

Inquiry into Skill Shortages in the Rail Industry

**Submission to the Victorian Education and
Training Committee**

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**ENGINEERS
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1. Introduction

Engineers Australia is the peak body for engineering practitioners in Australia and represents all disciplines and branches of engineering with over 88 000 members Australia wide. All members of Engineers Australia are bound by a common commitment to promote engineering and facilitate its practice for the common good.

The Education and Training Committee inquiry into *Skill Shortages in the Rail Industry* is welcomed by Engineers Australia. The discussion below considers the current engineering skills available in Australia and outlines the skills shortage currently being experienced in the sector.

The current education of engineers in the vocational and university sectors is considered. Because engineers are a key skills input for the rail industry, the most pressing issue is for the Australian education system is the need to produce more engineers.

Any renewal or new construction in railway infrastructure in Victoria will have an impact on the skills needs of the industry. A recent report produced by Engineers Australia on Engineering Construction in Victoria¹ has pointed to a significant underinvestment in rail (and other) infrastructure in Victoria. Any initiatives by the State and/or Federal Government to reverse this situation will be dependent on having the required engineering skills to undertake the work needed.

Engineers working in the rail industry represent a wide range of engineering disciplines, for example, civil, electronic, electrical, mechanical, industrial and production engineering. However, the skills of a many other engineers and engineering sub-disciplines are also called upon. This means that skill shortages in the industry are across a wide range of engineering disciplines and that specialisation in the rail sector often means that engineers need to develop very specific cross-disciplinarily skills which can be hard to replace when retirements occur.

A continued lack of investment and renewal in the rail sector with fluctuating job opportunities, combined with more generalised engineering skill shortages across the economy, a falling number of school students with the capabilities to study engineering, and stagnated engineering graduations have all combined to exacerbate engineering shortages in the rail industry. Engineers Australia is pleased that the Victorian Government is considering these issues in detail.

2. Factors influencing recruitment and retention

A skills shortage exists when employers have difficulty filling vacancies in a specialisation at reasonable levels of pay, conditions and locations. Shortages are typically for specialised and experienced workers, and can exist at the same time as high unemployment. Shortages may be numerically small, or in specific geographical areas. Skills shortages may arise for a number of reasons including:

- deficiencies in the education and training system,
- economic and demographic change,
- people not completing their training,
- qualified workers not working in the field of their formal qualifications and/or experience,
- cyclical fluctuations in labour demand,
- the demands of new technology,
- lack of flexibility in wages, and
- regional mismatches.

Fluctuations in labour demand discourage skill formation and encourage wastage as workers shift to better opportunities in faster growing industries and occupations. This has certainly occurred in the rail industry due to a prolonged period of restructure and adjustment combined with periods of fluctuating demand and government infrastructure spending in the sector.

The resources and building and construction booms have also drawn engineering expertise away from the sector while engineering graduations from Australian universities have remained static. The large growth across the Australian economy has increased the number of engineers and engineering graduates required, while the number of engineers has not increased to meet this demand.

The key adjustment within the rail sector linked to skills shortages, recruitment and retention was the movement of the industry from a government dominated sector, where adequate engineers were trained as public employees, to a commercial and corporate sector where an environment geared towards graduate training and continuing professional development did not exist. Training opportunities in niche rail specialisations disappeared as well as graduate training positions in the public sector. These were not replaced by the private sector.

This loss of government training occurred across the economy and was not specific to the rail sector. As government agencies and utilities have been privatised or have been outsourced, there has been a fundamental shift in the employment of engineers. Cadetships are virtually non-existent and engineers are now, on the whole, private sector employees and the major responsibility for training engineering graduates has been transferred with them.

Continuing education and post-graduation training are particularly important for engineering graduates. Engineers are not fully “formed” and are not competent to practice independently until they have gained several years of “mentored” engineering experience post graduation.

Additionally, it is recognised that in view of today’s rapid pace of change in technology, and the increasingly accountable and litigious environment in which engineers operate, it is essential that engineers adopt a program of lifelong learning through Professional Development. In this new environment, graduate and experienced engineers, industry, private training companies and universities have recognised the need to work together to support these changes in the employment, education and training environment of engineers.

Engineers Australia has been working for a number of years to help companies and enterprises in both the public and private sector to provide formalised training pathways for their staff through the Professional Development (PDP) and Continuing Professional Development (CPD) programs. These programs help to maintain the currency of an engineer’s qualifications and support engineers to train and “up skill” in new areas of engineering expertise.

