ENGINEERS IN THE NEW ZEALAND LABOUR MARKET

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IPENZ ENGINEERS NEW ZEALAND

ACENZ

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EXECUTIVE SUMMARY

This report presents for the first time a collection and analysis of labour market information and other data sources on a range of engineering occupations.

An estimated 54,000 workers were employed in engineering occupations in March 2008. They comprised 2.5% of the total workforce in New Zealand.

Very strong employment growth (4.8% per annum) for architects, engineers and related professionals over the last five years suggests that these occupations, which currently employ around 31,600 workers, are under considerable demand pressure.

The current labour market is changing rapidly; information that is just coming out and could not be included in the report indicates some softening is beginning to occur in this labour market. However, engineering-related job losses have not yet been reflected in official statistics.

Employment forecasts from the Department of Labour indicate that demand growth will continue for engineering professionals. It is expected that an additional 1,200 to 1,300 engineering professionals will be required each year over the next five years.

These growth forecasts are supported by information obtained from various industry sources which indicate that expenditure growth is likely to remain high across a number of infrastructure-related industries (such as road, rail, gas, electricity and telecommunications).

In addition to the increased demand caused by industry growth, more engineers will be required to replace engineers who leave their occupation because of retirement and other reasons. It is expected that an additional 500 workers per year will be required over the next five years to meet this net replacement demand.

At first sight, the supply of engineering professionals looks set to meet demand requirements. Around 1,200 to 1,500 people graduate with professional engineering qualifications each year and this supply is supplemented by engineering-qualified long-term immigrants, estimated to be around 200 to 350 per year.

However, the actual supply of engineers entering the New Zealand labour market may be considerably less than the sum of these numbers due to a number of factors. For instance, some engineering graduates may seek employment in other non-engineering occupations, for a variety of reasons, and therefore not end up working as engineers. Second, anecdotal information suggests around 30% of new graduate engineers leave New Zealand within three years of graduating. Third, some immigrants who list engineer as their occupation do not have the prerequisite qualifications, skills or experience to work as professional engineers in New Zealand.

The evidence is inconclusive on whether or not there are general skills pressures for non-professional engineering occupations, where around 22,100 workers are currently employed. Recent employment growth in physical science and engineering technicians (2003-08) was 2.4% which was half that of engineering professionals.

Bringing together labour market information on the supply and demand for engineers is complicated and limited by several factors.

i) Supply side data is limited – in terms of immigration and the flow from educational institutions to employment.
ii) Information for both supply and demand is largely at the level of aggregate engineering occupations, meaning that specific shortages are difficult to capture.

In order to gain a better understanding of the labour market challenges facing the engineering sector, further research is needed into the following areas:

i) An analysis of the employment outcomes of engineering graduates (in particular how they transition from training into employment).
ii) An investigation of the attributes and employment outcomes of migrants with engineering backgrounds.

Contents

1. INTRODUCTION

1.1 The engineering profession

The engineering profession will play an important role in New Zealand's future economic development. A 2008 report by the Institution of Professional Engineers New Zealand (IPENZ) states that:

"The engineering profession is a major contributor to New Zealand's development – engineers are vital to building a sustainable environment which enables economic productivity while protecting our natural resources. Many of those contributions are in the public arena, such as roads, water, wastewater, buildings, equipment, machinery, industrial plants, power stations and utility networks. But engineers also contribute in less visible ways in areas such as health, education, innovation, research and development. Engineers also bring technical expertise to management, and national and local affairs."

1.2 Objective of the report

This report aims to provide information on the demand for and supply of engineers in New Zealand to assist policy development and planning within the engineering profession.

This analysis is based on a collaborative study between the Department of Labour, the Institution for Professional Engineers of New Zealand (IPENZ) and the Association of Consulting Engineers New Zealand (ACENZ). Much of the content of this report comes from official sources but the findings also draw on non-official sources and engineering sector knowledge.

This report focuses on the engineering profession and will be related as closely as possible to the components of the supply of and demand for engineers. Supply is defined as the existing stock of engineers, new engineers in the form of new graduates from the education system and from skilled immigration, with losses through retirement and emigration of engineers. Demand is defined as the expected growth in the engineering profession and the number of vacated positions to be filled due to retirement or engineers exiting the profession for various reasons. Ideally, the objective would be to assemble consistent statistics for these components of supply and demand. Unfortunately, this objective is more ambitious than existing New Zealand statistics will allow.

1.3 Outline of the report

This report is divided into the following sections.

- The engineering workforce
- Industry drivers
- Demand for engineers
- Supply of engineers
- Work experiences of engineers

2. THE ENGINEERING WORKFORCE

This section presents information on the size and characteristics of the engineering workforce. For a definition of the engineering workforce, see Appendix One.

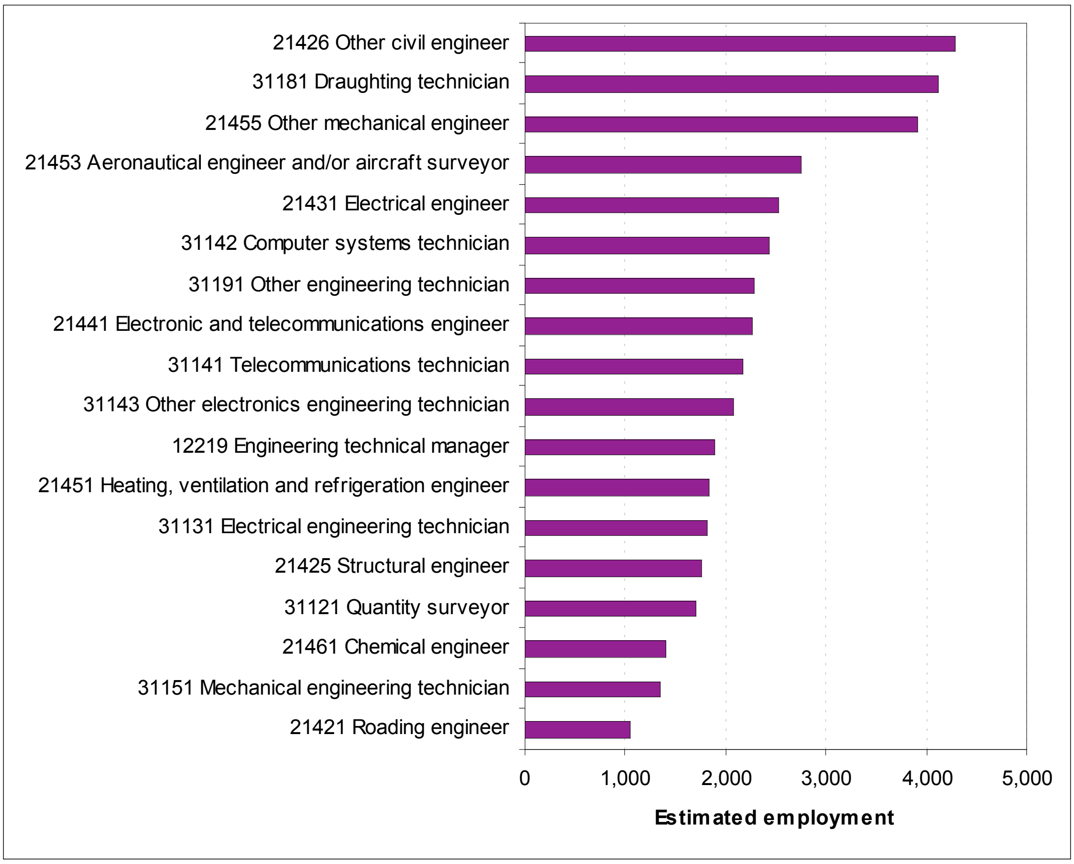
2.1 Current level of employment for engineers

In March 2008 there were an estimated 53,727 individuals employed in 3-digit engineering related occupations in New Zealand. Of these, 31,599 individuals were employed as architects, engineers and related professionals (NZSCO 3-digit: 214) and 22,128 individuals were employed as physical science and engineering technicians (NZSCO 3-digit: 311).[1]

Figure 1 shows employment levels for selected detailed 5-digit engineering occupations in March 2008. The occupations that employed the largest number of engineers were:

- Other civil engineer (4,281)
- Draughting technician (4,123)
- Other mechanical engineer (3,911)

Figure 1: Estimated employment for detailed engineering occupations (annual averages), March 2008



Source: Department of Labour Employment Estimates

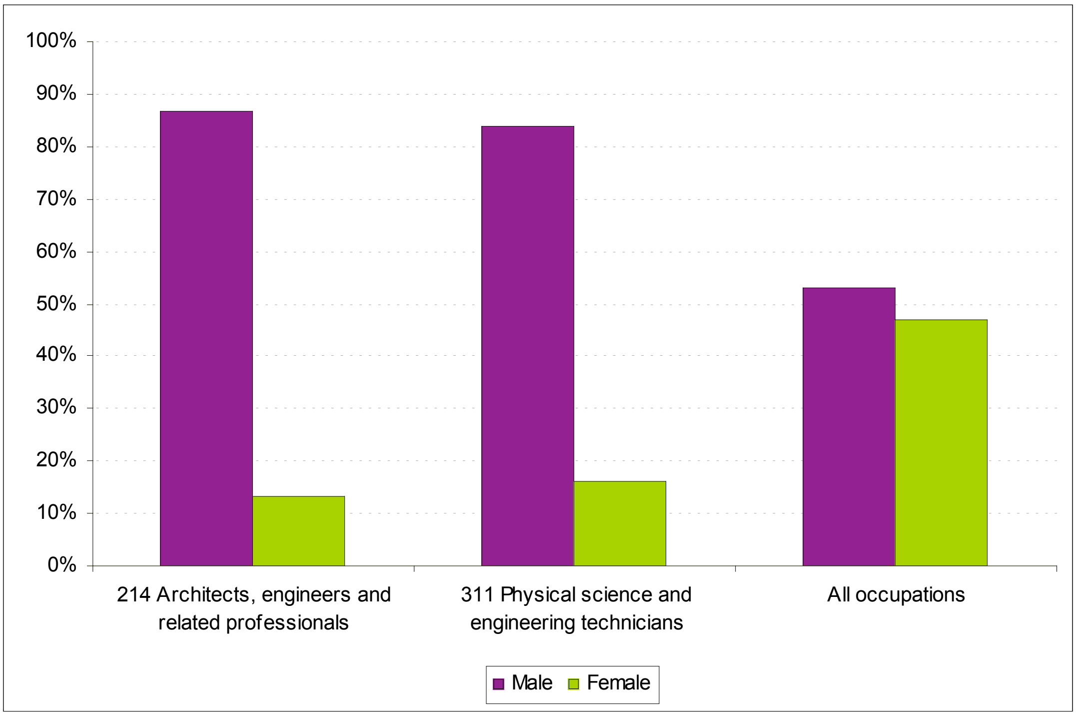
[1] Department of Labour employment estimates (annual averages)

2.2 Characteristics of the workforce

2.2.1 Gender profile

In 2006, the vast majority of individuals employed in engineering occupations were male (86.8% of architects, engineers and related professionals and 83.9% of physical science and engineering technicians). A comparison of detailed 5-digit engineering occupations shows that males predominated across the majority of occupations. Females made up a sizeable proportion of chemical engineers (38.3%) and chemical engineering technicians (33.2%) but this was still lower than the proportion of all occupations who were female (47.0%).

Figure 2: Gender profile of engineering occupations, 2006



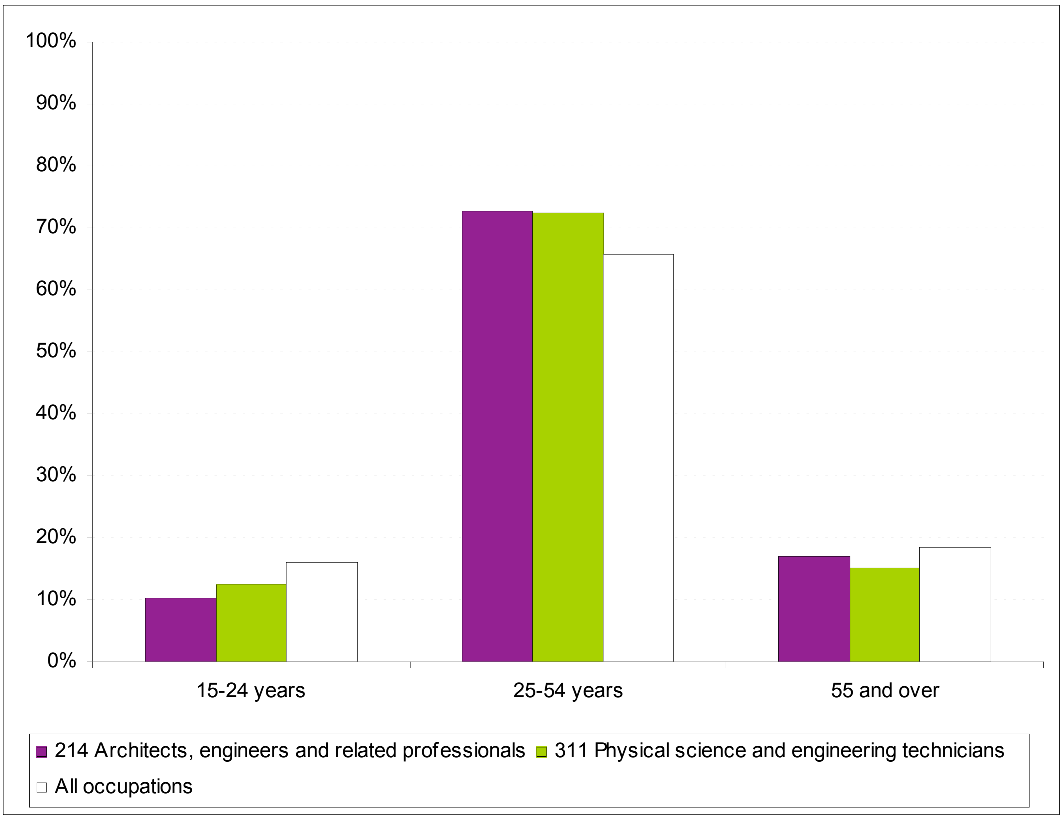
Source: 2006 Census of Population and Dwellings, Statistics New Zealand

2.2.2 Age profile

Information from the 2006 Census shows that engineering occupations had a higher proportion of workers in the 25-54 year age group than for all occupations. In 2006, 72.8% of architects, engineers and related professionals and 72.5% of physical science and engineering technicians were aged 25-54 years. This compares to 65.7% for all occupations.

Engineers were less likely to be aged 15-24 years than for all occupations. This may reflect higher participation rates in tertiary education among engineers, given that a tertiary level qualification is a pre-requisite for entry into many engineering occupations.

Figure 3: Age profile of engineering occupations, 2006



Source: 2006 Census of Population and Dwellings, Statistics New Zealand

Overall, engineers were slightly less likely to be aged 55 and over than for all occupations. However, a number of detailed 5-digit occupations recorded a higher proportion of workers aged 55 and over. They included:

- Other civil engineer (21.7%)
- Other engineering technician (21.7%)
- Electrical engineering technician (21.2%)
- Engineering technical manager (20.7%)

This suggests that these occupations may be affected by the retirement of a sizeable proportion of their workforce over the next five to ten years.

2.2.3 Ethnic profile

Table 1 shows the ethnic composition of 3-digit engineering related occupations.

Overall, Maori and Pacific people were under-represented among engineers. In 2006, 4.6% of architects, engineers and related professionals and 6.4% of physical science and engineering technicians identified as Maori. This was substantially lower than the proportion across all occupations who identified as Maori (11.3%).

Pacific people comprised 1.6% of architects, engineers and related professionals and 2.4% of physical science and engineering technicians. This is well below the proportion for all occupations who identified as Pacific people (4.8%).

Asian ethnic groups made up 7.9% of architects, engineers and related professionals and 9.5% of physical science and engineering technicians which was similar to their proportion across all occupations.

Engineers, however, were more likely to identify with 'Other' ethnic groups. This includes ethnicities other than New Zealand European, Maori, Pacific and Asian. In 2006, 17.9% of architects, engineers and related professionals and 18.6% of physical science and engineering technicians identified with 'Other' ethnicities, compared to 14.7% for all occupations.

In 2006, 73.2% of architects, engineers and related professionals identified as New Zealand European/Pakeha. This compares with 68.9% for physical science and engineering technicians and 68.8% for all occupations.

Table 1: Ethnic profile of engineering occupations, 2006

Occupation	New Zealand Europ-ean/Pakeha	Maori	Pacific	Asian	Other
Architects, engineers and related professionals	20,067 73.2%	1,251 4.6%	444 1.6%	2,154 7.9%	300 17.9%
Physical science and engineering technicians	14,220 68.9%	1,323 6.4%	495 2.4%	1,968 9.5%	186 18.6%
All occupations	68.8%	11.3%	4.8%	8.0%	14.7%

Source: 2006 Census of Population and Dwellings, Statistics New Zealand.

Note: Individuals can identify with more than one ethnic group. Therefore, the percentages may add up to more than 100%.

A comparison of detailed 5-digit engineering occupations shows:

- Maori made up 9.3% of chemical engineering technicians and 9.1% of other civil engineering technicians. In contrast, just 3.1% of engineering technical managers identified as Maori.
- Pacific people comprised 5.4% of chemical engineering technicians and 4.3% of telecommunications technicians but just 0.7% of engineering technical managers.
- Asian ethnic groups made up a high proportion of computer systems technicians (14.2%), chemical engineering technicians (14.2%), chemical engineers (12.5%) and structural engineers (12.0%). However, they were less likely to be employed as engineering technical managers (3.5%).

2.3 Discussion

Employment at the 5-digit occupation level shows that engineers are spread quite evenly across many specialist occupations. Chapter 4 examines employment growth at this level. Further understanding of trends and drivers for specific occupations will help us understand the extent to which skills are transferable across engineering occupations.

Although engineering occupations do not have particularly old workforces on average, industry comments suggest that succession is becoming an increasing challenge. Ensuring that succession strategies such as mentoring are in place for engineering-based firms may be particularly important for engineering occupations because of the high levels of specific technical knowledge involved.

