, et al., 2020b).

A number of training-related challenges were identified, including:

- Resource and capital constraints, particularly in SMEs.
- More value being given to technical skills than people-based skills.
- Time constraints – people are so busy doing the job that they don't have time to undertake training.
- A divergence in relation to how different cohorts learn and access knowledge, particularly between younger and older employees.
- Retention of younger people is an ongoing issue particularly in relation to apprentices and trainees. It was raised that it was important to attract the right people for the right job, rather than just a person to fill the job.
- A lack of context-specific training, learner-centric programs and environments.

A number of organisations raised that one of the key challenges was managing the investment in training and reduction of productivity, which could result from in-house training, with the need to train employees and develop their workforce. Trained employees being poached or leaving soon after completion, and the rise in pay once they were qualified, could also act as a disincentive to training in smaller organisations who are resource-constrained.

Future skills – understanding rolling stock skill needs in relation to Industry 4.0

The evolution of the digital and cyber technologies and advanced manufacturing, is changing how people work and the jobs they do globally. This evolution is commonly referred to as the Fourth Industrial Revolution or Industry 4.0.

Although some organisations are changing in response to this, during the organisational review there were indications of a lack of comprehensive understanding in relation to what this means in terms of future skills and training for the sector as a whole. This is in part due to speed at which some of these technologies are emerging but also a knowledge gap in this area. An Innovation and Business Skills Australia (IBSA) 2017 report examining information and preparedness for digital technology in manufacturing, printing and related industries found:

> … a plethora of reports discussing the impact of digital change on job roles and therefore skills, but very few which identified specific digital skill needs in the manufacturing sector or other related industries. (IBSA, 2017, p3)

Reports such as the World Economic Forum (2019), provide conceptual projections of the skills trajectories for the future workforce. Responses from interviewees in the organisational review indicate that the rolling stock sector will not necessarily follow the skills trajectories that has been outlined in generalised reports such as these. For example, Table 1 shows the skills that were considered important to employers in 2018, as well as those skills expected to be increasing or declining by 2022 (World Economic Forum, 2018).

Table 1: Comparing skills demand, 2018 vs 2022, top ten (World Economic Forum, 2018, p12)

Today – 2018	Increasing – 2022	Declining – 2022
Analytical thinking and innovation	Analytical thinking and innovation	Manual dexterity, endurance and precision
Complex problem-solving	Active learning and learning strategies	Memory, verbal, auditory and spatial abilities
Critical thinking and analysis	Creativity, originality and initiative	Management of financial, material resources
Active learning and learning strategies	Technology design and programming	Technology installation and maintenance
Creativity, originality and initiative	Critical thinking and analysis	Reading, writing, math and active listening
Attention to detail, trustworthiness	Complex problem-solving	Management of personnel
Emotional intelligence	Leadership and social influence	Quality control and safety awareness
Reasoning, problem-solving and ideation	Emotional intelligence	Coordination and time management
Leadership and social influence	Reasoning, problem-solving and ideation	Visual, auditory and speech abilities
Coordination and time management	Systems analysis and evaluation	Technology use, monitoring and control

Many of the skills identified as declining by 2022 (Table 1) were reported as still very much in use in areas of rolling stock, and were raised as being core to current tasks and anticipated to be needed for the next 10 years. Reasons given for this were:

- The longevity of rolling stock assets and the nature of the work undertaken, particularly in the trades areas.
- That many of these technologies require a low diversity of tasks and high volume output to be financially viable for organisations. Rolling stock organisations are often described as specialised, with a diversity of tasks and a low volume output.

A recurring theme for our interviewees was to identify what skills (particularly niche skills) need to be retained, and what skills are emerging (e.g., hydrogen technology/predictive maintenance/smart procurement/use of mobiles devices and augmented reality/big data). Skills types nominated by interviewees fell into the following categories:

- Skills for leadership (e.g., adaptive leadership, inclusive leadership, effective communication, transformation management, enterprise skills and management of strategic risk)
- Skills for management (e.g., communication, planning, cultural awareness, change management and enterprise skills)
- Core people skills for all employees (e.g., cultural awareness, unconscious bias, effective communication and self-management)
- Niche skills specific to task, product and context (e.g., textiles and weaving, and metal workers)
- Technical skills emerging as a result of new technologies (e.g., electrical mechanics, and digital and hydrogen technologies).

There was also variability found between the types of skills that may be needed in terms of the bus sector and rail, with bus interviewees feeling that uptake of new technologies would be different in their sector, as there were less constraints in relation to pre-existing infrastructure.

The sector is in a transition, which is driving the need for technological and people skills to develop capability and forward growth of the workforce and support uptake of new technologies (PwC, 2019; IBSA, 2017). People skills are non-technical skills, and include employability skills, enterprise skills, soft skills and capabilities. They are non-routine, difficult to automate, but highly transferable (e.g., creativity, emotional intelligence, critical thinking, persuasion, and negotiation). According to the Foundation for Young Australians (FYA) (2017), employers are already expecting and paying a premium for transferable enterprise skills for entry level roles.

Transformation itself requires specific skills, and changes throughout society and industry mean that leaders and managers will need the ability to influence, communicate new ideas and technologies, and build trust and common understandings across their organisations.

This points to the need for a focused systematic approach to identify what skills will need to be retained and those that need to be developed in different areas of the sector to guide strategic planning of specific training initiatives.

Training provision

'It is no longer about standing in a classroom and learning it is about learner-centric training.'

Training in rolling stock organisations was described as fulfilling the following purposes:

- Obtaining formal qualifications – apprenticeships, degrees.
- Reskilling – the process of learning new skills so you can do a different job, or training people to do a different job (e.g., training a trades person to become a manager).
- Upskilling – improving employees' skills profiles by training them in new skills (e.g., training tradespeople in mobile technologies to access and share information).

The training trajectory was described by interviewees as one of obtaining skills and competencies, and then becoming competent in a specific work environment. Designing, building and maintaining rolling stock is highly complex and different organisations have specific areas of expertise. As a result, training employees to a level where they are competent in the workplace can take considerable time and investment. Responses in relation to this varied from six months (simple trades-related tasks) to seven years (technical/engineering).

The Australian rail industry has been moving towards more competency-based training. The National Rail Industry Worker Governance Committee (NRIWGC) matrices provide the agreed minimum competency requirements across 'participating rail operators to assist contractors working for multiple employers, operators across multiple networks' (ARA, n.d). This adds additional complexity to the training environment, as employees with skills in a certain area may not be able to perform similar functions in different states or organisations due to the different networks and systems in use without additional formal training. Currently, there are moves to standardise roles across the industry to address this issue.

National Academies of Sciences, Engineering and Medicine (2015), provide an alternative workforce competency model developed for railroad industry employee groups in the US focusing on performance rather than credentials. It defines exemplary rather than minimal performance, and can be used to evaluate the capabilities of individuals and organisations. This study also noted a strong move towards people skills, as well as technology for those who perform management and leadership roles.

'I had no idea before I did that elective that this even existed.'

Australian universities offer rail-related courses in specialist skill areas such as rolling stock engineering and rail operations management, however more generalised engineering courses had little if any rail-related content in their courses (Young, et al., 2020b). A number of interviewees suggested that there was an opportunity to develop specific modules that could be embedded in more generalised engineering and trades courses to increase exposure and engagement with the industry – particularly in higher education and VET courses. Ooi and Cormick (2020) also reinforce the importance of this. It was also raised that one of the challenges for educational institutions in terms of delivering specific courses dedicated to rail, was that there needed to be a guarantee of students participating in these courses for the longer term to make this financially viable.

The current fragmented and highly changeable broader education environment was also identified as a substantial challenge for those trying to provide longer term training programs. There is also a lack of data in relation to effectiveness and appropriateness of the different types of courses delivered and a lack of understanding as to what contexts in the rolling stock area these are most applicable to.

The changing training environment

The process of learning in the past was linear, with a clear trajectory where employees obtained skills and competencies, became competent in the use of them in specific work contexts, and were promoted in line with this. The current dynamic social, environmental and economic context means that the process is no longer linear, but a process of continuous learning, where employees need to be able to upskill and adapt skills in response to technological changes.

Younger employees have grown up with unlimited access to knowledge through the internet and digital communication, and have different concepts of learning. This challenges conventional wisdom that older employees know more than their younger employees and are the knowledge holders who pass on learnings to the next generation. The emerging learning environment requires non-hierarchical approaches, which enable multi-directional learning within organisations. This means that more advanced communication and people skills are required in order to enable effective exchanges between younger and older cohorts.

This fundamental shift in knowledge-generation and access has also resulted in younger employees particularly seeking more collaborative and social learning environments (LinkedIn, 2019). It has also resulted in the broadening of learning mediums to include models such as:

- Blended learning
- Lifelong learning
- E-learning
- Reverse mentoring
- Guide beside
- Mentoring circles
- Virtual learning
- Mobile learning (e.g., learning through digital platforms and mediums such mobile phones or iPads).

(A complete list is detailed in Appendix 4.)

These mediums are starting to permeate areas of education more generally, and raise the need to reassess the current institutional and educational arrangements so that these types of learning can be harnessed more effectively to enable more cohesive and focused delivery of training.

Reskilling and upskilling

The need to leverage skilled employees from other sectors and upskill or reskill them was raised by BIS Oxford Economics (2018). There is evidence that this is starting to occur, with some interviewees reporting they previously worked in other industries (e.g., automotive, aerospace, mining and food sectors), who had adapted their skill sets to the rolling stock context. Upskilling areas nominated encompassed the entire workforce – including all levels of leadership and management – where more adaptive and inclusive approaches have emerged in recent years (see the Alstom summary case study below).

Summary case study: Leveraging funding to support changing supply chain upskilling – Alstom

As a sustainable mobility leader, Alstom have committed to the development of a sustainable supply chain that reduces environmental, social and ethical risks across their supply chain through the development of a sustainable sourcing policy. This requires building capability and skills within their supply chain.

They have also collaborated with other global transport rail operators and manufacturers to start up Railsponsible which adopts a sustainable sourcing approach to the whole supply chain (Alstom, 2019). This means that in order to participate in Alstom projects, suppliers need to meet strict social, environmental and ethical criteria.

In the response to Alstom securing the Metronet Railcar project in Western Australia, funding was provided through the State Government's Local Capability Fund to assist local suppliers to meet these requirements. Suppliers were able to apply for $20,000 grants to obtain 'essential pre-qualification requirements for supply chain entry' and to cover other costs associated with improving capability (Chamber of Commerce and Industry of Western Australia Limited, 2020).

The Victorian Government's Skills First program provides a framework to support upskilling and reskilling in response to technological transformation for priority industries including transport, to achieve the following (Department of Education and Training, 2016, p3):

- Restoring TAFE
- Improving quality of training
- Working with industry
- Focusing on students and addressing disadvantage
- Strengthening apprenticeships.

A more targeted approach that has been implemented overseas for reskilling is Canada's Second Career program. This program uses a job seeker-centric model that focuses on those who are unemployed and in temporary work who are seeking to change their career. Applicants are asked to provide evidence of their current job status and previous job seeking history, level of education, current skills and the skills they wish to acquire. They also need to provide information showing that the skills and job they are training for are in demand. The program covers the travel and training, and provides up to $28,000 for costs including tuition, books, manuals, workbooks or other instructional costs, transportation, basic living allowance and childcare (Government of Ontario, 2020).

International models for education

There are a number of international, collaborative industry-informed educational models that have been developed to support the growth of new skills and innovation. China has a long history of research and enterprise in relation to transportation, and offers established and industry-based training options (see summary case study below.)

Summary case study: China's education and industry approach

In a matter of ten years, China's high-speed rail sector has grown from a few short tracks (Shanghai Airport to the city fringe, Guangzhou to Shenzhen, and Beijing to Tianjin), to a rail network covering 120,000 km rail tracks with 29,000 km for high-speed services.

China has a long history of research in transportation. Its key institute is the China Academy of Railway Sciences (CARS), which was founded in the 1950s and is a comprehensive multi-disciplinary research institute whose focus is the transport industry. Its research covers multiple areas including experimental, industrial products, material inspection, scientific and technical information, and standards and metrology. It also offers numerous transport-related degrees, doctorates and certificates (UIC, n.d.).

The China Railroad Rolling Stock Corporation (CRRC) is global leader in rolling stock manufacturing, 'who have built a global network of 75 subsidiaries from Malaysia to South Africa, which includes 13 research and development centers in the United Kingdom, the US and Germany' (Ejilin, n.d). An innovation studio established in 2008 provides an open platform for company employees, university students and employees from other railway manufacturing companies (*China Daily*, 2019).

Germany's ABB Training Centre provides an example of an industry-driven approach to training delivered in collaboration with supply chain SMEs. It illustrates the deep integration of a global company in a national vocation education and training system (see summary case study below).

Summary case study: ABB Germany's collaborative industry approach

ABB is focused on modernisation of their dual apprenticeship program through the introduction of new forms of teaching and learning, as well as development of further qualifications modules that reflects new needs for advanced technologies and processes.

ABB operates mainly in robotics, heavy electrical equipment, and automation technology areas, power grids and corporate services. ABB Germany has established two regional training centres for training apprentices – ABB Training Centre (ATC) in Heidelberg and the Vocational Training Centre Berlin (AZB). Their largest training centre is ATC Heidelberg with around 590 apprentices, including around 250 dual students, in fields such as electronic technology, machine engineering and business engineering.

Apprentices in dual occupational programmes are in mechatronics, electricians, industrial mechanics, construction mechanics, tool makers and apprentices in commercial occupations. The ATC not only trains ABB apprentices, but also trains apprentices from 18 regional partner companies. These companies are often SMEs and linked to ABB as suppliers or cooperation partners. These training programs enable apprentices from smaller companies to obtain skills and competences in fields related to advanced manufacturing that are not currently implemented in their own company.

The industrial-technical apprentices are continuously trained at the ATC, to ensure the best possible vocational training. They are trained in pneumatics, CNC and electrical engineering, as well as in computer-aided design. In addition, the apprentices who do not work with computers at their workplace are offered the opportunity to obtain a 'European Computer Driving License' (ECDL) to obtain the basic digital skills they require. ABB also offers dual study courses for young people entering the labour market that are interested in combining bachelor study courses with practical training. Furthermore, ABB Germany offers dual study courses in engineering, business administration and management. All courses are set up according to the German dual system offering theoretical learning and practical work phases. The students graduate with a diploma in BA, BEng or BSc.

Source: Voss, 2019.

The Victorian context

The majority of large organisations working in Victoria have formal and informal in-house training, and in some cases, organisations are Registered Training Organisations (RTOs). Metro Trains Melbourne (MTM), for example, has a Metro Academy that provides a number of publicly available training courses for those working in rail (Metro Trains, n.d.). The internal training programs within large organisations are also supplemented by external providers.

SMEs were found to be far more reliant on external providers for training, but there was little that could be found that was able to ascertain the quality or effectiveness of much of the training provided – particularly in relation to the workforce and business development and management. Further information in relation to the training needs of SMEs can be found in Young, et al. (2020a).

There is a critical need for industry-focused programs that work in collaboration with established programs and are context-sensitive to support holistic growth of the sector. Two examples of current programs that illustrate this approach are the Newport Rail Academy (developed as part of the Level Crossing Removal Project), and the Ai Group Entrepreneurs' Programme that has a dedicated stream focusing on strengthening the SMEs organisations in the rolling stock supply chain.

Summary case study: Entrepreneurs' Programme – Supplier Development

The Entrepreneurs' Programme is the Australian Government's flagship initiative for business competitiveness and productivity at the firm level, delivering business advice and facilitation services to SMEs to help build capacity, improve capability, extend networks and take advantage of growth opportunities in Australian and overseas markets.

Currently, they have a supplier development project that focuses on building capability in the rolling stock supply chain (Ai Group, 2020). Skilled business advisers assess the capabilities of individual businesses to meet the requirements of rolling stock original equipment manufacturers (OEMs), identify any capability and skills gaps that may impact the business's ability to supply into rail OEM global supply chains, then prepare a tailored action plan with strategies to address gaps to better meet the needs of rail OEMs and the rolling stock sector.

The advisors then coach and mentor the SME for up to 12 months to help implement the actions, and businesses can also apply for funding to help implement the adviser's recommendations. Plans can include the development of business acumen in areas such as building networks, collaboration and relationships within the supply chain, development and certification of quality management systems, preparing a strategic plan and entrepreneurship (Commonwealth of Australia, n.d.). The program uses a 'light touch' approach across the organisations they engage with, so that SMEs retain ownership of their actions and decision making in relation to their business. This is designed to ensure that recommendations do not impose on the business, but are developed and 'owned' by the business so they can maintain their unique profiles and expertise.

Summary case study: The Railway Academy Newport

The Railway Academy was established in 2007 to provide specialist training and assessment facilities for rail and tram organisations in Victoria. This facility offers educational spaces for training providers that service the rail sector and other industries. A joint initiative from the Victorian Government's Training for the Future program, the Academy provides a training environment for the next generation of engineers, apprentices and cadets, including sections of off-network rail and tram track. They also have developed specific training courses to support inclusion of those from disadvantaged background. (See 'Industry highlights' in Young, et al., [2020a].)

Rail Academy Newport works with industry and current training providers to identify the current training gaps and future training needs. They collaboratively develop new qualifications and training products that support industry needs. The Rail Signaling Engineer Cadet Program is a fully paid, three-year cadetship with placements at a range of Australia's biggest rail and construction operators.

The Academy also supports career advisors through their rail career information sessions for the secondary school career advisors about the roles on offer. A career advisor mentioned that their time at the Rail Academy was worthwhile as it gave them an element of confidence in rail careers prior to their session at Rail Academy. Currently, there are a total of 19 cadets across the 10 program partners.

The latest course that will be piloted in 2020 is the Certificate II in Heavy and Light Rail Fundamentals (Pre-vocational) – a qualification for secondary school students to provide them with basic knowledge and a realistic preview of the heavy (train) and light (tram) rail industry in Victoria.

Source: Major Transport Infrastructure Authority, 2019.

Key findings

Young, et al. (2020a) found that there is a need to reassess training needs in line with the changing needs of the industry and their workforce. There is also variable capability and different challenges in relation to being able to uptake training and the delivery of training across areas of the supply chain.

Key findings were:

- The rolling stock training context reflects overall fragmentation, and lack of cohesion in the rolling stock and educational sector.
- Most training being delivered throughout the sector is in-house, and contains a large informal component.
- There is a need to build training capability within organisations and external educational providers.
- There is a lack of clarity in relation to its training needs, and little consistency in relation to approaches for the provision of training throughout the sector.
- SMEs have greater resource and capital constraints than larger organisations, which can negatively impact their ability to enact or uptake appropriate training.
- Training delivery modes have changed since the advent of digital technology, resulting in changing social norms and expectations of younger members of the workforce in particular.
- The issue of workforce training requires multi-tiered approaches that combine different types of training tailored to specific end user contexts.
- There is an opportunity to develop and pilot a model/framework for training that outlines long-term actions to address deeper systemic issues and short-term, flexible and adaptive actions that address immediate and emerging needs.

Phone survey of SMEs' training needs

A survey was conducted with representatives of companies (the majority of whom were managers), who are currently part of the rolling stock sector in relation to current training arrangements and needs. In total, 25 companies participated, drawn from a target sample list of 51 companies supplied by the Victorian Department of Transport. Time constraints meant that the interviews were limited to about 15 minutes, and thus the purpose of this survey was to determine if the findings from other parts of this project were consistent in relation to the needs of SMEs. The complete list of interview questions can be found in Appendix 3.

What types of companies participated in the survey?

In relation to geographical location, 20 of the participant organisations were located in Melbourne, with the other five located in regional Victoria. The majority of firms (21 of 25) were in the 21 to 200 employee category, characterised by the Australian Bureau of Statistics (ABS) as 'medium-sized businesses' (ABS, 2010). Three were classified as small organisations, and one as a large organisation.

The majority of companies (16 of 25) were involved in manufacturing related to rolling stock (rail component manufacturing [steel, glass, and seating], and electrical and electronic product manufacturing). Four were involved in maintenance, one in design, and four in manufacturing and maintenance.

The majority of companies were well-established long-standing businesses, with 20 of the 25 being more than 20 years old, and four of the remaining five being more than 10 years old.

What are the current training arrangements in rolling stock-related companies surveyed?

Participants were asked about their companies' current training arrangements, in terms of the proportion of formal and informal training. From the total of 25 companies surveyed, 18 offered apprenticeships. Five offered graduate recruitment programs, four offered internships, and two offered traineeships (note, the total of these adds up to more than 25, as some companies indicated that they offered more than one type of training program). Ooi and Cormick (2020) also identified that the presence of clear training pathways (apprenticeships, TAFE, or university course-linked pathways) was important to potentially recruiting young people into rolling stock careers.

