The Economic Basis of the Case for National Registration of Engineers in Australia

Revised Final Report

Prepared for the National Engineering Registration Board

January 2012

ACIL Tasman

Economics Policy Strategy

Reliance and Disclaimer

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Key Findings

In Australia the majority of professional engineers who work independently or supervise other engineers have not elected to register on a voluntary register and undertake continuing professional development. In addition to those engineers currently registered on the National Professional Engineers Register and/or with the Board of Professional Engineers of Queensland (estimated to total 12,810) another 55,990 would require registration under the proposed national mandatory scheme.

The change to a mandatory scheme involves costs and benefits. Combining the present value of total costs and total benefits associated with the proposed national registration scheme, the net present value of the scheme is estimated to be **$7.4 billion** under a seven per cent real discount rate while its benefit-cost ratio is calculated to be **3.14**. The internal rate of return is calculated to be **51.6 per cent**.

As the number of professional engineers on the national register increases during the assumed three-year transition to the full mandatory scheme, the annual cost of the proposed scheme increases from $176.2 million (2011 dollars) in Year 1 to $357.2million (2011 dollars) in Year 3, by which time the 55,990 unregistered engineers have been registered under the proposed mandatory scheme. The annual cost of the arrangements increases over the subsequent years as a result of the assumed net growth in the supply of professional registered engineers. Over a 20-year period the present value of this stream of costs is projected to be just under **$3.5 billion** (using a seven per cent real discount rate).

By comparison, the annual costs associated with current arrangements, where only some of the states and territories have registration schemes for certain types of engineers, have been estimated at $32.2 million (2011 dollars). Over a 20-year period and assuming no change in the current regulatory arrangements, the present value of this stream of costs using a seven per cent real discount rate would be **$681 million**.

Many stakeholders were of the view that a national registration scheme will be beneficial for the economy. For example, the proposed scheme has the potential to ameliorate information failure and to some extent improve the quality of engineering outcomes. Mistakes by poorly qualified and/or incompetent engineers have the potential to lead to catastrophic engineering failures but perhaps more frequently "botched" work. In Australia, there have been numerous catastrophic engineering failures in the last several decades. If on average national registration (once fully implemented) prevented one large engineering failure every four years, resulting in the saving of one fatality and five serious injuries, the benefit (including the value of a statistical life saved, medical costs and rectification costs) would be $13.20 million per annum.

While spectacular but sporadic large-scale engineering failures command considerable public attention, the costs associated with "botched" engineering projects are often hidden. Assuming that the proposed national registration system once fully operational results in one per cent fewer engineering construction projects being botched (say, from 20 per cent to 19 per cent or from 15 per cent to 14 per cent) and that the cost of rectifying such projects is equal to 25 per cent of the value of the original project, the benefits that can be attributed to the proposed system is estimated to be $207.08 million per annum.

The total estimated annual benefits of the proposed scheme is projected to be between $32.2 to $39.8 million in the first three years, jumping to $687.1 million in Year 4 when the scheme becomes fully operational and then rising progressively to $2.93 billion in Year 20 due to assumption that the value of engineering construction projects will be rising by ten per cent per annum in real terms. The present value of total benefits of the scheme is estimated to be **$10.8 billion** under a seven per cent real discount rate.

Executive summary

ACIL Tasman was commissioned by Engineers Australia, Consult Australia, the Association of Professional Engineers, Scientists & Managers, Australia (APESMA) and the Institute of Public Works Engineering Australia (IPWEA) to undertake an economic analysis of the case for the national registration of professional engineers in Australia. This report revises cost estimates and the cost benefit analysis undertaken in our earlier report, released in December 2011. The costs reported in this revision, amongst other things, reflect the process re-engineering currently being undertaken by Engineers Australia, which aims to minimise respondent burden. This process will see significant reductions in the time taken by engineers to prepare evidence of competence when applying for CPEng status and to report continuing professional development activities.

In undertaking this project ACIL Tasman consulted with a range of stakeholders to obtain information and data on the costs of the current system and the proposed national registration systems, as well as the potential benefits of the new system. These stakeholders included representatives from the proponent organisations, administrators of the current systems in various states and territories, as well as several engineering firms (some of which operate across a number of jurisdictions).

Why national registration is needed

Professional engineers are the focus of the proposed national registration scheme

Engineers require specialised skills and knowledge (including having a solid grounding in mathematics and science). Engineers undergo a lengthy period of study and practical training in order to practice. Engineers also have a responsibility to uphold standards in ethics, rigour and robustness of design, rational thinking, and most importantly, public safety[1]. Engineers can be categorised into three groups:

1. professional engineers who have completed a four year (full time) bachelor degree in engineering
2. engineering technologists who have completed a three year (full time) bachelor degree in engineering
3. engineering associates who have completed a two year (full time) associate degree in engineering, or a two year (full time) diploma or advanced diploma in engineering from university or TAFE college.

[1] WA Government and Engineers Australia (WA), *Discussion Paper: The Regulation of Engineers in Western Australia*, 2009, p.9.

The first group of professional engineers is the focus of the proposed national mandatory registration scheme.

Engineers Australia advises that professional engineers are required to take responsibility for engineering projects and programs in the most far-reaching sense. Professional engineers either supervise the work of others and/or work independently of others. Box ES 1 provides background information on professional engineers' responsibilities. Professional engineers are generally classified as being Level 1 (graduate) through to Level 5 (predominantly engineering senior management positions including, Managing Director, Chief Executive Officer and Group General Manager). Supervision responsibility is expected from Level 3 onwards.

There is currently no uniform registration or licencing regime covering engineers in Australia. In the eight states and territories the regulation/accreditation of engineers covers a broad spectrum from:

- no registration or licensing provisions for engineers in South Australia and Western Australia
- to the accreditation of engineer who are certifiers in certain aspects of the building industry in New South Wales, Victoria, Tasmania, the Australian Capital Territory (ACT) and the Northern Territory
- to the mandatory registration of all supervising engineers in Queensland.

While there is currently no national mandatory scheme for the registration of engineers there are a number of voluntary registration and accreditation arrangements in Australia. These voluntary schemes are operated by engineering associations, namely:

- Engineers Australia , which offers its suitability qualified members accreditation as a Chartered Professional Engineer (CPEng) and offers qualifying members and non-members registration on the National Professional Engineers Register (NPER)
- The Australasian Institute of Mining and Metallurgy (AusIMM) offers its members a Chartered Professional (CP) program which provides formal recognition of qualified, experienced members who actively engage in continuing professional development. The CP accreditation is open to engineers and other professional members working in the Mining industry.
- Institution of Fire Engineers (IFE), which is the international qualifying organisation and learned society for fire engineering, fire fighting and fire safety professionals, offers its suitably qualified members a pathway qualification as a Chartered Engineer (CEng).

We understand that there are a number of other engineering associations active in Australia and many of these have mutual recognition agreements with Engineers Australia.

Box ES 1 **The responsibilities of a professional engineer**

- Reliable functioning of all materials, components, sub-systems and technologies used; their integration to form a complete, sustainable and self-consistent system; and all interactions between the technical system and the context within which it functions. The latter includes:
  - understanding the requirements of clients, wide ranging stakeholders and of society as a whole
  - working to optimise social, environmental and economic outcomes over the full lifetime of the engineering product or program
  - interacting effectively with other disciplines, professions and people
  - ensuring that the engineering contribution is properly integrated into the totality of the undertaking.
- Interpreting technological possibilities to society, business and government
- Ensuring, as far as possible, that policy decisions are properly informed by such possibilities and consequences, and that costs, risks and limitations are properly understood as the desirable outcomes.
- Bringing knowledge to bear from multiple sources to develop solutions to complex problems and issues.
- Ensuring that technical and non-technical considerations are properly integrated, and for managing risk as well as sustainability issues.
- While the outcomes of engineering have physical forms, the work of professional engineers is predominantly intellectual in nature. In a technical sense, professional engineers are primarily concerned with the advancement of technologies and with the development of new technologies and their applications through innovation, creativity and change.
- Professional engineers may conduct research concerned with advancing the science of engineering and with developing new principles and technologies within a broad engineering discipline. Alternatively, they may contribute to continual improvement in the practice of engineering, and in devising and updating the codes and standards that govern it.
- Ensuring that all aspects of a project are soundly based in theory and fundamental principle, and for understanding clearly how new developments relate to established practice and experience, and to other disciplines with which they may interact. One hallmark of a professional is the capacity to break new ground in an informed, responsible and sustainable fashion.
- Professional engineers may lead or manage teams appropriate to these activities, and may establish their own companies or move into senior management roles in engineering and related enterprises.