When looking at how we can widen the pool of future potential engineers, it is clear that the Maori and Pacific populations are not well-represented in both professional and technical occupations. Although there are likely to be a variety of reasons for this, performance and choice of subjects at high school level are considered to be the main determinants of this outcome.

3. INDUSTRY DRIVERS

3.1 Introduction

This section identifies a range of industry drivers that may impact on the engineering workforce over the next five to ten years. Each section examines, where possible, the general economic outlook for the sector, followed by comments on possible skills shortages as recorded in various publications and other information sources.

The industries examined are those that employ a relatively high number of workers from the engineering disciplines:

- Transport
- Manufacturing
- Aeronautical engineering
- Electricity, Gas and Water Supply
- Telecommunications
- Construction

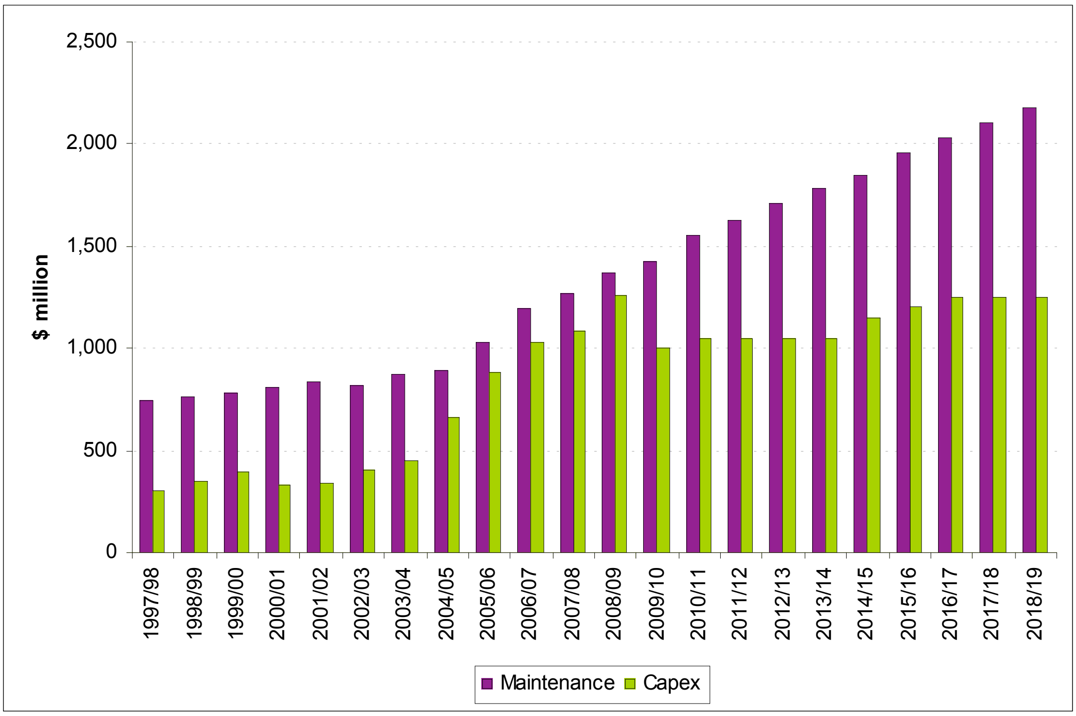
By comparing a range of different information sources, this chapter provides information on those specific industries that may experience strong growth over the next five to ten years, as well as those industries that may experience low and/or negative growth. This in turn provides an indicator of the potential spread of engineers in the short to medium term. For instance, it is possible that engineers currently working in industries with a low growth outlook may move in to those industries with higher growth prospects.

3.2 Transport

The transport industry employs a range of engineering occupations including roading engineers, structural engineers, other civil engineers, clerk of works and draughting technicians.

Figure 4 shows historical and forecast trends in roading maintenance and capital expenditure over the period 1997/98 to 2017/18. This covers expenditure by the New Zealand Transport Agency and local authorities. Overall, the outlook is for an increase in expenditure over the next five to ten years. Maintenance costs increased between 2004/05 and 2007/08 and are projected to continue to climb over the next ten years. For capital expenditure, there were considerable increases in expenditure in 2003/2004 to 2007/08 and these high expenditure levels are expected to remain at $1 billion per year for the next ten years.

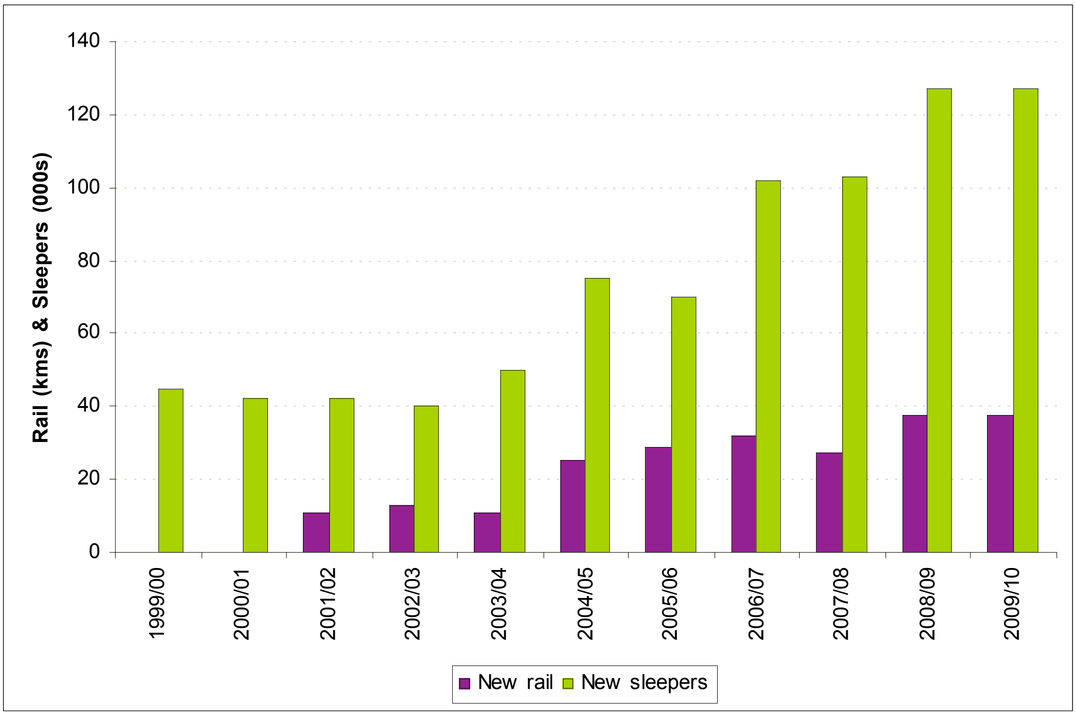
Figure 4: Historical and forecast expenditure for roading maintenance and capital expenditure, 1997/98 to 2018/2019



Source: NZ Transport Agency

Figure 5 shows historical and projected expenditure on rail infrastructure over the period 1999/2000 to 2009/2010. Rail infrastructure is funded by ONTRACK directly from the Crown Account. After a period of low investment, the government significantly increased rail infrastructure expenditure from 2003/04 onwards. This graph shows significant increases in both new rail laid and new sleepers laid and these are forecast to continue into 2009/10. Although these are proxies for the major new investments in rail infrastructure committed by the previous government that are underway and forecasted, these findings suggest that there will be an ongoing demand for engineers.

Figure 5: Expenditure on rail infrastructure, 1999/2000 to 2009/2010



Source: ONTRACK 2008 Annual Report

The major new investments include improvements in Auckland which consist of double tracking of the Western line, new signalling, the New Lynn rail trench, the Newmarket reconstruction and the Manukau rail link. These investments combined have an estimated total cost of $600 million. Other projects currently being proposed include the Auckland rail electrification with an estimated cost of $500 million, a range of freight network projects around New Zealand with a total estimated cost of $400 million and track and station upgrades in Wellington with an estimated cost of $180 million.

Rolling stock upgrades are also underway or planned in Auckland ($386 million), in Wellington - $280 million, and TranzScenic carriages and locomotive upgrades - $80 million. It is expected that some of the manufacturing and most of the assembly of rolling stock will occur in New Zealand.

3.3 Manufacturing

The manufacturing industry employs chemical and process engineers, mechanical engineers and electrical engineers. Information on recent activity indicates that employment in the manufacturing industry has remained relatively stable since 2003.

There is limited data available on projections of employment in the manufacturing sector. Some information is available through regional statements to the Tertiary Education Commission[2]. The regional statements are prepared by institutes of technology and polytechnics for their respective region and summarise tertiary education issues and trends in the regions. These show that the number of people

[2] http://www.tec.govt.nz/templates/standard.aspx?id=1844

employed in the manufacturing industry is expected to show a moderate increase for all the regions that present data in their regional statements.

Additionally, a number of the regional statements note that there is a skills shortage for engineers in the manufacturing industry, with comments such as:

- *"In addition to these skills gaps, industry and business are asking for:*
    - *Technicians to assist in manufacturing and product development especially engineering, information technology, electrical engineering, laboratory technicians, infrastructure designers, developers, generic management skills*
    - *Trade training at all levels including advanced trades levels, technicians*
    - *Supervisors" (Wellington)*
- *"The following key skill and labour shortages in the Canterbury labour market have been highlighted by previous Department of Labour work:*
    - *Skilled trades workers for the manufacturing sector including engineering" (Central South Island)*
- *"Several general themes emerged from the data collection and analysis similar to those expressed by other industries. These include:*
    - *The need for the industry to work together to address skills shortages of plastics technicians, plastics operators, designers, tool makers and plastic die fitters" (Canterbury)*

3.4 Aeronautical Engineering

Aeronautical engineers are employed to maintain, repair and overhaul aircraft engines, mechanical systems, structures and electronic equipment. Specific engineering occupations in this industry include aeronautical engineer and avionics technician.

Employment is the main indicator that is available for the aeronautical engineering industry.

Career Services presents[3] a job outlook for aeronautical engineers. The job outlook states that the global aviation industry is predicted to grow by five to ten percent each year. The job outlook also notes that if this growth occurs, New Zealand will need an additional 350 aeronautical engineers each year. A total of 120 aeronautical engineers graduated in 2006-07.

3.5 Electricity, Gas and Water Supply

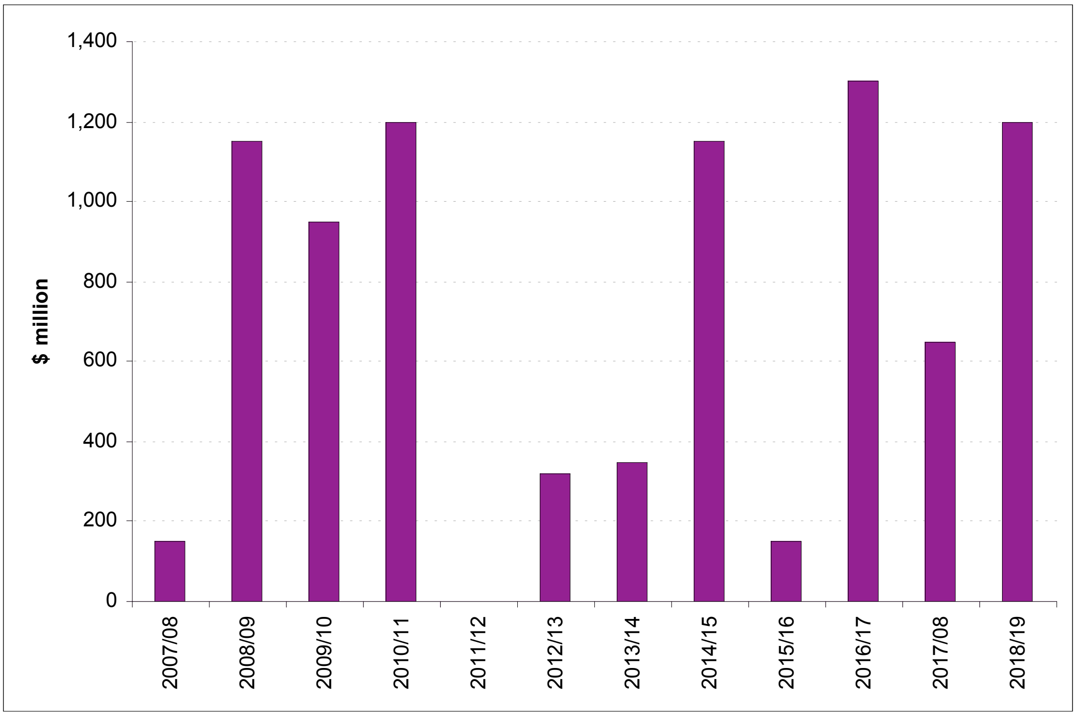
The Electricity, Gas and Water Supply industry employs electrical engineers, telecommunications technicians, water resource engineers and public health engineers.

[3] http://www.careers.govt.nz/default.aspx?id0=61103&id1=J28360

3.5.1 Electricity

As a result of a number of years of relatively moderate investment in electricity generation and transmission, the NZ Energy Strategy in 2007 anticipates there will be significant increases in investments in transmission and generation, and a shift in emphasis in the types of generation towards renewable energy generation. Figure 6 shows that generation costs will be approximately $800 million to $1 billion over the next 10 years, with a reduced expenditure in 2015/16. The type of investment in this scenario – the Sustainable Path Scenario, is consistent with the target of 90% renewable generation by 2025.

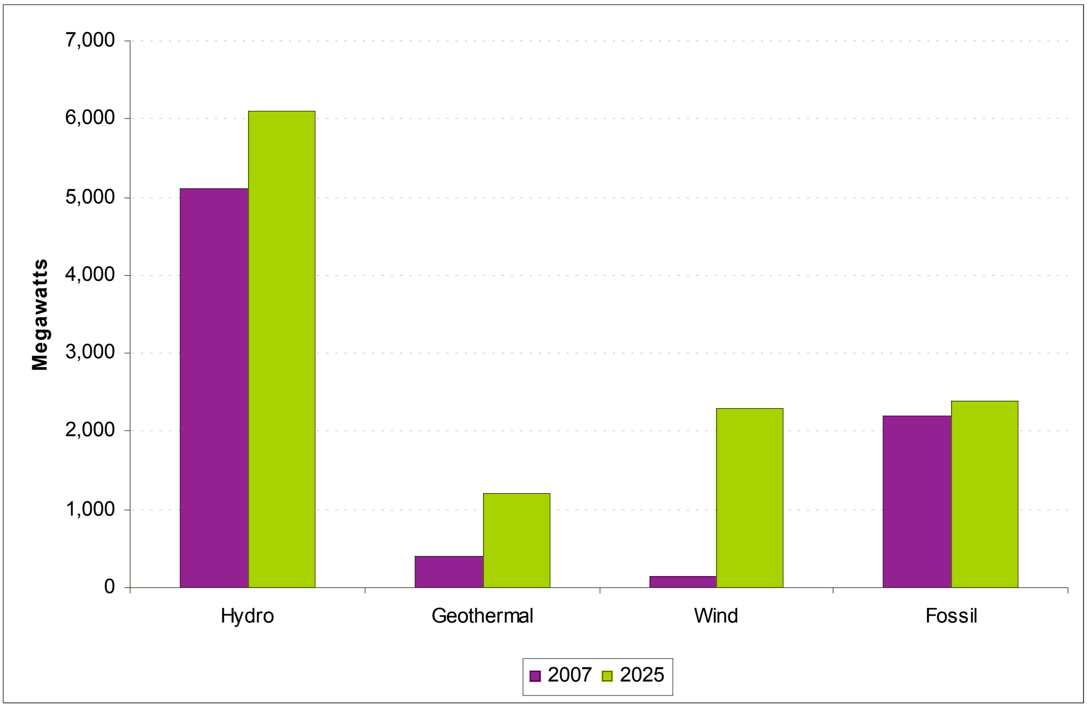
Figure 6: Generation Costs (Sustainable Path Scenario)



Source: Electricity Commission 2008 Statement of Opportunities – August 2008

Figure 7 shows the types of generation required to meet this target by 2025, compared to the types of generation in 2007. This graph suggests that there will need to be a greater number of engineers with skills in geothermal, and wind energy over the next decade. The new Government have indicated that gas will be part of the future energy generation mix. It is too early to understand the implications of this for engineering skills.

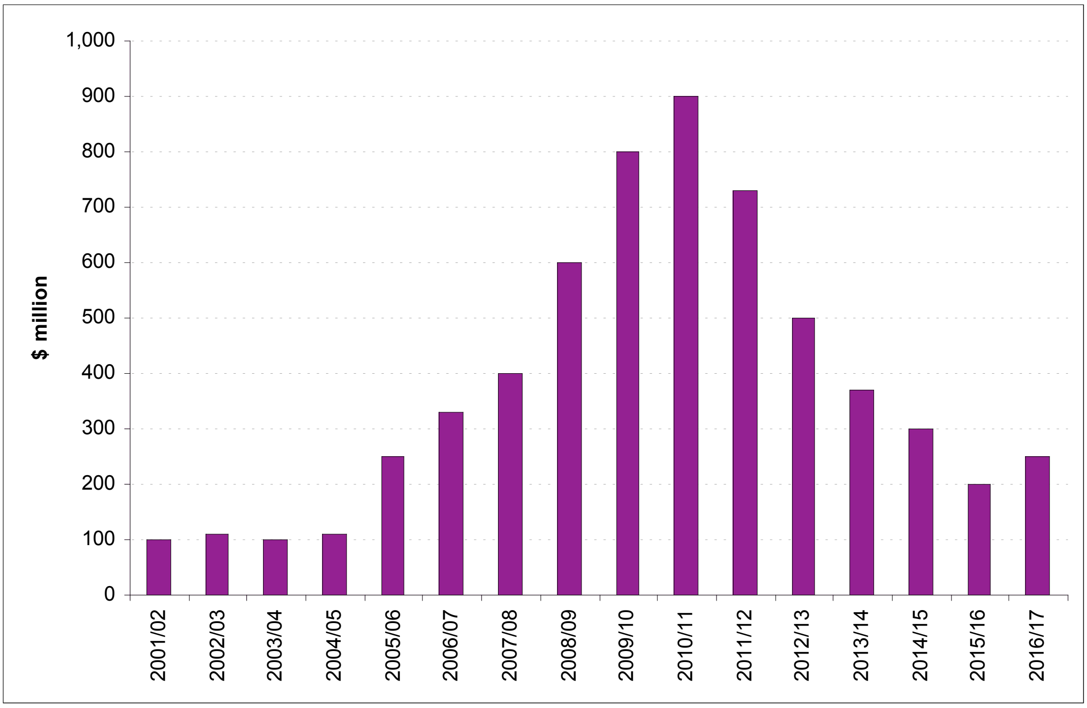
Figure 7: Types of Electricity Generation in 2007 and 2025



Source: New Zealand Energy Strategy 2007

For electricity transmission, Transpower has projected its capital expenditure over the next 10 years as shown in Figure 8. This shows that over the next 10 years there are expected to be very significant increases in capital expenditure up till 2010/2011 and then declining expenditure over the following five years. This contrasts with relatively low levels of investment from the mid 1990s.