When asked about what percentage of training at their firm in the last five years consisted of formal and informal training, it was consistently reported that the majority of training undertaken in SMEs was informal.

Who conducted this training?

Figure 1 (overleaf) displays survey respondents' answers about who is responsible for training in their company. Figure 1 shows responses of 20 companies (five companies either didn't respond or didn't know who was responsible). Interviewees were able to nominate more than one responsible party.

External providers were most frequently used, often for more tailor-made, ad-hoc training needs, although the satisfaction with their quality was mixed (Table 2, overleaf). The responses, however, reveal that much of the training is conducted in-house through HR/Management, on-the-job training, the organisation and the department respectively. This may indicate that SMEs feel ongoing training needs are best met through their own organisational capabilities.

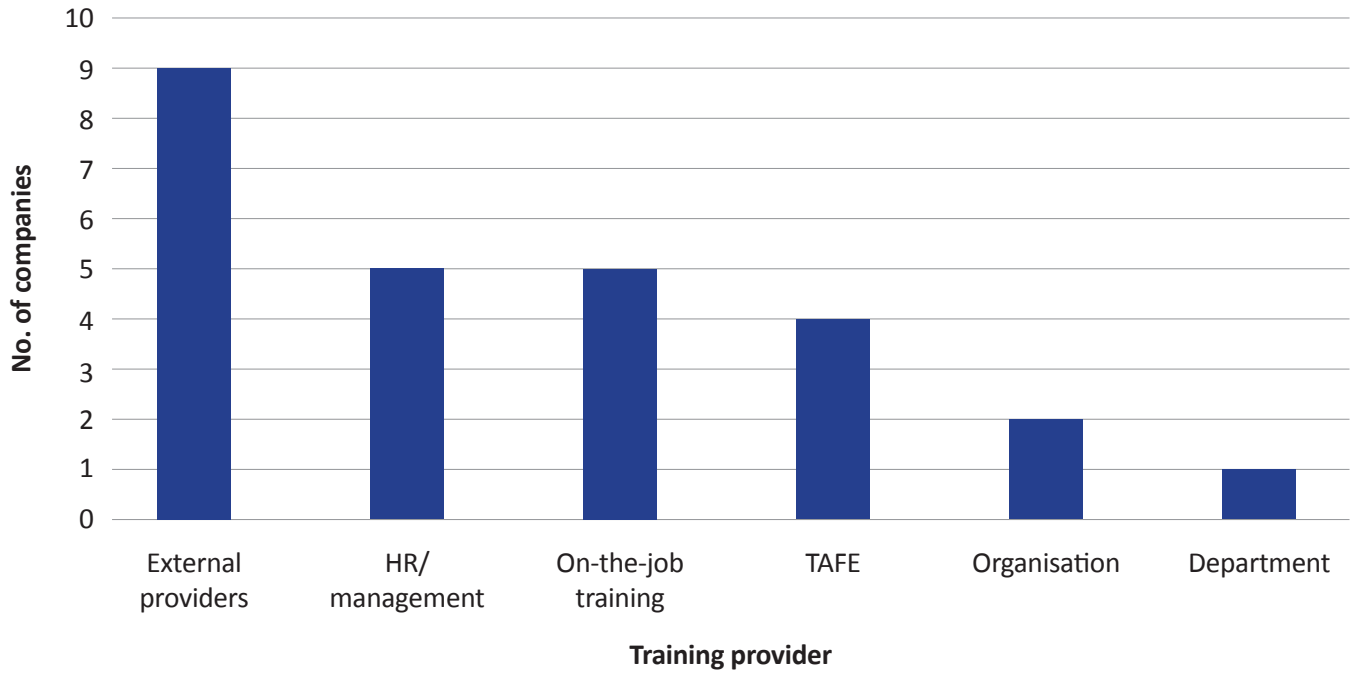

Figure 1: Who is responsible for training for the company?

What are the most effective and least effective types of training cited by company representatives?

Company representatives were asked about what they considered to be the most and least effective forms of training. The types of training and/or issues raised are displayed in Table 2. Note that these answers were self-reported, and are based on the representative's or company's assessment, rather than externally defined or verified criteria.

Table 2: Most effective and least effective training

	Most effective	Least effective
In-house training	■ In-house training and learning from existing staff ■ Mentoring from skilled operators and on-the-job training	■ Apprenticeship program ■ Online compliance training
External training assistance	■ Formal training in manufacturing, Certificate IV and Diplomas ■ Sales training ■ Specialist teaching teams	■ Poor quality training products ■ Courses that don't accommodate different literacy levels ■ One-day training courses ■ Training that is not context specific

Are rolling stock-related companies offering management and leadership training?

Twenty-one of the 25 representatives surveyed indicated that their companies offered leadership and management training. The type of management training provided is displayed in Figure 2. Responders were free to nominate more than one type of training, hence the total number of responses represented equals more than 21.

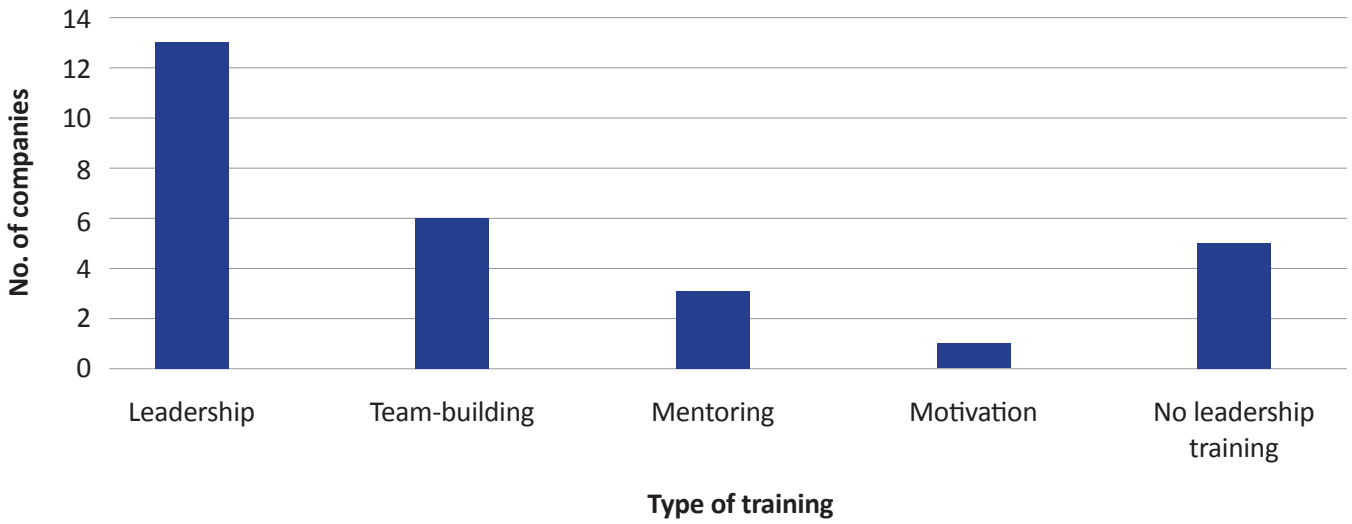

Figure 2: Type of management and leadership training provided

Only six of the companies interviewed indicated that team-building training is provided, indicating a significant opportunity for improvement, given the critical importance to outcomes that may contribute to retention and inclusion. Klein, et al., (2009), based on a meta-analysis of 20 studies, found that team-building had a 'positive moderate effect' on improving outcomes (defined across four domains – performance, process, cognitive outcomes and affective outcomes).

While the majority of companies offer some form of leadership or management training, it should be noted that the presence of leadership programs does not tell us about the quality of the programs. This information is important, but could not be covered in the short phone interviews.

Are rolling stock-related companies offering diversity and inclusion training?

Eleven of the 25 representatives surveyed indicated that their companies offered diversity and inclusion (D&I) training, which for some, included online components. Training took place internally and externally (e.g., by the Australian Industry Group).

It is notable, however, that when asked, a number of companies confused provision of information with training in relation to D&I. For example, they considered induction material related to equal opportunity, as training in D&I. In some cases, interviewees offered the presence of anti-bullying grievance procedures and/or a manual outlining the policy and procedures of the organisation as evidence of D&I training. It is interesting to note that at least one SME stated they did not think they needed training as they already had a diverse workforce. Some companies indicated that it was a requirement of their customers to fulfil a D&I policy.

What are the training challenges?

Survey participants were asked about whether they anticipated that training requirements would be different in five years' time. Seventeen of the 25 companies anticipated training challenges in the next five years, four were unsure, and four reported that they did not anticipate training challenges. The following training challenges were identified:

- **The challenge of passing on expertise and highly specific knowledge** from older workers to younger workers, and the need to invest in apprentices were common themes.
- **Lack of training pathways** in trades and concern of a future decline of the number of institutions offering training in areas (such as fitting and turning). There were also concerns about the lack of interest in pre-trades subjects in high school for those in trades areas.

- **Attrition in apprenticeships:** Although apprenticeships were offered, uptake of these was reported as decreasing, and some SMEs raised issues retaining those who did. For example, one company went through 12 people in a two-year period. It was cited that it was difficult to compete with mining company wages. Mature-age workers were described as having a stronger sense of responsibility and were seen as better recruits.
- **Capability constraints:** Cost and allocating time to training while keeping the business running was reported as a limiting factor in providing training.
- **Current training:** It was reported that current training products could be inflexible and limited. There is a need for training that caters for multiple and complex skillsets rather than a single focus. Those interviewed anticipated that a new technology (mechatronics, mechanical and electrical) would affect the skills needed in their firms, with an increasing need to understand all disciplines.

It is notable that many of these findings align with those in Young, et al., (2020a) and Jones, et al., (2020).

What training needs were identified?

When asked about training needs, 21 of the 25 companies were able to clearly identify their areas of training needs, with the following types of skills nominated:

- Training in **trade skills** (10 of the 25 companies)
- Training in **management skills** (5 of the 25 companies)
- Training in **engineering skills** (4 of the 25 companies).

When asked to describe some of these in more detail, participants offered the specific training needs related to current trades and technical workforce deficit areas (e.g., sheet metal workers, fabricators, welders, boilermakers, fitters, plastic moulding, tool-making, skilled operators, laser cutters, brake pressers).

Other more specific training needs identified were:

- Management/personnel skills/succession planning
- Technical sales capability
- Compliance skills in response to training regulation (e.g., use of ISO:9001).

Key findings

- There are common experiences, challenges and significant opportunities for improvement posed by the current operating environment for SMEs. Actively supporting SMEs in addressing these challenges is critical to securing their unique role of local content providers in the broader supply chain.
- There are constraints to fully realising the promise of training through apprenticeships. While most SMEs offer apprenticeships as an important pathway for training young people, the level of uptake and retention is low. SMEs report heavy competition from other sectors (notably mining) in terms of retaining apprenticeship recruits.
- A significant proportion of training in SMEs occurs informally. This points to the need for more assistance in developing a systematic approach to how quality training is designed and offered.
- Training by external providers is often regarded as less effective or not tailored to need. SMEs indicated that this was because their needs were highly specific, or because multiple competencies were increasingly required. How this can be addressed is a crucial question that needs coordinated assistance at a sectoral level.
- There is a lack of consistency in how SMEs defined training. For example, some equated the provision of information as training. This indicates a need for additional support for SMEs as a cohort in relation to the development of quality training
- Some of the answers suggest an ad-hoc approach to training, and opportunities exist for a more systematic approach to training in SMEs.

Mapping rolling stock training needs

Specific needs elicited as part of the organisational review (Young, et al. [2020a]) and phone survey have been collated into two tables that show the needs as reported by SMEs and large organisations. The training needs have been categorised into people and technology-based skill areas, and those associated with organisations (large) and businesses (SMEs) to provide a snapshot of the sector (Tables 3 and 4).

The overarching picture is of one of divergence between large organisations and SMEs' needs. There are, however, aligned areas – particularly in relation to digital technology, risk management and the need to address workforce shortages in trades, technical and engineering areas, and a focus on apprenticeships.

In terms of SME needs (Table 3), the key focus of training is to build business capability, and it was particularly notable that these were focused on the areas of management and leadership. It was observed that there was limited insight in relation to what their future training needs may be. This is also reflective of the size, constraints and less dispersed nature of their organisations. Key areas of focus were the need to:

- Build an employment pipeline of skilled employees to addresses current workforce shortages, particularly in trades and technical areas
- Build business capability to enable more effective participation in the rolling stock sector.

Specific examples that illustrate these needs were developing effective business structures, processes and systems, strategic planning and implementation of strategies, and risk management. Of particular note is the presence of the 'Training the Trainer' method, which shows a recognition of the need to build capability within organisations to effectively transfer knowledge between more experienced and newer employees.

Larger organisational needs (Table 4) reflected their current progress in relation to implementation of transformation and workforce development training needs, resulting in more specific and nuanced needs. There were also strategic needs raised to address emerging technologies skills training. Key areas of focus were:

- Current needs in relation to implementation of transformation management, leadership and workforce shortages, and the need to build an employment pipeline of skilled employees to support implementation
- Future needs for a suitably skilled workforce ready for new technologies as they enter the supply chain.

Specific examples that illustrate current needs in relation to transformation are leadership and management, implementation of diversity and inclusion, and legislative and regulatory requirements and compliance. Specific immediate technical needs were for high voltage training for electrical engineers (buses), and Reliability, Availability, Maintainability and Safety (RAMS) engineers (trains). Emerging technology needs were hydrogen technologies and electric vehicles in the bus industry, maintenance of digital technology on buses and trains, and the need to combine electrical and diesel mechanic training in apprenticeship training.

It was notable that much of the training reviewed in the literature review only contained people and soft skill areas as electives, and there was nothing specific that related to management of strategic risk or risks associated diversity and inclusion. People and soft skills are central to organisational sustainability, as they are critical to effective uptake and use of future technologies and development of an inclusive and diverse workforce (IBSA, 2017; PwC, 2019; Young, et al., 2020b). This suggests that there is a need to reassess which core skills should be mandatory in current training packages.

The tables also indicate areas where capital and resource constraints have resulted in specific training needs arising in the supply chain which will require specific attention and support for training development and uptake. This is particularly apparent with SMEs. Facilitation of collaboration will be needed across this cohort, so that they are able to engage with the development of training to ensure that training outcomes are useable and salient to their context.

Due to the unique nature of the sector, this will require a bottom-up approach that ascertains current skills and emerging skills needed from within organisations and the consolidation of these to create a sector-wide picture.

Table 3: Nominated SME training needs

Category	Training needs	Leadership	Management	General workforce
Business enterprise/ acumen	Business ownership training	✓		
	Intellectual property	✓	✓	
	Financial management	✓	✓	
	Risk management/compliance	✓	✓	
	Contract negotiation	✓	✓	
	Developing effective business structures, processes and systems	✓		
	Strategic planning and implementation of strategies	✓	✓	
	Developing efficient production practices		✓	
	Understanding product value and how to develop a value proposition	✓		
People	Management and leadership training	✓	✓	
	Managing innovation and new technologies	✓	✓	
	Workforce management and development		✓	
	Developing a workforce culture	✓	✓	
	Marketing and client management		✓	
	Leadership – succession planning	✓	✓	
	Management – personnel/workforce development	✓	✓	
	Workforce development – attracting and retaining a diverse workforce	✓	✓	
	Train the trainers for trades people (knowledge transfer)		✓	
	Soft skills	✓	✓	✓
	Effective decision-making	✓	✓	
	Digital literacy (e.g., phone apps, iPads in the workplace)			✓
Technology	Cyber and digital literacy – especially in relation to risks	✓	✓	✓
	Innovation and new technology	✓	✓	✓
	Digital marketing and the use of social media	✓	✓	
	Data analysis		✓	✓
	Trades skills training – sheet metal workers, fabricators, welders, boilermakers, fitters, plastic moulding, tool-making, skilled operators, laser cutters, brake pressers			✓

Table 4: Nominated large organisation training needs

Category	Training needs	Leadership	Management	General workforce
Organisation	Challenging conversations	✓	✓	
	Anti-bullying	✓	✓	✓
	Anti-discrimination	✓	✓	✓
	Asset management – long-term management of assets	✓	✓	
	Continuous improvement	✓	✓	✓
	Creating psychologically safe spaces	✓	✓	
	Leadership training – inclusive leadership/adaptive leadership	✓		
	Recruitment training new techniques (e.g., attributes-based recruitment)		✓	
	Safety and compliance (e.g., keep braking systems, suspension systems, workplace safety)	✓	✓	
	Unconscious bias	✓	✓	✓
People	Cognitive flexibility	✓	✓	✓
	Courses in emerging technology for leaders and executives	✓		
	Cultural awareness	✓	✓	✓
	Digital literacy – people now hook up computers and download things from their phones			✓
	Effective collaboration	✓	✓	✓
	Inclusive communication with people who are different	✓	✓	✓
	Active listening	✓	✓	✓
	Implementing diversity and inclusion in an organisation	✓		
	Managing diverse teams		✓	
	Leadership – inclusive and adaptive leadership	✓	✓	✓
	Relationship building	✓	✓	✓
	Training how to socialise new technologies and inclusion	✓	✓	
Technology	Electrical safety around electric vehicles			✓
	Leadership – new technologies	✓	✓	✓
	Electrical systems associated with evolving technology			✓
	High voltage training for mechanics			✓
	Blended electrical, mechanical and emerging technology apprenticeships/upskilling courses for mechanics			✓
	Hydrogen technology		✓	✓
	IT maintenance of digital technology on buses and trains			✓
	Predictive maintenance		✓	✓
	RAMs engineers			✓
	Cyber and digital literacy – digital and cyber risk	✓	✓	✓
	Refurbishment/retrofitting rolling stock assets course			✓
	Managing new technologies in the workplace		✓	✓
	Manufacturing – demystifying electric bus courses			✓
	Train modification course			✓
	Social media and recruitment		✓	

Key findings

The mapping was undertaken to obtain an insight into current training needs and potential gaps in different areas of the sector. However, they also show the emerging training needs arising in response to the need to develop new skills to manage the dynamic context in which these organisations exist. They highlight the following:

- Many of the critical training needs emerging are people-based soft skills, which are currently predominantly optional in many training packages. This indicates a gap in current training and a need to re-evaluate core competencies in current training packages.
- There are also indications that there are gaps in risk management particularly in the areas of digital technology and cyber risk, diversity and inclusion, and strategic risk.
- This reinforces the findings in Young, et al. (2020a), that there is a key opportunity to undertake a stocktake of current and emerging industry skills, and develop profiles that reflect the industry as it is and what it is becoming to provide a basis for focused training planning that addresses industry needs.
- Due to specific nature of the rolling stock sector, bottom-up processes that coordinate and facilitate collaboration are needed to ensure that training is salient, strategic and effective.

The way forward

The training of the future in rolling stock will need to continually evolve and use multiple mediums to address emerging needs. It will require the building of open and flexible thinking and environments that support ongoing learning in response to current drivers of change outlined in Young, et al. (2020a). There are, however, challenges to achieving this due to broader changes needed in the current tertiary education system.

The Ai Group report *Realising the potential: solving Australia's educational challenge* (2019), provides the broader context:

> We have now entered an era of mass tertiary education and the achievement of higher-level qualifications. Today, 85 percent of young people complete secondary education and most proceed to some form of tertiary education. In the decade to 2015 the proportion of the workforce without post-school qualifications fell from 42 to 32 percent. There has been significant expansion of participation in the higher education sector, and Australia is very close to achieving the Bradley Review target of 40 percent of 25 to 34-year-olds having a degree by 2020. The VET sector is the largest education sector with over 4.2 million students. (Ai Group, 2019, p3)

In addition to this, there are questions as to whether there is sufficient flexibility within training packages 'to meet the needs of the manufacturing sector as it responds to growing levels of digital disruption' (IBSA, 2017, p3). Funding models that focus on entry level training can also 'work in opposition to the need for continuous upskilling in [Science, Technology, Engineering and Mathematics] STEM skill areas' (Beddie, et al., 2014, p27). The sector will need to consider how they will develop training within this broader educational context.

There is an opportunity for rolling stock to rethink their system of education, from formal educational areas such as degrees and apprenticeship that provide the foundation, through to current and future upskilling and reskilling needs. If it is to achieve effective outcomes, consideration of the myriad of informal and formal training mediums where they are needed, and what is likely to be most effective in specific contexts needs to be undertaken. Figure 3 shows a conceptual model of the formal and informal training mediums and knowledge exchange mechanisms that are part of the continuous process of learning.