Source: Engineers Australia

An applicant for registration as a professional engineer must meet the Australian Engineering Competency Standards which consists of two Stages:

- Stage 1 assesses an applicant's qualifications
- Stage 2 assesses an engineering practitioner's capability of working unsupervised, independently or under general direction.

A CPEng with Engineers Australia has satisfied Stage 2 requirements and hence he/she is eligible for the NPER.

Economic basis of mandatory registration

In a market-oriented economy such as Australia's, the case for regulation such as the national registration of engineers is predicated on the existence of imperfections in the market economy and the likelihood of the benefits of regulation exceeding the costs arising from these imperfections. The market imperfections or market failures associated with the engineering profession include:

- Information asymmetry which exists when one party to a transaction has more information or better information than the other. Information asymmetry can produce poor (inefficient) outcomes. In the case of the engineering profession, the information in question would be the qualifications, competencies and experience of the engineer.
- Negative spillovers or externalities which include those impacting on health and safety, the environment and the economy. For example:
  - a safety externality can arise because the consequences of poor engineering are experienced by people other than those who directly purchase the engineering services.
  - a marine environmental externality could arise from an oil spill caused by poor engineering decisions and/or practices. The oil spill might also negatively affect the livelihoods of fishermen and other persons not affiliated with the oil industry, and the cost of the resulting clean-up is often borne by the general taxpayer.

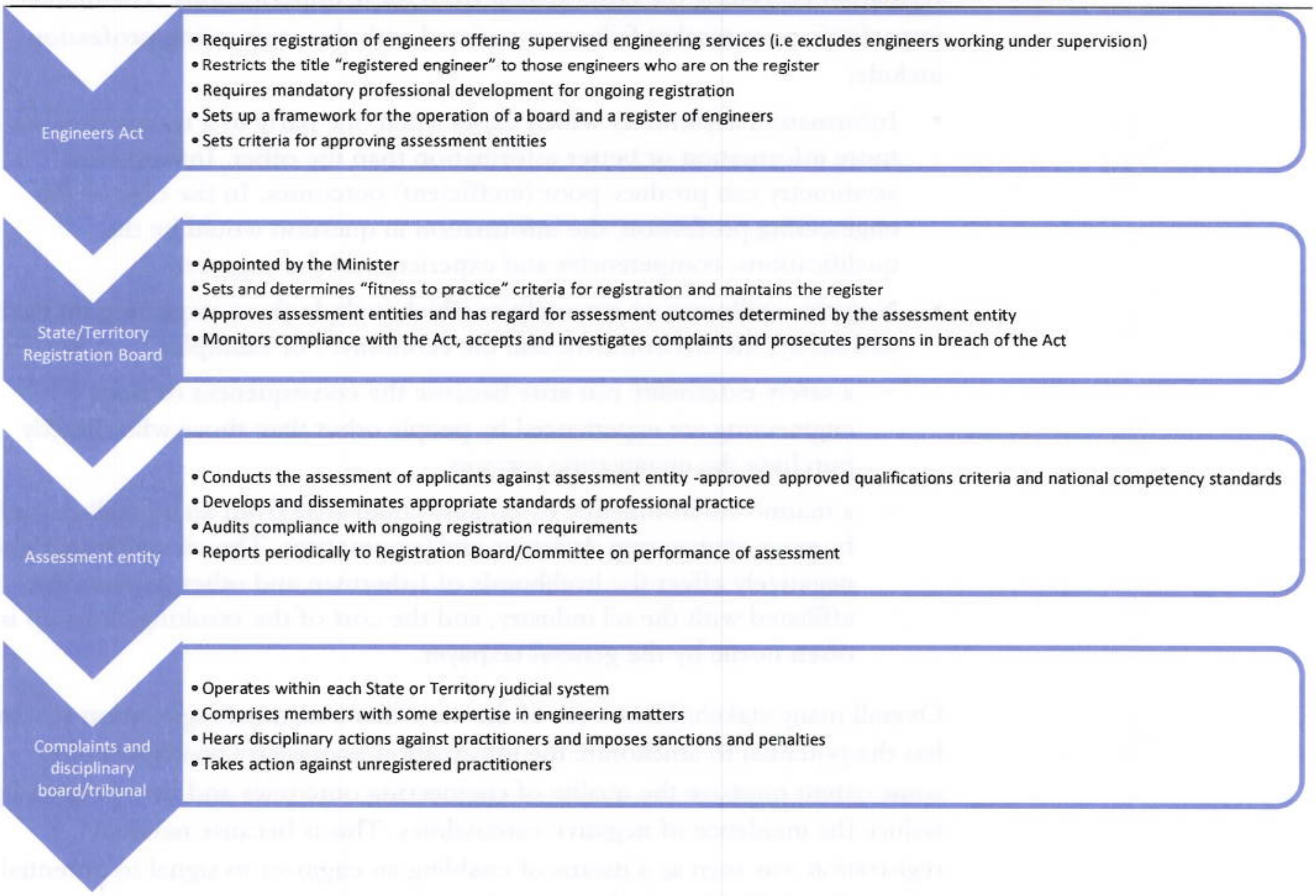
Overall many stakeholders were of the view that a national registration scheme has the potential to ameliorate the information asymmetry problem and to some extent improve the quality of engineering outcomes and thus potentially reduce the incidence of negative externalities. This is because national registration was seen as a means of enabling an engineer to signal to potential clients that he/she is qualified, experienced, continually undertakes professional development, is regularly audited and abides by an ethics code. The registration system may provide assurance that the engineer will be competent and hold the client's interest above any opportunity to achieve unscrupulous financial gain, and will be diligent in providing the contracted services.

The proposed national registration model

The proposed model for the national model is broadly based on the Queensland's current mandatory system of registration.

Under the proposed model there would be seamless inter-jurisdictional recognition of new legislation to be introduced in each state and territory – *The Engineers Act*. Each Act would require the registration of engineers offering professional engineering services and would restrict the title "registered engineer" to engineers on the register. Figure ES 1 describes the functions of the parties in the proposed model.

Figure ES 1 **Functions of parties in the proposed engineering registration model**



Data source: Engineers Australia

Costs and benefits of the proposed model

Costs of the existing arrangements

The annual costs associated with current arrangements have been estimated at $32.2 million (2011 dollars). These costs include the:

- application and renewal fees paid by engineers, which in most states and territories is used to recoup the costs of the registration entity
- opportunity cost of engineers' time taken to apply or renew registration or accreditation
- cost of continuing professional development (if mandatory)
- opportunity cost of engineers time taken up by mandatory continuing professional development (CPD).

Over a twenty year period and assuming no change in the current regulatory arrangements the NPV of this stream of costs using a seven per cent discount rate would be $681 million (Table ES 1).

Table ES 1 **NPV of the cost of the current regulatory arrangements**

NPV = 7%	$ million
Cost to Government	
New South Wales	$0.3
Queensland	$29.1
Victoria	$4.4
South Australia	$0.0
Western Australia	$0.0
Tasmania	$1.7
Northern Territory	$1.3
Australian Capital Territory	$0.0
Total cost to Government (application and renewal fees are assumed to cover all or the majority of these costs in the majority of jurisdictions)	**$36.8**
Cost to Engineers by state of registration	
New South Wales	$6.3
Queensland	$612.3
Victoria	$6.1
South Australia	$0.0
Western Australia	$0.0
Tasmania	$18.2
Northern Territory	$1.2
Australian Capital Territory	$0.0
Total cost to Engineers (excluding application and renewal fees)	**$644.1**
Total cost of the current arrangements	***$681.0***

Note: NPV over a 20 year period. The costs to engineers are reported in the state where they are registered rather than the state in which they reside. Data source: ACIL Tasman estimates.