Figure 8: National Electricity Grid Capital Expenditure



Source: Transpower, 2008

Transpower have considered the skill shortage issue and have forecast that they will require an increase in power designers from 45 in 2008 to 60 by 2010/2011. The number of staff required will then decrease to 30 by 2012/13.

As part of the regulatory regime the 17 lines companies that maintain electricity networks are required to disclose their 10 year asset management plans. Capital expenditure for the lines companies is projected to increase from a level of $450 million in 2006/07 to $570 million later in the 10 year period. The expenditure consists of renewal, replacement and new assets. It remains to be seen what impact the growth of distributed generation (e.g. localised wind turbines) will have on lines companies' investment programmes.

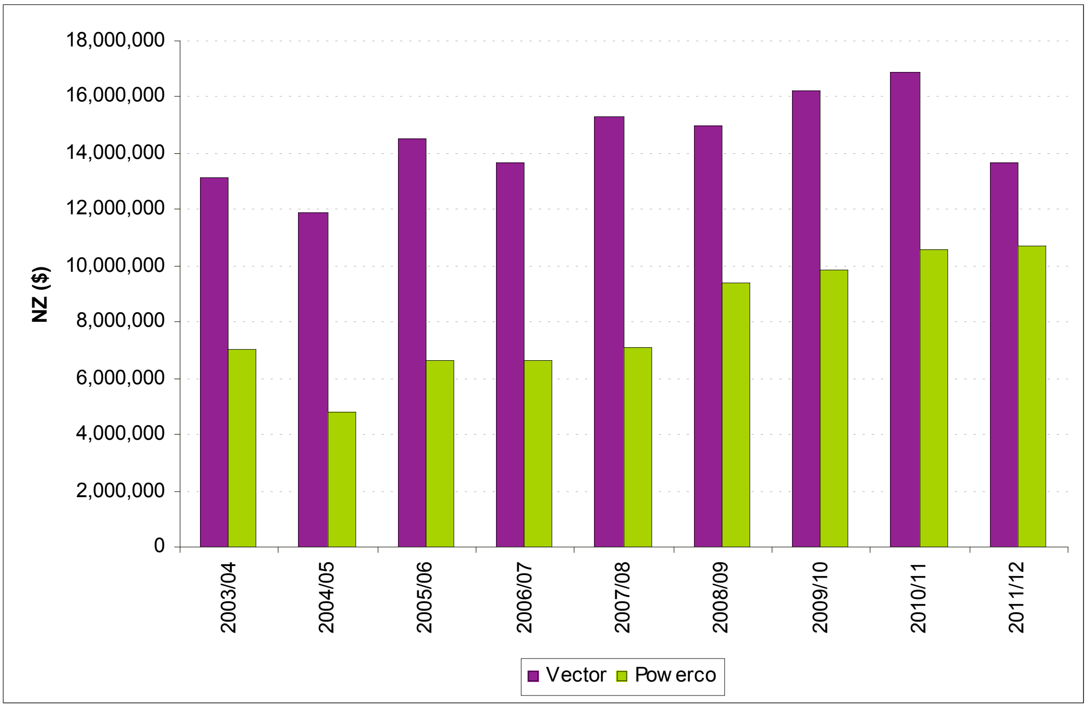
The Electricity Supply ITO published their Industry Skills Strategy in December 2006. Based on interviews with electricity supply leaders, it was concluded that there was an ongoing skill shortage. The degree of shortage differs across employers and specialties, but overall the shortage at that time appeared to be 8%-10% of total employment. The shortage of skilled trades labour was described in the Strategy as severe and it was noted there was also a shortage of professional engineers.

3.5.2 Gas

Natural gas is produced from 16 fields in the Taranaki region. Most of the production of gas is undertaken by Shell and Todd Energy (93% - NZ Energy File). The government has been encouraging further gas exploration and development and in 2007, 42 new wells were drilled. The potential for gas and oil finds is regarded as high, and this may lead to new fields being developed and associated production plant expansions.

The projected capital works programme for two of the major distributers (Vector and Powerco) has been made publicly available in the October 2008 "Authorisation for the Control of Supply of Natural Gas Distribution Services" - issued by the Commerce Commission. Their authorised forecast of capital works programmes are shown in Figure 9. This shows that while Vector anticipates a mild increase up to 2010/11 and a drop back to 2003/04 levels in 2011/12, Powerco foresees a steady increase over the same period. The capital works programme for these two entities is planned to increase from $12 million in 2003/04 to $16m in 2011/12 for Vector, and from $7 million in 2003/04 to $12m in 2011/12 for Powerco.

Figure 9: Capital Expenditure for Gas Distribution Companies



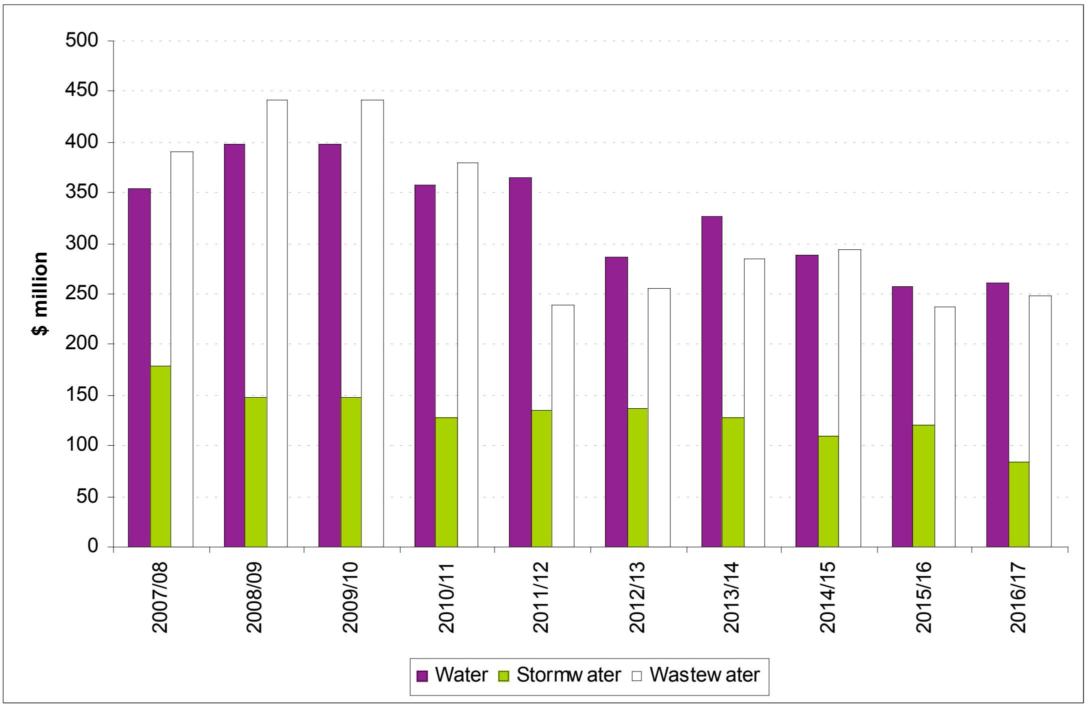
Source: Commerce Commission – Decisions Paper Powerco & Vector – Oct 2008

3.5.3 Water

Water services are provided by local authorities and the first Long-Term Council Community Plans (LTCCPs) were prepared for the 2006/16 period. Figure 10 shows the make up of water services capex over the 10 year period. All three water services show a decline in capital expenditure over the 10 year period. This expenditure was reviewed by the Local Government Rates Inquiry in 2007 and it was concluded that the forecast capital expenditure may be understated. Water capital expenditure is being driven by increased environmental standards (a number of local authorities are planning major expenditure for wastewater treatment and disposal), and by new mandatory drinking water standards. It is also difficult for local authorities to accurately predict capital works late in the 10 year period. Therefore it can be expected that capital expenditure will remain constant in the foreseeable future.

A review of the skills for the water industry was undertaken by the NZ Water and Environment Training Academy (NZWETA) in April 2008. Based on interviews with diverse employers in the water industry (including contractors, processing industry, councils, consultants), it was concluded that operational staff for treatment plants and maintenance/operations staff for networks are hard to find, and the employment of graduates and tertiary trained technicians is an ongoing problem. Small and medium sized councils have found it difficult to attract professionally qualified staff. Specific skill areas where there is a shortage identified include wastewater construction and asset and maintenance planning.

Figure 10: Local Government Water Capital Expenditure, 2007-2016



Source: Department of Internal Affairs – Capital expenditure from 2006/16 LTCCPs

3.6 Telecommunications

The telecommunications industry employs electronic and telecommunications engineers, telecommunications technicians and other electronics engineering technicians.

In 2004 Telecom announced that it will invest in a Next Generation Network (NGN) to provide improved telecommunications services including broadband transport technologies. The speed capability on an NGN infrastructure depends on the capability and length of the copper local loop and this speed can be increased by replacing copper circuits with fibre optic cable to roadside cabinets.

The key elements of Telecom's investment programme were identified as:

- $1.4 billion over the period 2007-2012 in core network components to provide broadband infrastructure;
- Replacing the existing telephone network with NGN components including upgrading and installation of new cabinets by 2012 commencing in 2006;
- Investing in fibre optic cable to the roadside cabinets (FTTN).

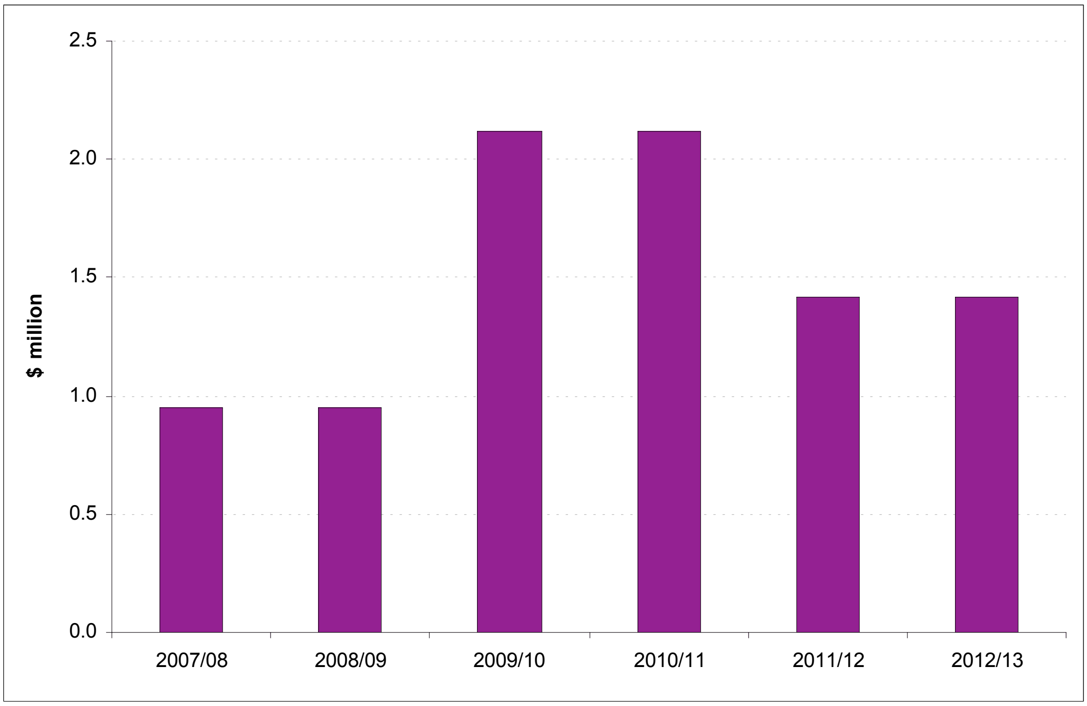
In November 2008 Telecom also indicated that they are investing heavily in their mobile phone network with an announcement of an increase in capital expenditure of 63% to $340 million, and an intention to spend a further $574 million over the next 2 years.

In addition Vodafone are rolling out a 3G broadband cell phone service and a new cellular phone network is being installed by NZ Communications Ltd.

The new government's telecommunications policy has given indication of investments of up to $1.5 billion over the next 6 years so as to accelerate the roll-out of a fibre-to-the-home network. The policy has also indicated that the new government will increase the Broadband Challenge Fund from $24m to $48 million. Five Broadband Challenge applications in for urban areas totalling $16.3 million four urban fibre network projects were approved in September 2008.

Estimates of these broadband and cellular network capital investments imply a capital expenditure programme as shown in Figure 11. This graph shows that there is expected to be a considerable increase in telecommunication capital expenditure over the next four years which is expected to continue beyond the period of observation.

Figure 11: Broadband and Cellular Network Capital Expenditure



Source: IPENZ assessment

The Telecommunications Carriers Forum is of the view that the telecommunications sector is currently at capacity in terms of skills. They have advised the new government that the capacity to deliver the fibre-to-the-home project is not currently available in New Zealand. However, some of their member companies are confident that they are able to source skills from overseas if necessary as a short term measure, and the medium-long term measure would be to build capacity in New Zealand.

3.7 Construction

The construction sector employs structural engineers, heating, ventilation and refrigeration engineers, clerk of works, quantity surveyors and draughting technicians.

In 2005 the Building Research Association of New Zealand (BRANZ) projected the number of people that would be employed in the non-residential building and construction sector. Their projections are presented in Figure 12. This graph shows that BRANZ expects the number of people employed in the construction sector to increase in 2009 and 2010 compared to 2008. It is important to note that the total people employed in the non-residential sector does not equal all those employed in the construction industry.

Figure 12: Employment in non-residential building, non-residential construction and air conditioning and heating services.

Source: BRANZ

The 2006 report 'Future of Housing in New Zealand' makes the following comments in relation to skills shortages in the construction industry:

- 'Future housing options will be affected by the construction industry's ability to respond to such issues as skill shortages, the ability to attract new entrants, the expense of retraining, and the impending retirement of many of the more skilled practitioners.'
- 'Retirement may also be a modifying factor in reduced demand levels, as 12% of the construction industry's labour force is currently nearing retirement age. If the industry does not appear attractive to new entrants over the next ten years, the number of experienced hands will be significantly diminished by 2030.'

Similarly, the Department of Building and Housing's Statement of Intent 08/11 states[4] that 'construction sector employment rates have declined in recent quarters. However, the labour market is likely to remain relatively tight because of a high and stable trend in the value of non-residential building consents, and the demand for skilled trades people and building professionals.'

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[4] http://www.dbh.govt.nz/UserFiles/File/Publications/Sector/statutory-reports/soi-2008-2011.pdf

3.8 Discussion

Table 2 summarises the overall outlook for each industry examined in this chapter. This shows that there is expected to be considerable ongoing expenditure on infrastructure namely transport, rail, electricity, gas, and the telecommunications sectors over the next five to ten years, providing an ongoing, and in some cases, increasing demand for these sectors. The outlook for the aeronautical industry is for further growth unless there is a significant decrease in international flights due to the international economic climate.

The manufacturing industry has historically not exhibited significant growth and hence the demand for the related disciplines is expected to remain flat with a possible small decline due to the international economic climate.

The construction industry is closely related to the property market and building and construction is expected to decline and remain relatively flat for two to three years – following forecast GDP projections.

Some engineering occupations are, on the face of it, common to different industries that have different outlooks – e.g. some structural engineers are associated with the transport sector which has a sound medium term future (civil structures such as retaining walls, bridges), and some are associated with the building and construction sector which has a poor short term future (commercial buildings).

However the ability of engineers to move across different occupations may be constrained due to the specialist skills required to work in particular fields. To some extent, managers and new engineering graduates may be more mobile. However, a major realignment of the sector is likely to require upskilling and /or retraining. Anecdotal evidence also suggests that many engineers may be reluctant to move out of their specialist area and/or retrain.

Table 2: Medium term outlook for major industries that employ engineers.

Industry Sector	**Medium term outlook**	**NZSCO Occupations**	**Outlook for Occupation**
Transport and Rail	High levels of spend of infrastructure opex and capex are forecast over the next 10 years.	Roading engineers	☺
		Structural engineers	☺
		Other civil engineers	☺
		Other civil engineering technicians	☺
		Clerk of works	☺
		Draughting technician	☺
		Other engineering technician	☺
Manufacturing	Historic low growth will continue with possible small decline due to international economic	Other mechanical engineers	😐
		Mechanical engineering technicians	😐

	climate.	Chemical engineers	😐
		Chemical engineering technicians	😐
		Metallurgist	😐
		Non destructive test technician	😐
Aeronautical	The demand will continue to grow for some time, unless local and international flights are significantly reduced due to the economic climate.	Aeronautical engineer and / or aircraft surveyor	☺
		Avionics technician	☺
Electricity and Gas	High level of electricity and gas capex are forecast over the next 6 years	Electrical engineer	☺
		Electrical engineering technician	☺
Tele-communications	High levels of broadband and cellular network capex are forecast over the next 6 years	Electronic and telecoms engineer	☺
		Telecoms technicians	☺
		Other electronics engineering technicians	☺
Construction	Following on from a buoyant period, building and construction will decline and remain relatively flat for 2-3 years, and follow NZ property market trends.	Structural engineer	☹
		Heating / ventilation / refrigeration engineer	☹
		Clerk of works	☹
		Quantity surveyor	☹
		Draughting technician	☹
Water	Due to higher drinking water and environmental standards, medium levels of capex will continue for next 10 years.	Water resources engineer	☺
		Public health engineer	☺

4. DEMAND FOR ENGINEERS

This section presents and assesses present and future demand for engineers through several main approaches. First, recent historical growth, particularly in professional occupations, provides one indicator of likely ongoing demand. Second, Department of Labour forecasts of industry-led demand also suggest ongoing strong demand, but again for professional occupations rather than for technicians. Third, analysis of replacement demand – looking at how many people move in and out of the engineering profession because of retirement, migration or movement to other types of work – indicates that there is less of a drain from engineering occupations than from across New Zealand occupations on average.