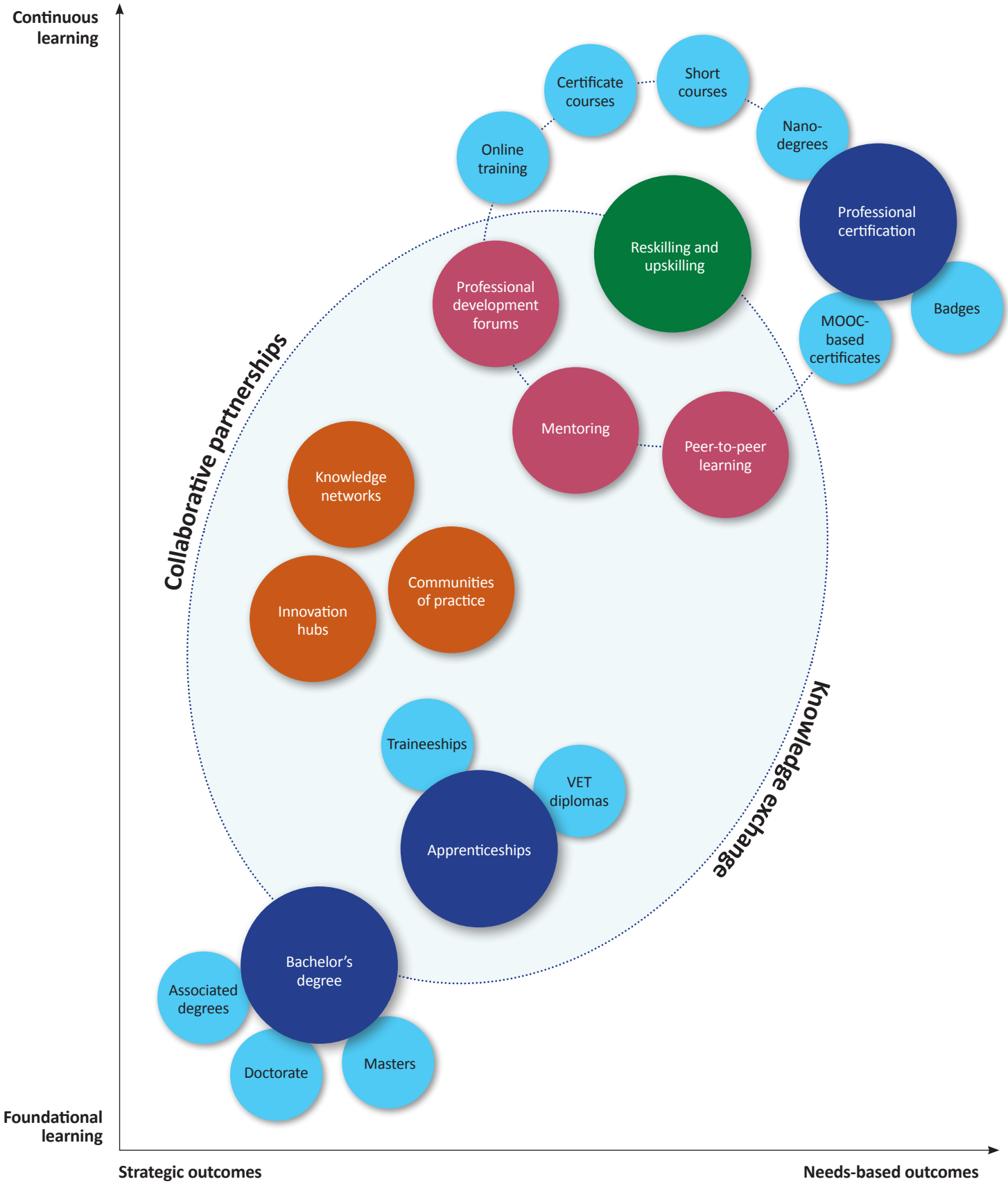

Figure 3: A conceptual model of the formal and informal training mediums and knowledge exchange mechanisms that are part of the continuous process of learning (adapted from Ai Group, 2019)

Conclusion

The organisational context for training in the rolling stock sector is one that is ripe for change. The current lack of structure offers a unique opportunity to pilot a model for a broader educational system, which is built from the bottom-up and is able to evolve over time in line with the sector's needs. To achieve this, a strategic multi-tiered approach is required to ensure that the training system built:

- Meets the future needs of the sector
- Is financially viable for organisations receiving and delivering training
- Is agile, flexible and context-specific
- Builds external and internal training capability.

Training to date has mostly occurred in response to needs when they arise, and in a stable environment this is adequate. In a dynamic environment where change is constant, however, this approach can lead to skills gaps that constrain development and competitiveness. As ongoing change is likely for the foreseeable future, there is a critical need for proactive strategic responses that pre-empt and plan for anticipated changes – particularly in relation to emerging technologies and development of the workforce. As different areas of the sector are at different stages of the transformation process and maturity, flexibility and adaptiveness will be needed in all training programs.

Currently there are key aspects missing, such as workforce profiles, that are critical to providing the basis needed to address the longer-term strategic challenges facing the sector. Without an understanding of what and who needs training, how they need it and who should deliver this, it is difficult to move beyond immediate needs and reactive responses.

Top down models that impose on this sector are unlikely to be successful. The unique structure, diverse skills contained within this sector and strong focus on in-house training will require industry-led context specific approaches that build external and internal capability. Consideration will need to be given to capital and resources constraints of SMEs and what is needed to support the rapid upskilling needed in areas of this cohort. The differing needs and contexts of larger organisations also provide an opportunity to leverage existing training knowledge within these organisations. Building communities of practice across the sector would also support more cohesive sector-wide approaches and potentially act as a catalyst for programs.

Training is critical to the future success of the sector and emergence of disruptive technologies and social changes have highlighted the need for new pathways. The current transformation in the rolling stock sector and disarray of the educational system presents a tantalising opportunity for this sector to start at the beginning and build the training system they need for the future. However, this is a longer term undertaking, and appropriate resources, funding and authentic collaborative partnership will be critical to future success.

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The economic context of dual training through apprenticeships

Glossary

ABS	Australian Bureau of Statistics
Apprenticeship	Name given to dual training in the trades mainly 3–4 years in length at the VET Certificate III and IV level
CB	Cost benefit
CBA	Cost-benefit analysis
Dual apprenticeship	Apprenticeship that combines on-the-job training with teaching conducted by a training organisation
GDP	Gross domestic product
GFC	Global financial crisis
GSP	Gross state product
GTO	Group Training Organisation
NCVER	National Centre for Vocational Education Research
NSNL	National Skills Needs List
OECD	Organisation for Economic Cooperation and Development
RGSP	Real gross state product
RTO	Registered Training Organisation
SME	Small to medium enterprise
TAFE	Tertiary and Further Education
Traineeship	Name given to dual training mainly 1–2 years in length at the VET Certificate I and II level
VET	Vocational Education and Training

Background

Despite the many different avenues for training, the economics of training apprentices was concentrated on for two main reasons. Firstly, it is a preferred avenue for training and workforce renewal for the rolling stock industry, especially by SMEs. Apprenticeships were raised as a key focus in relation to training in the organisational review and telephone survey. Secondly, reliable and comprehensive data on the economic benefits of training is difficult to collect, but limited information on apprenticeships is available from international sources.

The economics of dual training weigh up the costs of education and wages with the benefits of increasing productivity to the employer over time. From the literature, there are two models:
(1) A lower training cost, mobile market model from Switzerland, and
(2) A higher training cost, single employer model from Germany.

The relationship between costs and benefits for new trainees sees them starting at production levels below the cost of training and employment. By the time they are qualified, they should be approaching the production levels of a competent worker, therefore paying their way. Some organisations aim to have paid off the cost of training during the apprenticeship. Others invest in training with a view to retaining the trainee after qualification, particularly if they have gained skills specific to the firm and sector. The organisational review and a recent OECD survey present some evidence that SMEs tend to follow the latter model, with larger companies choosing the former.

Larger companies can afford the first approach, but SMEs who may not be able to guarantee long-term employment, face the economic pressures of training then retaining apprentices after qualification. This implies that a collective approach to training may be needed if SMEs across the rolling stock supply chain are to renew their workforces and gain the skills they need. Further investigation is needed to better understand the economic context of training specific to the needs of the rolling stock industry.

An econometric analysis of the relationship between apprenticeship commencements and short- and long-run economic impacts provides insights that can potentially contribute to the strategic planning of training initiatives within the sector. It covers the 14 main occupations in Victoria where most rolling stocks jobs are. Key findings are:

- Trade apprenticeships are more strongly influenced by economic conditions than traineeships, which are more strongly influenced by changes in training incentives.
- For the combination of rolling-stock occupations, for every one hundred million dollars increase (decrease) in real gross state product (RGSP; 2012 as the base year), on average, the estimated long-run impact is 1.64 apprentices in training. The short-run impact is stronger at up to 2.75 per $100 million.
- Higher overall employment leads to slightly fewer employees in training. For every thousand increase (decrease) in total employment, estimated employees in training decrease (increase) by 3.72 in the long run. The short-run impact is 3.83.
- The GFC event years had an estimated short-run reduction of 240 trainees in each occupation, and a long-run reduction of 26.6; the latter not statistically significant.
- The removal of employer subsidies from 2012 (except for occupations on the National Skills Needs List [NSNL]), resulted in an estimate average reduction of employees in training of 1,414 for each occupation (a total of 20,000). The short-run impact was about 25% of the long-run impact.
- Occupations not on the NSNL decreased by further 3,480 apprenticeships, with the short-run impacts about a half of the long-run impact.
- There is strong sample evidence that the employment of apprentices and trainees by the industry can readjust internally (to counteract under- or over-training) at a rate averaging 2,000 person per year in order to keep training in line with the economy. This shows the importance of integrating training within broader industry strategies.

The majority of the labour force and apprentices are employed by small firms. Large firms can employ multiple apprentices and rotate training to maximise apprentice exposure to skills, and provide attractive pathways for career development to retain the apprentice graduates. While large firms can sustain a temporary economic loss during apprentice indenture, most SMEs can only train one apprentice at a time and cannot afford an economic loss during the apprentice indenture without some government support.

The Australian economic context for apprenticeships

An apprentice is an employee contracted to the employer while being guaranteed a specific level of training for the indenture period, combining on-the-job training with the employer and off-the-job training with an educational institution. The contract is registered with State and Territory Training Authorities via an Australian Apprenticeship Support Network provider, to regulate the rights and obligations of all parties. Apprenticeships involve employers, employees and a training/education provider, and are an important part of VET. In Australia, TAFE colleges provide off-the-job apprentice training. Private RTOs and enterprise RTOs (in-house registered training) are becoming popular, particularly for addressing specific industry needs.

Australia has seen a great deal of policy change in apprenticeships and traineeships over the past three decades as recorded by the National Centre for Vocational Education Research (NCVER, Appendix 5). This has made the training sector more flexible, particularly with the expansion of training beyond the traditional trades to a range of other occupations. Traineeships are generally shorter, one to two years, and apprenticeships take up to four years. Many traineeships are at VET Certificate Level I and II, while most apprenticeships are VET Certificate Level III or higher. Higher apprenticeships are now being opened up to cater for the needs of advanced manufacturing, with final qualifications to the diploma and degree level (Voss and Bridgford, 2019). There are some important differences between how apprenticeships and traineeships operate in the market, as our research and the literature shows.

Australian apprenticeships exist within a "place and train" system, where an apprentice is working for the employer four days per week with full weekly pay and with one day per week (or some cases, more than one) for off-the-job training with an RTO. Variations of the apprentice system in other countries include the "train, work and train" system with a period of training before work starts. For example, Singapore apprenticeship program recruits polytechnic graduates who are already equipped with a "train" component before the "work" starts.

Apprenticeships are effective instruments in providing up-to-date skill training to fill industry skill gaps, reduce unemployment for younger people, and for mature-age adults (age restrictions in Australia were lifted in 1990). They produce profound flow-on social and economic benefits to communities. Governments worldwide have recognised these benefits, and a substantial body of studies by, for example, the International Labour Organization and the OECD, have been conducted (Gambin, et al., 2010; Kuczera, 2017a, 2017b; Lerman, 2019; Lodovici, et al., 2013; Muehlemann, 2016; Muehlemann and Wolter, 2014; Pfeifer, 2016; Reed, et al., 2012; Smith, et al., 2013).

The main beneficiaries of apprenticeships are the individuals who undertake them, the firms who get access to skilled labour, government, and the community who provide the workforce and receive the benefits of economic productivity. Economic studies on apprenticeships assess the economic cost and benefit (CB) of investing in apprenticeship training for each of these parties. Apprentices agree to accept lower pay, investing their time and effort in learning skills of an industry or trade, seeking higher long-term returns than they would have obtained without training. Governments, who through policy, may seek to influence employers to employ more or less apprentices in specific areas, will also base their preferences on some kind of value-for-money measure. This may be focused on economic outcomes, but also considers a range of social benefits, including a higher skilled workforce and better educated population.

Most economic studies on apprenticeships worldwide, including those commissioned by governments, are qualitative in nature. This is due to the complexity of how different industries are structured and organised, the spectrum of industries apprenticeship covers, the variety of training models and how they are funded. Many studies have assessed costs, but only two, Germany and Switzerland, have undertaken comprehensive long-term studies that also consider benefits (Kuczera, 2017b; Muehlemann, 2016; Muehlemann and Wolter, 2014). The German and Swiss apprentice systems are quite different and we contrast these with current arrangements in Australia.

For Australia, surveys have been conducted by Dockery, et al. (2001); Dockery, et al. (1997); Dockery, et al. (1998), and more recently by the Australian Industry Group (2019). The former studies are largely out-of-date, but reveal cost pressures for employers and a preference for in-house training when that is the case. The latter presents a range of general statistics, such as commencements and withdrawals as well as case studies. Data suitable for directly assessing the economic performance of apprenticeships in the rolling stock industry is not available at the national or state level. For that reason, we construct and detail two illustrative models from the German and Swiss studies.

NCVER carries out research and data collection on all forms of VET training. Data available on apprenticeship training and economic data from the ABS is used to conduct econometric modelling on firms' behaviour in skill training for areas relevant to the rolling stock industry in Victoria. Special attention is paid to firms' choice in responding to government apprenticeship policy changes.

Benefits of VET, apprentice and other training in Australia

The Longitudinal Surveys of Australian Youth 1997–2005 allows the comparison of different education and training pathways on training for young people. These are analysed in Marks (2008), and the following findings are relevant to this study (the cohort was between 18–25 with a median age of about 22):

- Compared to no qualifications, an apprenticeship increased earnings by about 25% or 20% with an employment history, a university degree by 31%, university diploma 17%, TAFE diploma 14%, traineeship 8% and TAFE certificate 5%.
- Earning increases for women with apprenticeships were just over half those for men, partly reflecting occupational choices, partly reflecting outright discrimination.
- The effect for apprenticeships was greater for men than women. Participation rates were 22.4% men and 4.1% women, with 18.6% and 2.7% qualifying. Although there is concern about low qualification rates, this data suggests many who withdraw from apprenticeships go onto some other qualification.
- The seven years' available data measuring occupational status for apprenticeships, showed they stayed reasonably flat, suggesting that those who qualified stayed at the occupational level they trained in (at least until their mid-20s).

Earnings trajectories for a completed apprenticeship were about 3% per year, but only for men, compared to a bachelor's qualification of 9% for women and 5% for men. Other qualifications led to flat earnings trajectories into people's mid-20s. Earnings initially accelerate faster than for other qualifications.

Griffin (2016) discusses the benefits of VET to government and the economy, business, industry and the individual. The economic benefits to the economy are explored through employability and productivity. Examples include:

- The effect of training on the economy at the firm level from training reviewed by the Australian Workforce Productivity Agency (2013) was zero to 13% (Griffin, 2016).
- One year of education across the whole economy would increase productivity by 3–15%, but this process also results in diminishing returns (Australian Workforce Productivity Agency, 2013).
- An additional year of learning increases an individual's wage by 5–16% (Australian Workforce Productivity Agency, 2013).
- At the firm level, one year of training increases firm productivity by 0.07–1.7% (Australian Workforce Productivity Agency, 2013; Griffin, 2016).
- For VET qualifications, the private benefit in earnings is proportional to the move from existing education levels. Higher level certificates can provide significant gains for older workers.
- Benefits at the lower educational levels tend to be income-related, whereas benefits at higher education levels include greater gains in productivity.
- A modelling assessment of total VET funding 2013–17 had costs of $7 million split between $2.3 million tuition and $4.7 billion foregone wages, for benefits of $18.4 billion employability and $2 billion productivity (Independent Economics, 2013).

Cost-benefit model

The economic assessment of apprenticeship training is ideally carried out using cost-benefit analysis (CBA). However, due to data limitations and the complexity of the task, usually only a partial CBA is performed. The broader decision making around whether to offer, undertake or financially support apprenticeship schemes involves weighing up economic and non-economic costs and benefits to the employer, prospective apprentices and government (Schueler, 2016). At the business scale, apprenticeships need to be economic or they will not provide a return on investment. The basic structure is shown in Figure 4.

Apprentices impose a training cost, spending most time on the job and some time at school, either in-house or externally. At the start of the apprenticeship, the firm pays a wage to the apprentice, which is generally higher than the revenue the apprentice can generate because they lack the skills and training required. Over time, their productivity increases as their training proceeds. At the end of training, they graduate onto a full-time wage. Initially, the apprentice's marginal productivity will be less than the apprentice wage and training cost, making a loss. Once it climbs above this level, the firm will receive a net productivity gain. A mature-age apprentice may start at a higher productivity level, but will also generally be receiving a higher wage.

This curve can also be treated as the apprentice learning curve. The net benefits of training only become positive when the areas B and C under the curve become greater than the area of A. Area C represents the productivity gains of the apprentice graduate. Return on investment (ROI) for the training depends on the size of the gap between wages and marginal productivity, and how long that person remains with the firm. If B is larger than A, then the firm is ahead during the training period. If it is less, the apprentice would need to stay beyond qualification for the firm to be ahead.

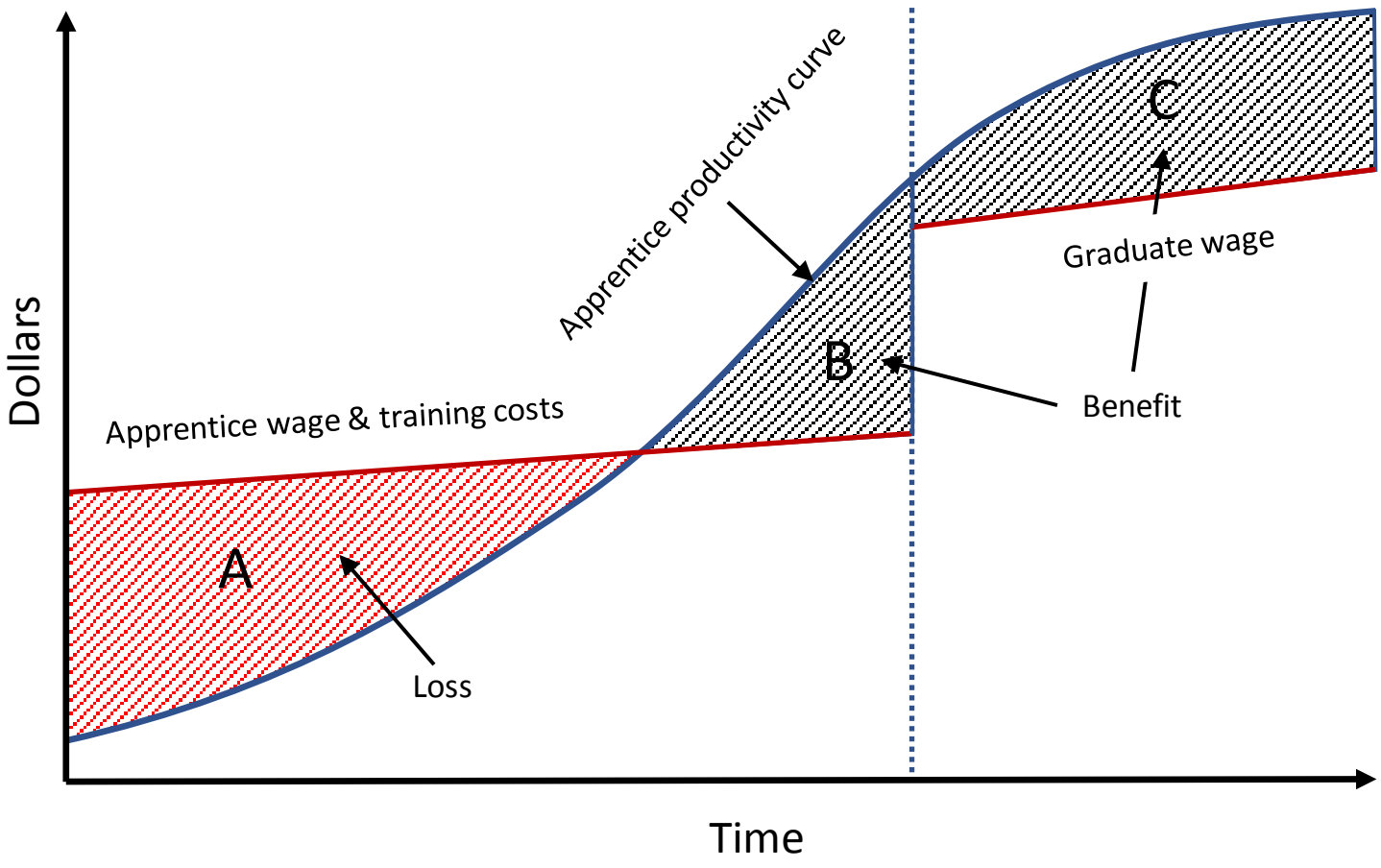

Figure 4: Recovering the cost of apprenticeship training. The vertical dashed line marks the apprentice completion: the apprentice indenture period is to the left, a fully qualified employee to the right. Area A is an area of loss, B and C areas of gain. Adapted from Gambin, et al., 2010.