The majority of this cost is incurred by the Queensland Government's BPEQ (which operates on a cost recovery basis) and the engineers registered in that state. The majority of the cost associated with engineers is the opportunity cost of undertaking mandatory CPD.

Costs of the proposed national registration model

When considering the costs of the proposed national registration arrangements the first step was to estimate the number of engineers that are currently not registered on the NPER or on the RPEQ that would have to be registered under the proposed arrangements.

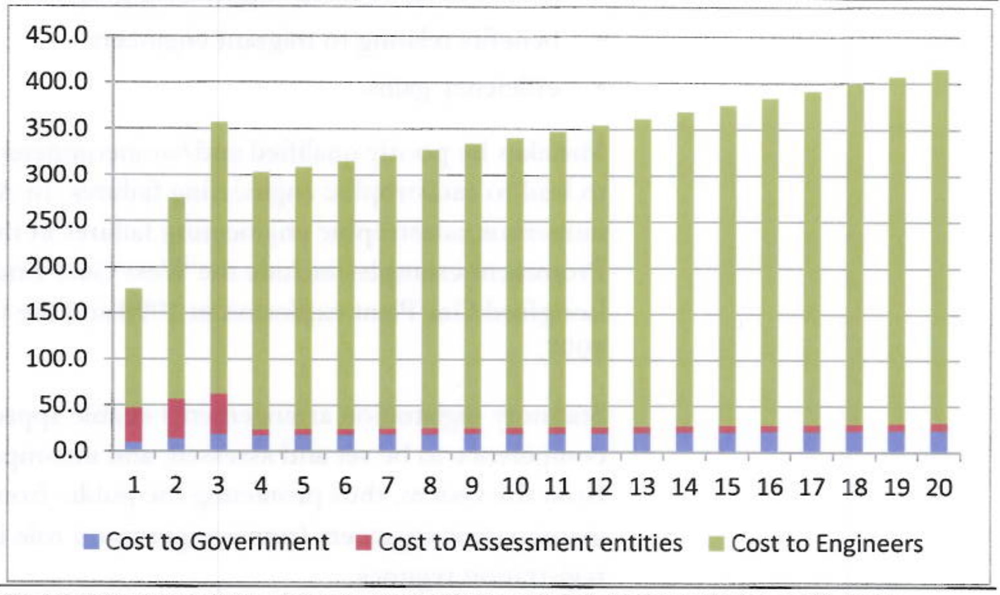
The starting point was to assume that there are currently 150,169 professional engineers in the labour market. Based on the Queensland experience, we have estimated that just under 46 per cent of engineers would need to be registered under the proposed national scheme. However, some of these professional engineers are already registered on the NPER and/or the BPEQ. In all we estimate that:

- 9,850 are registered on the NPER
- 2,960 are registered on the BPEQ but not on the NPER.

Assuming that the registration of these 12,810 engineers would be rolled over to the new national scheme, another 55,990 (68,800 minus 12,810) would need to be registered under the proposed national scheme. We have assumed that these additional engineers would be registered over a transition period of three years.

As the number of professional engineers on the national register increases during the transition phase, the cost of the scheme increases from $176 million in year one to $357 million in year three, which is the final year of the assumed phased registration of previously unregistered professional engineers. In subsequent years the increase in cost is primarily driven by the assumed net growth in the supply of professional registered engineers (Figure ES 2).

Figure ES 2 **Estimated annual cost of the proposed national arrangements (2011 dollars)**



Note: Cost to Government and cost to assessment entities is assumed to be covered by fees paid by Engineers.

Cost to engineers excludes fees and charges paid to Government or assessment entities by the engineers or their employers.

Source: ACIL Tasman estimates.

Over a twenty year period the NPV of this stream of costs using a seven per cent discount rate would be just under $3.5 billion (see Table ES 2). Of this cost, around 90 per cent is incurred by the individual engineers or their employers through the opportunity cost of time spent completing applications and paying for and attending continuing professional development activities and the like. As the national scheme is assumed to be cost neutral for Government and the assessment entities, the remaining ten per cent of these costs is also paid out by engineers or their employers as application and/or renewal fees.

Table ES 2 **NPV of the cost of the proposed national arrangements**

NPV = 7%	$ million
Cost to Government (assumed recovered through fees)	$191.8
Cost to Assessment entities (assumed recovered through fees)	$161.8
Cost to Engineers (excluding fees)	$3,096.6
NPV total cost of proposed system	**$3,450.3**

Note: NPV, seven per cent discount rate over a 20 year period

Data source: ACIL Tasman estimates.

The proposed national registration scheme is expected to produce a range of benefits. The key benefits that have been estimated by ACIL Tasman are:

- the avoided costs associated with current arrangements, particularly through a more streamlined application process

- reduction in large engineering failures
- reduction in botched engineering projects
- benefits relating to migrant engineers
- efficiency gains.

Mistakes by poorly qualified and/or incompetent engineers have the potential to lead to catastrophic engineering failures. In Australia, there have been numerous catastrophic engineering failures in the last several decades. Prominent examples include the West Gate Bridge collapse in 1970, the Esso Longford Gas Plant explosion in 1998 and the Canberra Hospital implosion in 1997.

Statutory registration arrangements enable appropriate standards of competence to be set and assessed, and incompetent engineers to be removed from the system, thus protecting the public from harm. The removal of incompetent engineers from a supervision role is not feasible under voluntary registration regimes.

Benefits from reducing the number of large engineering failures

To quantify the potential benefits of the proposed national registration system in reducing the likelihood and occurrence of large engineering failures, ACIL has made the following assumptions:

- national registration once fully implemented will prevent 1 large engineering failure every four years
- each of these failures result in one fatality and five serious injuries
- the average response and rectification costs associated with each of these failures is $50 million.

Assuming that each fatality results in 40 years of life lost due to premature mortality, a real discount rate of seven per cent and the Value of a Statistical Life Year of $168,000 (following advice from the Office of Best Practice Regulation), the value of each life lost is approximately $2.24 million.

Assuming the average value of each serious injury to be $339,000 per hospital admission (based on a 2009 Victorian Department of Transport discussion paper), the benefit of the national registration system in reducing the incidence of large engineering failures is estimated to be **$13.20 million per annum**.

Benefits from reducing the number of botched engineering projects

While spectacular but sporadic large-scale engineering failures command considerable public attention, the insidious potential losses to the economy from myriad engineering projects that are executed less than optimally because of incompetent and inadequately qualified engineers are far greater.

Recent research indicates that the engineering profession's early moves to corporatisation, the deskilling of the public sector of engineers and other such systemic issues have, in the absence of a national performance standard for engineers, resulted in regular and preventable failures to deliver engineering services with commercially efficient and predictable outcomes.

It is believed by Engineers Australia that performance standards for engineering could be integrated within competency standards and an appropriate code of practice under a statutory registration system in order to improve the reliability of engineering services.

According to the Australian Bureau of Statistics (ABS), the value of engineering construction projects in Australia totalled $83.04 billion in 2010-11.

Assuming that the proposed national registration system once fully operational results in one per cent of engineering construction projects *not* being botched and that the cost of rectifying such projects is equal to 25 per cent of the value of the original project, the benefits that can be attributed to the proposed system is estimated to be **$207.08 million per annum**.

A national statutory registration process would also assist engineers to have international mobility and could help to integrate engineers from overseas.

Benefits of national registration to new migrant engineers

Studies have shown that migrants with foreign qualifications in engineering are considerably less likely to work as engineers than native-born Australians with engineering qualifications. In addition, migrants are likely to face a lengthier job search and to earn less than Australians with similar qualifications and experience levels.

It has been argued by Engineers Australia that the development of a statutory national registration system would allow the engineering profession to more easily access international markets where registration is essential. It would also provide a framework within which engineers coming to Australia from overseas could be assessed and recognised more easily where they are appropriately qualified and competent.