4.1 Historical employment of engineers: Last 5 years and past year

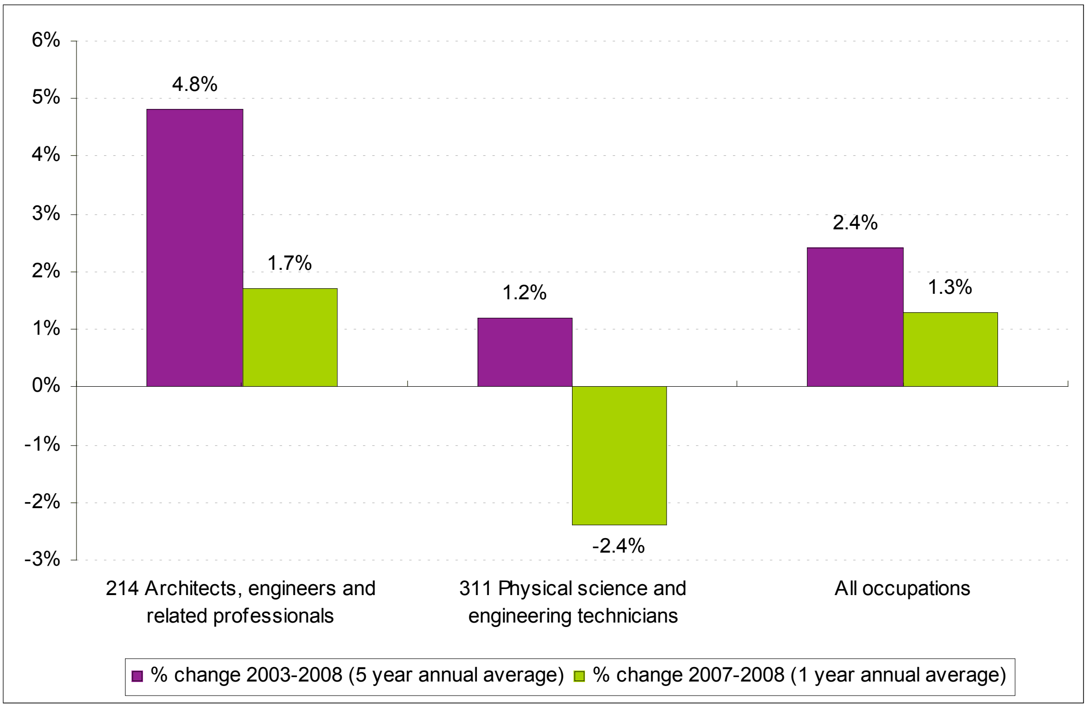
Figure 13 shows the annual average employment growth for 3-digit engineering occupational groups during the 2003-2008 and 2007-2008 March years.[5] This provides an indicator of changes in the demand for those in engineering related occupations over recent time and during the past year.

Architects, engineers and related professionals have experienced strong employment growth in recent years. Between 2003 and 2008, employment growth for this occupational group increased by 4.8% per annum. This was twice the rate of growth observed for all occupations over this period (2.4%). Employment growth for architects, engineers and related professionals slowed somewhat during 2007-2008 to 1.7% but still remained above the level of employment growth across all occupations (1.3%). Overall, the number of individuals employed in this occupational group increased by 6,571 between 2003 and 2008.

At 1.2% per annum, employment growth for physical science and engineering technicians was considerably below that of architects, engineers and related professionals. This pattern of below average employment growth continued over the most recent year, with negative employment growth of 2.4%. Between 2003 and 2008, the number of individuals employed in this occupational group increased by a total of 1,280.

[5] Department of Labour Employment Estimates (annual average percent changes)

Figure 13: Employment growth for engineering related occupations (annual average % changes)



Source: Department of Labour employment estimates

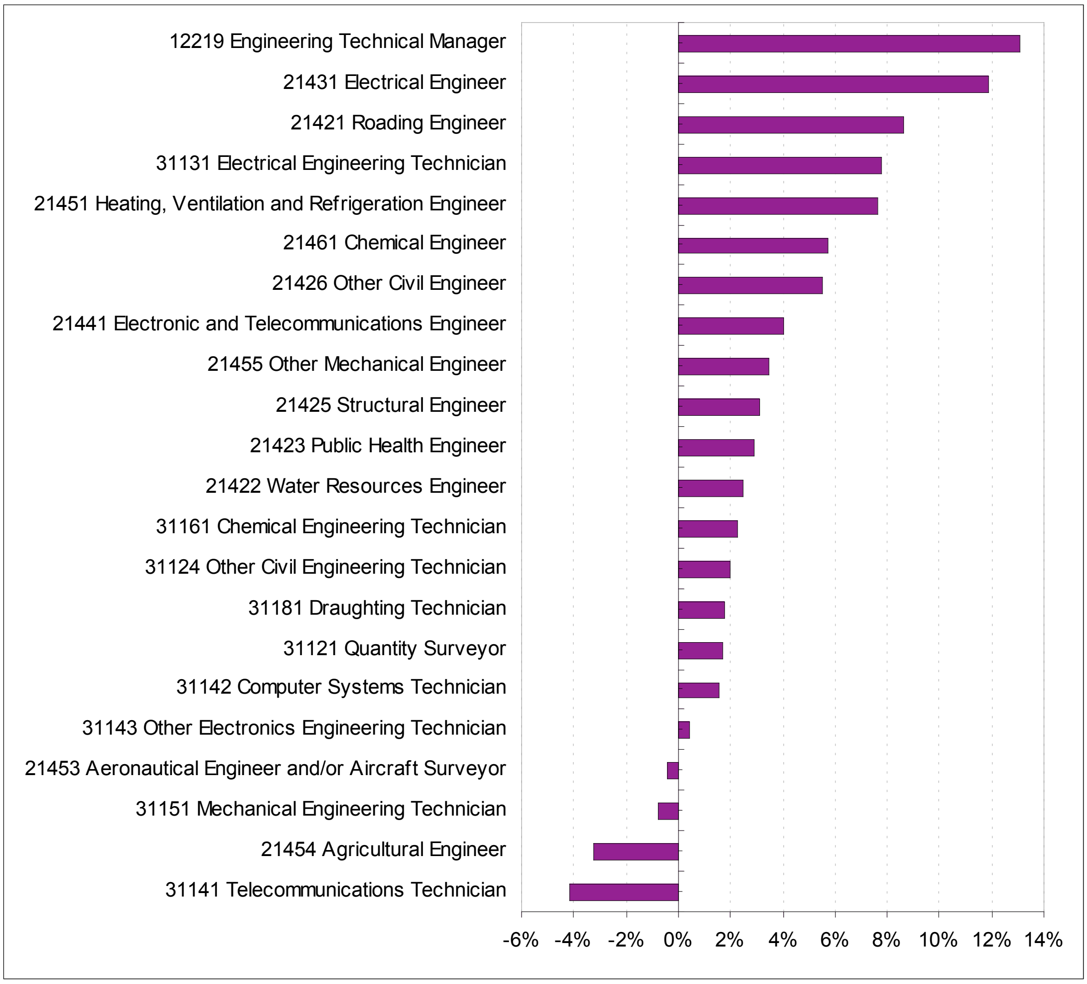
Information on employment growth over the past five years for detailed 5-digit engineering occupations is shown in Figure 14. Specific engineering occupations which experienced strong annual average employment growth during this period included:

- Engineering technical manager (13.1%)
- Electrical engineer (11.9%)
- Roading engineer (8.7%)
- Electrical engineering technician (7.8%)
- Heating, ventilation and refrigeration engineer (7.6%)

Conversely, a number of occupations experienced a decline in annual average employment growth during 2003-2008. They included:

- Telecommunications technician (-4.2%)
- Agricultural engineer (-3.2%)
- Mechanical engineering technician (-0.8%)
- Aeronautical engineer and/or aircraft surveyor (-0.4%)

Figure 14: Employment growth for detailed engineering related occupations, 2003-2008 (annual average % changes)



Source: Department of Labour Employment Estimates

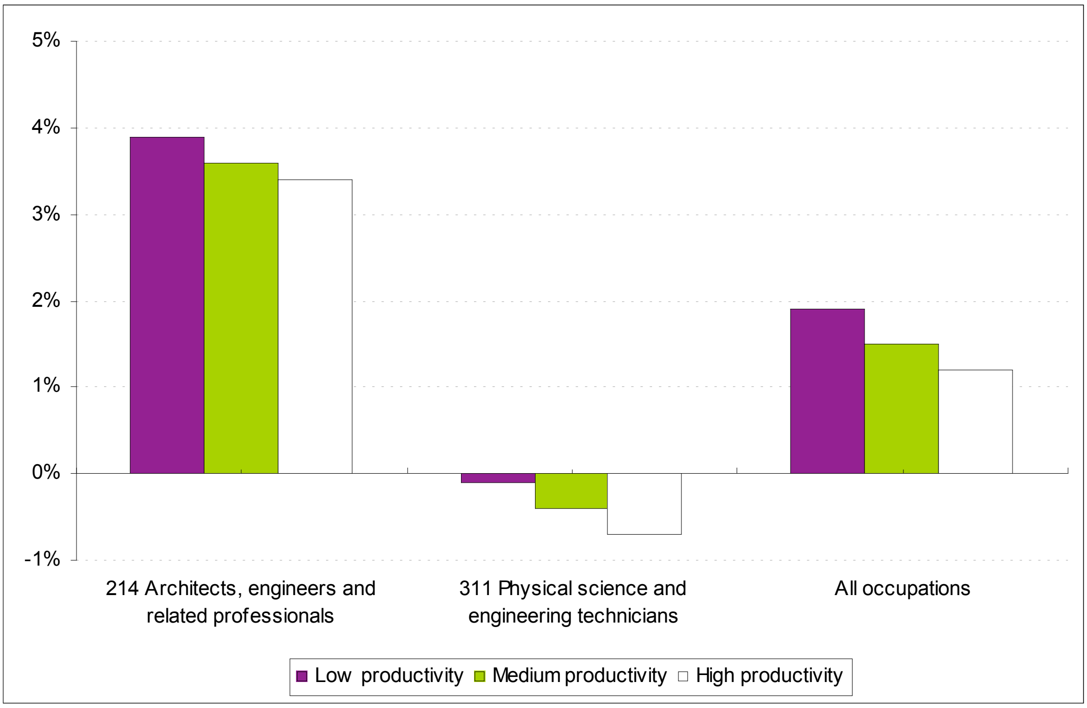
4.2 Employment outlook for engineers

Figure 15 shows the forecast annual average employment growth for 3-digit engineering occupations between 2008 and 2013.[6] This provides an indication of the future demand for engineers.

The employment outlook for architects, engineers and related professionals is for further high levels of employment growth over the next five years. Under medium productivity projections, annual average employment is projected to increase by 3.6% per annum between 2008 and 2013. This is more than twice the projected level of employment growth for all occupations over the period (1.5%). Based on these projections, the estimated number of architects, engineers and related professionals in 2013 will be 37,966, up from 31,599 in March 2008.

In contrast, employment growth for physical science and engineering technicians is forecast to decline over the next five years (-0.4% per annum). The follows on from the below average employment growth experienced by this occupational group over the last five years. The forecast number of physical science and engineering technicians in 2013 is 21,943, down from 22,128 in March 2008.

Figure 15: Forecast employment and annual average employment growth for engineering related occupations, 2008-2013



Source: Department of Labour employment forecasts

[6] The employment projections use 2-digit industry GDP forecasts from NZIER and forecast labour productivity levels suggested by historical trends. This results in employment projections to 2013 for 2-digit industries. Using industry by occupation employment matrices from the 1996, 2001 and 2006 Censuses, occupational shares in 2013 are derived. These shares are then applied to the industry employment projections.

Table 3: Forecasted annual average employment growth for engineering related occupations, 2008-2013

	Low productivity	Medium productivity	High productivity
Forecast employment in 2013			
214 Architects, engineers & related professionals	38,371	37,966	37,569
311 Physical science & engineering technicians	22,248	21,943	21,644
All occupations	2,340,587	2,305,715	2,271 465
Forecast % change in employment 2008-2013			
214 Architects, engineers & related professionals	3.9%	3.6%	3.4%
311 Physical science & engineering technicians	-0.1%	-0.4%	-0.7%
All occupations	1.9%	1.5%	1.2%

Source: Department of Labour employment forecasts[7]

[7] The employment projections use 2-digit industry GDP forecasts from NZIER and forecast labour productivity levels suggested by historical trends. This results in employment projections to 2013 for 2-digit industries. Using industry by occupation employment matrices from the 1996, 2001 and 2006 Censuses, occupational shares in 2013 are derived. These shares are then applied to the industry employment projections.

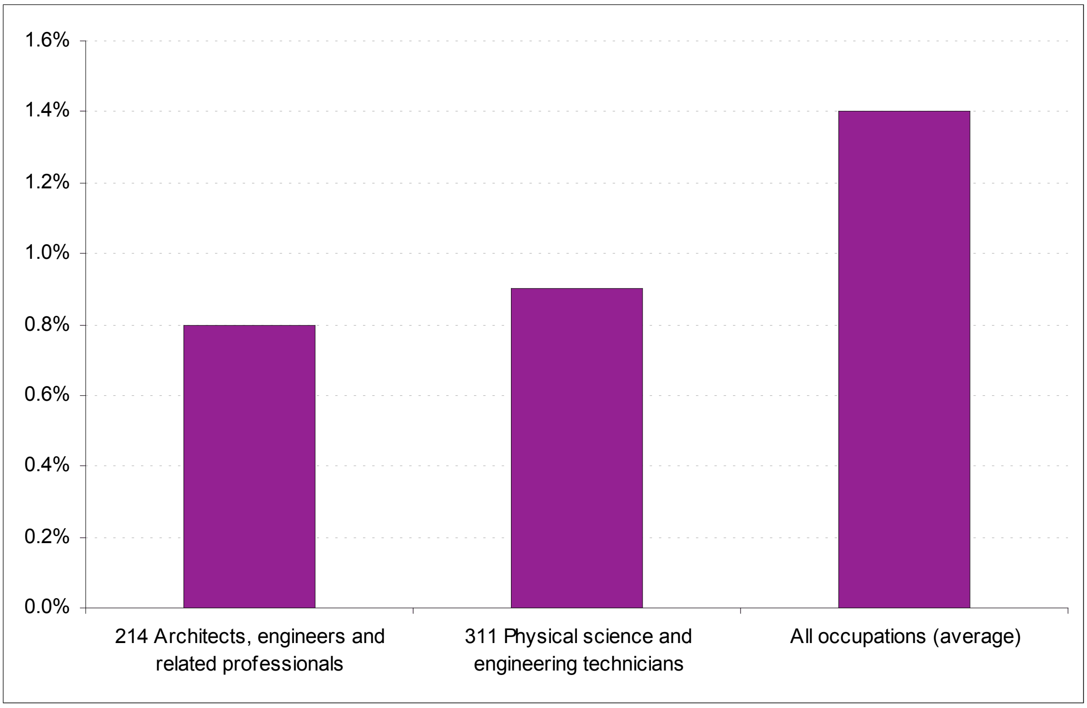
4.3 Historical net replacement demand

A further indicator of the demand for engineering related occupations is the net replacement demand rate. Net replacement demand is defined as the number of job openings that arise from individuals leaving an occupation for a number of reasons, net of jobs taken by individuals re-entering an occupation also for a number of reasons. This measure gives an indication of the historical loss of current workers who will need to be replaced.

Figure 16 shows the net replacement demand rate for 3-digit engineering related occupations. Overall, the net replacement demand rate for engineering occupations was lower than the average rate for all occupations. Between 2001 and 2006, the net replacement demand rate for architects, engineers and related professionals was 0.8% per annum and the net replacement demand rate for physical science and engineering technicians was 0.9% per annum. In comparison, the average for all 3-digit occupations in New Zealand was 1.4% per annum. This indicates that engineering occupations experienced lower levels of net outflow over the period than for all 3-digit occupations. For example, for every 100 individuals employed as architects, engineers and related professionals, approximately one individual will need to be replaced every year for the next five years. This compares with an average of approximately one and a half workers for all occupations.

One possible reason for the slightly lower net replacement demand rates for engineers is that engineering is a specialised profession and is less mobile than other occupations. Anecdotal evidence also suggests that many older engineers are remaining in the workforce or being recruited back into the workforce. This may mean that there will be large outflows for some occupational groups over the next five to ten years.