This model applies to all apprentices and new trainees, whether the training is done in-house or outsourced. Apprentice and graduate wages tend to be standard across firms within an industry, and are governed by legislation such as minimum wage laws and training standards. This allows an industry-average model to be constructed where broad characteristics from a country and industry can be used to characterise a type of model. These characteristics include apprentice wages levels, average apprentice learning curve, length of training, who pays, and the skill levels required at graduation. The ability of individual apprentices to progress during the indenture period will form individual marginal productivity curves. Apprentices who learn quickly will produce a smaller Area A and larger Area B.

Different apprenticeship models

The economics of German and Swiss apprenticeship models show quite different characteristics (Kuczera, 2017b). In Germany, apprentice jobs attract high-performing school leavers and are highly competitive. Qualified skilled workers are well paid and enjoy a career path to a status of master craftsman in their guilds. Globally, Germany employs the greatest number of apprentices and has the highest proportion of apprentices in the workforce (Smith, et al., 2013). Australia is not far behind. Due to strong unionisation, the German workforce tends to be relatively stable with limited movement between firms. The "sticky" labour market reduces the need for new recruitment, so there are fewer opportunities available for recent graduates to move. Firms tend to source skilled labour from their own apprentice graduates, rather than recruiting from other firms in the industry. German employers are less concerned about breaking-even during the apprentice period, anticipating a long-term return from training.

The Swiss employment market is much more mobile, with apprentices tending to leave their training firm after graduation. The apprenticeships are designed to become highly productive within the indenture period (Muehlemann and Wolter, 2014) making training a "no regrets" exercise if graduates decide to leave. In Germany, 60% of the apprentice graduates continue to work for the training firm after they qualify, while about 35% of graduate apprentices are retained in Swiss firms (Kuczera, 2017b).

Pfeifer (2016) compared the German and Australian apprentice models in depth. They both have similar numbers of apprentices as a proportion of the workforce. The German model is initially more costly because work/off-the-job training is a ratio of 3:2 whereas in Australia it is generally 4:1. In Germany, wages can be no lower than 80% of the equivalent industry awards; in Australia they are generally lower, but are also age-based for younger people. Advanced apprenticeships in Germany are often shorter than in Australia at 3–3.5 years. The German standards are co-developed by a training standard entity, employers and unions, are continually modernised to keep up with technological development, and are more occupation-based. In Australia, unions have largely been removed from the process and employers given relatively more say. Australian training is more modular and less occupation-based than the German system, allowing it to be more easily tailored to specific employer needs (Pfeifer, 2016).

In Germany, the Government covers tuition and companies invest about twice that amount (net) after productivity benefits are extracted. There is no similar data for Australia, but individual studies suggested investment rates similar to Germany's in the trades (Pfeifer, 2016). In Australia, employers have more choice between trainers and there are more pathways to qualification, which Pfeifer (2016) concludes provides more flexibility, but may also create confusion amongst prospective trainees. In Australia, completion rates and continuing employment in the training firm are generally understood to be much lower than in Germany, but a close look at the data suggests the difference is not so great.

Pfeifer (2016) estimated that 20–25% of German apprenticeships and traineeships are terminated and a maximum of 16% withdraw, approximately 30–35% in total. For Australia, terminations are lower and voluntary withdrawals higher, with the 2019 NCVER (2019) survey data for Australia showing 54% completion and 46% non-completion. Pfeifer (2016) quoted a figure of 60% being retained by the training employer and Australia 43%, but the NCVER data shows that 62% of total trainees who qualify continue with their training employer (though not always in the same occupation), and that almost 18% of those who withdraw also remain with their training employer (Appendix 6). When allowing for the survey sample weightings, this comes to 41% for all trainees continuing with the same employer in Australia; the equivalent measure for Germany would be around 46%. For the automotive and engineering trades in Australia, 56% of qualifiers and almost 15% of non-qualifiers remain with their training employer, close to the average for all trades.

Therefore, employment outcomes between the two countries are closer than they first appear. A key difference is that in Germany, the qualification is more necessary for continuing employment, and their system is more constrained, motivating the trainee to see it through. In Australia, even though policy has been designed to give employers more flexibility, it also gives employees more flexibility. However, the outcomes may not be positive for the employee, which we discuss in the section on employee costs and benefits.

Costs and benefit analysis for employers

Most studies in the literature look at cost-benefit from the employer perspective. Comprehensive international reviews have been carried out by Muehlemann and Wolter (2014) and Kuczera (2017b). A firm's costs broadly consist of the following (Muehlemann and Wolter, 2014):

- **Apprentice wages:** regular and irregular wage payments, compensation for food, travel costs or living expenditures
- **Training personnel costs:** full-time, part-time and external training personnel for the period in which they were unable to work productively because they instructed apprentices
- **Recruitment and administrative costs:** wage costs for administrative tasks and recruitment related to apprenticeship training
- **Cost for infrastructure:** machinery/appliances for apprentices at the workplace, rent for premises necessary for apprenticeship training, cost of premises and infrastructure for company training centres
- **Cost for supplies:** cost of supplies used for non-productive activities in the workplace, cost of books, learning software and videos, costs of working equipment
- **Other costs:** fees (e.g., exams), capital costs for recruitment/administration related to apprenticeship training, costs of external courses, duties and taxes to third parties.

Benefits come through a combination of skilled and unskilled tasks:

- **Skilled tasks:** the time that apprentices spend on such tasks, multiplied by the wage of a skilled worker multiplied by the productivity of an apprentice relative to that of a skilled worker.
- **Unskilled tasks:** the wage that the firm would have had to pay to employ an unskilled worker.

According to Kuczera (2017b), the cost of work-based training is the second largest cost of apprenticeships to employers after the wages paid to employing apprentices, although some of these costs may be offset through government support.

Most international CBAs conclude that Area A (loss) is generally larger than Area B (gain) during the training period. For the UK, taking net present values of future returns into account through a social discount rate, Gambin, et al. (2010) found that average payback periods were between two to three years after completion for engineering and construction apprentices, and between one to two years after completion for hospitality, retail and business administration apprentices.

Large firms who can employ many apprentices and rotate them between tasks are best situated to provide training opportunities for apprentices, utilise their capabilities and thus maximise the firm's benefit. Large firms tend to attract apprentices who remain after graduation. When this occurs, productivity is gained through Area C (gain). SMEs who are unable to provide sufficient opportunities for graduate apprentices to progress through their career path may be unable to retain graduates. Hence it is important for SMEs to break even during the indenture period in order avoid the risk of net loss.

Group Training Organisations that circulate apprentices between employers for shorter periods offer one way through this, where employers gain a production benefit from the employee without bearing the entire cost and apprentices gain wider industry experience.

When economic break-even cannot be achieved during the training period, cost-sensitive employers may reduce apprentice intake. When skills shortages exist, recent graduates may find better pay elsewhere. Training firms that experience a net loss during the training period will be more reluctant to take on apprentices. When an industry makes a collective decision to reduce apprentice training, the pipeline for skill supply will dry out, and in the long-run the industry will decline. To grow that industry, economic incentives, including financial support for training, could be a policy option (Kuczera, 2017a).

Low completion rates may indicate problem(s) in the apprenticeship system and discourage employers from further recruitment. In Australia, for apprentices commenced in 2013, the completion rate was 47.1% for trade apprentices, and 57.1% for non-trade apprentices (Australian Industry Group, 2019). While completion rates above 80% have been claimed for some countries (e.g., Egypt, France, Germany and Turkey) (Smith, et al., 2013), the above data does not support that claim for Germany at least. No completion may incur a net loss to business, unless apprentices are being used as cheap labour, which is against both the spirit and letter of the training contract.

Cost and benefit analysis for apprentices

Individuals considering apprenticeships as a career path are likely to compare its costs and benefits (employability and income) with alternative career paths. The two main types of economic costs for the employee are monetary and opportunity costs – the direct monetary outlay and foregone welfare.

If the apprenticeship is self-funded, direct monetary outlays may include course fees, teaching material fees, and transportation costs to attend off-work training. Even if out-of-pocket costs can be reimbursed through tax refunds, this incurs an upfront cost and only partial return. Sometimes such costs are fully or partially met through government or employer support. Welfare forgone includes earning lower wages compared to unskilled jobs during the indenture period, leisure time reserved for structured studies and practices, and efforts involved in gaining the specific learning outcomes.

The benefits include higher wages and better career pathways to more senior/skilled positions, better lifetime employability, shorter job-seeking period, greater career mobility and greater job satisfaction. A comparison between the UK, Europe, Germany and Switzerland found that apprenticeship programs gave positive economic benefits compared to unskilled workers, although the results varied between countries (Lodovici, et al., 2013), and also improved school-to-work transitions.

Using a net present value (NPV) method for the UK, Level 2 apprentices had an economic loss of £7,400, and Level 3 apprentices £10,900 for the indenture period (Lodovici, et al., 2013). However, for lifetime earnings after completion, Level 2 apprentices earn £131,600 and Level 3 apprentices £200,900 more than an unskilled worker (Gambin, et al., 2010), an ROI of 17.8 and 18.4 respectively). In the US, lifetime earnings for an apprentice are around US$300,000 better than workers in a similar position but without an apprentice qualification (Reed, et al., 2012). Comparing apprenticeships with full-time vocational qualifications (college-based education), apprenticeships have no particular advantages in lifetime earnings (Lodovici, et al., 2013).

In 2019, the qualifying sample of Australian trade apprentices had an income of $45,800 on average, ranging from $29,900 for those aged 18–24 to $61,100 for the over 45s. After completion, the average increased to $62,000, with the youngest cohort receiving the largest marginal increase to $40,600, compared to $71,000 for the over 45s.

The NCVER 2019 survey data (Appendix 6) shows that the highest motivation amongst qualifiers or non-qualifiers was that they wanted to ‘do that particular job’. To get a qualification was the second highest, and to gain knowledge and skills the third, and they are often prepared to forgo income to reach these goals. The money is not the strongest draw, but it does matter.

For different levels of satisfaction for those who qualified, pay is lowest with 63% satisfied; for those who withdrew, 49% were satisfied. Conversely, dissatisfaction with pay amongst qualifiers was 21% and non-qualifiers 34%. This suggests that the personal cost-benefit for many apprentices is to be paid fairly for what they do, but the key motivation is employability in a job that interests them in a work environment they enjoy. This is also reflected in the data for non-completion. Only 10% of the NCVER trade respondents withdrew from their apprenticeships for better conditions, 41% left for negative reasons (mainly workplace conditions rather than training), and 33% were involuntary. Some of the negative conditions were external and some internal, but it is clear that the workplace environment is the major factor. Organisational culture and its effect on employment and employee retention is discussed in Young, et al. (2020a).

Cost and benefit analysis for the social and public sector

Measuring the macroeconomic cost and benefit of apprenticeship training is difficult, and the long-term effect on the public sector and social benefit to communities is even harder. Government contributions to training have varied widely over the years, mainly in funding to TAFE and the creation of an environment that fosters RTOs. A relative constant in recent years has been government incentives to employers totalling up to $4,000, along with reductions in worker’s compensation fees. Extra incentives are available for disability, mature aged, school-based and Indigenous Australians. The employer’s allowance was withdrawn in 2012 except for the occupations on the National Skills Needs List (NSNL) and was reinstated in 2018 in Victoria for most occupations. Governments also fund associated regulations and qualification standards for the VET sector.

The public sector benefits from lower youth unemployment and lower general unemployment, savings on social security on unemployment benefits, the population is more highly skilled, and government receives more tax revenue with less outlay. According to Kuczera (2017b), apprenticeship programs tend to be a lower cost investment compared to alternative school-based options.

In a study of ten US states, Reed, et al. (2012) estimated that for every $1 of government investment in apprenticeships, the social returns ranged from $13.96 to $24.62 over the medium term, with a lifetime career average of $35.86. In the UK, for every £1 in government investment, social returns of £16 to £21 were estimated (Lodovici, et al., 2013).

For government, the costs of apprentice administration, law and legislation, and subsidising training organisations (such as RTOs), and the cost of employer incentives schemes are measurable in monetary terms. Society benefits from lower youth unemployment and lower general unemployment, and savings on social security unemployment benefits. However, it is difficult to quantify the benefits and attributes of those benefits as the return directly to the apprentice investments (Cedefop, 2011). Schueler, et al. (2017) have developed a framework for measuring ROI that includes monetary and social returns, but this has not yet been put into practice. The economic benefits of social returns from employment are discussed in Jones, et al. (2020).

Apprenticeships in advanced manufacturing

Most of this analysis and discussion takes place at the enterprise scale, but the economics of training and upskilling at the industry scale are especially important for industries in transition. The rail industry acknowledges it has an image problem with young people (BIS Oxford Economics, 2018). Universities are also competing with vocational education in the marketplace and apprenticeship commencements and retention are declining generally (Fowler and Stanwick, 2017). Ooi and Cormick (2020), also explore the rolling stock sector as an employment destination for young people.

One counter to this has been the development of apprenticeships for advanced manufacturing – starting with a dual apprenticeship, but progressing towards a diploma, bachelor or even master's degree. Voss and Bridgford (2019) undertook a multi-country analysis of apprenticeships aligned to advance manufacturing covering five EU states, the USA and Australia. Although apprenticeships vary significantly, the issues of disruptive technologies, the need to modernise and develop new skills, competencies and qualifications were common to all. They also note that within Europe, a key part of industry policies involving VET were local and regional industry policies at the sector level involving government, private and educational investment (Voss and Bridgford, 2019).

The two Australian examples, Siemens and Varley, involve a combination of in-house training and partnerships with educational institutions to develop new courses suited to company needs. Both have a role in the rolling stock sector, Siemens mainly as a manufacturer, and Varley in freight operations and maintenance. Voss and Bridgford (2019) emphasise the need for top industry management to invest in VET training and apprenticeship, collaboration and sharing responsibilities in a multilevel network, the backing and support of change and adjustment processes by social partners, and supportive national and regional frameworks, including the reliable provision of financial and non-financial support. The Australian involvement is supported by the Skilling Australians Fund, with the Australian Industry Group developing higher apprenticeships in other areas of advanced manufacturing.

With much higher levels of public and social support than currently being applied in Australia, the sector-based approach being used in Europe should not be overlooked. While large companies may be able to set up their own facilities in Australia, SMEs are largely being left up to their own devices. For example, the ABB training centre in Berlin (a large manufacturer who is involved in the transport sector amongst others) has 800 apprentices, but only 5% are employed by ABB, while the majority are from collaborating firms (Voss and Bridgford, 2019).

One Australian example of a collective approach to training in the rail sector is with the development of the Sydney Metro infrastructure and operations. It is the implementation of a Group Training Organisation (GTO) to manage apprentice training in the different occupations involved in the project (OECD, 2019). A similar approach is being undertaken by The Railway Academy in Newport, a key component of the Victorian Government's Level Crossing Removal Authority project.

Factors affecting apprentice commencements in the trades

To understand the importance of incentives to apprentice training in Australia, we analysed time series data available from NCVER and the ABS, with particular attention paid to the case of Victoria's rolling stock industry. The analysis shows how businesses respond to global and local economic conditions, and adjust their training investment in response to government incentive changes.

The model structure, methodology and estimation technique are presented in Appendices 7 and 8 along with model results and their interpretation. A brief history of apprenticeships and traineeships in Australia is shown in Appendix 5. Figure 5 shows apprenticeship commencements from 1996 to 2018 for states and territories and nationally, with a general increase in commencements observed. New South Wales, Victoria and Queensland employ the most apprentices and exhibit the greatest fluctuations in employment. For Australia as a whole, total commencements peaked at 375,000 in 2012, declining thereafter. There are four clear peaks of the data: 1999, 2003, 2008 and 2012. Those peaks closely reflect government policy changes and economic conditions of the country (Atkinson and Stanwick, 2016). After 2012, commencements declined in all states and territories, reflecting the restriction of apprenticeship subsidies to occupations on the NSNL. By 2018, total commencements had fallen to 1998 levels, less than a half of the 2012 peak.

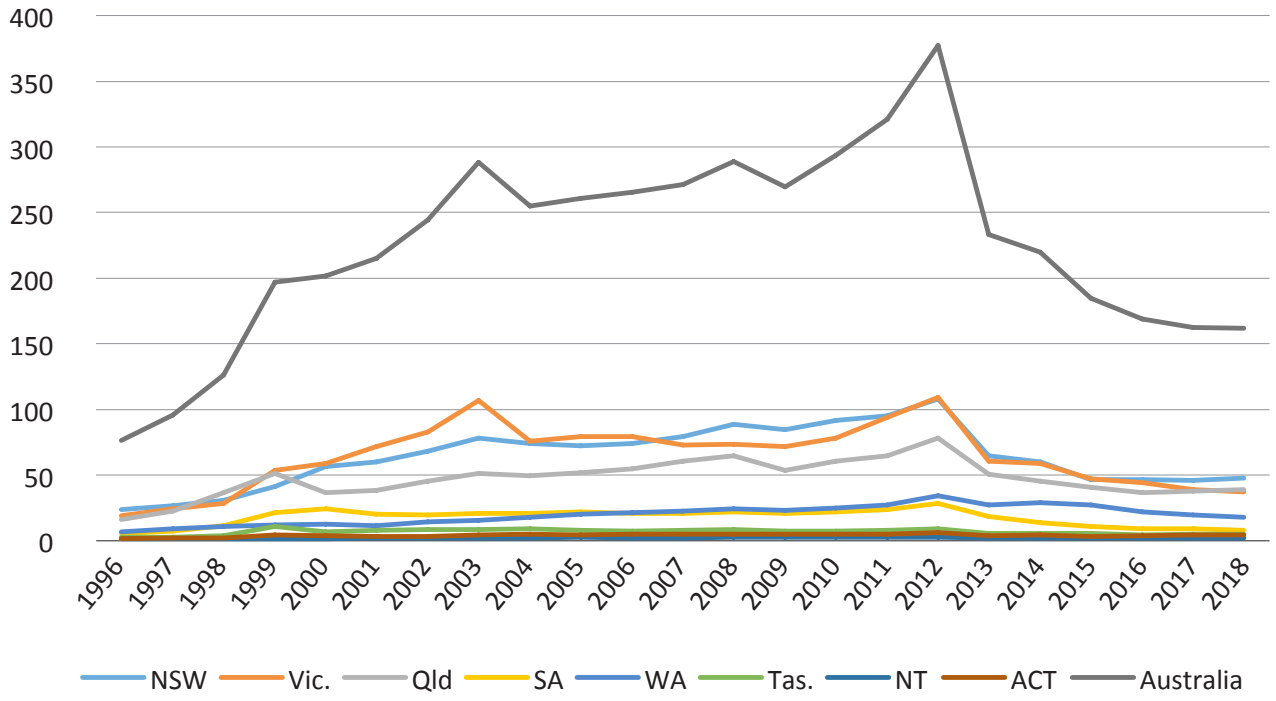

Figure 5: Apprentice commencements, Australia, states and territories ('000). Source: NCVER. (2019).

Total commencements can be disaggregated into trade and non-trade occupations and by age groups. Figures 6 and 7 show commencements by age groups for non-trade occupations and trade occupations respectively. The non-trade occupations closely resemble total commencements for all age groups. The striking feature is that since 1999 and up to 2012, the non-trade sectors recruited more apprentices in the age group 25–44 than any other age groups. The age group 19 years and under is perceived as the traditional targeted age group for apprenticeships, but this perception is not supported by the non-trade data. The non-trade commencements strongly reflect the government subsidy withdrawal and fell sharply after 2012, dropping back to the 1998 level.