To estimate the potential benefits of a national registration system to migrant engineers, ACIL Tasman assumed the following:

- 25 per cent of new migrant engineers would enjoy the credentialing benefits offered by the proposed national registration system
- national registration would reduce the duration of job search for these new migrant engineers by one month on average
- there is a 20 per cent wage gap between the salaries of new migrant engineers and that of equivalent native-born engineers
- this gap would close by approximately 50 per cent for the 25 per cent of new migrant engineers who benefit from the proposed system.

Using Department of Immigration and Citizenship (DIAC) data that indicate there were 6,712 engineers in the 2009-10 permanent migration intake and information from mycareer.com.au showing that the average salary of Australian engineers is currently $121,513 per annum, the benefits of the proposed national registration system to new migrant engineers is estimated to be **$29.91 million per annum.**

If the national registration system induces an additional five per cent of foreign engineers to migrate permanently to Australia each year (approximately 336 engineers), this would increase the existing pool of approximately 150,200 practising engineers in Australia by 0.22 per cent.

Assuming that the value of engineering construction activity is proportional to the number of practising engineers in the country, this small reduction in skills shortage is estimated to generate an additional **$185.58 million per annum** in engineering construction activity alone in Australia.

ACIL Tasman did not attempt to quantify the general reduction in skills shortage arising from the introduction and implementation of the proposed national registration scheme. The majority of stakeholders consulted by us on this issue believed that such a scheme by itself would not have a major impact on the skills shortage problem.

Benefits from efficiency gains enabled by national registration

As described previously, engineers operating throughout Australia are currently covered by over a dozen Acts and regulations that contain various competency standards and processes for (mostly voluntary) registration. This creates complexity as well as added compliance costs.

A uniform national statutory registration scheme for engineers should drive efficiencies for the entire system and improve productivity for engineers by reducing their compliance costs. Under a national scheme, the non-productive time spent in preparing applications and the fees currently paid by engineers to various registration and other bodies around the country could be consolidated to cover one mandated registration process. This would also significantly reduce the current administrative burden for engineers of registering with various bodies in different jurisdictions and complying with a raft of different regulatory requirements.

Additional efficiency gains from a national registration system include reduced search costs for clients associated with acquiring information on the competency and skills of engineers they are potentially entering into contracts with.

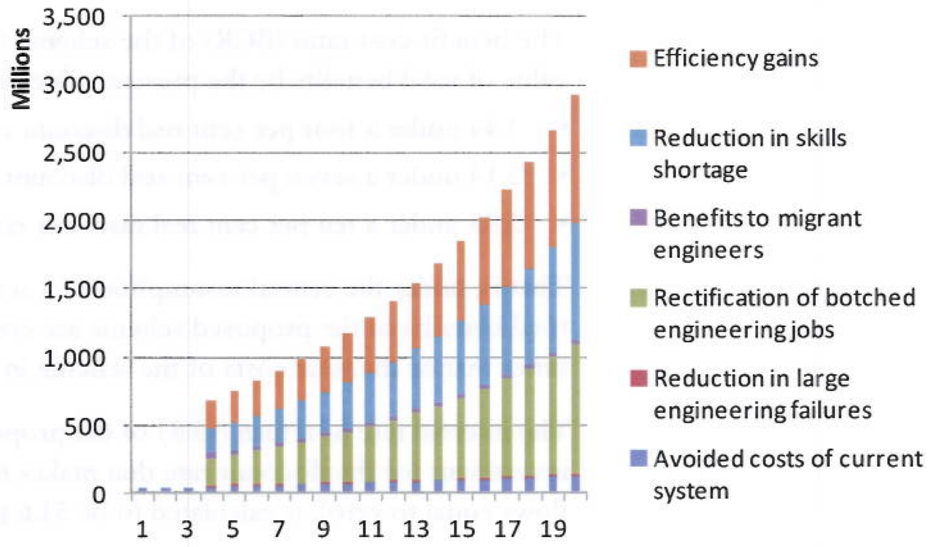
The proposed national registration system would also ensure existing Australian engineers have mobility of trade. The increased portability of the profession across jurisdictions would allow professional labour to flow freely across state/territory borders and respond to demand without having to comply with the different requirements in each jurisdiction.

Assuming that the national registration system would lead to an efficiency gain of 0.25 per cent, based on the current value of engineering construction projects, such benefits would amount to **$207.60 million per annum**.

Cost-benefit analysis

The projected benefits of the proposed national registration scheme over the 20-year time horizon of the cost-benefit analysis are shown in Figure ES 3.

Figure ES 3 **Annual benefits of the proposed national registration scheme, Year 1 to Year 20**



Data source: ACIL Tasman

The total estimated annual benefits of the proposed scheme is projected to be between $32.2 to $39.8 million in the first three years, jumping to $687.1 million in Year 4 when the scheme becomes fully operational and then rising progressively to $2.93 billion in Year 20 due to assumption that the value of engineering construction projects will be rising by ten per cent per annum in real terms.

Over the 20-year time horizon of the cost-benefit analysis, the present value of the total benefits of the proposed national registration scheme is:

- $15.59 billion under a four per cent real discount rate
- $10.83 billion under a seven per cent real discount rate
- $7.74 billion under a ten per cent real discount rate.

Over the 20-year time horizon of the cost-benefit analysis, the present value of the total costs of the proposed national registration scheme, including the opportunity cost of undertaking mandatory CPD is:

- $4.53 billion under a four per cent real discount rate
- $3.45 billion under a seven per cent real discount rate
- $2.71 billion under a ten per cent real discount rate.

Key results of the cost-benefit analysis

Combining the present value of these total costs and total benefits associated with the proposed national registration scheme, the net present value of the scheme is estimated to be:

- $11.06 billion under a four per cent real discount rate
- $7.38 billion under a seven per cent real discount rate
- $5.03 billion under a ten per cent real discount rate.

The benefit-cost ratio (BCR) of the scheme (obtained by dividing the present value of total benefits by the present value of total costs) is:

- 3.44 under a four per cent real discount rate
- 3.14 under a seven per cent real discount rate
- 2.85 under a ten per cent real discount rate.

That is, under the central assumption of a seven per cent real discount rate, the total benefits of the proposed scheme are estimated to be more than three times that of the total costs of the scheme in present value terms.

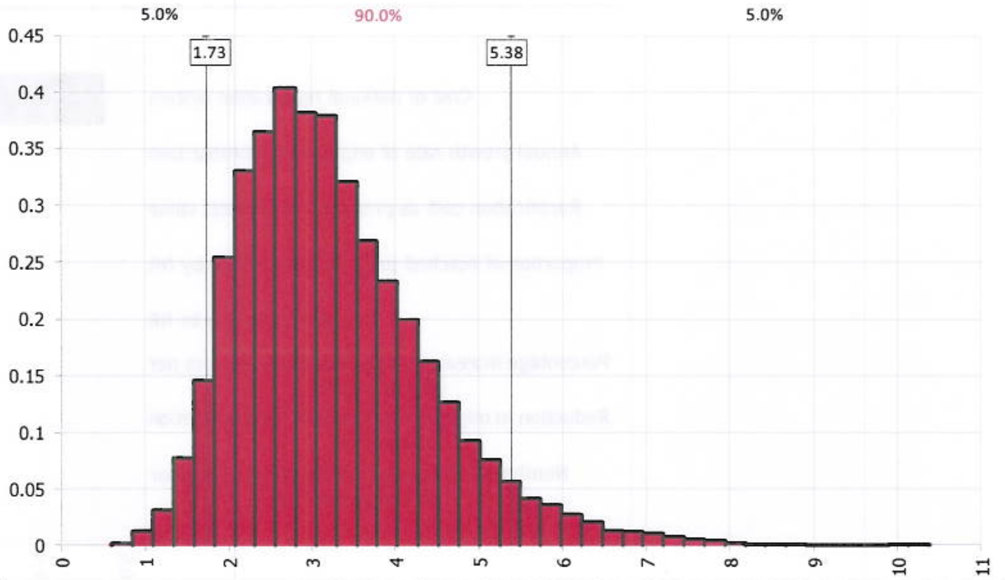
The internal rate of return (IRR) of the proposed scheme, the yield on the investment (or the discount rate that makes the net present value of all cash flows equal to zero), is calculated to be **51.6 per cent**.