The Professional Development Program (PDP), which focuses on the professional development needs of recent engineering graduates, is a formally recognised agreement between Engineers Australia, the enterprise/employer and the individual/graduate engineer. The PDP is a structured program delivered in the workplace with external assessment and support from Engineers Australia. Participation in a PDP is open to engineering practitioners employed in all fields, types and sizes of enterprise.

Under the Continuing Professional Development (CPD) program, professional engineers, on an individual level, undertake activities in order to maintain and extend their knowledge, skills and judgment. For an activity to qualify as CPD it must be related to the engineer’s professional career. For many engineers CPD activities will include both technical and non-technical topics. Non-technical topics include management, accounting, law, economics, and foreign languages.

Engineers must undertake CPD to maintain Chartered Status with Engineers Australia and are subject to regular audit. These programs have not only improved the skill level of the engineers involved, but have made many companies employers of choice for new graduates. They are also an excellent example of how partnerships between organisations can work to influence recruitment, retention and skills formation. Engineers Australia has a small but growing number of PDP partners in the rail sector from both government and industry.

Engineers Australia is also working with the Railway Technical Society of Australia - RTSA (a joint Technical Society of Engineers Australia and the Institution of Professional Engineers New Zealand) to promote and deliver PDP and CPD programs to individual engineers and companies working in the Victorian rail industry.

A new RTSA initiative "Meet the Railway People Expo" is an event designed to bring undergraduate students from Victorian Universities and the railway industry together to improve direct communication and allow the sector to promote the undergraduate project opportunities, workplace internships, secondments and scholarship opportunities available. It is hoped that the expo will also provide a forum for networking and exploring partnerships opportunities between academics and university staff from leading tertiary institutions. The first expo will be held in Melbourne on Saturday 12 September 2009.

The Engineers Australia reports *Engineering for Rail Sector Growth* (1999) and *Post-graduate courses in railway engineering: the needs of Australian engineers and rail organisations* (2000) (attached as Appendix A and B) considered the factors influencing recruitment and retention of engineers in the rail industry. Unfortunately Engineers Australia has not undertaken a more recent analysis, but many of the conclusions found in these reports continue to be supported anecdotally by engineers working in the rail sector.

Engineers Australia believes that for more than a decade there have been (real or imagined) impediments limiting private sector rail organisations from either completely re-employing displaced public sector engineers or hiring graduate engineers. Research supporting this includes that:

- Many rail engineers who have left or leave the public sector are not re-employed by the private sector,
- Market instability (particularly true in Victoria where infrastructure investment has been below the national average) has resulted in rail organisations taking a conservative position on staff hiring and training, resulting in reduced numbers of new entrants to the rail sector, and
- Many rail consultancies have been limited in their capacity to take on recently graduated staff. These organisations (which are common in the rail sector) are unable to generate new skilled rail engineers.

Engineering for Rail Sector Growth also provided insights into the reasons why engineers were leaving the rail sector. The key reasons why engineers were changing employers included to seek new challenges, due to a company restructure, promotion, higher salary and/or better conditions.

The key reasons identified as to why engineers were leaving the rail sector entirely were to seek new challenges, retirement and being forced to leave due to company restructuring. Better conditions and higher salary rated very low as reasons for leaving the rail sector.

At the time of the two reports, Engineers Australia recommended that rail organisations should acknowledge these reasons and consider a number of activities to counteract them. The key objective of any company program would be to identify and provide the challenges sought by each engineer as long as they would also be of benefit to the organisation.

Suggestions made in the 1999 report included project management opportunities, linking key performance indicators with the challenges being sought to ensure that the organisation and engineer focus on the desired outcome and temporary work placements with upstream and downstream organisations.

Other incentives identified included overseas postings, support for post-graduate courses, access to in-house training, opportunities to work on advanced technology development projects, and the development of a career plan for each engineer which directly addresses their needs and ensures that the organisation is aware of them.

The issue of whether there is any need for increased training opportunities at university and trade levels for the rail industry were considered in the report *Post-graduate courses in railway engineering: the needs of Australian engineers and rail organisations*. While this work requires updating it does provide an overview of the types of training which could be provided to engineers within the rail sector. Engineers Australia recommends the findings of the report to the Committee.

3. Demography and meeting labour market needs

Engineering for Rail Sector Growth attempted to document the demographic profile of the rail sector. Ten years later Engineers Australia has put significant resources into expanding our demographic understanding of the engineering profession with the publication *The Engineering Profession: a statistical overview²*. While this report (updated annually) is the most comprehensive statistical assessment of the engineering profession in publication, it does not currently provide a profile of the engineers working specifically in the rail industry.