Figure 16: Net replacement demand rate for engineering occupations, 2001-2006



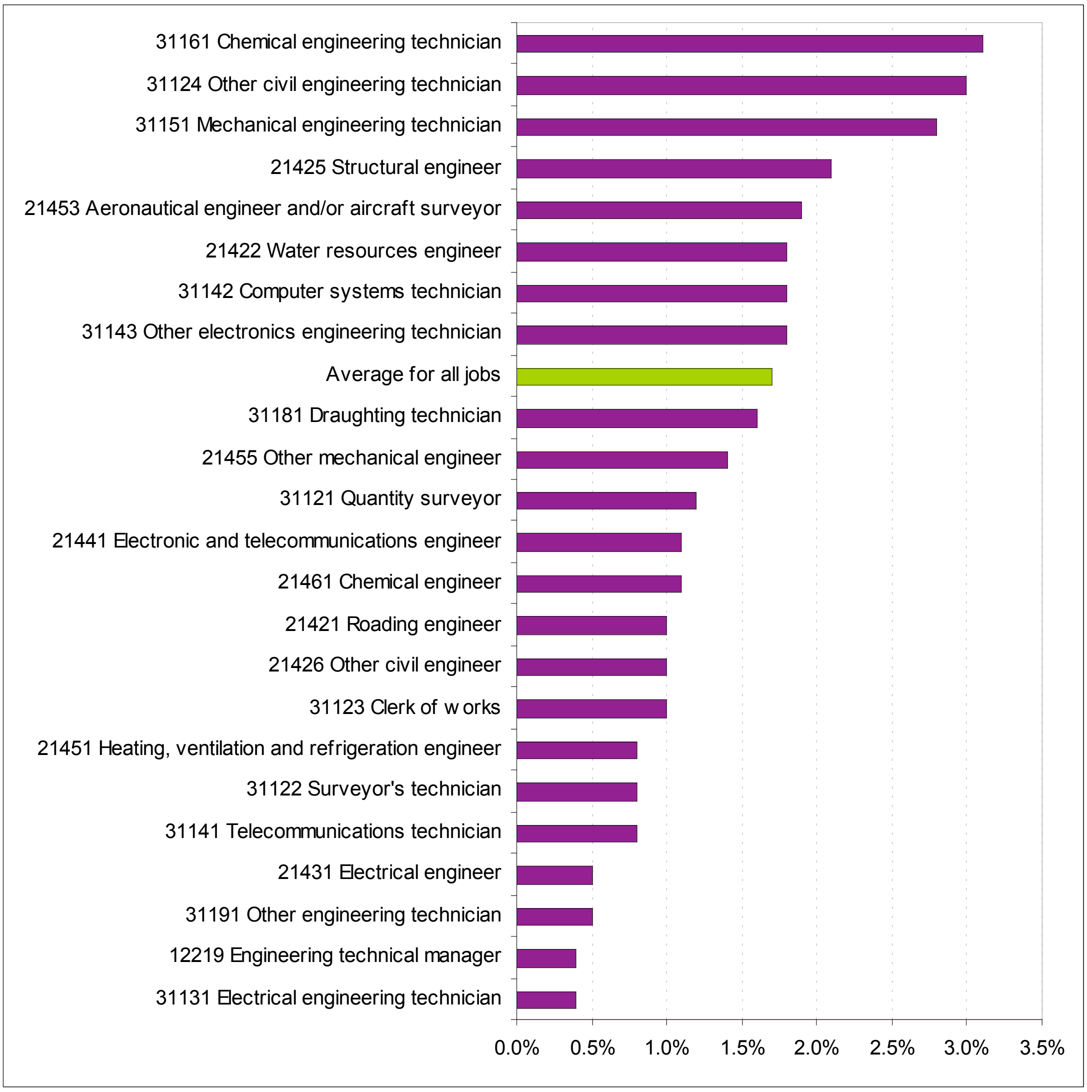
Source: Department of Labour estimates

The net replacement demand rates for 3-digit occupations presented above capture only net movements across other 3-digit occupations. They do not cover net movements between specific 5-digit occupations within the 3-digit occupation groups. Figure 17 shows the net replacement rate for selected 5-digit engineering occupations.

Between 2001 and 2006, the overall average net replacement demand rate for 5-digit occupations was 1.7% per annum, showing a higher movement among detailed engineering jobs. Engineering occupations with higher than average net replacement rates included chemical engineering technician (3.1%), other civil engineering technician (3.0%), mechanical engineering technician (2.8%) and structural engineer (2.1%). These occupations, therefore, experienced greater than average levels of net outflow over the five years between 2001 and 2006.

Occupations with lower than average net replacement demand rates included engineering technical manager (0.4%), electrical engineering technician (0.4%), electrical engineer (0.5%) and other engineering technician (0.5%). This implies that these occupations experienced less than average net outflow over the 2001-2006 period.

Figure 17: Net replacement demand rate for detailed engineering occupations, 2001-2006



Source: Department of Labour

4.4 Salaries of engineers

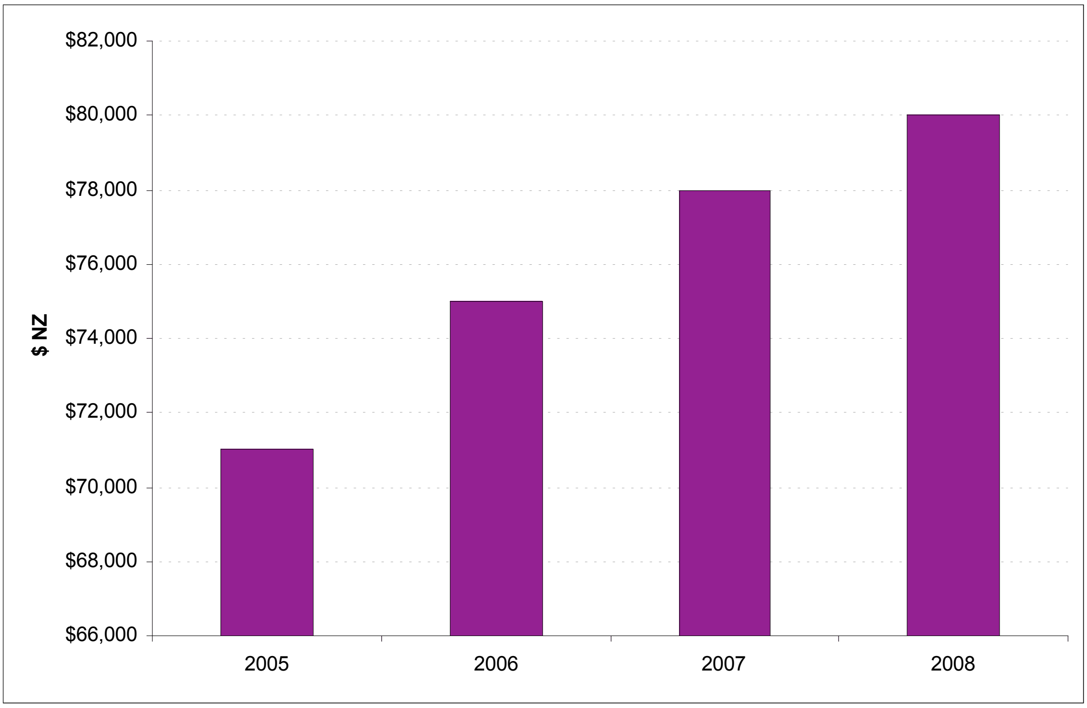
According to the available evidence salaries for engineers have grown at a similar rate to the rest of the labour market, indicating that there are not exceptional demand pressures.

This section on engineering salaries uses information from annual remuneration surveys undertaken by the Institution of Professional Engineers New Zealand (IPENZ). It is important to note that this information pertains to a subset of the engineering workforce, namely those engineers who are members of IPENZ. This means that the findings are not directly comparable with the other demand indicators included in this section which relate to specific 3-digit and 5-digit occupational groups as defined using the New Zealand Standard Classification of Occupation (NZSCO). Additionally the survey results presented here are affected by the response rate to the survey, which was approximately 25% in 2008. This affects the level of inferences that can be made about the findings.

Figure 18 shows the change in the median base salary for engineers between 2005 and 2008. Within this four year period, the median base salary for an engineer rose from $71,000 to $80,000. The average annual percentage change over this period was 3.0%.

The level of increase was very similar to the overall annual percentage growth in salary and wage rates for all occupations over this period (3.1%), as recorded in the Labour Cost Index. However, is not possible to make direct comparisons between the two data sources due to differences in the methodologies employed.

Figure 18: Median base salary for engineers, 2005-2008



Source: IPENZ, 2005-2008

4.5 Industry trends

Engineers are spread widely across many industries, as shown by the high number employed in the technical services industry which in effect provides services across almost the whole economy. Very large employment growth for engineers has occurred in this particular industry, while a number of other industries – connected mostly with installation, business services and construction – have also seen significant growth. The only major fall in employment has been in transport equipment manufacturing.

This section presents trends in the demand for labour (employment) of engineers for industries (at the 3 digit ANZSIC96 level of detail) in which engineers are dominant. Firstly, it examines the top ten industries that employ engineers. It then considers those industries that have experienced the greatest increase and declines in employment for engineers. Lastly, it attempts to decompose the change in employment into the change due to fixed industry effects and the change due to occupational shift effects.

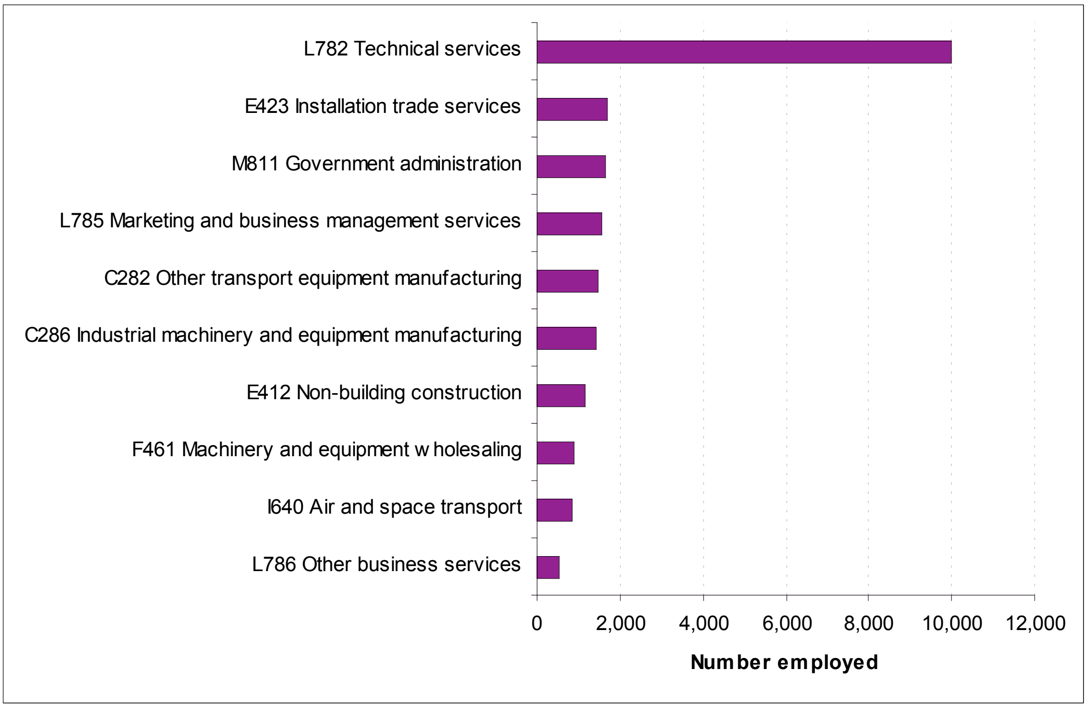
4.5.1 Professionals: Architects, engineers and related professionals

In June 2008, the technical services industry was the largest employer of architects, engineers and related professionals, accounting for about 10,000 employees, or 30.9% of this occupational group. The technical services industry is a broad category incorporating a range of activities, so it is no surprise that it employs the highest number of engineering-related professionals.[8]

Other main industries that employed architects, engineers and related professionals were installation trade services (1,692), government administration (1,661), marketing and business management services (1,574) and other transport equipment manufacturing (1,477).

[8] The industry includes chemical analysis service, forensic science consulting service (other than pathology service), geological and geophysical consultancy service, laboratory operation (providing chemical, food, electrical engineering or other technical services), materials strength testing service; meteorological services, non-destructive testing service, pollution monitoring service, scientific or technical services, seismic survey data analysis service, testing or assay service (on a fee or contract basis), weather station operation, wool testing service.

Figure 19: Top ten industries employing architects, engineers and related professionals, 2008

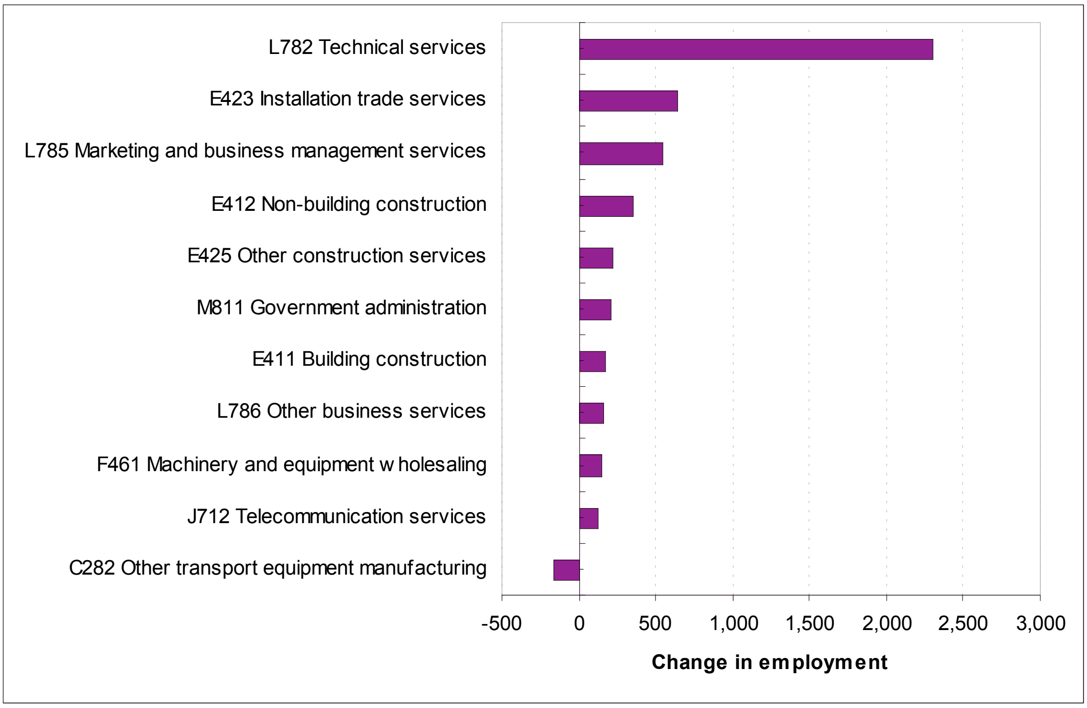


Source: Department of Labour Employment Estimates

Over the past five years (2003-2008), architects, engineers and related professionals employed have increased by 19.7%, adding 6,405 workers to their ranks. Figure 20 shows that the industries that saw the highest occupational growth were the technical services (2,303), installation trade services (643) and marketing and business management services (543) industries.

By far the industry with the largest decline in this occupation group was other transport equipment manufacturing which saw 166 architects, engineers and related professionals leave the industry over the past five years.

Figure 20: Employment change for selected industries that employ architects, engineers and related professionals, 2003-2008



Source: Department of Labour Employment Estimates

A note of caution is required here as the occupational shares of industry employment change are drawn from the population Censuses of 2001 and 2006 and changes in these shares are interpolated in a linear way for the in-between years. The rapid decline of engineers may well be the result of a change in industry coding practices.

4.5.2 Decomposition of employment growth for architects, engineers and related professionals

The change in employment of the architects, engineers and related professionals occupation can be broken down into a "fixed industry share effect" and an "occupational shift effect."

- i) The fixed industry share effect captures how much of the total growth in occupational employment came solely from growth in the industry itself.
- ii) The occupational shift effect captures the degree to which occupational growth comes from changes within an industry – technological changes in a manufacturing process, for example, can lead to an increase or a decline in the number of qualified engineers required.

This breakdown is additive in that the components add up to total employment growth. It also helps to explain the sources of occupational employment change in the industries mentioned in the previous section. In the case of the technical services industry, for example, architects, engineers and related professionals grew by some 30% (2,303 workers). The vast majority of this growth came solely from the growth of the technical services industry (1,750 engineers, 22.7%). The rest came from a modest occupational shift within the industry (553 workers, the other 7.2%) towards employing engineers at the cost of other occupations.

This is also the case with other industries such as government administration which had a growth of 213 workers overall (248 from industry growth and a decline of 35 from occupational shifts). Thus, government administration demanded more labour overall and also more engineers, yet at the same time engineers became relatively less important compared to other occupations in government administration.

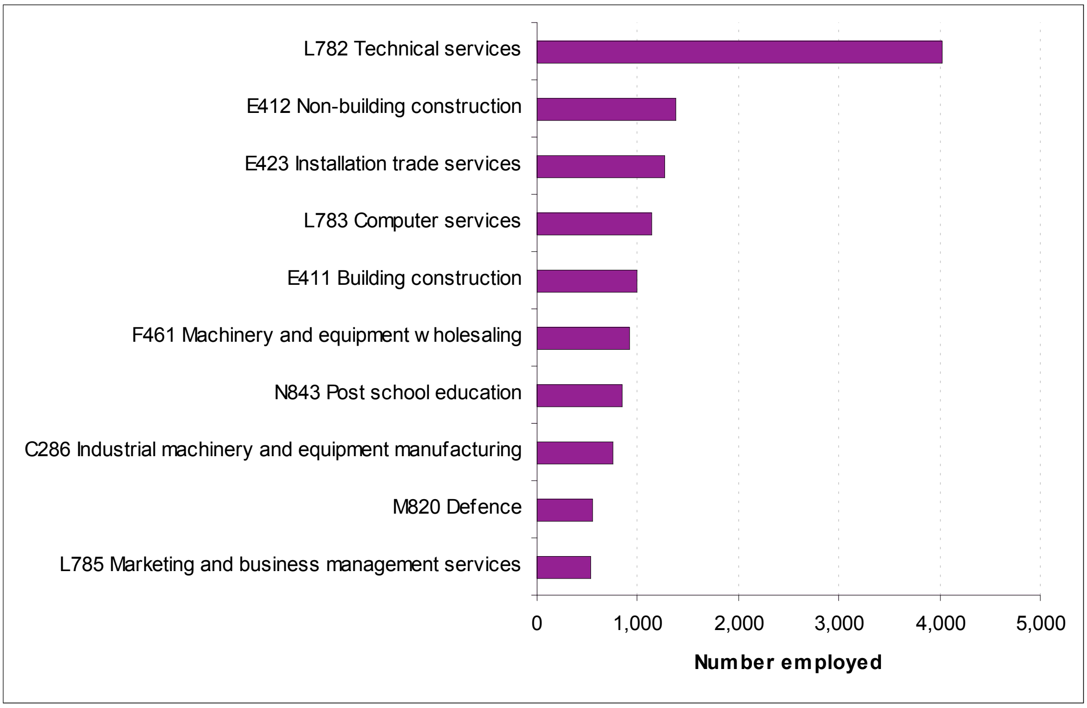
By contrast, growth in other industries for professionals in engineering came mostly from a shift in importance of the occupation within the industry. This is the case for marketing and business management services which had a growth of 543 workers overall (153 from industry growth and 390 from occupational shifts) as well as other construction services which had a growth of 225 workers overall (77 from industry growth and 147 from occupational shifts).