Sensitivity analysis using Monte Carlo techniques

To test the robustness of the cost-benefit analysis results and recognising that they may be highly sensitive to assumed parameter values, ACIL Tasman undertook sensitivity analysis using Monte Carlo simulations.

Based on the chosen statistical distributions for the key parameters, ACIL Tasman generated a 90 per cent confidence interval around the central estimate of the BCR (which, as reported previously, was 3.14 under a seven per cent real discount rate). After 10,000 iterations, the 90 per cent confidence interval was found to be (1.73, 5.38), as can be seen in Figure ES 4. That is, there is a 90 per cent probability that the 'true' BCR lies within this interval.

Figure ES 4 **90% confidence interval for BCR**



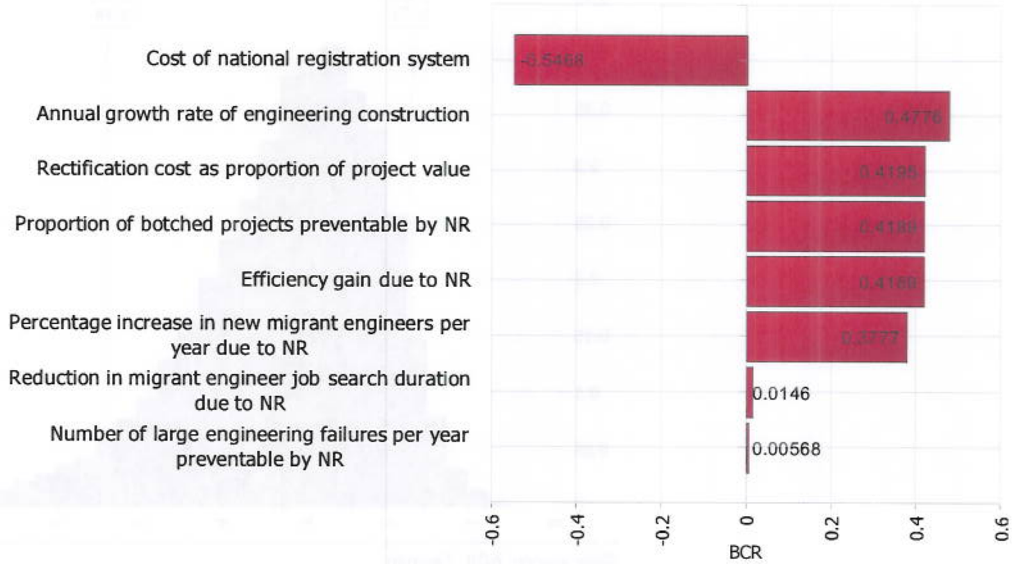
Data source: ACIL Tasman

In addition, ACIL Tasman generated Tornado diagrams that illustrate that relative importance of each assumption in determining the BCR (and hence the economic viability) of the proposed scheme.

As can be seen in Figure ES 5, the key assumptions in decreasing order of importance are:

- present value of cost of national registration scheme
- annual growth rate of engineering construction
- rectification cost of botched jobs as proportion of project value
- efficiency gain due to national registration
- proportion of botched projects preventable by national registration
- percentage increase in new migrant engineers per year due to national registration
- reduction in migrant engineer job search duration due to national registration
- number of large engineering failures per year preventable by national registration.

Figure ES 5 **Tornado diagram illustrating the impact of key assumptions on BCR**



Data source: ACIL Tasman

1 Introduction

ACIL Tasman was commissioned by Engineers Australia, Consult Australia, the Association of Professional Engineers, Scientists & Managers, Australia (APESMA) and the Institute of Public Works Engineering Australia (IPWEA) to undertake an economic analysis of the case for the national registration of engineers in Australia. This report revises cost estimates and the cost benefit analysis undertaken in our earlier report, released in December 2011. The costs reported in this revision, amongst other things, reflect the process re-engineering currently being undertaken by Engineers Australia, which aims to minimise respondent burden. This process will see significant reductions in the time taken by engineers to prepare evidence of competence when applying for CPEng status and to report continuing professional development activities.

1.1 Background and context

There is currently no uniform regulatory regime covering engineers in Australia. As a result, engineering services in Australia are regulated by different Acts, by-laws and orders-in-council in the various states and territories. While less regulation is generally seen by industries as better, in the engineering profession there is some concern that the lack of uniform regulation is providing inadequate protection for consumers and the community at large, and negatively impacting on productivity and efficiency.

Engineers Australia, Consult Australia, APESMA and IPWEA have recognised a need for uniform regulation of engineers in Australia, with national registration being a starting point. These entities believe that a national scheme will drive efficiencies for the system as well as employers, and improve productivity for engineers. Flow-on benefits could also include consumer protection; public safety, health and welfare; the introduction of performance standards for engineers; and the facilitation of international mobility.

The preferred model for the statutory registration of engineers incorporates: a nationally consistent *Engineers Act* introduced in each jurisdiction with seamless inter-jurisdictional recognition governing the registration of professional engineers; jurisdiction run boards that would approve assessment schemes and authorise assessment entities.

The proponents believe that comprehensive economic analysis and modelling to identify costs and benefits, including those that go beyond the profession and the regulatory framework, will provide quantitative economic arguments to substantiate the case for national registration.

1.2 Study approach

ACIL Tasman undertook extensive consultations with a range of stakeholders to obtain information and data on the costs of the current system and the proposed national registration systems, as well as the potential benefits of the new system. The stakeholders included representatives from the proponent organisations, administrators of the current systems in various states and territories, as well as several engineering firms (some of which operate across a number of jurisdictions). The list of stakeholders consulted by ACIL Tasman is shown in Table 1.

Table 1 **Stakeholders consulted**

Stakeholder	Organisation / company	Jurisdiction
Michael Bevan	Engineers Australia	National
Rolfe Hartley	National Engineering Registration Board	National
Rupert Grayston	Engineers Australia	National
Andre Kaspura	Engineers Australia	National
David Robinson	Engineers Australia	National
Navchaa Tumurbaatar	Engineers Australia	National
Jonathan Russell	Consult Australia	National
Megan Motto	Consult Australia	National
Clare Murray	Registrar Board of Professional Engineers of Queensland	QLD
Jamie Shelton	Northrop Engineers	NSW, Vic, ACT, QLD, WA
Risden Knightly	RJK Consulting Engineers	Tas
Gerry Doyle	Tonkin Consulting	SA, NT
Philip Verco	Aecom	National
Nicholas Bonner	Bonner Engineering	WA, Tas
Mike Marley	Golder Associates	QLD
David Silcox	Sinclair Knight Merz	National
Don Freeman	Department of Planning and Local Government	SA
David Abbott	Institute of Public Works Engineering Australia	National
Ashley Van Krieken	AusIMM	National
Brendon Bowes	Workplace Standards Tasmania, Department of Justice	Tas
Peter Russell	Sitzler Pty Ltd	NT
Neil Cocks	Building Professional Board	NSW
Jane Valance	Building Commission	WA
Craig Simmons	Planning and Land Authority	ACT
Andy Sharrad	Institution of Fire Engineers, Australia	National
Barry Seager	Raytheon	National
Andrew McMahon	NSW Mining Council	NSW
Julie Dalton	Building Practitioners Board, Building Commission, Victoria	Vic

Using the information collected in the course of the stakeholder consultations coupled with data from other relevant sources, ACIL Tasman then undertook a cost-benefit analysis. The robustness of the key results was tested through sensitivity analysis using Monte Carlo techniques.

1.3 Report structure

This report is structured as follows:

- Chapter 2 presents a profile of the engineering sector in Australia
- Chapter 3 describes the current registration and accreditation schemes operating in the various states and territories
- Chapter 4 discusses the economic basis of the proposed national registration scheme
- Chapter 5 outlines the key features of the proposed scheme and stakeholder views on its potential benefits and costs
- Chapter 6 quantifies the cost of the current system in the various states and territories and presents estimates of the likely costs of the proposed national registration scheme for administrators and engineers
- Chapter 7 quantifies some of the major economic benefits of the proposed national registration scheme in addition to the avoided costs enabled by the scheme
- Chapter 8 discusses the key results of the cost-benefit analysis undertaken by ACIL Tasman.