What the analysis of the Australian Census does show is that in the five years between 2001 and 2006, the number of Australia's engineers in the profession has decreased by around 6500 individuals, with more engineers having left the engineering workforce than having joined it. By the 2011 Census, a conservative estimate of up to 70,000 retirements may have occurred from the engineering profession. Over the same time period, only 45,000 Australian graduates will have completed study in engineering.

Engineers Australia believes that the future Australian skills base will not cover retirements, let alone increased demand for engineering expertise driven by growth in the Australian economy and our transition to a climate friendly, knowledge based economy. It is certain that engineering skill shortages in all sectors will continue to some degree, however there will be some sectoral changes to the depth of engineering skill shortages due to the effects of the global economic crisis.

Despite this, the engineering skill shortage has been acute in Australia for a prolonged period and the existing skills deficit combined with the government focus on infrastructure renewal means that demand for engineering expertise will continue. Any renewal in the rail industry in Victoria will without doubt require additional engineering skills.

What is particularly concerning in terms of the long term skills need of Australian industry, including the rail industry, is that graduation and migration rates are not meeting the current engineering skills shortage, let alone compensating for retirements from the profession.

Currently migrants account for more than half of growth of new entrants to the Australian engineering profession each year. The immigration of professional engineers into Australia through both the off-shore and on-shore permanent visas since 2000-01 and via the temporary 457 visa since 2003-04 are shown in Table 1.

Table 1: Immigration of Engineers to Australia 2000-01 to 2006-07

YEAR	PERMANENT OFF-SHORE	PERMANENT ON-SHORE	TOTAL PERMANENT	TEMPORARY 457 VISA	OVERALL TOTAL
2000-01	1240	31	1271	0	na
2001-02	1140	271	1411	0	na
2002-03	1447	451	1898	0	na
2003-04	1420	952	2372	810	3182
2004-05	1732	1800	3532	540	4072
2005-06	2312	1629	3941	1380	5321
2006-07	1980	2140	4120	1970	6090

Source: To 2003-04 Birrell, Sheridan and Rapson; since 2004-05 and 457 data Department of Immigration and Citizenship

Since 2003-04, the number of engineers working in Australia on 457 temporary visas has more than doubled, increasing from 810 to 1,970. The increase between 2005-06 and 2006-07 was particularly large and may be related to the fall in permanent off-shore migration between those years.

The significance of these changes can be put into perspective by comparing migration to the output of Australian universities. In 2006, there were 5044 new four year Bachelor of Engineering graduates. The supply of new engineers to the Australian workforce is the sum of university output and immigration. Thus in 2006, the supply of new professional engineers was 11,134 (5044 new domestic graduates and 6090 new migrant engineers) with migration accounting for more than half of new supply.

Engineers Australia recognises the significant contribution made by migrant engineers to Australia's competitiveness and economic growth. Migrant engineers are a vital element in generating new ideas and approaches to engineering, and for providing skills where there are shortages.

However, there is an acute need for the Australian education system to produce more engineering graduates. Until relatively recently, only traditional immigrant countries (Australia, New Zealand, Canada and the United States) competed for immigrants. Now European nations and nations elsewhere (especially in the Middle East and Asia) are entering the competition for migrants with desired characteristics, especially skills in short supply. Countries experiencing labour shortages and population pressures are directing their focus toward skilled migration. Australia's reliance on migrant engineers to meet skills shortages leaves industry and our innovation system vulnerable.

The engineering profession is already experiencing a significant skills shortage which is not being met by current university graduations or significantly increased migration rates. The flow on effects of low participation in science, engineering, technology and mathematics at primary and secondary school into the tertiary level has been inevitable and the domestic engineering skills base has been allowed to languish. This will have significant implications for the Victorian Industry and Manufacturing Statement in relation to local content.

For local content provisions to be able to be met, Victorian companies need to have the available expertise in order to seek out opportunities. Analysis by Engineers Australia has shown that engineering companies across Australia (that is all sectors, not just the rail industry) have had some difficulty undertaking work due to skills shortages.

In a regular survey of engineering companies, Engineers Australia has included questions on engineering skill shortages. Anecdotal information that engineering skills shortages were harming the Australian economy has been confirmed with 82% of businesses reporting that there were moderate to severe consequences caused by skill shortages.