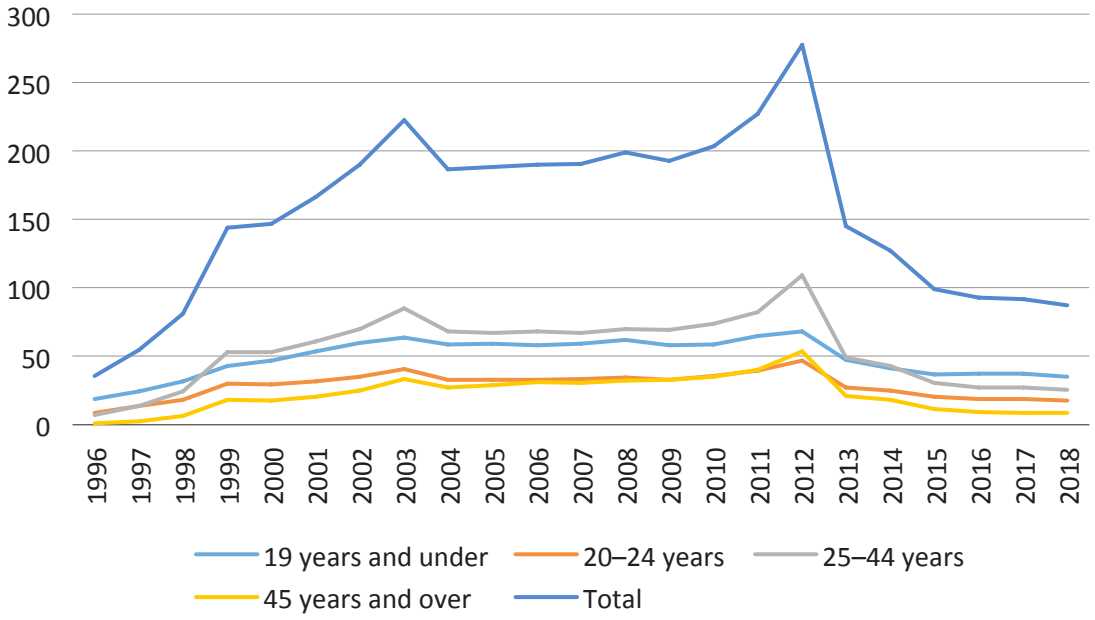

Figure 6: Apprenticeships commencements by age group for non-trade occupations ('000). Source: NCVER. (2019).

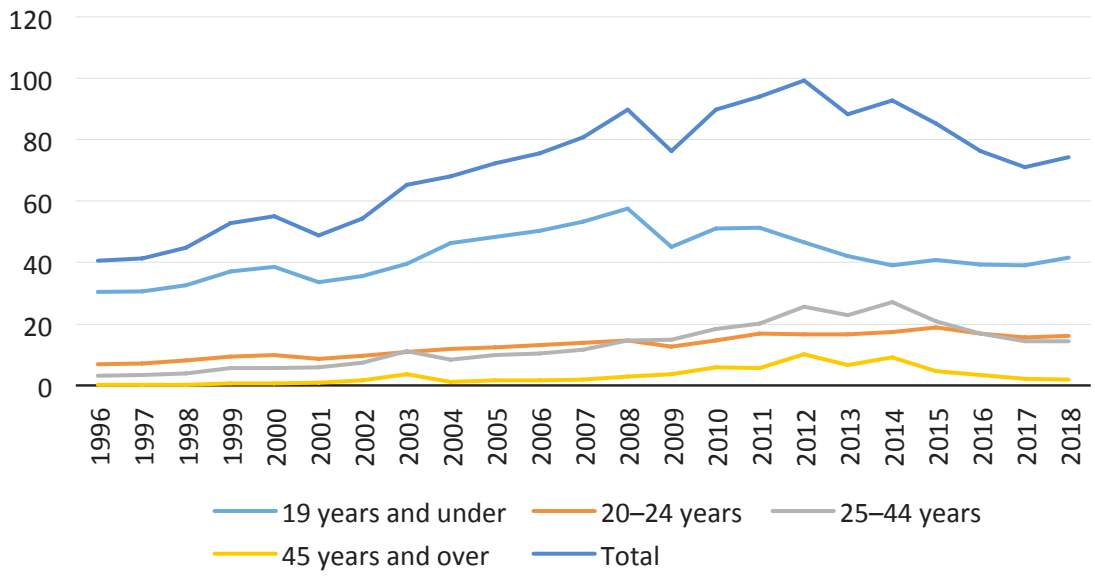

Figure 7: Apprentice commencements by age group for trade occupations ('000). Source: NCVER. (2019).

For the trade occupations, apprentices in the 19 years and under age group are the major source of commencements, consistent with the traditional view of apprenticeships. However, this has only been the case since 2015. Non-completion rates are slightly higher for the younger cohort, so it is possible that when economic conditions allow, more experienced candidates are employed, although when cost pressure increases, the younger cohort is more affordable. This age group has a different time series pattern from the others, reaching a peak in 2008, then declining to a trough from 2014, while the other age groups continued to rise until 2014. Non-trade commencements are more than double the trade commencements at their peaks.

Almost half of apprentices withdraw during the indenture period (Figure 8). New South Wales, Victoria and Queensland top the list, the pattern resembling the commencements in Figure 5 (p37).

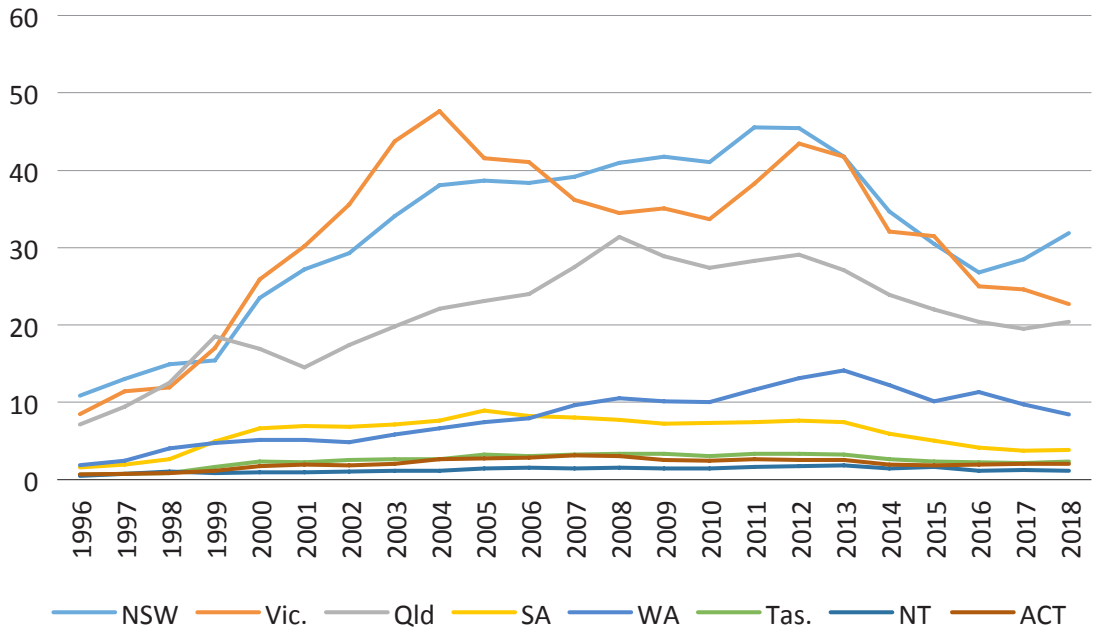

Figure 8: Apprentice withdrawal by state/territory ('000). Source: NCVER. (2019).

To investigate the rolling stock industry in Victoria in more detail, we selected in-training data for Victoria for 14 occupations to represent the rolling stock sector workforce (shown in Table 8A, p62). The data is also extracted from the NCVER time series data mentioned above.

Figures 9 to 11 display the in-training numbers for trades, clerical and operations occupational groups, respectively. These patterns are less sensitive to government incentives and tend to reflect to changes in economic conditions. Training for clerical and machine operators are in two waves of decline: a rapid decline after the withdrawal of subsidy in 2012 and an earlier decline back in around 2003. The reason for the 2003 spike in several occupations remains unknown, but this date marked a low in unemployment and was followed by a change in incentives (Atkinson and Stanwick, 2016).

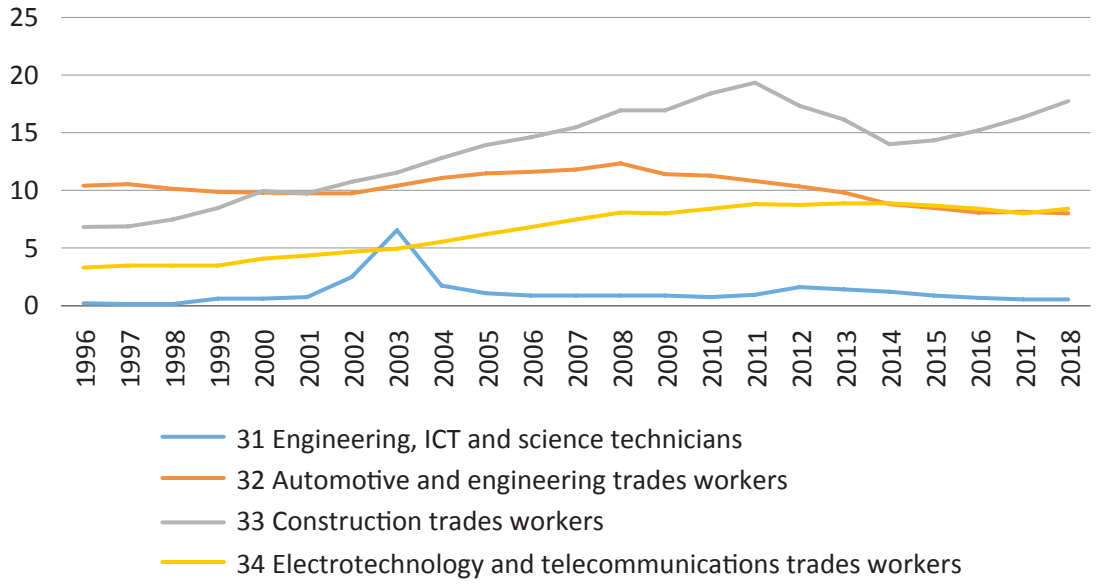

Figure 9: In-training for technicians and trades workers 1996–2018 ('000). Source: NCVER. (2019).

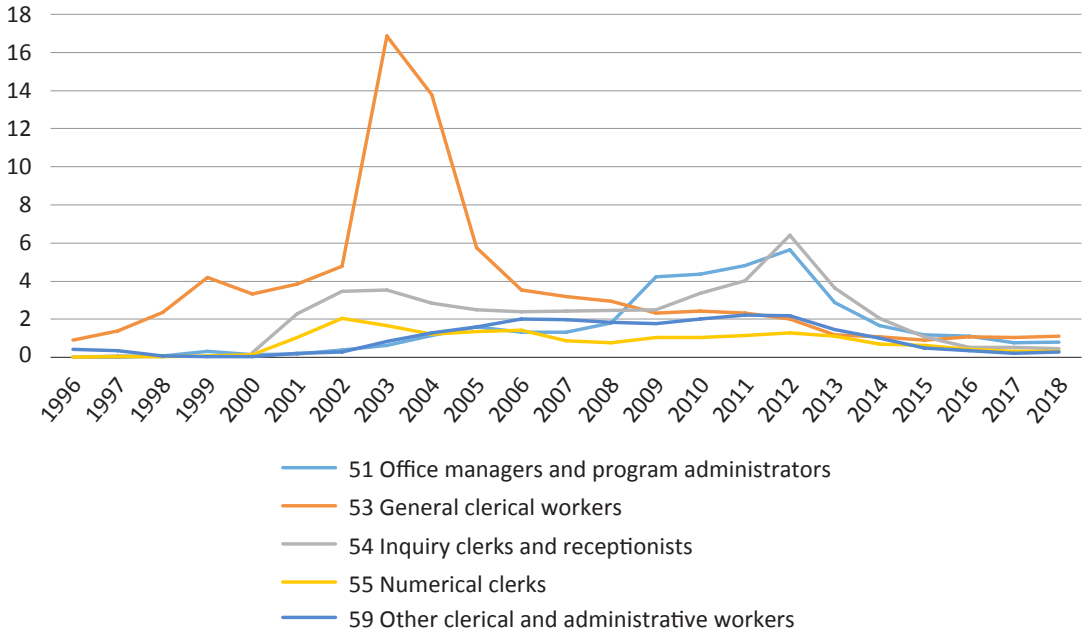

Figure 10: In-training for clerical workers 1996–2018 ('000). Source: NCVER. (2019).

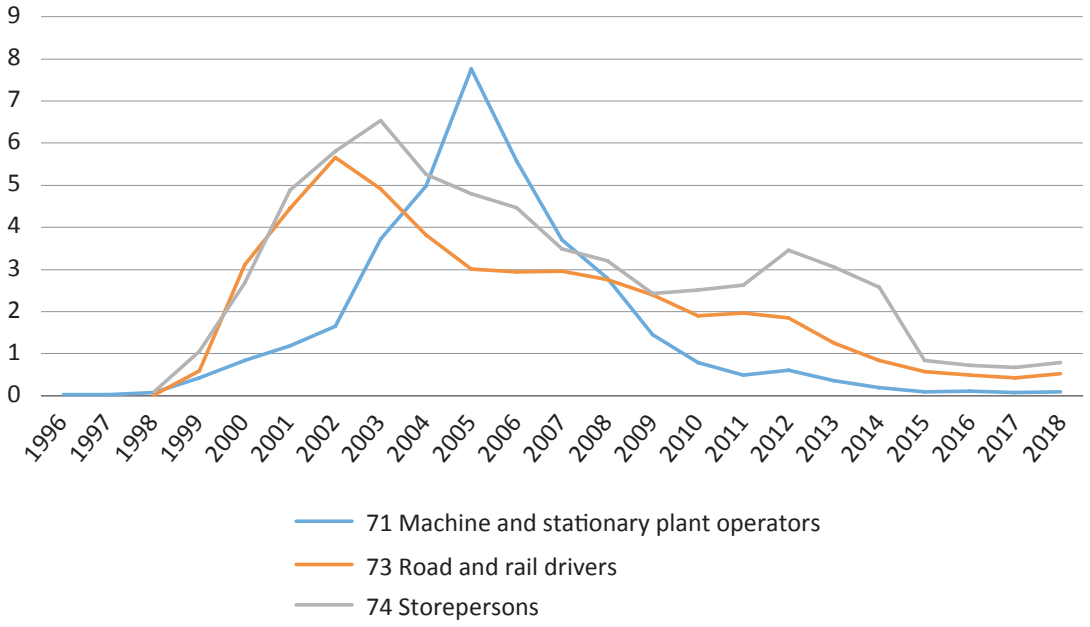

Figure 11: In-training for machine operators 1996–2018 ('000). Source: NCVER. (2019).

Construction shows a different pattern and is mainly affected by government infrastructure-building, and during much of the 2000s it was also influenced by the mining boom. Some of these occupations show a clear pattern of decline after the withdrawal of government subsidies for apprenticeship training. Automotive and engineering trades show signs of the slow collapse of the car industry as tariff protection was removed. Some patterns are also affected by changes in training packages that preference different occupations (Atkinson and Stanwick, 2016). Pfeifer (2016) found that Australian firms aim to achieve net benefits within the indenture period, and responded to the withdrawal of employer assistance by reducing apprentice numbers.

The following analysis applies econometric techniques to investigate the impact of the economy and government policy changes on apprenticeship training: short-run impacts reflecting the dynamic readjustments of industry to change and long-run impacts forming the big picture are analysed.

All economic time series data in the analysis have been tested for data stationarity by employing unit root tests. The first test was for unit root (memory) effects, finding that its presence could not be rejected. Possible cointegration effects between the economic variables were also tested and the null hypothesis rejected. This meant that panel cointegration techniques could be used to estimate the long-run relationships between apprenticeship commencements and Victorian real gross state product (RGSP), and also with overall employment.

Any dynamic adjustment in apprenticeship commencements can then be attributed to short- and long-run economic and policy drivers. All the occupations associated with the rolling stock industry in Victoria were tested. The model also tests how business responds to the removal of apprenticeship subsidies, and how the employment rate of apprentices responds to economic fluctuations. The estimation results are presented in Table 7.1 in Appendix 7.

The results show that in Victoria, economic fluctuations have a positive impact on apprenticeship commencement. For every $100 million of RGSP increase (decrease), the industry increases (reduces) 1.64 apprentices in the long run, and 2.75 apprentices in a short run.

The size of the overall labour force also influences the number of apprentices employed. In the long-run model, the employment of apprentices is negatively associated with the size of the workforce employed in the rolling stock occupations. On average, for every one thousand persons employed by the industry, there will be a reduction of 3.72 apprentice positions. In the short-run, the reduction is about the same, however, this estimate is not statistically significant.

This may reveal substitution between employing skilled labour and investing in training skills. It may also show that as apprentices qualify, the workforce becomes more skilled and fewer positions are becoming available. This is consistent with the slow decline in the rate of apprentices in training within the workforce overall.

During the GFC, some firms moved offshore to save labour costs. Tested within the model, the GFC had a significant negative impact on employing apprentices in the short run, reducing an average of 240 apprentices per occupation.

To test how industry may have responded to changes in government subsidies for apprenticeship training, two dummy variables were incorporated into the model: one to capture the industry response to the withdrawal of $1,500 provided at the commencement of training and $2,000 at completion (increased to $2,500 from 1998). These are relevant for occupations not on the NSNL. The results estimate that the average reduction of commencements is 1,400 in the long run, with the short-run reduction averaging about 380.

Comparing to the firms whose occupations are on the NSNL, firms whose occupations are not on the NSNL experienced an average of a further reduction of 587 apprentices in the long run or an average of a further reduction of 225 apprentices in the short run. This result somewhat matches the picture in Figure 3, where non-trade apprentices experienced a sharper decline after 2012 compared to the trade occupations.

The error correction term in the short-run dynamic model measures the effect of the natural industry self-correcting process to correct the over- or under-employment of apprentices in the short run, toward a “should-be” level of apprentice employment in the long run. The average re-adjustment factor over the period 1996–2018 is 144 apprentices per occupation per year, which is approximately a total of 2,016 apprentices (up or down) each year as industry corrects to long-run economic conditions.

It is important to remember that the rolling stock industry in Victoria, even taking in total manufacture, maintenance and operations of trains, trams and buses, is only a small proportion of employment in the selected occupations within the model. The self-correcting nature of the model, however, shows that unless any training strategy is part of a broader industry investment strategy, any short-term positive measures may result in a negative response down the track. When there is demand for training in response to higher levels of procurement, and the need to upskill to stimulate business investment or to rejuvenate an ageing workforce, targeted investment in training will yield positive economic and social benefits, even though these cannot be well quantified.

Apprenticeship completion rates and SMEs

The factors estimated above have different relevance for firms of different sizes. Understanding the training behaviour of SMEs is important for policy makers to develop the right incentives to encourage greater skill training (OECD, 2019).

O'Dwyer and Korbel (2019) compared completion rates between apprentices with Group Training Organisations (GTOs) and direct employees, assessing why rates may be different. GTOs have the advantage of being able to provide additional support that may not always be available from employers, especially SMEs. In 2018, GTOs managed 8.3% of apprentices nationally. From 2002 to 2007, GTOs maintained the advantage in trades (starting from 50% versus 45%), but from 2010 to 2013 trades maintained a 2–3% advantage (note: data for completion rates lag four years behind commencements). The pattern was similar in Victoria (Figure 12a). O'Dwyer and Korbel (2019) suggested that completions were closer to changes in unemployment than to GDP, but comparing Figure 12a with 12b, the link between trades and GSP may be influencing completion.

Figure 12: Apprenticeship completions for (a) GTOs and direct employers trades and non-trades, (b) all apprentice completions for GTOs and direct employers with economic indicators, (c) trades completions for GTOs, SMEs and large employers, (d) trades completions for GTOs, SMEs and large employers with standard demographic mix. Left axis is percent of total. Source: O'Dwyer and Korbel, 2019.

Completion rates are higher amongst older people and those with previous education and work experience. Younger, school-based, rural, Indigenous and people with special needs all have lower completion rates. They are in higher proportions in GTOs, but all less-advantaged cohorts have been increasing in proportion to total commencements over recent years. From 2010–13, completion rates in trades decreased from two-thirds to about 60% for large direct employers, were just below 50% for GTOs and just above 40% for SME direct employers. For Victoria, these completion rates are about 5% lower for the general cohort (Figure 9c). When the same demographic mix is used, large employers have the advantage, but GTOs perform better than SMEs (Figure 9d).