2 A profile of the engineering sector in Australia

2.1 Defining an engineer

An engineer's job is to plan, design and implement projects ranging from the smallest consumer item to the largest of industrial processes. Engineers require specialised skills and knowledge, in particular having a solid grounding in mathematics and science. Engineers undergo a lengthy period of study and practical training in order to practice. Engineers also have a responsibility to uphold standards in ethics, rigour and robustness of design, rational thinking, and most importantly, public safety[2].

Engineers can be categorised into three groups:

1. professional engineers who have completed a four year (full time) bachelor degree in engineering
2. engineering technologists who have completed a three year (full time) bachelor degree in engineering
3. engineering associates who have completed a two year (full time) associate degree in engineering, or a two year (full time) diploma or advanced diploma in engineering from university or TAFE college.

The first group of professional engineers is the focus of the proposed national mandatory registration scheme.

2.2 Professional engineers

According to Engineers Australia, professional engineers are required to take responsibility for engineering projects and programs in the most far-reaching sense. This includes the reliable functioning of all materials, components, sub-systems and technologies used; their integration to form a complete, sustainable and self-consistent system; and all interactions between the technical system and the context within which it functions. The latter includes:

- understanding the requirements of clients, wide ranging stakeholders and of society as a whole
- working to optimise social, environmental and economic outcomes over the full lifetime of the engineering product or program
- interacting effectively with other disciplines, professions and people

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[2] WA Government and Engineers Australia (WA), *Discussion Paper: The Regulation of Engineers in Western Australia*, 2009, p.9.

- ensuring that the engineering contribution is properly integrated into the totality of the undertaking.

Professional engineers are responsible for interpreting technological possibilities to society, business and government. They are also responsible for ensuring, as far as possible, that policy decisions are properly informed by such possibilities and consequences and that the costs, risks and limitations are properly understood as the desirable outcomes.

Professional engineers are responsible for bringing knowledge to bear from multiple sources to develop solutions to complex problems and issues. They are also responsible for ensuring that technical and non-technical considerations are properly integrated, and for managing risk as well as sustainability issues.

While the outcomes of engineering have physical forms, the work of professional engineers is predominantly intellectual in nature. In a technical sense, professional engineers are primarily concerned with the advancement of technologies and with the development of new technologies and their applications through innovation, creativity and change. Professional engineers may conduct research concerned with advancing the science of engineering and with developing new principles and technologies within a broad engineering discipline. Alternatively, they may contribute to continual improvement in the practice of engineering, and in devising and updating the codes and standards that govern it.

Professional engineers have a particular responsibility for ensuring that all aspects of a project are soundly based in theory and fundamental principle, and for understanding clearly how new developments relate to established practice and experience, and to other disciplines with which they may interact. One hallmark of a professional is the capacity to break new ground in an informed, responsible and sustainable fashion.

Professional engineers may lead or manage teams appropriate to these activities, and may establish their own companies or move into senior management roles in engineering and related enterprises.

2.2.1 Levels of professional engineering

APESMA categorises professional engineers into the following five levels:

- **Level 1 Professional Engineer**; this is the graduate engineer entry level. The engineer undertakes engineering tasks of limited scope and complexity in offices, plants, in the field or in laboratories under the supervision of more senior engineers.

- **Level 2 Professional Engineer**; this level recognizes the experience and competence gained as a Level 1 Engineer. At this level engineers have greater independence and less supervision, but guidance on unusual features is provided by engineers with more substantial experience.
- **Level 3 Professional Engineer**; this level requires the application of mature engineering knowledge with scope for individual accomplishment and problem solving that require modification of established guides. Original contributions to engineering approaches and techniques are common. This level outlines and assigns work, reviews it for technical accuracy and adequacy and may plan, direct, coordinate and supervise other professional and technical staff.
- **Level 4 Professional Engineers**; this level requires considerable independence in approach with a high degree of originality, ingenuity and judgment. Positions' responsibilities often include independent decisions on engineering policies and procedures for overall programs, provision of technical advice to management, detailed technical responsibility for product development and the provision of specialized engineering systems and facilities and the coordination of work programs, administrative function, directing several professional and other groups engaged inter-related engineering responsibilities or as an engineering consultant. This level independently conceives programs and problems to be investigated and participates in their resolution within existing organizational operating and management arrangements. Typical reporting line is to senior management.
- **Above Level 5 Professional Engineer**; this level is predominantly engineering senior management positions including, Managing Director, Chief Executive Officer and Group General Manager[3]

2.3 Number of engineers

There is no accurate information on the number of engineers in Australia. In terms of this project, it is therefore difficult to estimate the number of engineers that would be directly affected by national registration. As a result, we have considered two approaches to obtain the best estimate of the number of engineers. The first is by using estimates of the engineering labour force. The second is by considering those individuals with qualifications in engineering who are working in engineering jobs.

2.3.1 Number of engineers based on the engineering labour force

The engineering population is a sub-set of the Australian population holding some form of tertiary (or similar) qualification in engineering, for example bachelors, diploma, post graduate or under graduate. The engineering labour

[3] Kaspura, Andre, *The Engineering Profession: A Statistical Overview, Eighth Edition, 2011*, 2011.

force is the engineering population divided into those that are employed or that are unemployed but actively seeking work.

In 2006 (i.e. the last year for which Census data from the Australian Bureau of Statistics [ABS] is available) there were 304,988 people in the engineering population. Of these, 249,755 were in the engineering labour force, implying that 55,233 were not in the engineering labour force[4].

Kaspura notes that while the engineering labour force provides the base count of those with formal educational qualifications in engineering, it does include individuals in both engineering work and generic non-engineering work. For example, this count does not separate out an individual with an engineering degree that chooses to work in an unrelated profession such as teaching, and an individual with an engineering degree that works, for example, as a civil engineer. This is a significant limitation on this estimate.

2.3.2 Number of engineers based on engineering skills applied in engineering jobs

An estimation of the number of engineers can also be determined through a count of those individuals formally qualified as an engineer and who work in recognised engineering jobs.

In 2006, 142,803 individuals in the engineering labour force were employed across 51 engineering occupations, with the remaining 99,586 employed in non-engineering occupations. The remaining 7,366 were unemployed[5].

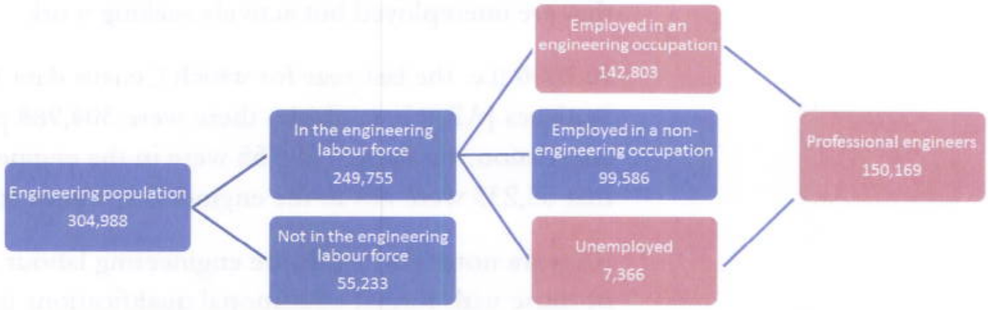
Given this data distinguishes between qualified engineers working in engineering jobs (or unemployed but looking for work) and qualified engineers working in unrelated jobs, we use it to find a best estimate of the number of practicing engineers.

We estimate the number of practicing engineers to be the 142,803 individuals in the engineering labour force that are employed in engineering occupations plus the 7,366 individuals in the engineering labour force that are unemployed. This makes the number of practicing engineers in Australia 150,169 in 2006. This estimate has been used in our analysis of the costs of a national registration system.