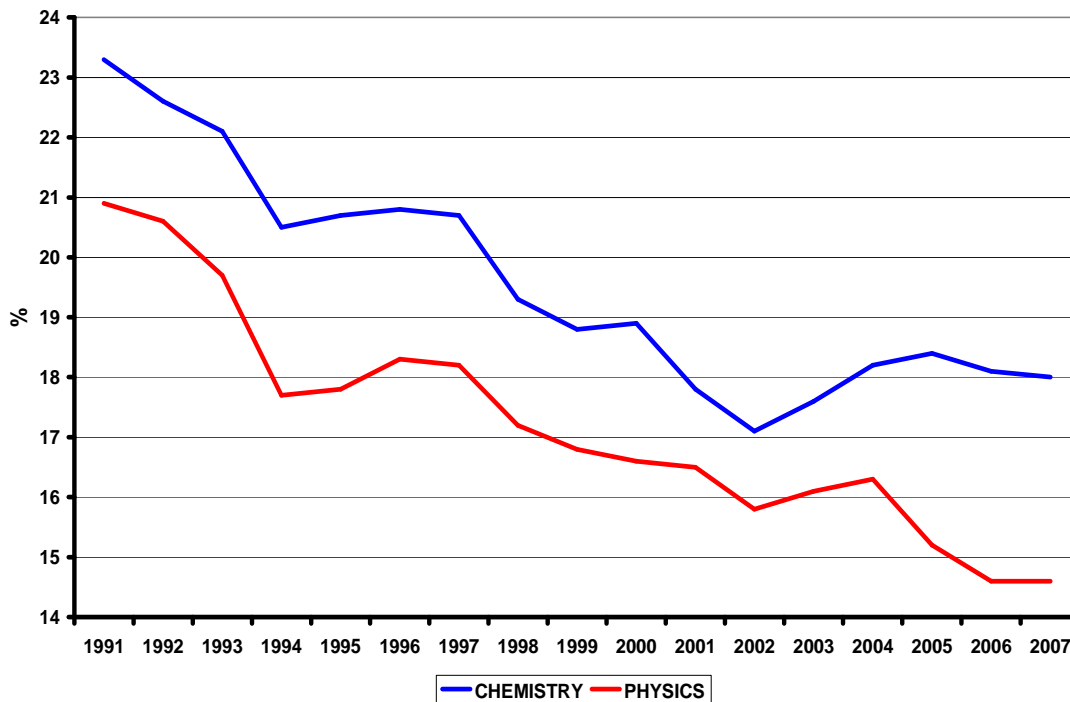
Moderate problems with some monetary consequences were experienced by about half of this group and major problems including project delays and major cost consequences by the other half. Of particular interest to the local content commitments in the Victorian Industry and Manufacturing Statement is that 6-7% of businesses reported that projects did not proceed because of engineering skills shortages.³

4. Increasing education and training opportunities

Engineering university graduates are the main domestic supply from which new demand for engineers and the replacement of older engineers, retiring from the workforce, must be met. Although there have been some increases in the number of undergraduate places in engineering, many more are needed. However, currently there is not a large enough pool of school students capable and interested in studying engineering and other science and maths subjects.

The subject choices of Year 12 students in Victoria mirror national trends. As the following figure indicates, the falling participation rates in physics and chemistry are alarming. Nationally, less than 15 percent of students are studying physics while only 18 percent are studying chemistry:

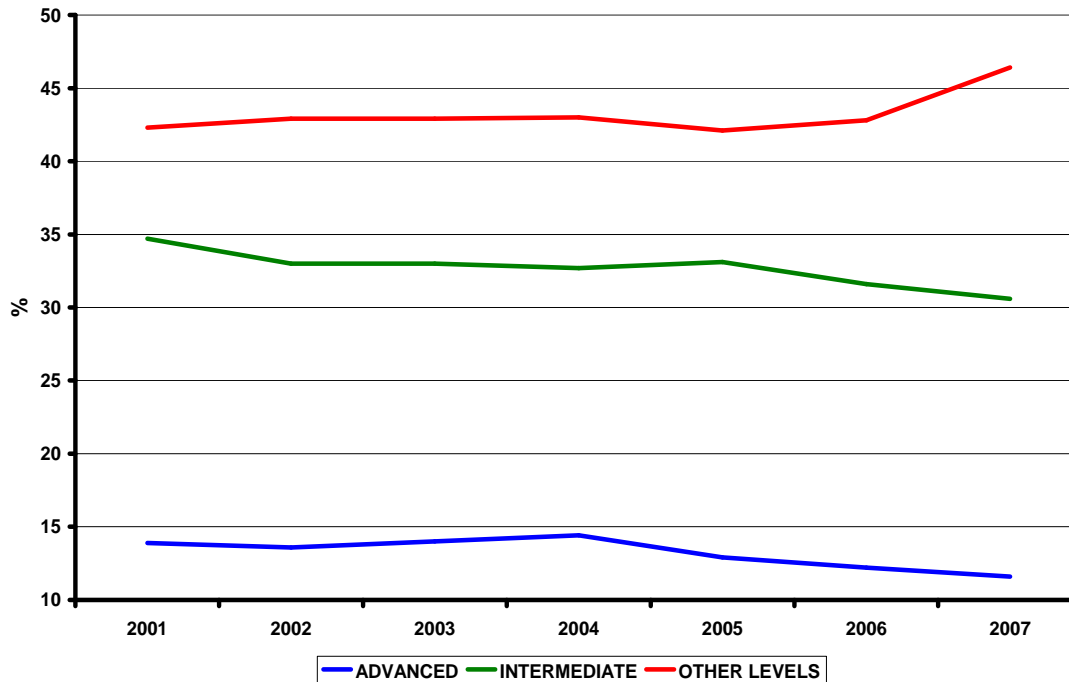
Figure 1: Year 12 Participation in Physics and Chemistry in Australia



Source: Ainley, Kos and Nicholas, ACER, 2008

The situation is mirrored for advanced mathematics with only 11.6 percent of students choosing to study at the advanced level in 2007:

Figure 2: Year 12 Participation in Mathematics in Australia



Source: Ainley, Kos and Nicholas, ACER, 2008

The number of enrolments in engineering education is dependent on two factors: the number of qualified applicants and the proportion of these who are motivated towards engineering. Generally, enrolments in engineering are low across all education levels. More graduates are needed and mechanisms to encourage school leavers to choose engineering education options must focus on promoting all the available education and career pathways within the engineering profession, including those in the rail industry.

In an environment where unit offerings within engineering schools have been driven by student demand, there has also been ongoing concern, particularly from industry, that some disciplines of engineering are in danger of disappearing because of small student numbers. The issue of maintaining specialist areas of study, critical to Australia's economy, regardless of student numbers must be addressed. This may be a critical issue for rail offerings at Victorian universities, and as for many other industries, the skills needs of the rail industry could be better aligned with university offerings.

However, education institutions currently supply education and training on the basis of student demand, with student choice being the key determinate in what is offered. Due to this there is strong potential for the system to fail to meet industry needs in both the number and type of engineering graduates produced, leading to skill shortages.

There is also a lag problem when pricing and labour market signals act as the key influencer of student choices. Fluctuations in the economy, combined with the length of a standard degree mean that it may take three to four years before graduate supply will begin to react to labour market signals.

This situation is at an even more critical stage for engineering skills as the number of high school students studying prerequisite subjects including maths and science continues to decline. The lag problem might in fact be more like 10-15 years.

The success of the higher education system in meeting Australia's needs for highly skilled and capable people will be determined primarily by "schoolroom solutions" that work to ensure enough students are interested and capable of studying engineering at a level that meets industries current and long-term skills needs.

We need students capable and willing to fill university places. With an ageing population and booming economy it is no surprise that both graduating and experienced engineers are in high demand. For the long-term success of the Australian economy and to meet the challenges of the future, the domestic supply of "home grown" engineers must be increased.

5. Increasing training opportunities

There is a broad range of skills and services that fall within the ambit of engineering and not all of these are provided by "professional" (four year university trained) engineers. Most professions, including engineering, acknowledge the broad scope of possible practice within them, and allow for differences in qualifications and for specialisation in areas of work. Engineering work is undertaken by individuals trained at both university and through the vocational educational system. As a group these engineers form the "Engineering Team".

For example, engineers can be divided into three main occupational categories. These are professional engineer, engineering technologist and engineering officer/associate. The occupational categories can be differentiated by the length of education and training undertaken by the engineer.

Professional engineers, technologists and associates come together in different combinations to undertake projects and programs. Their activities and competencies are often closely inter-related with some features of engineering being common to all three categories. All members of the engineering team work together and provide services to each other in order to complete engineering tasks.

Just like the university system, the vocational education system (VET/TAFE) needs to increase graduation numbers in order to meet industry needs. Skill shortages exist across the engineering team and the problems of attracting students to study engineering are equally valid for both the university and vocational education system.