Apprentice withdrawals for Queensland were investigated by Mangan and Trendle (2010). Taking a sample of 15,804 individuals who took up apprenticeships over a 60-month period, they recorded some taking up to six contracts, capping the sample at three contracts (2%). Of that sample, 53% (8,320) had one cancellation, 31% (4,829) returned, 14% (2,275) cancelled a second time, and 8% (1,214) returned and one quarter of those cancelled a third time. In all, there was a 63% (10,015) completion rate, though if all the withdrawals were totalled, they would equal 69% of the original cohort. The factors contributing most to withdrawals were level of schooling, people from Aboriginal and Torres Strait Islander and culturally and linguistically diverse (CALD) backgrounds, and people with special needs. Those living in more remote areas were more likely to return to training. Any personal increase in income associated with the first withdrawal reduced the likelihood of return, but an increase after the second withdrawal subsequently improved the likelihood of return. The latter may be due to trainees changing employers who offer better pay but also require qualifications, however the authors could not confirm that hypothesis without more data (Mangan and Trendle, 2010).

According to a survey conducted by the OECD (2019), the most commonly cited barrier to apprentices for employers in small firms was lack of resources and support for training, consistent with our findings in Young, et al. (2020a) and Ooi and Cormick (2020). Nearly 90% of firms with 100–249 employees in their survey employed apprentices, whereas less than one quarter of firms with less than 10 employees did. However, 50% of the micro-businesses kept all their apprentices, whereas only 12% of the firms with >250 employees in the survey did. Off-the-job training not suitable for company needs was also frequently cited as an issue (OECD, 2019), and this is a particular issue for the rolling stock industry, as also discussed in Jones, et al. (2020) and Young, et al. (2020a).

In the Australian rolling stock industry, about 80% of the firms are small (<20 employees). These firms employ proportionally more apprentices than large firms. According to the Australian Small Business and Family Enterprise Ombudsman (2019) study, small businesses are major providers of apprenticeships. Small businesses employ 33% of the apprentices in Australia, while large businesses employ 23% (Table 5). Small business owners, particularly in trades, often make effective use of apprentices, as they may have gone through apprentice training themselves and understand the journey (Kuczera, 2017a).

Table 5: Apprenticeships and traineeships by firm size for Australia

Size	Jul–Sept 2012	Jul–Sept 2013	Jul–Sept 2014	Jul–Sept 2015	Jul–Sept 2016	Jul–Sept 2017	Jul–Sept 2018
Small	119,691	103,244	89,501	84,248	85,810	85,443	86,903
Medium	162,484	133,685	104,669	88,826	85,020	78,502	76,628
Large	95,390	81,567	64,051	50,119	44,272	40,754	39,644
Unknown	107,875	94,327	78,373	68,023	63,750	64,260	64,209
Total	**485,440**	**412,823**	**336,594**	**291,216**	**278,852**	**268,959**	**267,385**

Source: Reproduced from the Australian Small Business and Family Enterprise Ombudsman (2019, p19)

Large firms can leverage the economies of scale in employing multiple apprentices. For example, the Downer group employed almost 450 apprentices in 2019 (Downer, 2019), and managed 78 rail apprentices Australia-wide in 2018, graduating with very high retention rates. Cost pressures mean that small firms often offer lower pay and may be less attractive to prospective employees. However, while employment of apprentices by large business has continued to decline from 2012, employment in small firms has been increasing slowly from 2015 onward (The Australian Small Business and Family Enterprise Ombudsman, 2019).

The economic aspects of vocational training can be considered at a range of scales: personal, firm, firm size (SME and large), region, sector and economy-wide. While the literature mainly deals with personal and firm-scale approaches, when considering the type of industrial environment the rolling stock sector finds itself in, the European experience suggests that a strategic approach at the sector scale would be the most effective. With billions of dollars to be spent in Victoria on new rolling stock – trains, trams and buses – over the next decade, an approach that combines procurement, training, skill development and industrial transformation of the rolling stock sector that extends through the supply chain to involve SMEs would yield much higher economic and social returns than would a piecemeal incremental-policy approach.

Consideration could be given to the development of GTOs, including widespread stakeholder involvement with strong social support. A GTO could mirror and/or collaborate with the training academies that some of the large manufacturers are able to support, but specialise in servicing SMEs in the rolling stock supply chain. Trade apprenticeships are an important component of workforce investment and skill development with the potential to deliver substantial return on investment for employers, employees and the sector in general.

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Appendix 1: Working from the inside out: end user research methodology

The 'Working from the inside out' methodology was developed in 2006 to support development of a behaviour change program in a private company. It has since been used extensively to develop programs for local government and by the team at Victoria University to develop decision-making frameworks and support practice and policy in areas such as climate change adaptation, strategic management of natural hazards, and an economic framework for green infrastructure. Working from the inside differs from many conventional research methods as it is not driven by the discovery of theory-driven ideas that are peer reviewed, but provides an evidence base through combining different forms of knowledge and integrating these into the decision-making systems as part of the process. Its key focus is on the needs and context of those making the decisions and how they will be using the research. To understand this, researchers need to think from 'inside' the end users' context.

Stages of end user research are illustrated as a series of tasks, and the process starts with ascertaining the end user need and working outwards through the different tasks (Figure 1A). The ultimate goal is the integration of the research into the end users' decision-making context to enable uptake and use. A key aspect of this process is defining the boundaries in relation to the key area of research for the system, and the key drivers and influences, so they can be assessed.

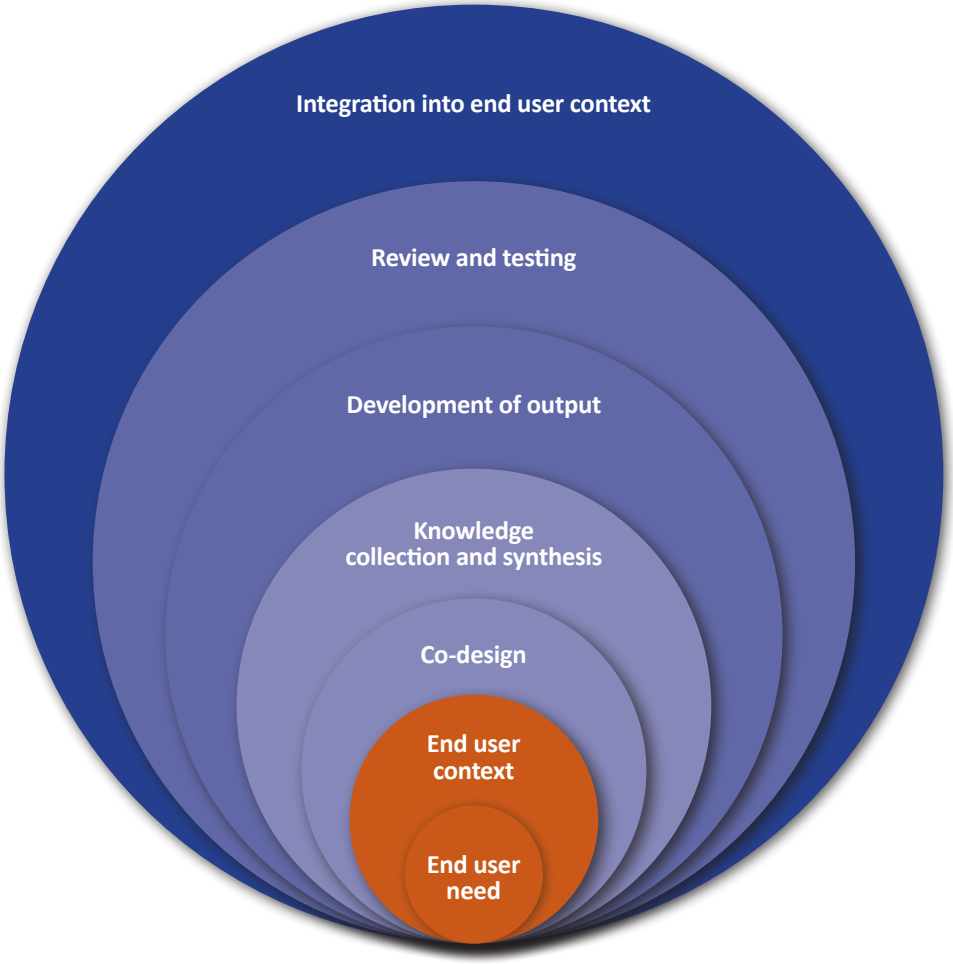

Figure 1A: Key tasks undertaken during the research process. Source: Young, C. (July 2016). *Working from the inside out: implementation-based research*. Conference Poster Presentation. NCCARF Climate Change Adaptation Conference, Adelaide.

Appendix 2: Composition of organisational interviewees

Of the sixty-three people who participated in this study:

- 71% were male and 29% were female
- 81% represented rail sector interests (trains and light rail) and 19% represented bus sector interests.

In relation to the age demographic, the largest group represented were the 50–60 year old demographic, and the smallest representation was the 60+ year old demographic (Figure 2A).

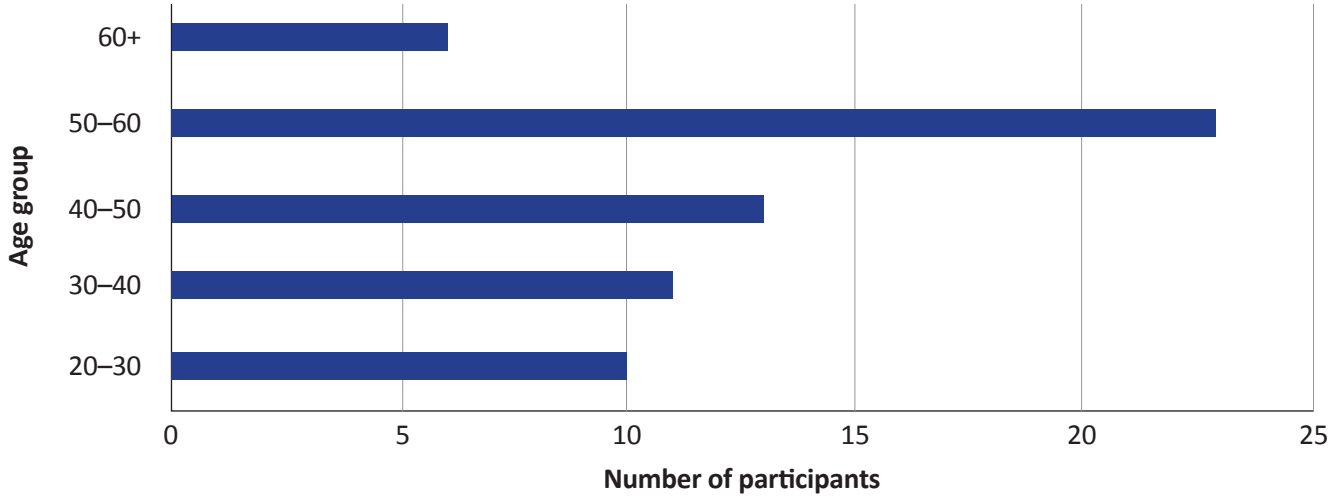

Figure 2A: Demographic composition of research participants

Seventy-six percent of participants worked for organisations who were directly involved in the rolling stock supply chain. Eighty-one percent of these were large organisations and 19% were SMEs.

In terms of their core functional areas represented within these organisations, 41% worked in technical and trades areas, 30% professional areas (including sales), HR, finance, service delivery, logistics, business owners, CEOs and managing directors. The remaining 29% worked in engineering.

In relation to their roles within these organisations, 16% were executives, 39% management and the remaining 45% were classified as general workforce who worked below executive and manager level. The remaining 24% who did not work in supply chain organisations included those from peak bodies, government, educational providers, consultants, and industry related networks and bodies.

Appendix 3: Training survey questions

1. What is your position (or job title)?

OPTIONAL

2. How long has your firm been operating?
   - > Less than 2 years
   - > 3 to 5 years
   - > 6 to 10 years
   - > 11 to 20 years
   - > More than 20 years
3. What is the focus of what you do?
4. In total, how many people does the firm employ?
   - > I am the sole employee
   - > 1 to 4 employees
   - > 5 to 20 employees
   - > 21 to 200 employees
   - > 200 or more employees
   - > Do not know
5. Are all of the firm's clients based in Australia?
   - > Yes
   - > No
   - > If no, what percentage (%) of your firm's work comes from clients based overseas?
6. In your opinion, what is the greatest need in terms of training/skills in the firm at the moment?
   a) So do you think your training needs will change over the next 5 years?
   b) Are there any training challenges?
7. Who is responsible for the delivery of training conducted at your firm?
8. Approximately what percentage of the training at your firm in the last 5 years consisted of the following?
   a) Formal (e.g., RTOs, in-house or outsourced training providers).
      Less than 50%
      50%
      More than 50%
   b) Informal (e.g. on-the job training).
      Less than 50%
      50%
      More than 50%
9. Do you offer any of the following?
   - > Apprenticeships
   - > Traineeships
   - > Internships/cadetships
   - > Professional graduate recruitment programs
10. What is/has been the focus of your training?
    a) What has been the most effective?
    b) What has been the least effective?
11. Do you conduct any management and leadership training?
    - > Yes
    - > No
    - > If yes in what areas has it targeted? For example, project management, team building, people management, future technologies (innovation), engineering, etc.
12. Have you conducted any training on diversity and inclusion?
    - > Yes
    - > No
    - > If yes, can you explain what it involves?

Appendix 4: Types of learning and definitions

Type of learning	Description
Peer-to-peer learning	Peer learning occurs when members of a cohort or area of expertise teach each other. This can be both formal and informal nature.
Blended learning	Blended learning involves combination of online training accompanied by classroom modules, on-the-job training and mentorship programmes, which brings significant impact on the learners (Kaur, 2013).
On-the-job training	On-the-job training is training that is provided to develop skills and competencies in a work environment from an experienced employee or supervisor, who can pass on company-specific knowledge and skills (Flexible Training Solutions, 2016).
E-Learning	E-learning is the use of network technology to design, deliver, select, administer, and extend learning
Apprenticeship	Apprenticeships and cadetships offer a pathway for employment to industry through employment in private and public sector organisations.
Classroom training	Traditional training provided In a classroom setting.
In-house training	In-house training refers to learning for employees led by the company itself. 'Frequently, an in-house training programs features the development of training materials, courses, assessment and supervision' (Train in a Day, 2020).
Mentoring	Mentoring is provided to support the development of skills and knowledge through the pairing up of a more experienced person with a less experienced person. It can take different forms such as person-to-person mentoring or mentoring circles which involve 'a number of people (mentees), usually about 5 or 6, who sit down – usually in a circle – to discuss a topic of interest with one (or multiple) mentors or facilitators who have expertise or experience in that subject matter' (https://mentorloop.com/blog/mentoring-circles-effectively-organisation).
Lifelong learning	'Lifelong learning is a continuously supportive process which stimulates and empowers individuals to acquire all the knowledge, values, skills and understanding they will require throughout their lifetimes and to apply them with confidence, creativity and enjoyment in all roles, circumstances, and environments' (Watson, 2003, p3). Lifelong learning includes informal, non-formal and informal learning.
Virtual Learning	'Virtual learning is a learning experience that is enhanced through utilizing computers and/or the internet both outside and inside the facilities of the educational organisation.' The instruction most commonly takes place in an online environment and can include technologies such as virtual reality tools, Facebook or online forums (https://www.vedamo.com/knowledge/what-is-virtual-learning).
Reverse mentoring	Reverse mentoring is when younger members of the workforce who have expertise share their knowledge with older members who have different expertise to build expertise.
Experiential learning	Experiential learning is a method of educating through first-hand experience. Skills, knowledge, and experience are acquired outside of the traditional academic classroom setting, and may include internships, studies abroad, field trips, field research, and service-learning projects. (Study.com 2020).
Community of practice	'Communities of practice are groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly' (Wenger, 2011, p1). In this practice, communities come together for the purpose of learning and often include a mixture of academics, experts and practitioners.

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Appendix 5: A brief history of apprenticeships and traineeships in Australia

1992	Australian National Training Authority (ANTA) Act establishes an independent statutory body charged with formulating, developing and implementing vocational education and training policy. 'One Nation Economic Statement' measures introduced to address the decline in apprenticeship and traineeship commencements. Age restrictions removed from apprenticeships, providing new pathways for adults and career changers.
1994	Australian Vocational Education and Training Management Information Statistical Standard (AVETMISS) introduced to provide a nationally consistent standard for the collection and analysis of VET information. National Employment and Training Taskforce (NETTFORCE) established to encourage employer take-up of traineeships. NETTFORCE resulted in the extension of traineeships beyond basic certificate levels to higher certificate and diploma levels and the introduction of the National Training Wage (NTW). Remaining age restrictions to traineeships removed.
1995	Australian Qualifications Framework (AQF) established to bring all post-compulsory education and training qualifications into the one national system of qualifications.
1996	Decision made to develop and introduce national training packages across a wide range of industries and occupations.
1998	New Apprenticeship System introduced, merging traditional (trades) apprenticeships and traineeships in other occupation areas, and articulating apprenticeship and traineeship qualifications within the AQF. Australian Recognition Framework (ARF) established, introducing a new set of nationally agreed registration requirements for training providers. User choice principles, designed among other things to open up the training market to allow private providers to access public funds, introduced.
1999	First wave of training packages implemented.
2001	AQF arrangements reviewed and replaced by the Australian Quality Training Framework (AQTF).
2003	Industry skills councils established to replace existing industry advisory bodies.
2004	Announcement of the abolishment of ANTA, with its functions brought into the Department of Education, Science and Technology (DEST) from 1 July 2005.
2006	New Apprenticeships re-launched as Australian Apprenticeships, including Australian School-based Apprenticeships. Australian Technical Colleges established, catering for Years 11 and 12 students wishing to combine study for a secondary school certificate and a school-based apprenticeship in a traditional trade.
2007	Change to the management of Australian Technical Colleges announced, with colleges to be wound back into the state and territory education systems after 2009.
2008	Council of Australian Governments (COAG) initiates major reforms to increase participation in vocational education and training in Australia, particularly higher-level VET. Productivity Places Program (PPP) provides funding of training places to job seekers and existing workers in identified areas of skills shortages. State and territory government employers become ineligible to attract employer incentives.
2009	Apprentice Kickstart initiative introduced December 2009 until November 2010. This initiative was designed to maintain the increase in commencements of young people in skills shortage traditional trade apprenticeships as the Australian economy recovered from the impact of the global recession.
2011	Accelerated Australian Apprenticeships initiative announced with the aim of allowing apprentices and trainees to progress through training as they demonstrate required competencies, rather than on a time-served basis. Universal access to commencement and completion incentives for Certificate II apprenticeships and traineeships removed, with access to the standard commencement and the Group Training Organisations completion incentive only available to Indigenous Australians, people with a disability, the mature-aged, those in rural or regional areas, and those in other equity groups.

2012	Further Commonwealth changes to incentive payments for apprenticeships and traineeships: ■ Commencement incentives for existing worker apprenticeships and traineeships not on the National Skills Needs List (NSNL) removed from 1 July 2012. ■ Commencement and completion incentives for diploma and advanced diploma qualifications not leading to aged care, child care or enrolled nursing removed from 23 October 2012. ■ Commencement incentives for part-time apprenticeships and traineeships removed from 23 October 2012. The following cohorts unaffected: part-time, Certificate III/IV qualifications on NSNL, school-based apprenticeships and traineeships, and part-time diploma and advanced diploma qualifications leading to aged care, child care or enrolled nursing. Victoria introduces new fee and funding rates effective from 1 July 2012 for all new course commencements ("Refocusing Vocational Training in Victoria").
2013	Alternative Pathways for the Trades Program announced to develop an alternative approach to the traditional trade apprenticeship model. Program to trial an initial period of full-time training at a recognised training provider, followed by structured on-the-job training with an employer. Further Commonwealth changes to incentive payments for apprenticeships and traineeships: ■ Completion incentives for existing worker apprenticeships and traineeships not on the NSNL removed from 3 August 2013 (priority occupations such as aged care, childcare, disability care and enrolled nurses exempt from the change). Fair Work Commission announced in August 2013 to increase apprentice pay rates under a number of modern awards. The new rates of pay will apply to apprenticeships commencing from 1 January 2014. The main changes to modern awards will include: ■ Rates for apprentices increased. ■ Adult apprentice rates introduced into a number of awards that did not currently contain them. ■ Minimum award rates for adult apprentices increased.
2014	Announcement of Trade Support Loans of up to $20,000 over four years to apprentices undertaking a Certificate III or IV qualification leading to occupations on the NSNL. Announcement of intention to cease the following skills and training programmes: ■ Tools for Your Trade Payment ■ National Partnership Agreement on Training Places for Single Parents ■ Accelerated Australian Apprenticeships Programme ■ Australian Apprenticeships Mentoring Programme ■ National Workforce Development Fund ■ Workplace English Language and Literacy Programme ■ Alternative Pathways Programme ■ Apprenticeship to Business Owner Programme ■ Productive Ageing through Community Education ■ Australian Apprenticeships Access Programme ■ Step Into Skills Programme. Announcement of Australian Apprenticeship Support Network to replace Australian Apprenticeship Centres from 1 July 2015 with the aim to increase completion rates through targeted support to apprentices and employers.
2015	In the 2015–16 budget, Victorian Government announced: ■ Back to Work Fund (a capped two year $100 million fund) which includes $50 million to help more Victorians start an apprenticeship of traineeship, from 1 July 2015. ■ $3.5 million investment funding to continue support and guidance to apprentices aged 15–24 in their first year of apprenticeships for another 12 months (to 30 June 2016).
2016	Youth Jobs PaTH (Prepare-Trial-Hire) program announced, combining pre-employment skills training with internship placements in businesses for job seekers aged under 25 years. Employers who then hire an eligible job seeker as an apprentice may benefit up to $10 000 under the Youth Bonus Wage Subsidy. Apprenticeship Training – Alternative Delivery Pilots establish five industry-led pilots to trial the adoption of alternative approaches of delivering apprenticeship training outside of the traditional trade training models.
2017	The Australian Government announced, on 9 May 2017 in its 2017–18 budget, an estimated $1.5 billion was to be available from the Government for the Skilling Australians Fund (SAF) between 2017–18 and 2021–22. With matched funding from the states and territories, the SAF will grow the number of apprentices and trainees to support Australia's future productivity, jobs and growth. Also announced was a new $60 million Industry Specialist Mentoring for Australian Apprentices program to provide support to apprentices and trainees, particularly during their first two years, in order to improve retention rates.