[4] Kaspura, Andre, *The Engineering Profession: A Statistical Overview, Eighth Edition, 2011*, 2011.

[5] Ibid.

Figure 1 **Estimating the number of practicing engineers in Australia**



Data source: Kaspura, The Engineering Profession: A Statistical Overview, Eighth Edition, 2011, 2011.

Of the estimated 150,169 practicing engineers, just under 90 per cent are located in NSW, Victoria, Queensland and Western Australia (Table 2).

Table 2 **Number of engineers in each jurisdiction**

	NT	TAS	ACT	SA	WA	QLD	VIC	NSW	Australia
Engineering population	2,107	4,674	5,919	19,583	32,557	50,764	84,502	104,882	304,988
In the engineering labour force	1,931	3,465	4,806	15,591	27,366	41,573	69,184	85,839	249,755
Employed in an engineering occupation	*1,125*	*2,063*	*3,054*	*9,305*	*17,883*	*25,277*	*37,806*	*46,290*	*142,803*
Employed in a non-engineering occupation	*790*	*1,303*	*1,657*	*5,769*	*8,940*	*15,381*	*28,987*	*36,759*	*99,586*
Unemployed	*16*	*99*	*95*	*517*	*543*	*915*	*2,391*	*2,790*	*7,366*
Not in the engineering labour force	176	1,209	1,113	3,992	5,191	9,191	15,318	19,043	55,233
Practicing engineers	**1,141**	**2,162**	**3,149**	**9,822**	**18,426**	**26,192**	**40,197**	**49,080**	**150,169**
Proportion of practicing engineers	**0.76**	**1.44**	**2.10**	**6.54**	**12.27**	**17.44**	**26.77**	**32.68**	**100.0**

Data source: *Kaspura, The Engineering Profession: A Statistical Overview, Eighth Edition, 2011, 2011*– reports for ACT, NT, Tasmania, SA, WA, Queensland, Victoria and NSW.

2.3.3 Migrant engineers

The principles of engineering knowledge mean that it is possible to transfer skills and qualifications to other countries. For this reason, there are a significant proportion of engineers in Australia that were born (and potentially educated) overseas. Around 41 per cent of the practicing engineers working in Australia are migrants (see Table 3).

Table 3 **Migrant engineers in Australia**

	Born in Australia	Born overseas	% born overseas
Engineering population	304,988	140,312	46.0
In the engineering labour force	249,755	112,086	44.9
Employed in an engineering occupation	142,803	56,515	39.6
Employed in a non-engineering occupation	99,586	50,700	50.9
Unemployed	7,366	4,871	66.1
Practicing engineers	150,169	61,386	40.9
Not in the engineering labour force	55,233	28,226	51.1

Data source: (Kaspura, The Engineering Profession: A Statistical Overview, Eighth Edition, 2011, 2011)

2.4 Other characteristics of engineers in Australia

2.4.1 Industry and specialisation distribution

The 'Professional, Scientific and Technical Services' sector engages the majority of engineers – 48,454 in 2006 (20 per cent of the engineering labour force) – with 'Manufacturing' the second largest employer of engineers with 47,129 (19.4 per cent). 'Public Administration and Safety' is third, employing 22,696 engineers (9.4 per cent).

In terms of the specializations of engineers, 103,434 had 'engineering and related specializations' (42.6 per cent of the engineering labour force), 53,399 had 'electrical and electronic' specializations (22 per cent) and 21,946 had 'civil' specializations (9.1 per cent).[6]

2.4.2 Remuneration

Engineering is a relatively well paying profession for both established and graduate levels, with significant differences depending on whether the engineer is employed in the public or private sector; particularly for the higher level engineers (see Table 4 and Table 5)

Supervision responsibilities commence at Level 3, with engineers at higher levels taking on progressively more responsibility.

[6] Ibid.

Table 4 **Average salary packages for engineers in the public sector**

Year	Level 1	Level 2	Level 3	Level 4	Level 5	> Level 5
1997	41,012	52,668	63,498	74,444	93,957	135,549
1998	42,777	55,215	66,707	78,010	97,719	131,238
1999	45,360	57,365	68,995	80,465	120,879	145,035
2000	46,631	63,423	73,361	88,824	103,265	181,818
2001	53,055	65,426	76,451	91,863	110,276	162,933
2002	54,373	68,744	78,240	95,105	114,067	152,316
2003	54,606	69,536	79,941	99,881	118,755	154,710
2004	54,599	70,524	79,676	100,533	119,385	156,599
2005	58,287	74,843	83,329	107,197	122,616	174,749
2006	63,285	84,328	91,844	111,052	133,185	192,196
2007	63,535	85,384	98,664	118,833	142,997	176,529
2008	70,754	88,651	103,325	125,394	151,387	198,850
2009	71,571	95,034	110,307	132,450	159,729	228,699
2010	83,200	94,878	113,198	139,449	165,396	222,321
% change between 1997 and 2010	103%	80%	78%	87%	76%	64%

Data source: Kaspura, The Engineering Profession: A Statistical Overview, Eighth Edition, 2011, 2011, p. 67.

Table 5 **Average salary packages for engineers in the private sector**

Year	Level 1	Level 2	Level 3	Level 4	Level 5	> Level 5
1997	40,748	55,639	66,767	78,707	105,095	150,965
1998	43,454	54,360	67,673	83,663	107,593	155,598
1999	44,071	56,030	70,124	87,675	109,068	149,836
2000	48,081	60,897	74,765	95,275	114,206	187,468
2001	51,503	60,484	75,707	97,547	115,901	173,646
2002	50,597	64,995	81,192	106,729	120,076	181,688
2003	51,455	65,438	80,574	103,891	127,149	181,468
2004	53,277	64,989	81,045	108,929	125,415	192,623
2005	56,757	71,121	84,590	113,328	131,810	219,408
2006	60,006	77,148	96,671	129,719	157,797	224,784
2007	66,098	80,726	103,971	136,672	173,580	267,480
2008	69,684	92,838	112,678	150,957	183,428	263,493
2009	76,717	89,658	116,856	154,179	199,355	248,915
2010	74,359	95,562	122,389	163,535	224,035	300,165
% change between 1997 and 2010	82%	72%	83%	108%	113%	99%

Data source: Kaspura, The Engineering Profession: A Statistical Overview, Eighth Edition, 2011, 2011, p. 67.

3 Current jurisdiction registration and accreditation schemes

The following sections summarise some key aspects of the registration/accreditation arrangements adopted by Australia's state and territory governments, with a tabulated comparison on the main features in Table 6. Appendix A provides additional background on the arrangements in these jurisdictions.

As the Queensland model is in many respects similar to the preferred model for the national scheme, it receives greater focus in Section 3.2. In addition section 3.3 describes Australia's national voluntary registration arrangements.

3.1 Comparing current state and territory schemes

There is currently no uniform registration or licencing regime covering engineers in Australia. In the eight states and territories the regulation/accreditation of engineers covers a broad spectrum from:

- no registration or licensing provisions for engineers in South Australia and Western Australia
- to the accreditation of engineers who are certifiers in certain aspects of the building industry in New South Wales, Victoria, Tasmania, the Australian Capital Territory (ACT) and the Northern Territory
- to the mandatory registration of all supervising engineers in Queensland.

3.1.1 Disciplines and coverage

Most schemes operate through the jurisdiction's relevant building practitioner board and, consequently, are related mostly to engineers involved in building practices. Queensland is the only state with mandatory registration of engineers across all disciplines. That said, while registration is mandatory across all disciplines, it only applies to supervising engineers – unregistered engineers must work under the supervision of a registered engineers. NSW regulates its mining engineers separately with registration overseen by relevant competency boards.