The current blurring of the boundary between the delivery of vocational (VET) and university education does not need to have a negative outcome. There are significant benefits to creating clear pathways between vocational and higher education where students can maintain lifelong learning by jumping in and out of education between vocational and university provided training.

Setting up pathways between VET and university education with clearly defined options and credit transfer arrangements would support the different roles of VET and university education and encourage life-long learning. Given that skill shortages are being experienced in engineering at both the trade, associate, technologist and professional level, training options need to be maintained at both the vocational and university level.

A shift toward any one level could have a negative outcome as engineering skills are needed by industry across the engineering team. A focus on education and training opportunities, with the application of “schoolroom solutions” to encourage students into engineering careers are all important in working to ameliorate engineering skill shortages in the rail industry.

The earlier reports by Engineers Australia on the rail industry considered an action program to counteract skill shortages in the sector. Many of the options canvassed remain relevant and Engineers Australia recommends the findings of the report related to the development of an action plan to the Committee.

Engineering for Rail Sector Growth indicated that despite the shortage being recognised by rail sector organisations, very few were taking substantial action to counteract the situation. This is despite organisations having the potential to undertake initiatives aimed at both reducing staff turnover and attracting experienced rail engineering staff. The report recommended that companies consider the introduction of policies and programs which:

- reduced the number of engineers moving into another industry sector,
- reduced the number of engineers moving into non-engineering management in the rail sector,
- attracted former rail engineers who now work in another sector,
- redeployed experienced rail engineers who are working in rail sector organisations on non-rail projects, and
- retained engineers who would otherwise take early retirement.

However, because these actions do not address the underlying reasons for shortages the report suggested that the most effective actions to ensure the availability of a pool of skilled engineers in the long-term were:

- increasing the number of graduates in the rail sector,
- increasing the number of experienced engineers employed from other sectors in the rail sector, and
- increasing the number of railway employees who upgrade their qualifications and skills into/within the engineering team. For example, engineering technologists who undertake study to upgrade their qualifications to the level of a professional engineer.

The key recommendation was that a sector-wide skills strategy was required for the rail industry. Given the ongoing nature of skill shortages it would seem that this recommendation is still valid and that a strategy must be developed as a priority and include the input and support of industry, government, professional associations and education providers.

Comments from Engineers Australia members and the RTSA indicate that a number of options exist to increase the number of graduates interested in being employed in the rail sector including the introduction of industry based training opportunities or cadetships, a promotional campaign to raise the profile of railway engineering and excite the interest of students so they consider railway engineering as a career and the introduction of railway specific undergraduate electives and design projects to encourage engineering students to seek employment in the sector. Other suggestions were the need to increase industry linkages with university programs including opportunities for students to undertake industry placements with companies in the rail sector and increased options to specialise in the industry with post-graduate and short-courses.

Many of these measures including the upcoming RTSA “Meet the Railway People Expo” would help to provide exposure to both engineers and the wider community about the varied, high tech and innovative aspects of the railway industry. Apart from changing the perception among undergraduates that the rail industry is very low tech and non-progressive, it would also lead to a greater interest in undergraduate and post graduate opportunities and careers in the railway industry.

Engineering for Rail Sector Growth provided an outline of how a sector-wide strategy might operate while *Post-graduate courses in railway engineering: the needs of Australian engineers and rail organisations* considered what additional training opportunities were required to support the strategy.

It has been ten years since this work was undertaken and there is a case to be made that many of the issues identified in both reports continue without remedy. There is scope for the Victorian Government to take a lead role and partner with the rail sector, and organisations like Engineers Australia to review the current skills environment in the rail industry and to work on a comprehensive sector-wide skills strategy.

Engineers Australia recommends the earlier work attached as Appendix A and B for consideration by the Committee as to how the strategy might be developed and the scope of the training opportunities needed.

Appendix A:

Engineering for Rail Sector Growth, Engineers Australia (1999)

Appendix B:

***Post-graduate courses in railway engineering: the needs of
Australian engineers and rail organisations,
Engineers Australia (2000)***

Skills Shortages in the Rail Industry

¹ <http://www.engineersaustralia.org.au/representation/publications>

² The Engineering Profession: statistical overview, fifth edition 2008, Andre Kaspura, Engineers Australia, <http://www.engineersaustralia.org.au/representation/publications>

³ <http://www.engineersmedia.com.au/bookshop/salarysurvey.html>