In other transport equipment manufacturing, there was a major decline in architects, engineers and related professionals over the past five years, about half the loss came from the fixed industry share effect and the rest was attributable to the occupational shift effect.

4.5.3 Technicians: Physical science and engineering technicians

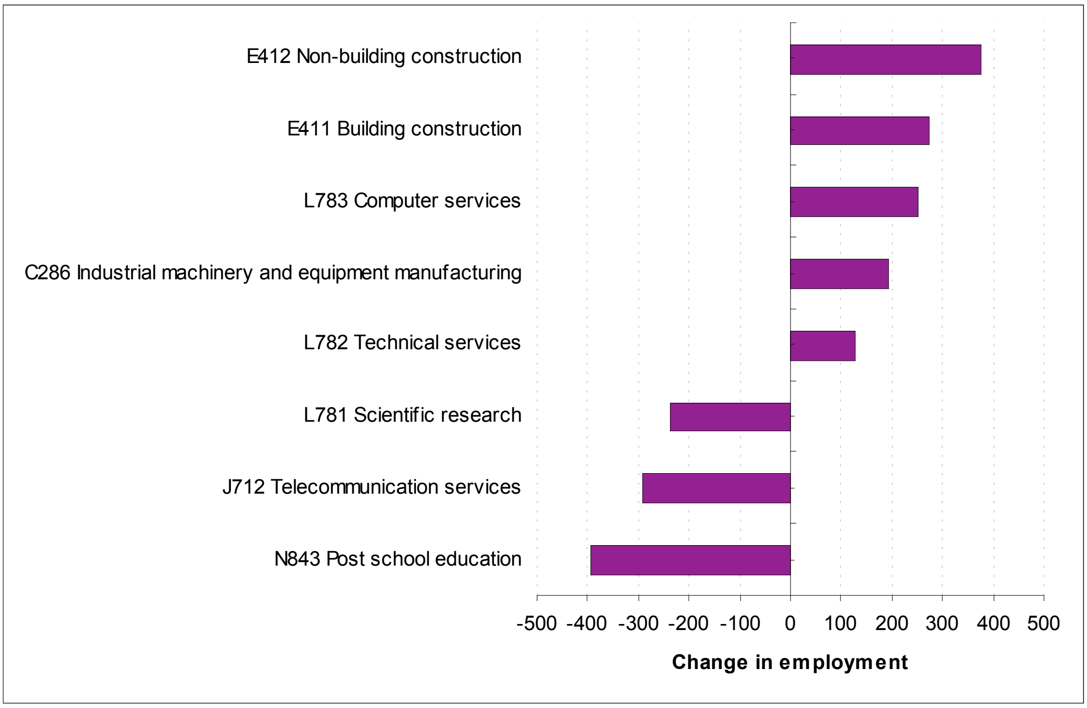
Figure 21 shows the top ten industries that employed physical science and engineering technicians in March 2008. The technical services industry was also the largest employer of physical science and engineering technicians, accounting for 4,031 individuals or 17.8% of this occupational group. Physical science and engineering technicians were also employed in the non-building construction industry (1,386), the installation trades services industry (1,266) and the computer services industry (1,136).

Figure 21: Top ten industries employing physical science and engineering technicians, 2008



Source: Department of Labour Employment Estimates

Figure 22: Employment change for selected industries that employ physical science and engineering technicians, 2003-2008



Source: Department of Labour Employment Estimates

Figure 22 shows that the industries with the largest occupational growth of physical science and engineering technicians include non-building and building construction (376 and 272 employees respectively) followed by computer services

(252) and industrial machinery and equipment manufacturing (195). The industry with the greatest overall decline in physical science and engineering technicians was post school education (at a loss of 393 employees) followed by telecommunications services (-292) and scientific research (-236).

4.5.4 Decomposition of employment growth for physical science and engineering technicians

The majority of the growth in non-building and building construction came from expansion in those industries (238 of the 376 and 168 of the 272 new workers respectively). This was also the case for computer services which grew 173 from the fixed industry share effect and only 78 from the occupational shift effect. The technical services industry also expanded over the past five years, creating an expected 888 jobs for physical science and engineering technicians. However, overall occupational growth for physical science and engineering technicians within technical services was only 126 indicating a significant occupational shift effect out of the industry (-761 workers). Given that the opposite change took place with regard to engineers, as reported in the previous section, it may well be that a degree of upskilling has taken place, although it is hard to draw any firm conclusions for such a broadly defined sector.

In contrast to the industries above, the majority of the growth in the industrial machinery and equipment manufacturing industry came from occupational shifts (189 of the 195 new workers).

A similar analysis can be performed on the industries with the greatest decline in physical science and engineering technicians. The industry with the greatest overall decline in physical science and engineering technicians was post school education (-393) followed by telecommunications services (-292) and scientific research (-236). Interestingly, all three had modest growth from the fixed industry effect (82, 47 and 14 respectively) but this was overwhelmed by large declines from the occupational shift effect (-475, -338 and -250 respectively). In the case of the telecommunications services industry it has been suggested by IPENZ that outsourcing in this industry combined with the fallout from the privatisation of Telecom may have contributed to this occupational shift.

4.6 Discussion

Industry stakeholders do not think that the recent slow growth for engineering technicians and the flat employment outlook for these occupations is an accurate representation of demand at the firm level. Instead, lower growth may reflect a shortfall in supply that means firms are unable to hire more technicians. Industry stakeholders indicate that both large and small firms are reporting critical shortages for engineering technicians. In some instances, employers report that they have had to put experienced engineers on tasks that would usually be undertaken by technicians. Some employers also indicate that they are taking students out of training in order to fill their vacancies.

One possible reason for this discrepancy is that the employment forecasts presented in this report are not available at detailed 5-digit level. Therefore, it is possible that some detailed occupations may have a stronger employment outlook over the next five years and that these differences have not been captured in this report. We see, for instance, that employment for electrical engineering technicians increased by 7.8% per annum over the past five years, the fourth highest growth rate for all the 5-digit occupations included in this study. So, it is possible that future oversupply situations for some technical occupations could co-exist with undersupply of other specific technical occupations.

We should also note that Department of Labour forecasts are informed by general forecasts at the economy-wide level as well as industry-specific forecasts. As we enter recessionary conditions, these general and specific forecasts are being revised and future updates at the occupational level are likely to see a slowdown in employment growth in a number of areas.

5. SUPPLY OF ENGINEERS

At first sight the supply of engineers appears healthy. Enrolments in engineering-related courses at tertiary institutions are generally on the increase. Completions are also increasing fairly steadily over time. Females represent only around 15% of enrolees in all engineering-related courses, although their completion rates are higher than for males.

However, there are a number of information gaps on the supply of engineers that make it difficult to draw conclusions about the current state of supply. These include a lack of information on how many graduates move from tertiary study into engineering occupations, the quality of courses and the exact numbers and actual qualification and skill levels of those immigrants who have engineering backgrounds.

5.1 Changes in tertiary enrolments

This section presents findings on the number and annual average percentage change in tertiary enrolments in the broad field of study 'engineering and related technologies' (NZSCED 03).[9] Information on enrolments provides an indicator of the future supply of engineers through training.

The findings presented here include training undertaken through universities, institutes of technology/polytechnics, colleges of education, wananga and private training establishments. It excludes training undertaken through industry training organisations. Information is presented for domestic students only and excludes international students enrolled in engineering courses.

Table 4 shows that the number of learners undertaking study in engineering and related technologies has increased over the last six years. In 2007, 36,233 learners were enrolled in Level 1-4 certificates in engineering and related technologies. This includes a range of qualifications, some of which may lead to further study in engineering. Between 2002 and 2007, enrolments in this subject area at Level 1-3 and Level 4 increased sharply by 11.4% and 11.1% per annum respectively. The rate of growth exceeded that for enrolments in all subjects at these levels (4.2% and 10.2%).

A total of 4,823 learners were enrolled in Level 5-7 diplomas in engineering and related technologies in 2007. Enrolments at this level increased by 1.9% per annum between 2002 and 2007, which was slightly higher than the rate of increase for enrolments in all subjects at this level (1.0%). However, the number

[9] Engineering and related technologies includes manufacturing engineering and technology, process and resources engineering, automotive engineering and technology, mechanical and industrial engineering and technology, civil engineering, geomatic engineering, electrical and electronic engineering and technology, aerospace engineering and technology, maritime engineering and technology and other engineering and related technologies.

of learners enrolled in Level 5-7 diplomas in this subject declined by 24.9% between 2006 and 2007.

In 2007, there were 7,154 learners enrolled in engineering and related technologies at bachelors level and above (Level 7 and above). Enrolments at this level increased by 2.8% per annum between 2002 and 2007 which was considerably higher than the rate of growth for enrolments in all subjects at this level over this period (0.9%). The pattern of growth continued over the most recent year, with an increase of 4.4% or 301 enrolments.

Table 4: Enrolments in engineering and related technologies by qualification level, domestic students, 2002-2007

Year of enrolment	Level 1-3 certificate	Level 4 certificate	Level 5-7 diploma	Level 7 bachelors and above
2002	17,658	3,540	4,396	6,280
2003	17,115	4,262	5,960	6,605
2004	16,983	5,142	5,199	6,623
2005	26,444	6,010	5,392	6,718
2006	25,813	6,324	5,505	6,893
2007	30,245	5,988	4,823	7,194
Annual average % change (AAPC) 2002-2007	11.4%	11.1%	1.9%	2.8%
AAPC 2006-2007	17.2%	-12.4%	-24.9%	4.4%
AAPC 2002-2007 (all subjects)	4.2%	10.2%	1.2%	0.9%
AAPC 2006-2007 (all subjects)	-7.7%	1.4%	1.2%	0.1%

Source: Ministry of Education

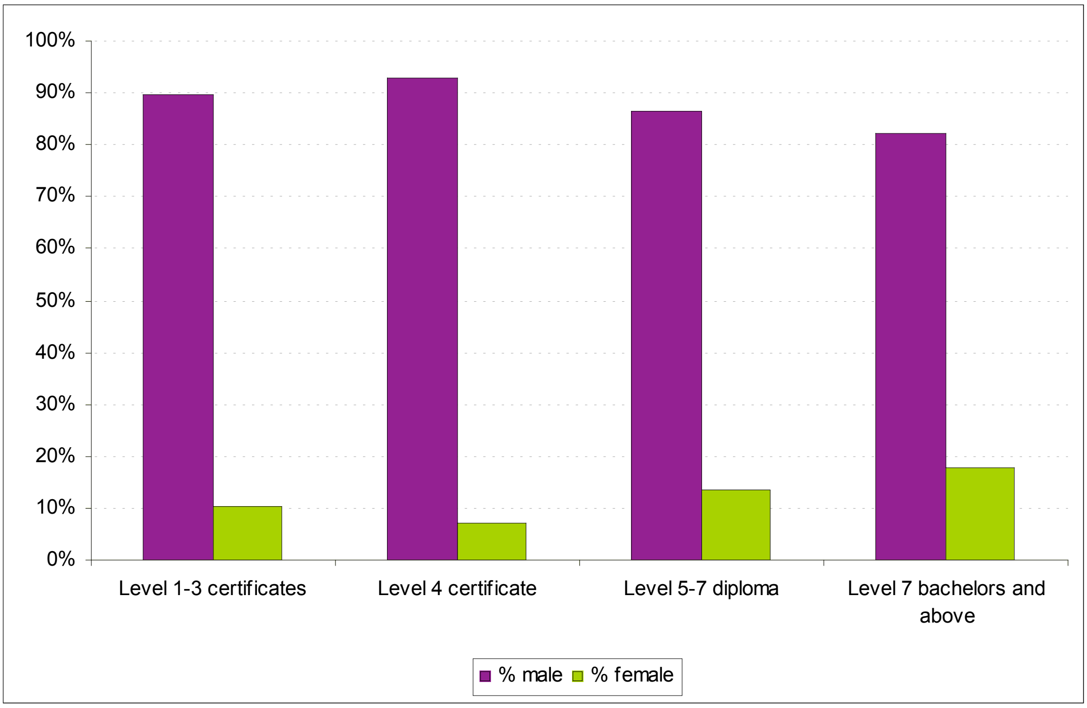
5.2 Demographic characteristics of tertiary enrolees

5.2.1 Gender profile of tertiary enrolees

Figure 23 shows that the overwhelming proportion of learners enrolled in engineering and related technologies were male. While males predominated across all qualification levels, there were slight differences in the gender profile of enrolments at each level of qualification. In 2007, females comprised 17.9% of enrolments at Level 7 bachelors and above. This compares to 10.2% for Level 1-3 certificates and 7.2% for Level 4 certificates.

Overall, the gender composition of enrolments in engineering and related technologies was similar to the gender profile of engineering related occupations. Information from the 2006 Census shows that 86.8% of architects, engineers and related professionals and 83.9% of physical science and engineering technicians were male.

Figure 23: Gender profile of learners enrolled in engineering and related technologies by qualification level, domestic students, 2007



Source: Ministry of Education

5.2.2 Ethnic profile of tertiary enrolees

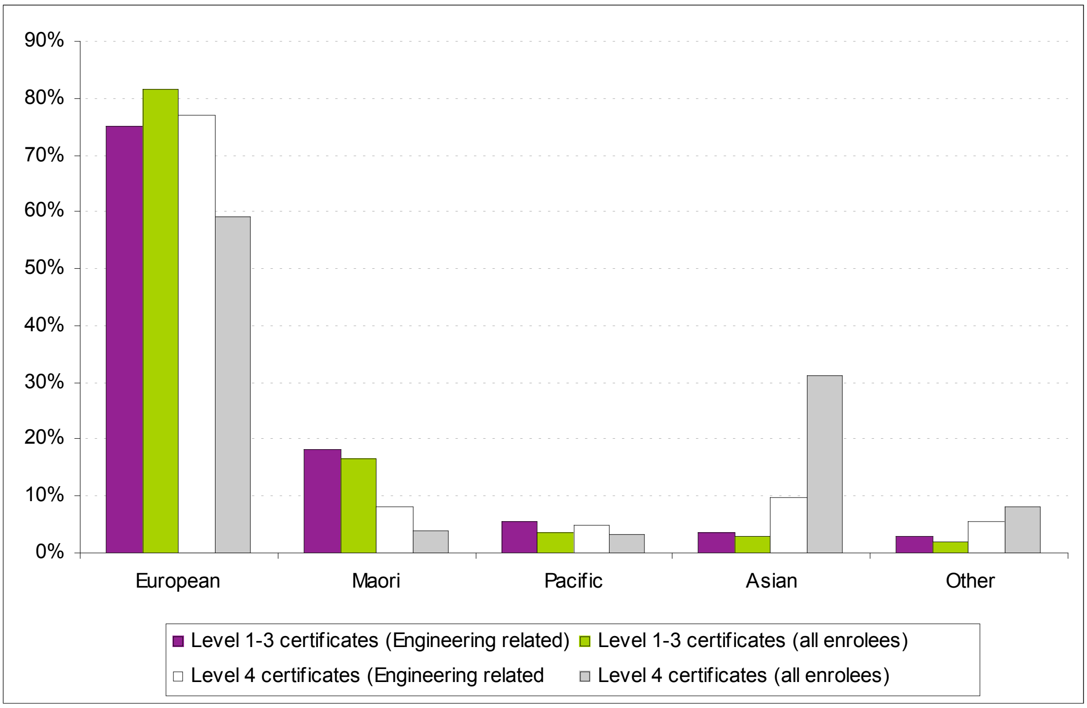
Figure 24 shows the ethnic profile of learners enrolled in engineering and related technologies by qualification level. The proportion of learners who identified as Maori declined across each level of qualification. In 2007, Maori made up 18.1% of learners enrolled in Level 1-3 certificates in this subject area, 16.6% of learners enrolled in Level 4 certificates and 8.3% of learners enrolled in Level 5-7 diplomas. Just 4.0% of learners enrolled in Level 7 bachelors and above qualifications in this subject area were Maori. Overall, 18.9% of learners enrolled in all subjects identified as Maori in 2007.

In 2007, Pacific people comprised 5.6% of learners enrolled in Level 1-3 certificates in engineering and related technologies, 3.6% of learners enrolled in Level 4 certificates and 4.9% of learners enrolled in Level 5-7 diplomas. A small proportion of learners enrolled in this subject area at Level 7 and above identified as Pacific people (3.2%).

Asian ethnic groups were less likely to be enrolled in Level 1-4 certificates and Level 5-7 diplomas in engineering and related technologies. However, they comprised a higher proportion of learners enrolled in Level 7 bachelors and above qualifications in this subject area (31.3%).

To a large extent, ethnic differences in enrolments in engineering courses reflect different levels of achievement in science and mathematics subjects at secondary school. A 2001 Ministry of Education report found that Year 9 Maori and Pacific students achieved lower mean scores in science and mathematics than their Asian and European counterparts[10]. This means that Maori and Pacific students are less likely to have achieved the subjects required to undertake training in engineering at tertiary level.

Figure 24: Ethnic profile of learners enrolled in engineering and related technologies by qualification level, domestic students, 2007[11]



Source: Ministry of Education

5.3 Changes in tertiary completions

This section highlights findings on the number of, and annual average percentage change in learners completing tertiary qualifications in engineering and related technologies between 2001 and 2006.[12] As with enrolments, this provides an indicator of the future supply of engineers through training. In particular, completions at Level 7 (bachelors and above) provide an indicator of the number of newly qualified engineers who may subsequently enter the engineering profession.