2018	From 1 July 2018, the Skilling Australians Fund was to be managed through a new project-based National Partnership Agreement, which required matched funding from state and territory governments. Six jurisdictions (at the time of writing) have signed the agreement: New South Wales, South Australia, Western Australia, Tasmania, Australian Capital Territory and Northern Territory. Note: Victoria and Queensland have not signed.
2019	The Australian Government introduced the Australian Apprentice Wage Subsidy (AAWS) for eligible employers employing apprentices in rural and regional areas. Apprentices had to be new employees undertaking a full-time Certificate III or Certificate IV qualification leading to an occupation on the National Skills Needs List. ■ Phase 1 began on 1 January 2019 until 1,630 sign-ups were reached. ■ Phase 2 began on 1 July 2019 until 1,630 sign-ups were reached The Australian Government introduced the Additional Identified Skills Shortage (AISS) Payment starting 1 July 2019, which provided incentives to eligible employers and apprentices new to the employer. Apprentices must commence a Certificate III or Certificate IV qualification leading to an occupation on the AISS list.

Source: NCVER. (2019). Historical time series of apprenticeships and traineeships in Australia from 1963 to 2019. Accessed 29 December 2019 from: https://www.ncver.edu.au/research-and-statistics/data/all-data/historical-time-series-of-apprenticeships-and-traineeships-in-australia-from-1963-to-2019

Appendix 6: Apprentice outcomes 2019

These collated statistics are from the Apprentice and Trainee Experience and Destinations 2019 tables of data collected by NCVER (2019). They are compiled from questionnaires answered by an estimated 8,615 out of an estimated 81,081 who qualified as apprentices or trainees and an estimated 2,408 people out of 70,059 who did not complete. In the trades area, which is of most interest, there were 3,589 who completed and 1,198 who did not. Numbers are sufficient for reliable estimates in most cases. Estimates with asterisks mark a standard error greater than 10%.

Table 6A: Outcomes for trade apprenticeships after training and main reason for non-completion (if non-completed)

Outcomes after training	Completed	Non-completed	Main reason for not completing	
After training (at 31 May 2019)			**Employment-related**	**73.8**
Employed	91.5	74.1	Offered a better job	6.1
Full-time	84.2	56.5	Pay was too low	6.7
Part-time	7.1	17.3	Poor working conditions	7.7
Not employed	8.5	25.9	Not happy with job prospects in the industry	3.2
Unemployed	4.3	19.2	Didn't like the type of work	8.1
Not in the labour force	4.1	6.7	Didn't get on with boss or others at work	11.9
Employed in same occupation	50.0	19.5	Lost my job/was made redundant	11.7
Employed with same employer	56.5	14.3	Transferred to other training	2.3
Employed or in further study	93.3	79.4	Left job/changed career	8.2
Enrolled in further study	22.8	30.2	Training cancelled/discontinued	6.6
Satisfaction outcomes			Not able to use skills I was learning at work	0.6
Satisfied overall	88.9	51.9	Business closed/went into liquidation	0.7
Satisfied with off-the-job training	87.2	70.0	**Training-related**	**10.8**
Satisfied with skills learnt on-the-job	90.5	77.2	Not happy with the on-the-job training	3.8
Satisfied with employment overall	85.1	57.0	Not happy with the off-the-job training	1.2
Salary (median annual)			Found the study too difficult	1.0
In last week of training ($)	45,800	31,100	Studying elsewhere (university/school)	1.2
After completion (31 May 2019) ($)	62,800	44,000	Lack of interest/support	3.6
Benefits of training			**Personal reasons**	**13.5**
Training relevant to their current job	92.0	54.2	Problems with travelling/transport	1.1
			Illness/health reasons	5.5
			Family reasons	3.8
			Lack of time	0.4
			Moved	2.7
			Other reasons	**1.8**

Table 6B: Income for trade apprentices during last week of apprenticeship and after (31 May 2019)

	During	After
Completers income employed full-time	**45,800**	**62,800**
Age group		
18 to 19 years	29,800	40,600
20 to 24 years	41,700	59,300
25 to 44 years	52,200	70,400
45 years and over	61,100	71,000
Non-completers income employed full-time	**31,100**	**44,000**
Age group		
18 to 19 years	24,700	33,900
20 to 24 years	31,100	41,500
25 to 44 years	41,100	57,300
45 years and over	49,900	63,100

Table 6C: Satisfaction of trade apprentices with training and employment by completion status

	Satisfied		Dissatisfied	
	Completed	Non-completed	Completed	Non-completed
Off-the-job training overall	**87.2**	**70.0**	**5.6**	**18.5**
Relevance of skills to workplace	87.0	75.8	6.2	12.1
Fairness of the assessments of skills and knowledge	88.0	71.8	5.5	13.3
Quality of the training facilities and equipment	80.2	75.0	9.8	13.5
Quality of trainers/teachers/instructors	86.1	69.1	6.0	16.3
Skills learnt were up-to-date	82.4	73.6	7.6	11.5
Recommend training provider	**88.9**	**73.1**	**11.1**	**26.9**
Employment overall	**85.1**	**57.0**	**6.6**	**25.6**
Type of work	88.5	69.6	4.3	17.3
Working conditions	85.5	64.9	6.3	21.6
Pay	62.6	49.0	20.8	33.9
Hours of work	85.7	71.9	5.4	15.5
Supervision	82.9	63.7	7.9	22.4
Relationship with co-workers	88.2	70.3	4.6	17.7
Skills learnt on-the-job	90.5	77.2	4.0	13.4
Safety in the workplace	86.5	73.2	5.8	16.3

Table 6D: Main reason for undertaking an apprenticeship or traineeship for trade apprentice completers and non-completers

	Completers	Non-completers
Employment-related	**55.6**	**54.5**
Wanted to work in that type of job	37.5	37.8
Wanted a job (any type)	9.0	12.2
It was a requirement of my job	5.6	2.7
Recommended/offered by company (non-mandatory)	2.8	1.7
Change of career	**0.6**	**0.0**
Training-related	**30.2**	**31.8**
To gain a recognised qualification or certificate	19.4	19.5
Get paid to learn	1.3	1.6
Opportunity to further knowledge and skills	9.3	10.4
Part of school program/curriculum/offered through school/requirement for school	0.2	0.3
Future prospects	**7.2**	**5.2**
Good job prospects	2.9	2.2
Good pay once qualified	1.4	0.6
To start my own business	2.9	2.4
Other reasons	**7.0**	**8.5**
Didn't get into university/didn't want to go to university	1.2	1.1
Family influence/interest/tradition/business	1.4	0.6
To get out of school/didn't like school/dropped out of school	0.7	0.8
Passion for subject/area of interest/for enjoyment	1.8	2.6
Recommend by friend	0.1	0.3
Fall back	0.1	0.1
Travel	0.0	0.0
Location	0.1	0.1
Other	1.7	2.9

Table 6E: Employment outcomes for apprenticeships and traineeships by completion status, gender, location, special needs, language, training level, pre-training and occupation

Employment outcomes	Completed			Non-completed		
	Employed	Same occupation	Same employer	Employed	Same occupation	Same employer
Gender						
Males	88.7	45.9	60.9	75.9	21.5	17.6
Females	85.9	37.8	64.0	69.9	19.6	17.9
Age group						
18 to 19 years	75.6	30.0	48.6	69.2	15.2	13.4
20 to 24 years	89.7	45.6	56.9	74.3	19.2	14.4
25 to 44 years	89.9	44.0	67.1	76.6	26.2	23.0
45 year and over	89.6	45.6	79.1	77.3	28.1	28.3
Student remoteness (ARIA+) region						
Major cities	86.2	44.1	62.0	72.8	22.5	18.6
Inner and outer regional	90.0	42.7	62.7	74.8	17.3	15.9
Remote and very remote	91.6	30.7	56.5	82.0	22.3*	18.4*
Indigenous status						
Indigenous	81.9	39.7	59.7	64.2	17.7	10.9
Non-Indigenous	88.1	43.2	62.0	74.0	21.4	18.3
Disability status						
With a disability	71.6	38.0	50.1	55.2*	18.6*	19.1*
Without a disability	88.0	42.9	62.2	74.3	21.2	17.6
Home language						
Other language	79.8	44.8	70.2	74.5	22.8	14.4
English	89.0	42.8	60.8	73.5	20.6	18.1
Employed before training						
Employed	91.8	42.7	63.9	79.9	21.3	20.2
Not employed	77.9	44.2	56.8	62.2	20.0	11.7
Qualification						
Diploma or higher	93.1	36.4	78.0	79.0	41.8*	45.9*
Certificate IV	91.9	38.5	73.5	83.1	32.6	31.4
Certificate III	88.9	44.4	60.8	74.0	18.7	15.4
Certificate II	76.4	40.5	60.6	61.5	22.0	11.2
Certificate I	54.3	17.9*	27.8*	53.9*	np	np

Employment outcomes	Completed			Non-completed		
	Employed	Same occupation	Same employer	Employed	Same occupation	Same employer
Occupation						
In a trade occupation	91.5	50.0	56.5	74.1	19.5	14.3
Automotive and engineering trades	94.3	38.6	56.1	76.6	15.9	14.6
Construction trades	91.9	62.0	49.6	73.1	23.5	11.7
Electrotech and telecomms trades	92.7	44.2	62.6	82.9	19.1	17.0
Food trades workers	90.5	64.4	50.9	64.0	16.2	12.4
Other technicians and trades	85.9	48.2	63.7	73.1	21.6	16.3
In a non-trade occupation	85.0	37.7	66.3	73.5	22.2	20.8
Managers and professionals	90.9	36.2	76.2	86.4*	30.4*	21.0*
Community and personal services	86.0	39.7	63.1	69.7	16.4	22.1
Clerical and administrative	84.6	28.7	65.6	76.3	22.4	23.5
Sales	86.3	37.1	68.1	78.1	24.3	28.2
Machinery operators and drivers	86.2	43.3	68.5	80.2	31.5	14.8
Labourers	78.1	41.8	66.8	62.8	16.7	13.7
Pre-vocational or pre-apprenticeship course						
Yes	89.4	43.8	61.3	74.2	22.5	14.2
No	87.5	43.0	62.0	73.8	20.2	19.2
Employer type						
Group Training Organisation	83.9	35.2	51.3	64.2	13.0	12.2
Direct employer	88.1	43.8	63.1	75.0	21.8	18.3
All completers	87.7	43.1	62.0	73.8	20.9	17.7

Appendix 7: Results of econometric analysis of apprentices in training

Table 7A: Long-run panel cointegration estimation and short-run panel error correction estimations for apprentice in training for occupations associated with the rolling stock industry 1996 to 2018, Victoria

Variable	Long-run	Short-run
Vic RGSP	0.0000164***	0.0000275***
	(0.000)	(0.000)
Employment	-0.00372***	-0.003834
	(0.001)	(0.003)
GFC	-0.02667	-0.240219***
	(0.179)	(0.092)
After 2012	-1.41399***	-0.378226***
	(0.281)	(0.107)
Non-NSNL after 2012	-0.58731*	-0.225703*
	(0.310)	(0.133)
Vic Gov funding	-0.23689	0.107332
	(0.224)	(0.120)
Err Corr		-0.142227***
		(0.028)
Obs	317	302
R-squared	0.855	0.253

Source: Gross state product (GSP) for Victoria: ABS 5220.0 Australian National Accounts: State Accounts. Current prices in $million, annual data. GDP deflator for Victoria: ABS 6401.0 Consumer Price Index (CPI), Australia, Melbourne, quarterly. Annual CPI are adjusted by the author. Real gross state product (RGSP) are calculated by adjusting GSP by CPI. All other economic variables: Apprentices and trainees historical time series 1963–2018, NCVER at occupational level.
Note: Robust standard errors are provided in parenthesis. Significance levels: *p-value < 0.1, **p-value < 0.05 and ***p-value < 0.01. Dependent variable: In-training ('000) in yearly data.

Appendix 8: Research methodology

Here we describe the methodology employed in modelling and estimating apprenticeship training of the industries in Victoria associated with the rolling stock sector.

The model

As economic agents, firms are assumed to make rational decisions to optimize and to balance their long-term and short-term economic outcomes. Firms can train workers, including apprentices, up to the levels required to meet current and future needs. Alternatively, firms can buy-in skills. The choice of whether to train or to buy-in depends on the costs and benefits of each strategy and the opportunity costs in exercising a specific option. For apprenticeship training, three main factors the decision whether to employ more or fewer apprentices: the current and future state of the economy, the current level of employment and the cost and benefit of apprenticeship training. Our estimation model is built on those three major factors. The model can be expressed as:

$$App = f(GDP, Emp, CB) \qquad (1)$$

Where App stands for apprenticeships volume, GDP is for the state of the economy, Emp stands for employment in the industry, CB is for the cost or benefit outcomes.

The data

The National Centre for Vocational Education Research (NCVER) makes available apprenticeships time series data for Australia. For data relevance and compatibility, we selected the time frame 1996–2018. At the state scale, the NCVER data contains commencement rates and apprentices in training for 31 occupations. Out of those, we identified 14 as relevant to the rolling stock industry (Table 8A).

Figure 8A (overleaf) illustrates the total in-training data for the 14 occupations. It has a general increase over the period of study with two prominent peaks in 2003 and 2012. Over the 2003 peak follows a sharp decline but the decline is not as aggressive as that after 2012. Figures 6 to Figure 8 in the body section of the report separate into trades, clerical and machine operators, showing that clerical and machine operators contribute to the two peaks but trades do not (Figure 8A).

The GFC period could have an impact on training as some business moved offshore seeking lower labour costs. However, although the Australian economy slowed during the GFC, it did not experience a large economic downturn. The second peak and the decline after could be due to the impact of major apprenticeship policy reform in 2012. We will return to this point.

Table 8A: Occupations included in the study

Occupations		NSNL
1	Managers	No
2	Professionals	Yes
31	Engineering, ICT and science technicians	Yes
32	Automotive and engineering trades workers	Yes
33	Construction trades workers	Yes
34	Electrotechnology and telecommunications trades workers	Yes
51	Office managers and program administrators	No
53	General clerical workers	No
54	Inquiry clerks and receptionists	No
55	Numerical clerks	No
59	Other clerical and administrative workers	No
71	Machine and stationary plant operators	Yes
73	Road and rail drivers	Yes
74	Storepersons	Yes

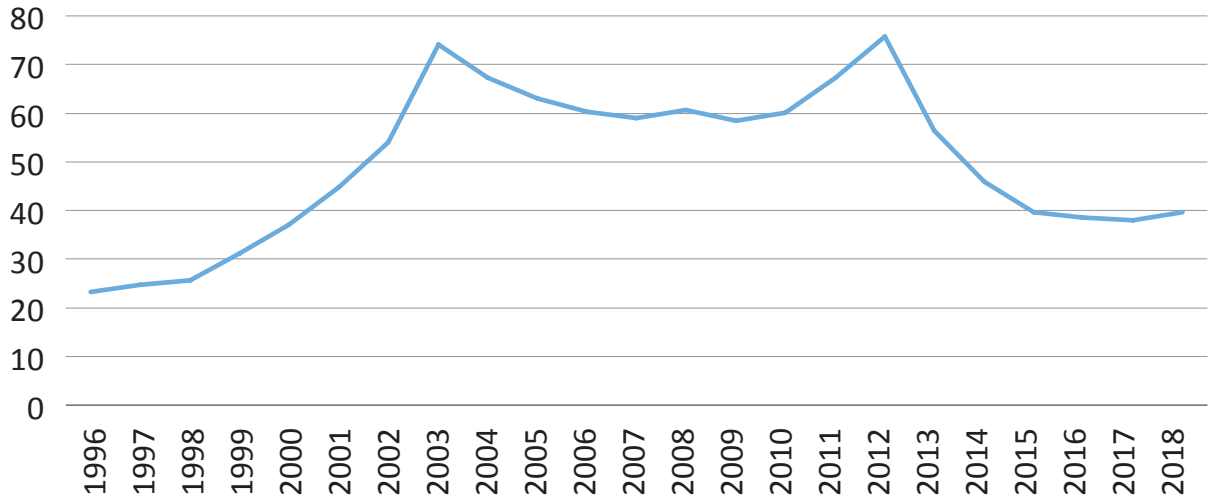

Figure 8A: In-training ('000) for the fourteen occupations in total, 1996–2018. Source: NCVER. (2019). Apprentice and trainee historical time series 1963–2018

Figure 8B shows the level of real gross state product (RGSP) in Victoria for 1996 to 2018. Gross state product at current price is collected from the ABS.[1] The current price GSP is then adjusted by Melbourne CPI[2] with a base year of 2012 to obtain the real value. Victoria RGSP exhibits a long-term growth with slightly drop back in 2013 and slightly slowed down during the GFC period. We model the GFC effect by incorporating a GFC dummy variable.

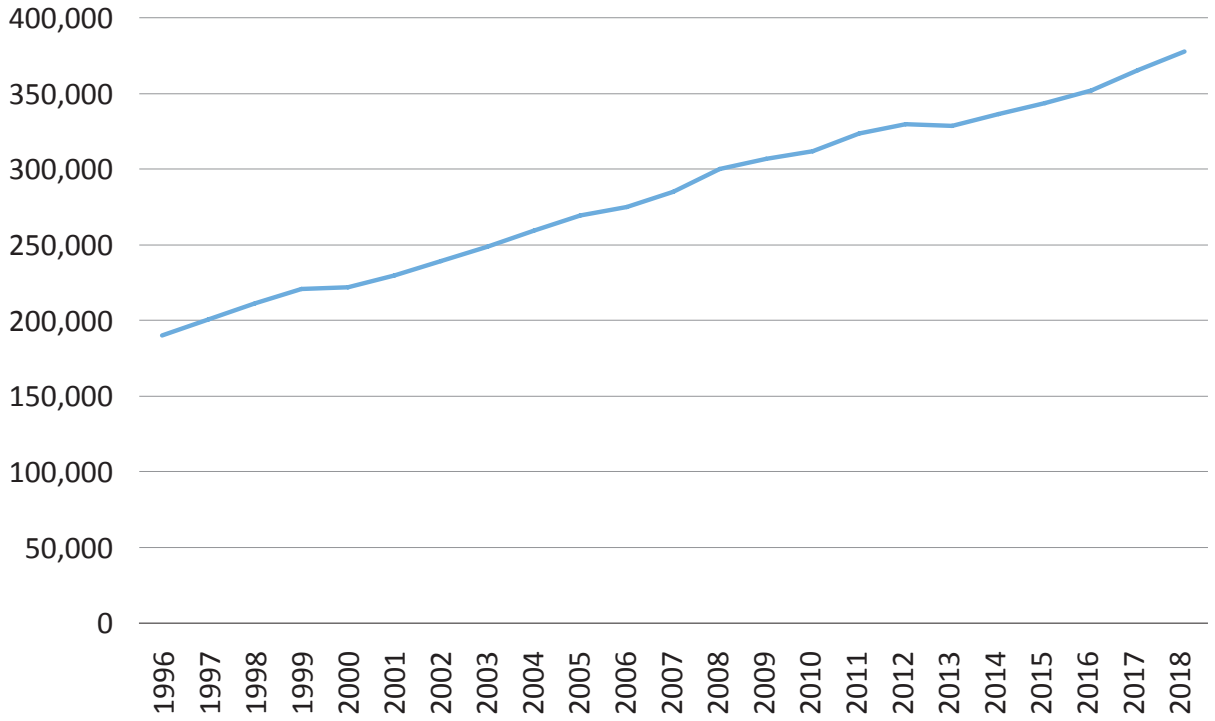

Figure 8B: Victoria real gross state product (RGSP) 1996–2018. Source: calculated by the author from ABS GSP data and Melbourne CPI

1. 5220.0 Australian National Accounts: State Accounts. Gross State Product, Chain Volume Measures and Current Prices.
2. 6401.0 Consumer Price Index, Australia. CPI: All Groups, Index Numbers and Percentage Changes.