As with enrolments, the results presented here exclude qualifications undertaken through industry training organisations. The results also exclude international students who complete qualifications in engineering related subjects.

In 2006, 3,873 learners completed Level 1-3 certificates in engineering and related technologies and 353 learners completed Level 4 certificates in this subject area. Completions at Level 1-3 and Level 4 certificates increased by

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[10] Chamberlain and Walker, 2001.

[11] Learners may specify up to three ethnic groups. This means that the percentages may add up to more than 100%.

[12] Completions data for 2007 was not available at the time of writing this report.

6.7% and 11.1% per annum respectively between 2001 and 2006. This was lower than the rate of growth for all subjects at these levels (11.3% and 17.3%).

A total of 504 learners completed Level 5-7 diplomas in engineering and related technologies in 2006. Over the most recent year, the number of individuals completing Level 5-7 diplomas in engineering and related technologies declined by 10.3%.

At Level 7 and above, 1,464 learners completed qualifications in engineering and related technologies in 2006. After remaining relatively unchanged during 2001 to 2005, completions at this level increased sharply by 16.8%, or 211 completions, during 2005-2006. The overall annual average percentage change during 2001 to 2006 was 3.5%, compared to 2.0% for all subjects.

Table 5: Completed qualifications in engineering and related technologies by qualification level, domestic students, 2001-2006

Year of completion	Level 1-3 certificate	Level 4 certificate	Level 5-7 diploma	Level 7 bachelors and above
2001	2,802	209	424	1,230
2002	2,343	246	552	1,231
2003	2,624	193	460	1,228
2004	3,137	445	532	1,216
2005	7,923	465	562	1,253
2006	3,873	353	504	1,464
Annual average % change (AAPC) 2001-2006	6.7%	11.1%	3.5%	3.5%
AAPC 2005-2006	-51.1%	-24.1%	-10.3%	16.8%
AAPC 2001-2006 (all subjects)	11.3%	17.3%	5.0%	2.0%
AAPC 2005-2006 (all subjects)	-17.1%	-9.7%	7.9%	3.5%

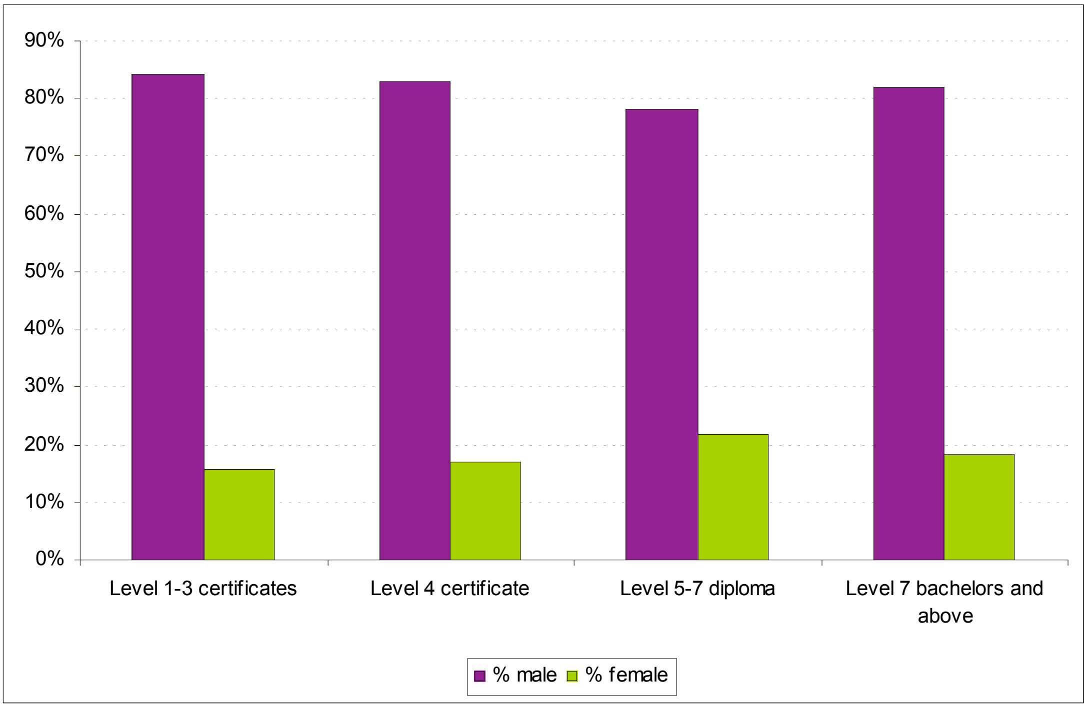
Source: Ministry of Education

5.4 Demographic characteristics of learners completing qualifications

5.4.1 Gender profile of learners completing qualifications

Figure 25 shows the gender profile of learners completing qualifications in engineering and related technologies. As with enrolments, the vast majority of learners completing qualifications in this subject area were male. In 2006 females comprised, 21.8% of learners completing Level 5-7 diplomas, 18.1% of Level 7 bachelors and above qualifications and 17.0% of Level 4 certificates. Just 15.8% of learners completing Level 1-3 certificates were female.

Figure 25: Gender distribution of learners completing qualifications in engineering and related technologies by qualification level, domestic students, 2006



Source: Ministry of Education

Information on ethnicity was not available for learners completing qualifications in engineering and related technologies.

5.5 Training rates

A further indicator of the supply of engineers is the training rate. This indicator provides an approximate measure of the rate at which the supply of engineers can potentially grow through training. The training rate is calculated by expressing the number of graduates completing qualifications in relevant subjects as a percentage of total employment in that occupation. This tells us the percentage of an occupation that is being trained in a given year.

In 2006, the training rate for architects, engineers and related professionals was 3.3% which was very similar to the training rate for all occupations (3.0%). The training rate for physical science and engineering technicians was slightly lower, at 2.5%.

Table 6: Training rates for engineering occupations, 2006

Occupation	Training rate
214 Architects, engineers and related professionals	3.3%
311 Physical science and engineering technicians	2.5%
All occupations (average)	3.0%

Source: Ministry of Education; Department of Labour

5.6 Migration trends

This section presents findings on the supply of engineers through migration. This data can be used as an indicator of the supply of labour from non-domestic sources. Information is presented for two indicators:

i) Permanent and long term arrivals, departures and net migration
ii) Number of approved skilled migrant category applicants

It is important to emphasise that information on occupation is only collected for approximately 30% of permanent and long term migrants. This means that the findings presented here will significantly understate the number of engineers moving in and out of the country. When interpreting the findings, it is best to consider the direction of change rather than the total number of migrants.

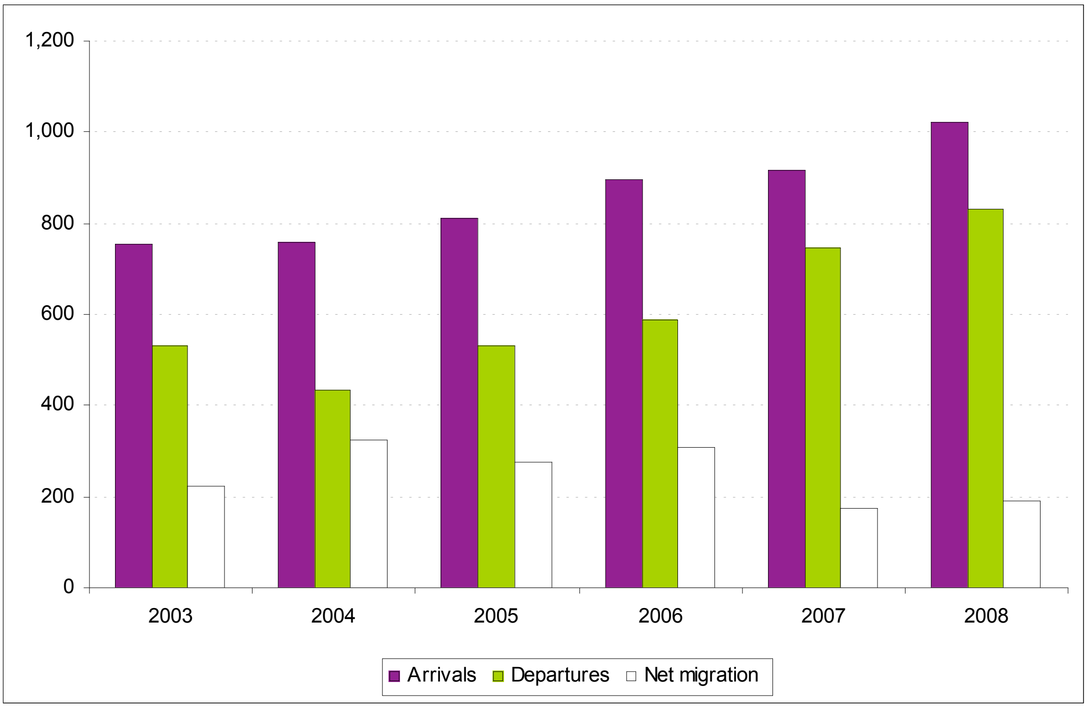
Likewise, information on occupation is available for approximately one third of work permits. The reason for this is that occupation is only recorded where it is a policy requirement. This means that the findings will understate the number of engineers who enter the country through this route.

5.6.1 Permanent and long term arrivals, departures and net migration[13]

Figure 26 shows the annual number of permanent and long term arrivals, departures and net migration for 3-digit engineering related occupational groups during 2003 to 2008. Engineering related occupations have experienced a net migration inflow over the last six years. This is due to the number of arrivals exceeding the number of departures for each of these years.

[13] Permanent and long-term arrivals include overseas migrants who arrive in New Zealand intending to stay for a period of 12 months or more, plus New Zealand residents returning after an absence of 12 months or more. Permanent and long-term departures include New Zealand residents departing for an intended period of 12 months or more, plus overseas visitors departing New Zealand after a stay of 12 months or more. Net PLT Migration shows the number of permanent and long-term arrivals less permanent and long-term departures.

Figure 26: Annual permanent and long term arrivals, departures and net migration for engineering related occupations, 2003-2008



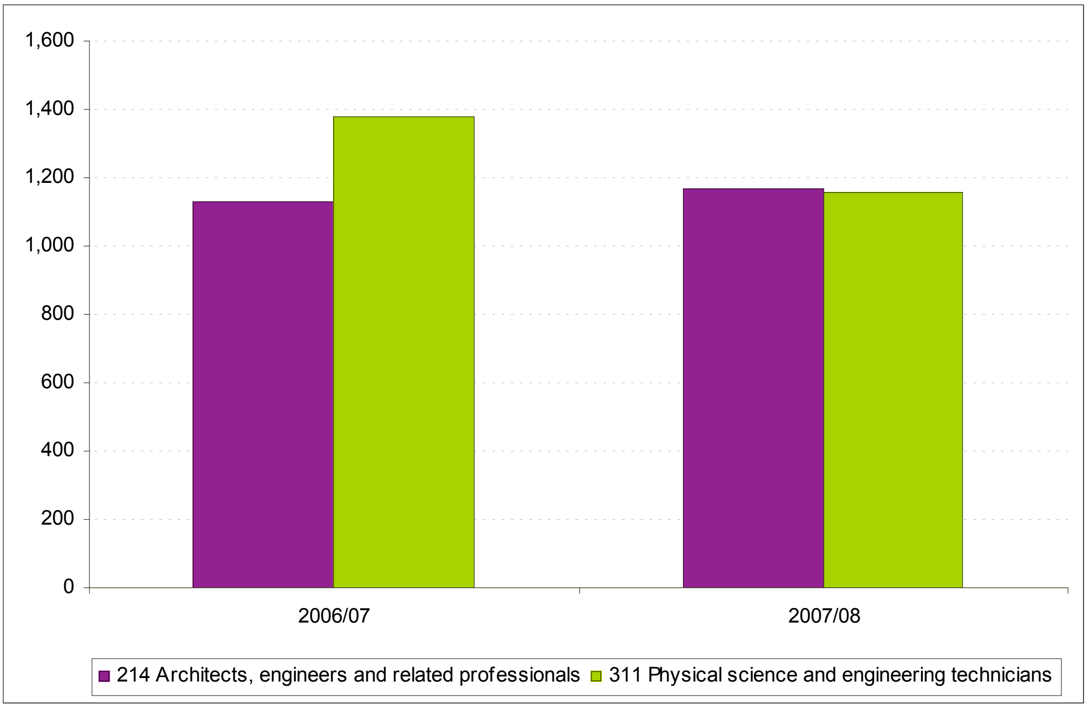
Source: Statistics New Zealand

5.6.2 Number of work permits

Figure 27 shows that there were 1,170 temporary work permits issued for architects, engineers and related professionals in 2007/2008. This represents an increase of 261 from the previous year. A total of 1,158 temporary work permits were issued for physical science and engineering technicians in 2007/08 which was largely unchanged from the previous year.

In 2007/08, work permits comprised 3.7% of total employment for architects, engineers and related professionals and 5.2% of total employment for physical science and engineering technicians.

Figure 27: Number of temporary work permits issued for engineering occupations, 2006/07 and 2007/08



Source: Immigration New Zealand

5.7 Discussion

Despite many healthy signs about the supply of engineering graduates, there are some areas where we lack information or where industry expresses particular concerns.

Although the information presented in this section suggests that the number of enrolments and completions in engineering courses has increased slightly, there are a number of factors that need to be taken into consideration when interpreting the results. For instance, it is not currently known what proportion of learners who complete qualifications in engineering related subjects actually seek and obtain employment in engineering occupations. If a large proportion of graduates go on to work in non-engineering occupations, the training information will overstate the potential supply of new engineers from training.

Additionally, there is anecdotal evidence to suggest that approximately 30% of New Zealand graduate engineers leave the country within one to three years of graduating. These findings indicate that the graduate figures may overstate the number of engineers who are actually available to work in the engineering sector in New Zealand.

Furthermore, stakeholders within the industry indicate that there are a number of issues with the quality of engineering training in New Zealand. For example, concern has been expressed that there is a lack of consistently in engineering courses across different tertiary institutions. This is particularly an issue for diploma level courses. Work is currently underway to re-develop Level 7 and 8 engineering qualifications to address some of these issues.

Industry employers have also expressed a view that insufficient attention is currently devoted to the practical component of engineering training and that engineering graduates lack practical experience. Currently, engineering graduates are required to complete some industry based training before they graduate. However, this is less than what was traditionally required under the New Zealand Certificate of Engineering which stipulated that learners complete one year of industry based training. Stakeholders within the industry also indicated that industry based training was important in developing closer relationships between tertiary institutions and industry. In many instances, graduates obtained employment with the company in which they completed their industry based training.

In addition, a recent study of engineering graduates across Institutes of Technology found that some learners felt that the practical component of their coursework was inadequate and that students required more laboratory based work and greater technical support.

The supply situation in relation to engineering migrants is more unclear than that of New Zealand graduates and there are concerns in relation to future supply flows. Although New Zealand continues to experience net inflows of migrant engineers, the ability of the engineering sector to meet future shortfalls of workers through migration may also be constrained in future years. A recent meeting of the International Federation of Consulting Engineers (FIDIC) established that of the 58 nations in attendance, all but one were experiencing moderate to severe shortages for engineers and engineering technicians. Anecdotal evidence suggests that countries are increasingly competing with each other to recruit skilled engineers.

International salary differentials mean that New Zealand may struggle to compete with other nations to attract skilled engineers to meet industry shortfalls. A comparison of engineering salaries indicates that New Zealand sits near the bottom with salaries comparable only to those offered in the Philippines and Malaysia.

There is also anecdotal evidence to suggest that some migrant engineers experience difficulties obtaining employment. In some instances, migrants do not possess the required skills or experience to obtain employment in the sector. Additionally, some qualifications obtained overseas are not recognised in New Zealand.

6. WORK EXPERIENCES OF ENGINEERS

6.1 Introduction

The long term supply of engineers will be influenced by a number of retention factors. Overall, findings presented in this report indicate that engineers are not facing a marked retention problem.

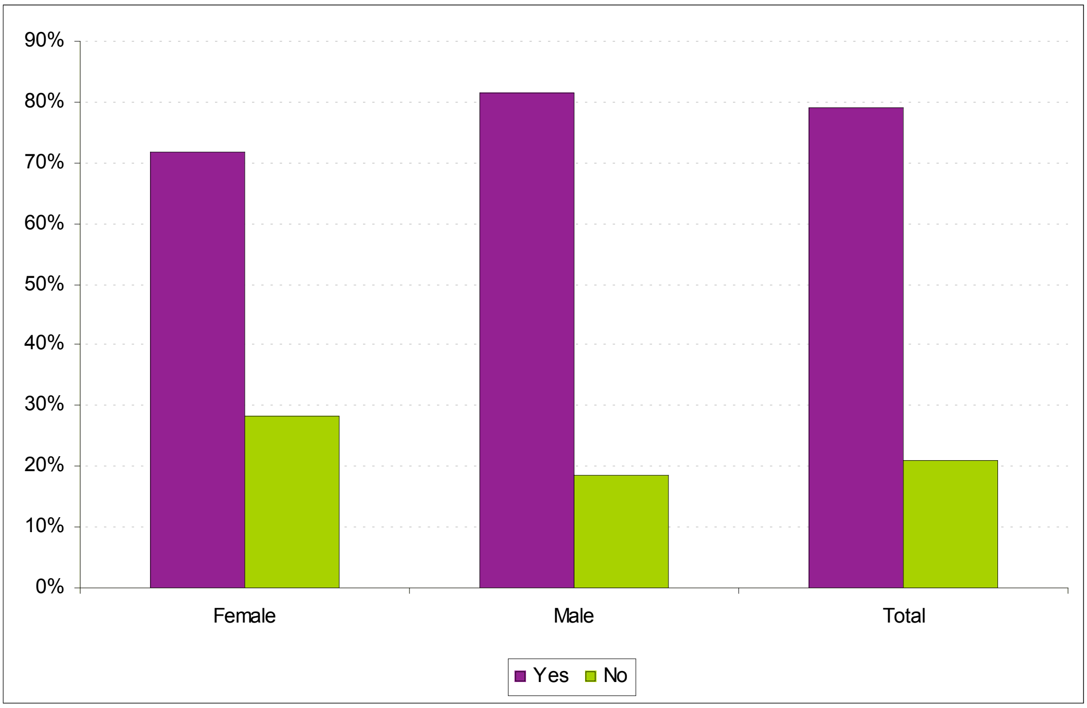
In October 2008, IPENZ undertook a survey on Women in Engineering. The purpose of this survey was to compare the employment experiences of male and female engineers. A total of 1,965 individuals participated in the survey of which 25% were female. Approximately one third of respondents were Chartered Professional engineers.