Figure 8C shows total employment for the 14 occupations in Victoria, with data from the NCVER time series. Total employment generally increased over time with occasional periods of slow-down reflecting economic conditions. The source for increasing employment could be from skilled migration or interstate migration of skilled labour, population growth and other industries.

The employment data in Figure 8C includes apprentice employment but Equation 1 requires them to be separate. We therefore deducted the number of apprentices in training from the employment data for each occupation, in order to ensure the results were sound.

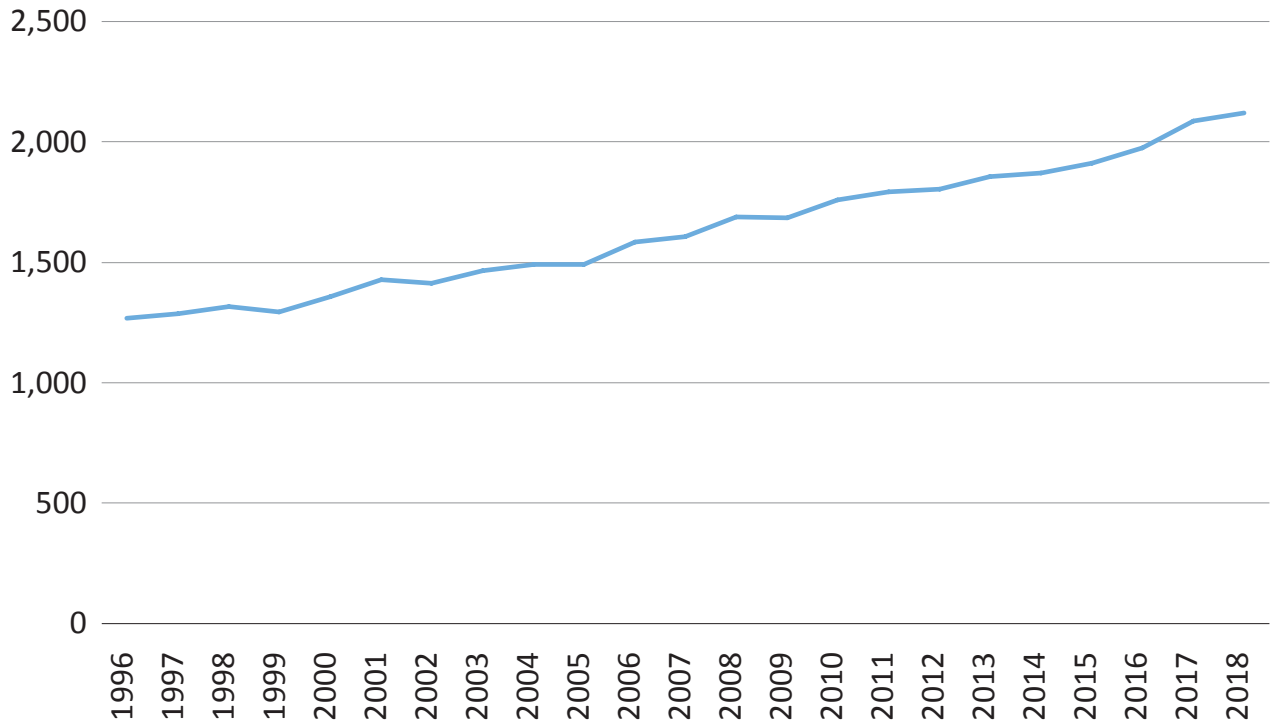

Figure 8C: Employment of the selected occupations in Victoria 1996–2018. Source: NCVER. (2019). Apprentice and trainee historical time series 1963–2018.

Figures 8D to 8F show the time series of employment for the occupations in Table 8A, collected into trade, clerical and machinery operator groups.For trade occupations in Figure 8D, a general increase in employment is observed, with construction topping the series with a 60% gain. Engineering and electrotechnology employment increased by approximately 20,000.

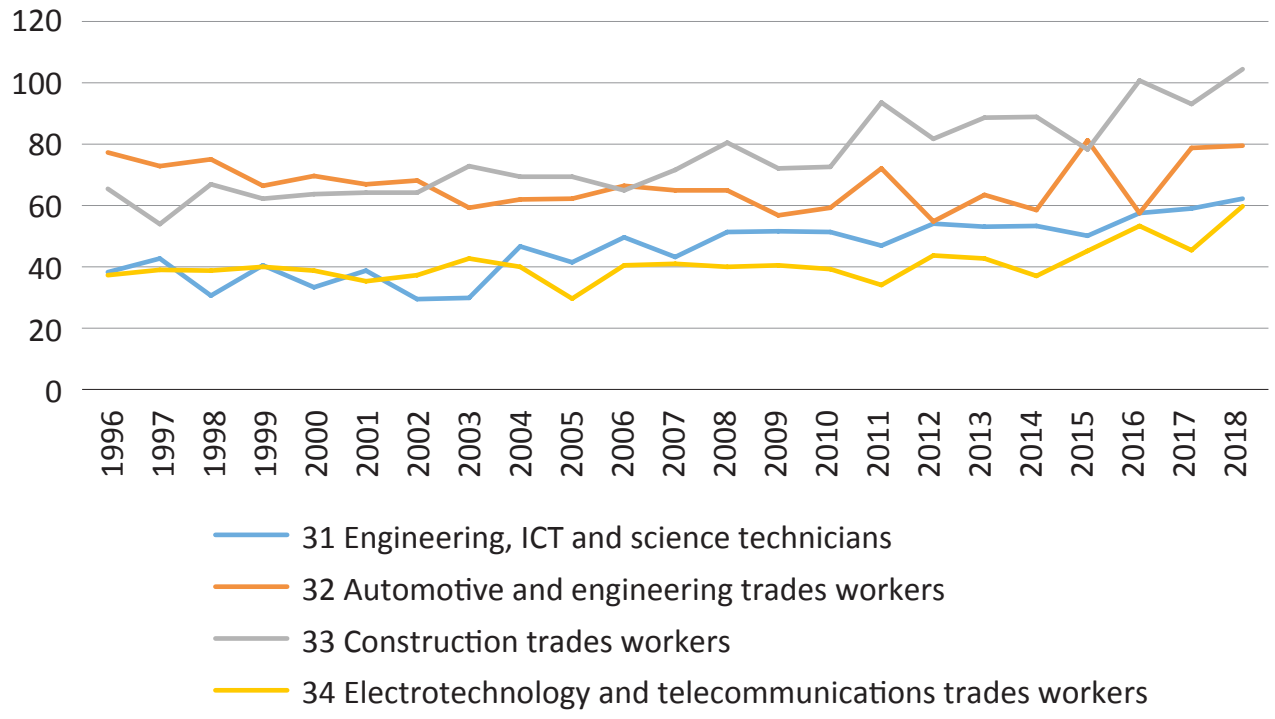

Figure 8D: Employment in trade occupations ('000) 1996–2018. Source: Calculated from NCVER. (2019). Apprentice and trainee historical time series 1963–2018.

Employment in clerical occupations (Figure 8E) increased gently with an exception of the office manager occupation, which tripled over this period.

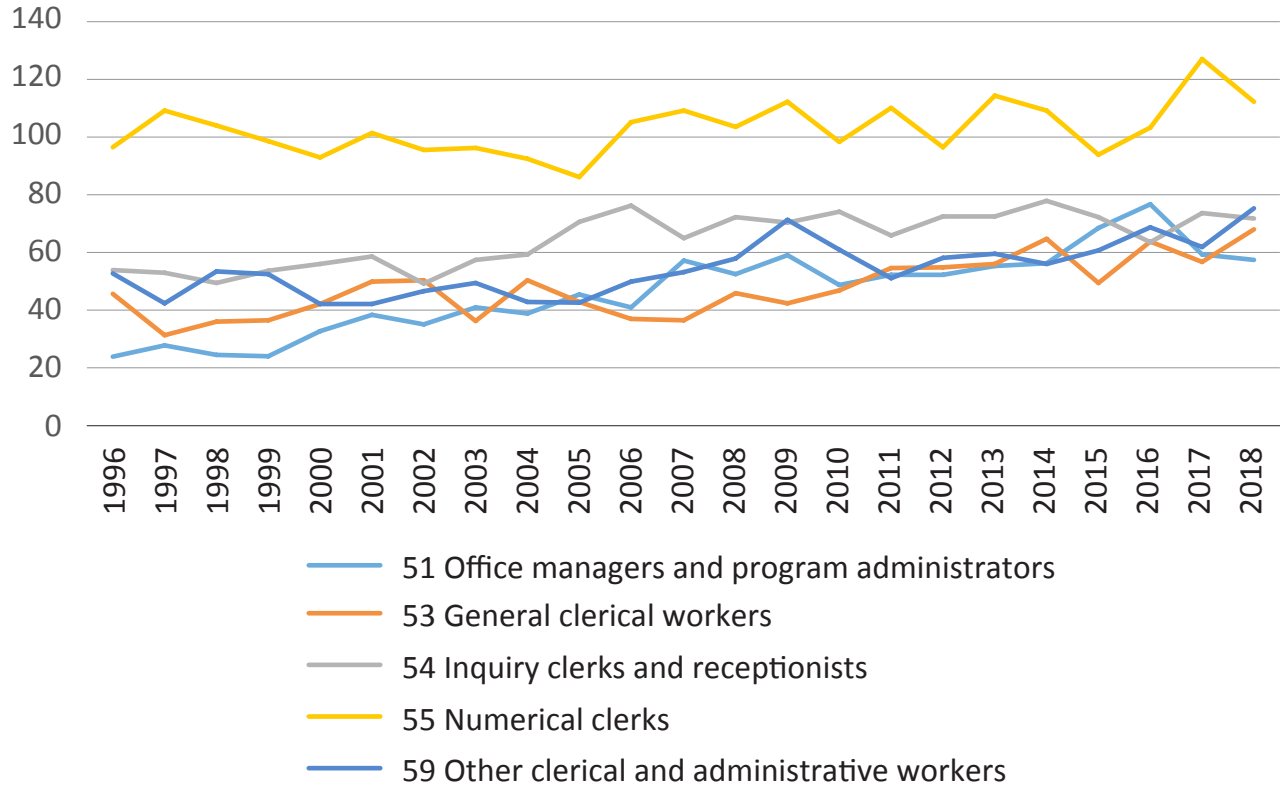

Figure 8E: Employment in clerical occupations ('000) 1996–2018. Source: Calculated from NCVER. (2019). Apprentice and trainee historical time series 1963–2018.

In Figure 8F, machinery operators decreased significantly, while road and rail drivers increased. Stationary machines and plant have become more automated, but self-driving vehicles are still some time away from being widely applicable.

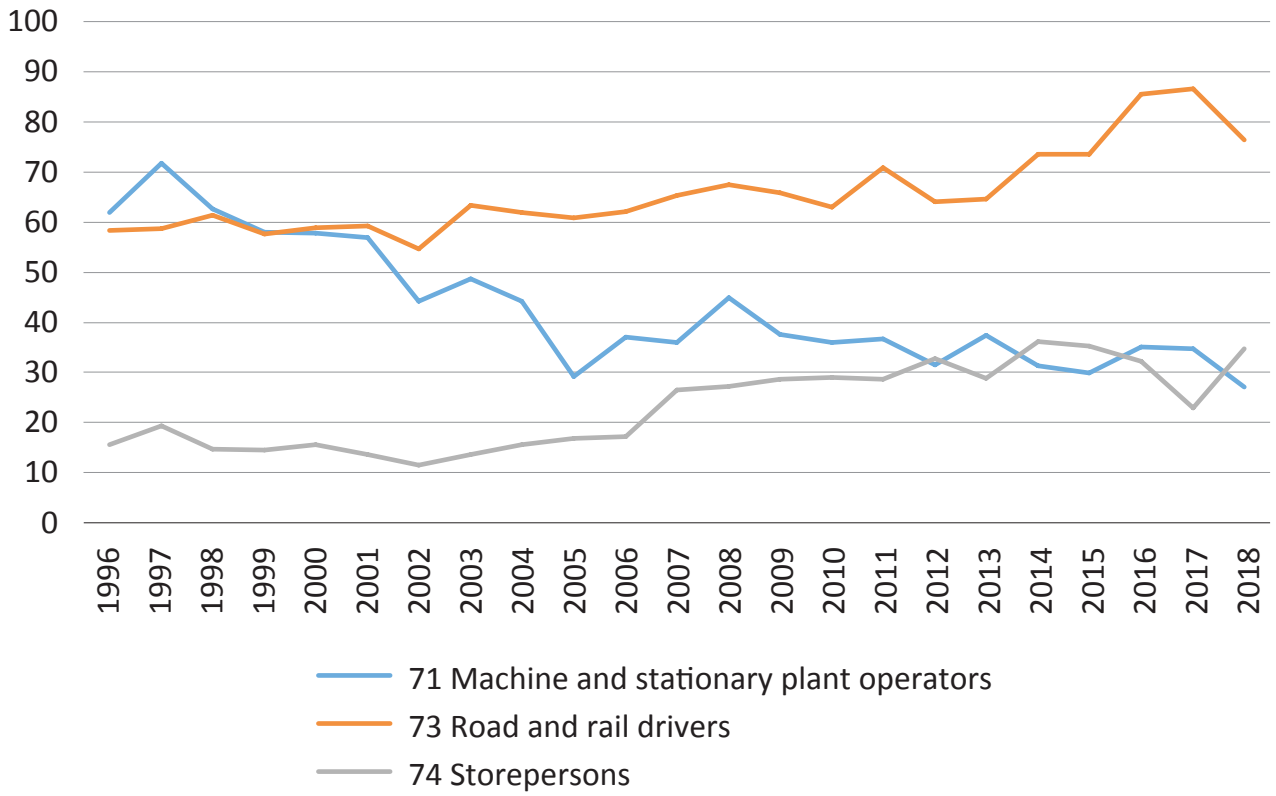

Figure 8F: Employment in machine operator occupations ('000) 1996–2018. Source: Calculated from NCVER. (2019). Apprentice and trainee historical time series 1963–2018.

While employers may not have an accurate measure of measure productivity gains from training, they will have a good idea of the level of experience an employee has. Firms make decisions on whether to provide training based on the profit/cost position they perceive with that information. Our objective is to reveal their collective decision making by analysing the regular pattern of behaviour captured in the data.

There were two major government policy changes over the period of study. The major policy reform by the Federal Government in 2012 restricted the training subsidy to occupations on the National Skills Needs List (NSNL). Most traineeships (at Certificate levels I and II) were no longer supported while trade apprenticeships were (Levels III and IV). There have been some modifications to the NSNL, but these are minor.

This policy changed the cost/benefit balance to some types of training. The mass of apprentices is skewed toward smaller firms; hence, any cost/benefit balance shift could have a profound impact on small firms and on apprentice jobs. We model this policy shift with two dummy variables – one represents the period after the withdrawal of the subsidies on the average change in apprentice jobs, the other represents the occupations not on the NSNL to see the impact on them.

The second policy shift was the $100 million Victorian Government Back to Work Fund, which included $50 million to encourage more apprenticeships and traineeships, and was implemented in 2015. The funding within that policy was largely indirect (e.g., to TAFE colleges), so we were unable to test its impact on employment using our model.

The empirical model

Following the discussion above, we convert Equation 1 into:

$$Y_{it} = \beta_0 + \beta_1 X_{1,it} + \beta_2 X_{2,it} + \beta_3 D_{1t} + \beta_4 D_{2t} + \beta_5 D_{3it} + \beta_6 D_{4t} + u_{it} \quad (2)$$

Where Y is the number of In-training measured in thousand jobs. Subscript it are for the ith occupations in Victoria at tth year. Data are collected from the NCVER Apprentice and trainee historical time series 1963–2018. β_s represent parameter values for each variable. X_1 stands for the Victorian economy and is represented by RGSP in million dollars for Victoria. X_2 is the employment for the corresponding occupations in thousand jobs. D_1 is for dummy variable 1 and represents the GFC effect on the in-training jobs. D_1 equals 1 for the GFC period from 2007 to 2009. D_1 equals 0 for other time periods. D_1 captures the effect of the in-training shock from the impact of the global economic environment. D_2 is a dummy variable that measures the effect major policy reform after 2012. It has the value of 1 for the years after 2012 and the value of 0 on and before 2012. D_3 measures the effect on in-training jobs of non-NSNL occupations after 2012 and takes the value of 1. Otherwise (if before 2012 or the NSNL occupations) it takes the value of 0. D_4 is a dummy variable with the value of 1 for 2015 and 2016 and 0 otherwise. The three dummy variables (D_2 to D_4) together capture the firm's choice when responding to cost/benefit changes in training. The additional benefit from using this set of dummy variables is that they can reveal the effect of individual policy change. u_{it} represents the error term of the regression model.

The estimation techniques

The model employs a data set of 14 occupations over 23 years for Victoria to form a panel data set with 14 cross-sections and 32 time series periods. This panel data set has moderate cross-section and time series dimensions, allowing panel data regression to be used. Since economic time series data are complex, we conducted panel unit root LLC, Breitung, IPS, ADF and PP tests to identify possible stochastic (or non-stationary) process problems[3] in the economic variables of apprentices in training, RGSP and Employment variables. The panel unit root tests[4] found non-stationarity in RGSP and Employment variables at level data for all five tests and with all test options[5]. For the in-training variable, at level data, the non-stationarity hypothesis cannot be rejected in Breitung and PP tests. For all three variables at first difference, panel unit roots test rejected non-stationarity. Combining the test results on the level data and on the first differenced data, the three economic variables are identified as $I(1)$ process or first order unit root time series. Regressions with some economic variables having $I(1)$ process could produce "spurious" regression estimates. Spurious regression over-gilds the regression estimation results making the independent variables appears to be strongly contributing to the dependent variable even if the underlying economic relations between them are poor.

However, if dependent and independent economic variables are in $I(1)$ processes, it is possible that they are in a long-run steady-state relationship bound by some underlying economic equilibrium. If this is the case, the regression between the independent and dependent variable is called a cointegration regression, which is powerful enough to reveal the long-run equilibrium between dependent and independent variables. The short-run counterpart can also be estimated by taking the first difference of each economic time series.

We conducted panel cointegration tests for apprentices in-training with RGSP and Employment. The test results significantly reject the no-cointegration hypotheses using the Kao test, Fisher test and some of the Pedroni tests.

3. Stochastic process in economic data will cause spurious regression problems making the estimation results look good but may not be true.
4. All panel unit root tests (and later for the panel cointegration tests) results are not included in this appendix to conserve space. Interested parties can contact the analyst (Sidney Lung) for the test results.
5. The options include: No intercept and no trend, with intercept but no trend, and with intercept and with trend.

Equipped with the test results, we employed Equation 2 for the long-run panel estimation and Equation (3) below for a short-run error correction estimation. The estimation results are presented in Appendix 7.

$$\Delta Y_{it} = \delta_0 + \delta_1 \Delta X_{1,it} + \delta_2 \Delta X_{2,it} + \delta_3 D_{1t} + \delta_4 D_{2t} + \delta_5 D_{3it} + \delta_6 D_{4t} + \gamma \hat{u}_{it-1} + \varepsilon_{it} \quad (3)$$

Where Δ stands for the first difference or integration. ΔY_{it} measures the yearly changes in In-training for occupation *i* in Victoria in time *t*. δ_s are the parameters for the short-run dynamic model. X_s and D_s are the same variables as in Equation (2). $\Delta X_{1,it}$ stands for the yearly change of RGSP in Victoria. $\Delta X_{2,it}$ is for the yearly changes in Employment for occupation *i* in Victoria at time *t*. γ is the parameter for the error correction term $\hat{u}_{it\text{-}1}$. $\hat{u}_{it\text{-}1}$ is the estimated residuals of Equation (2) for occupation *i* at time *t*-1 which lagged for one time period. Equation (3) is formulated to capture the short-run impact of yearly fluctuations of RGSP and employment on the yearly fluctuation of the in-training jobs. The error-correction term $\hat{u}_{it\text{-}1}$ can reveal the constant adjustment to overcome the over- or under-employing apprentices in training in the previous year, hence it is a dynamic adjustment function to correct previous errors. The error-correction term is expected to have a negative sign and having the value range between 0 and 1. A negative sign means that if over-employment of trainees is greater than what the economy can support in the previous year, the current year will lower apprentices in training to correct the last year's mistake, and vice versa for an under-employment situation. Thus, the negative sign shows that on average, over the period of study, the firms are constantly correcting (negating) their under- or over-employment to keep or readjust the quantity of training in-line or in equilibrium with the economy.

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