This information addresses some of the information gaps that currently exist with respect to the supply of engineers. For example, information on retention provides an important source of information on the flows of engineers in and out of the profession. Similarly, information on career breaks and the reasons why individuals take career breaks provides a useful source of information on the potential loss of engineers through migration and other factors.

6.2 Retention of engineers

The Women in Engineering survey asked participants whether they expected to be in their current job in twelve months time. Figure 28 shows that the majority of engineers (79.1%) expected to be in their current job in twelve months time. Female respondents were slightly more likely to report that they did not expect to be in their current job in twelve months time than male respondents.

Figure 28. Proportion of respondents who expect to be in their current job in twelve months time by gender, 2008



Source: IPENZ, 2008

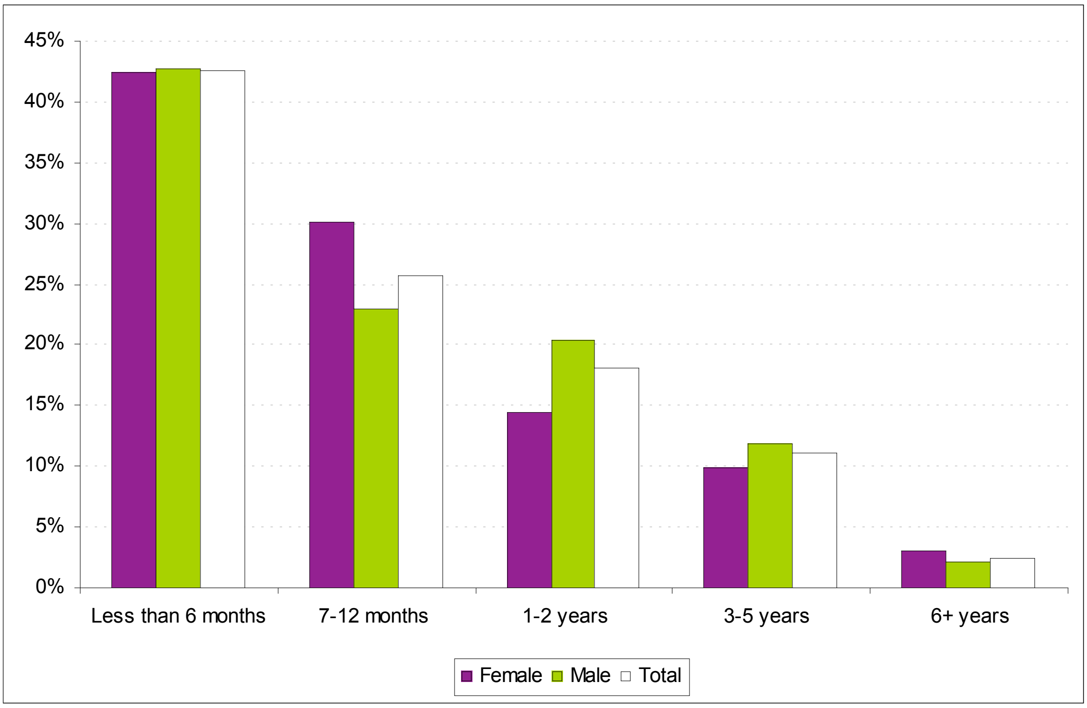
Participants who were intending to leave their current job permanently were also asked whether they would seek another engineering position. The vast majority of respondents (82.0%) stated that they would seek another engineering position. This result was similar for female and male respondents for whom 83.9% and 81.4% respectively would seek another engineering position.

6.3 Career breaks

Participants were asked how long a career break they had taken, if they have taken one. The results for those who had taken a career break are shown below. Note that for 64.3% of respondents a career break was not applicable and a further 9.1% did not respond to this question.

Figure 29 shows that the majority of those who had taken a career break returned after 12 months. Only 2.5% of those who had taken career breaks took over six or more years away.

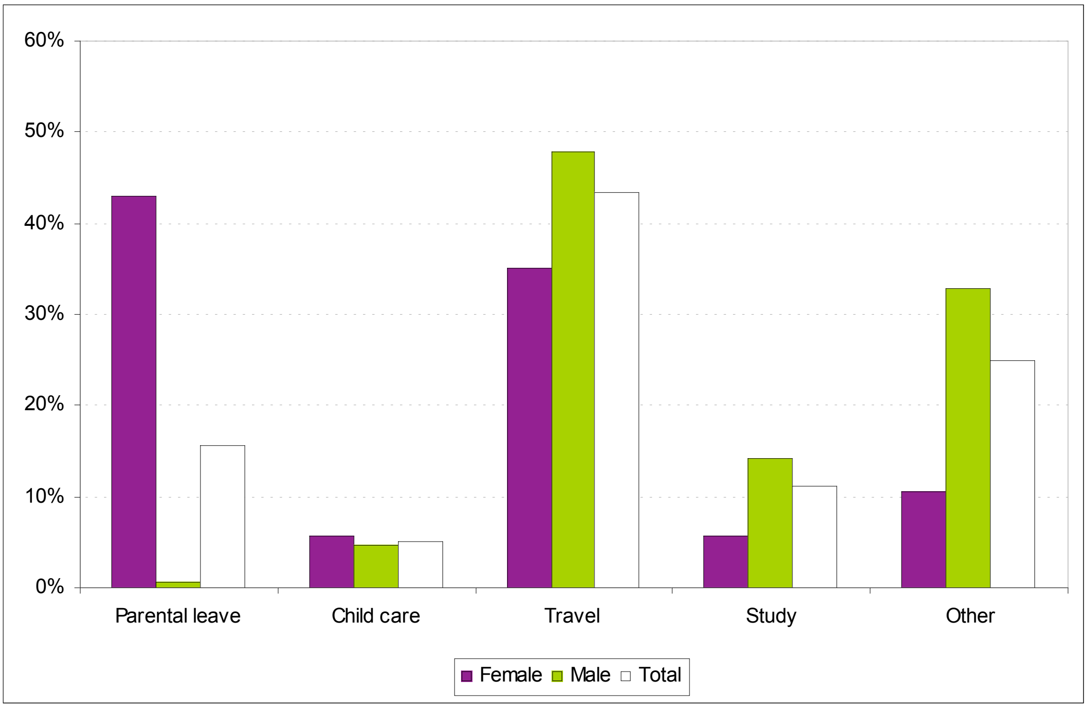
Figure 29: Length of career break for respondents who had taken a career break and returned to work as an engineer



Source: IPENZ, 2008

Participants were asked why they had taken a career break and the results for those who had taken a career break are shown below. Note that 73.4% of respondents had not taken a career break and/or did not respond to this question. Figure 30 shows that travel was the most common reason for a career break for male respondents. Travel and parental leave were the most common reasons for female respondents.

Figure 30: Reasons for taking a career break among respondents who had taken a career break and returned to work as an engineer



Source: IPENZ, 2008

6.4 Returning to work

Participants were asked about their return to work after a career break. Firstly, participants were asked whether they returned to the same employer. Approximately half of those who had taken a career break returned to work for the same employer (48.5%). For female respondents the percentage was slightly higher with 57.8% of female respondents saying that they had returned to work for the same employer.

Participants were asked whether they returned to full-time or part-time work. Of those who had taken a career break, 81.0% returned to full-time work. For female respondents, 64.0% returned to full time work.

Participants were also asked about the level of their position on return to work. Approximately one in six of those who had taken a career break returned to a job that was a lower position that the one they had left before their career break (15.8%). A total of 59.8% returned to a position that was equivalent to the one they had left before their career break. The remaining 24.3% returned to a position that was higher than the one they had left before their career break.

Finally participants were asked about what they found to be the greatest impediment to returning to work. Just under one third of those who had taken a career break found a lack of personal confidence to be the greatest impediment (30.6%). Approximately one fifth of those who had taken a career break felt technically out of date (18.2%) and another 14.1% found a lack of employee-friendly practices to be the greatest impediment. 8.5% of those who had returned after a career break found a lack of refresher courses to be an impediment. The remaining respondents cited other impediments such as:

- Lack of motivation
- Limited employment opportunities
- The need for learning as the respondents had changed countries
- Change in role, requiring up-skilling
- Time pressures

6.5 Family friendly employment practices

Participants were asked about their workplace's "family friendly" employment practices and whether they had taken advantage of these. Respondents were asked about the following:

- Flexible work hours
- Part time work
- Leave without pay
- Caregiver's leave
- Paid maternity leave
- Paid paternity leave

Flexible working hours

More than half of all respondents have taken advantage of flexible working hours (61.5%) while 14.2% of all respondents had not. A further 10.5% of respondents were not offered flexible working hours in their current job, 4.8% of respondents said flexible working hours were not relevant to them and the remaining 9.1% of respondents did not respond to this question.

Part time work

A total of 15.3% of all respondents had taken advantage of part time work. For female respondents, this percentage was slightly higher with 21.3% having worked part time. 38.1% of all respondents had not worked part time and 15.1% of all respondents were not offered part time work. A further 22.5% of all respondents said part time work was not applicable to them and 9.1% did not respond to this question.

Leave without pay

Approximately one third of all respondents had taken leave without pay (33.7%). The percentage was higher for female respondents, 43.8% of whom had taken leave without pay. More than four in ten respondents had not taken leave without pay (42.1%) and 3.3% of respondents say they were not offered leave without pay. A further 11.8% of respondents said that leave without pay wasn't applicable to them and 9.1% of respondents did not respond to this question.

Caregiver's leave

Just under one in ten respondents indicated that they had taken caregiver's leave (7.8%) while 44.9% of all respondents had not taken caregiver's leave. A small proportion of respondents indicated that they were not offered caregiver's leave (5.3%) and 33.0% of respondents said caregiver's leave was not applicable to them. 9.1% of respondents did not respond to this question.

Paid maternity leave

A total of 16.3% of female respondents had taken paid maternity leave, 36.8% of female respondents had not taken paid maternity leave and 4.3% of female respondents said they were not offered paid maternity leave. One third of female respondents said paid maternity leave was not applicable to them and 9.1% of female respondents did not respond to this question.

Paid paternity leave

Just under one in ten male respondents had taken paid paternity leave (7.9%). 42.1% of male respondents had not taken paid maternity leave and 8.0% of male respondents said they were not offered paid paternity leave. One third of male respondents said paid paternity leave was not applicable to them and 9.1% of male respondents did not respond to this question.

6.6 Discussion

Information presented in this section indicates that approximately one quarter of engineers take career breaks, with migration the most common reason among those who take a career break. Of those who took a career break, most returned to work within one year.

To a large extent, career breaks or an 'overseas experience' may form part of the career cycle for specialist engineers. Stakeholders within the industry report that twelve of the fifteen large engineering firms send their young engineers overseas for one or two years and this is seen as part of their career development.

The information in this survey is based on engineers currently employed in New Zealand and does not provide any information on New Zealand engineers who are working overseas. There is currently no information source that can tell us about the experiences of those overseas based engineers and whether they plan to return to New Zealand to work at some stage.

7. SUMMARY AND IMPLICATIONS

This report presents information on indicators of the demand for and supply of engineering occupations. In this chapter, we review the key findings of the report and outline some implications of the findings.

7.1 Summary of demand

Engineering professionals have experienced strong employment growth over the past five years. Patterns of employment growth varied considerably across specific engineering occupations. The strongest employment growth rates were observed for engineering technical managers, electrical engineers, electrical engineering technicians and roading engineers. Low or negative employment growth rates were experienced by a number of occupations including telecommunications technician, agricultural engineer, mechanical engineering technician and aeronautical engineer and/or aircraft surveyor. Anecdotal evidence collected from the engineering sector suggests that the declining growth for some occupations is due to outsourcing and the changing nature of occupations due to technology changes.

The employment outlook for engineering professionals is for continued employment growth over the next five years. Department of Labour employment forecasts indicate that an additional 1,200 to 1,300 engineering professionals will be required each year over the next five years.

In addition to the forecast employment growth, new engineers will be required to replace those engineers who leave the profession for various reasons. Assuming that the historical patterns observed over the 2001-2006 period continue over the next five years, a further 500 engineers will be required per annum to maintain employment at its current level.

Combining information on employment forecasts and net replacement demand suggests that an additional 1,700 to 1,800 engineers will be required per annum over the next five years.

7.2 Summary of supply

Findings presented in this report examined the supply of engineers through training and migration. Between 2001 and 2006, there were approximately 1,300 graduates per annum in engineering courses at Level 7 and above. A further 504 learners per annum completed Level 5-7 diplomas in engineering related subjects. In 2006 the training rates for engineers were similar to the average rate for all occupations.

Interpreting the potential supply of new engineers from training is complex. Although we know that approximately 1,300 learners completed graduate level qualifications in engineering related subjects, we do not know what proportion actually sought and obtained employment as engineers. Without this critical piece of information it is difficult to draw conclusions about the capacity of training to keep pace with the demand for skilled engineers. If a large proportion of engineering graduates go on to work in non-engineering occupations, the training information will overstate the potential supply of new engineers from this source.

In addition, anecdotal evidence indicates that 30% of New Zealand graduate engineers leave the country within one to three years of completing their qualification. This considerably reduces the pool of engineers available to work in New Zealand.

Information on permanent and long term migrants indicates that there was a net inflow of between 200-350 engineers per annum over the past three years. Additionally, there were approximately 2,300 work permits issued to individuals working in engineering occupations in 2007/08.

- These figures are likely to be an under-estimate of total migrant engineers as information on occupation is recorded for just 30% of migrants and approximately one third of work permits.

- In addition to the data issues, there is also anecdotal evidence to suggest that not all migrant engineers possess the qualifications and experience required to obtain employment as engineers in New Zealand. Stakeholders within the industry estimated that 150-200 migrant engineers were considered to be unemployable and would require at least twelve months on the job training to meet the standards required by employers.

7.3 Implications

The findings presented in this report have a number of implications for the engineering workforce and for the New Zealand economy as a whole.

Although existing employment forecasts indicate that demand for engineering professionals is likely to remain high over the next five years, recent economic trends indicate a slowdown in economic growth. If this trend persists, this may impact on the demand for engineering staff.

A March 2009 survey of consulting engineering firms found that more than half of small and low to medium sized firms reported a reduction or slowing down in workload, with the residential construction sector the most hard hit. Furthermore, most small and low to medium sized firms were expecting a decrease in upcoming workloads over the next year. Despite this slowdown, most firms indicated that they expected to maintain staff at current levels.

Information presented in this report have broader implications for the role of engineers in the changing economic environment. Following a long term trend of employment growth and low unemployment, recent economic indicators show a more negative picture of economic growth and an easing labour market. In response to the changing conditions, considerable emphasis has been placed on investing in infrastructure as a means of creating new jobs.

Information presented in this study suggests that job transitions from declining industries into growth industries such as infrastructure may be constrained by difficulties in moving workers across sectors due to different job requirements and skills. Currently, engineers are spread across a range of sectors and any realignment of the sector is likely to require up-skilling and/or retraining to enable engineers to move across industries.

Historically, migration has played an important role in meeting demand shortfalls for skilled engineers. However, there are a number of factors that suggest that the ability of New Zealand to attract skilled engineers may be constrained in future years. A recent meeting of the International Federation of Consulting Engineers (FIDIC) established that of the 58 nations in attendance, all but one were experiencing moderate to severe shortages for engineers and engineering technicians. Anecdotal evidence suggests that countries are increasingly competing with each other to recruit skilled engineers.

International salary differentials mean that New Zealand may struggle to compete with other nations to attract skilled engineers to meet industry shortfalls. A comparison of engineering salaries indicates that New Zealand sits near the bottom with salaries comparable only to those offered in the Philippines and Malaysia.

These challenges emphasise the importance of ensuring that New Zealand takes steps to ensure it has sufficient engineering graduates to meet the ongoing demand for skilled engineers as well as retaining them on shore.

7.4 Next steps

To build on the findings presented in this report, we recommend that further work is undertaken to address the supply side information gaps. This includes:

- A study of employment outcomes for engineering graduates. At present it is unclear what proportion of engineering graduates go on to enter engineering occupations and what proportion enter other fields. Information on the flow of individuals between training and the workplace would provide a more accurate picture of the supply of engineers from training.
- A study of the experiences and career plans of New Zealand engineers currently living overseas. This would include information on whether they plan to return to work in New Zealand. This would provide information on the potential pool of individuals who may form part of the engineering workforce in New Zealand over the next five years.

APPENDIX ONE

Definitions

3-digit engineering related occupations
214 Architects, Engineers and Related Professionals
311 Physical Science and Engineering Technicians

5-digit engineering occupations
12219 Engineering Technical Manager

21421 Roading engineer
21422 Water resources engineer
21423 Public health engineer
21425 Structural engineer
21426 Other civil engineer
21431 Electrical engineer
21441 Electronic and telecommunications engineer
21451 Heating, ventilation and refrigeration engineer
21452 Naval architect and/or ships' surveyor
21453 Aeronautical engineer and/or aircraft surveyor
21454 Agricultural engineer
21455 Other mechanical engineer
21461 Chemical engineer
21471 Metallurgist
21472 Mining engineer

31121 Quantity surveyor
31122 Surveyor's technician
31123 Clerk of works
31124 Other civil engineering technician
31131 Electrical engineering technician
31141 Telecommunications technician
31142 Computer systems technician
31143 Other electronics engineering technician
31144 Avionics technician
31151 Mechanical engineering technician
31161 Chemical engineering technician
31181 Draughting technician
31191 Other engineering technician
31192 Non destructive testing technician

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