Table 6 **Summary of Australia's current arrangements for the regulation or accreditation of engineers**

	Active scheme for engineers	Regulator	Disciplines requiring regulation	Coverage within discipline	NPER recognised in application for state scheme	Requirement for CPD	Estimated number of registered or accredited engineers (2010-11)
NSW	Yes	Building Professionals Board	Building	Accredited certifiers for various building and infrastructure	Yes	Accredited certifiers must undertake two courses that are approved by the NSW Board	150
	Other related regulation	Mining competency Boards	Mining	Electrical engineer manager, mechanical engineer manager, mine manager. ventilation officer	No	No	Unknown
Vic	Yes	Building Practitioners Board	Building	Civil (incl. structural), mechanical (incl. hydraulics), electrical, fire safety	Yes	The Board encourages CPD, but participation is voluntary	1,892
QLD	Yes	Board of Professional Engineers of Queensland	All	All supervising engineers	Yes	The Board has aligned its CPD policy with those of approved assessment entities	7,818 (as at 7/10/11) 7,619 (as at 30/06/11)
Tasmania	Yes	Building Control Branch of Workplace Standards	Building	Building designers, including engineers.	Yes	Undertake 30 hours each year (for each category an engineer is registered under).	300
NT	Yes	Building Practitioners Board	Building	Certifying engineers - hydraulic, mechanical and structural	Yes	The Board encourages registered practitioners to embark on a program of activity, but participation is voluntary	132
SA	No	n/a	n/a	n/a	n/a	n/a	n/a
WA	No	n/a	n/a	n/a	n/a	n/a	n/a
ACT	Yes	Building, Electrical & Plumbing Control Section	Building	Accredited certifiers for Principal Building Surveyor and Plumbing Plan Certifier	Yes	n/a	No engineers currently registered

Note: Data source: Various regulator websites, annual reports and personal communications.

3.1.1 Recognition of National Professional Engineers Register

In all jurisdictions that have some form of registration or accreditation scheme, an engineer's registration on the National Professional Engineers Register (NPER)[7] is recognised during the application process and replaces the need to provide certain pieces of evidence of experience. If an engineer is seeking registration in a jurisdiction's scheme and is not on the NPER, then they are required to provide other pieces of evidence to prove their claims.

3.1.2 Continuing professional development (CPD)

The requirement to continue professional development to remain registered varies across jurisdictions. In NSW, accredited engineers are required to attend two approved courses. In Queensland, registered engineers are required to undertake the CPD requirements of the assessment entities (i.e. EA, AusIMM or IFE). In Tasmania, registered engineers must undertake 30 hours of CPD for each field they are registered in. In the NT, registered engineers are required to undertake an unspecified amount of CPD activity. In Victoria, CPD is encouraged but remains voluntary.

3.2 The Queensland scheme

The Queensland mandatory registration system is legislated by the *Professional* Engineers Act 2002 (as amended) (the *Engineers Act*) and accompanying regulations. The legislation is administered by the Board of Professional Engineers of Queensland (BPEQ).

Under the Queensland legislation, professional engineers providing professional engineering services in Queensland must have Registered Professional Engineers of Queensland (RPEQ) status. However, it is not mandatory for engineers to register *if they practise in Queensland under the supervision of registered professional engineers that are registered in the same area of engineering*. In other words, supervised engineers may voluntarily register but their registration in these circumstances is not mandatory.

3.2.1 Number of registered engineers

As at 7 October 2011, there were 7,818 engineers with RPEQ status, with registration numbers growing progressively over the last few years. The BPEQ reports that in June 2011 there were 7,619 registrations, up from 6,588 the previous year (see Table 7).

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7 The NPER is a national register administered by the NERB. This register is discussed in detail in Section 3.4).

Table 7 **RPEQ registration activity**

	2006-07	2007-08	2008-09	2009-10	2010-11
New Registrations	534	742	742	547	954
Reinstatement	220	303	269	220	159
Disqualification				-1	0
Removals	-533	-547	-470	-511	-82
Total registrations as at 30 June 2011	5,294	5,792	6,333	6,588	7,619

Data source: BPEQ Annual Reports, 2010-22 and 2009-10.

Registered engineers living outside Queensland

The *Engineers Act* requires that all supervising engineers working in Queensland or working on equipment, machinery, etc., that will later be used in Queensland must have RPEQ status. As a consequence of this requirement, a number of the 7,818 registered engineers reside outside of the state and in some cases outside Australia. The BPEQ's database indicates that as at 7 October 2011, there were 1,506 registered engineers (nearly 20 per cent) that reside in other Australian states or territories.

Engineers Australia has advised ACIL Tasman that in the last year, the rate of applications for RPEQ from engineers residing outside of Queensland has increased. Engineers Australia estimates that at this point in time, some 40 per cent of RPEQ applicants reside outside of the state.

Table 8 **RPEQ engineers residing in other Australia jurisdictions, 7 October 2011**

State of residence	Number of RPEQ engineers
NSW	696
VIC	447
SA	95
WA	180
TAS	41
NT	22
ACT	25
Total	**1,506**

Data source: BPEQ personal communication

3.2.2 Registration across disciplines

Civil engineering is the most common engineering capability for RPEQ holders, with 4,320 engineers registering this capability. Mechanical engineering (1,332 engineers) followed by electrical engineering (1,259 engineers) are the next most common capabilities registered (see Table 9).

Table 9 **Engineers registered in each discipline, 7 October 2011**

Discipline	Number of RPEQ engineers
Aeronautical	9
Aerospace	17
Agricultural	26
Biomedical	3
Building Services	53
Chemical	285
Civil	4,320
Computer Systems	38
Electrical	1,259
Environmental	44
Fire Engineering	7
Fire Safety	37
Geological/Geotechnical	48
Heritage and Conservation	0
ITEE	53
Amusement Rides & Devices	1
Management	28
Mechanical	1,332
Metallurgical	54
Mining	176
Naval Architecture	10
Pressure Equip Design Verifier	5
Structural	363
Subdivisional Geotechnics	9
Total	**8,177**

Data source: BPEQ personal communication

The number of engineers registered in some of Queensland's major industry sectors is surprisingly low. For example, 176 engineers have registered in the mining discipline which, given the size of the mining sector in Queensland, seems low. Similarly only 26 have registered in aeronautical or aerospace disciplines, which are traditionally considered strong industries in Queensland.

We have been advised by the BPEQ that it does not have the authority under The *Engineers Act* to check registration arrangements of supervising engineers working on site. Such a practice is carried out by the Queensland Building Service Authority, which has the power to enter a workplace and check trade persons' licences. Thus registration while technically mandatory would appear to be avoidable. We have been further advised that the Board is working to increase registrations, particularly in the mining sector. If all engineers who technically should be registered were registered in Queensland, it has been estimated that the number of engineers with RPEQ status could be as high as 12,000 (or around 4,000 more than currently registered).

3.2.3 RPEQ assessment

Under the Queensland legislation, entities representing the interests of professional engineers can apply to the BPEQ for approval to assess applications for registration in their relevant disciplines. At the time of writing, the entities approved to carry out RPEQ assessments are:

- Engineers Australia (appointed 1 July 2008)
- Australasian Institute of Mining and Metallurgy (AusIMM) (appointed 1 July 2008)
- Institution of Fire Engineers, Australia (IFE) which is the international qualifying organisation and learned society for fire engineering, fire fighting and fire safety professionals (appointed 1 February 2010).

Of these three entities, Engineers Australia deals with the majority of applications. For example, in the 12 months to 31 March 2011, Engineers Australia assessed 851 RPEQ applications, whereas AusIMM assessed 97 RPEQ applications in 2010 and expects to assess around 127 in 2011. IFE assessed nine applications in 2010 and expects to assess 12 applications in 2011.

Engineers Australia's assessment process involves confirming that the RPEQ applicant has achieved Chartered Professional Engineer (CPEng) status and/or is registered on the NPER[8]. For those applicants who are not CPEng or NPER registered, an assessment is undertaken that mirrors the assessment process required for NPER registration.

In the case of AusIMM, assessment of an RPEQ application involves (among other things) confirming that the applicant has a four year engineering degree and relevant experience. This is because AusIMM's Chartered Professional (CP) membership is available to a range of professions with three year degrees rather than the four year degree engineers qualification required for RPEQ status.

The applicant for RPEQ is required to pay the fees charged by the approved entity. For example:

- EA's fees are:
  - No charge if the applicant is a CPEng or NPER registered
  - $605 if the applicant is not a CPEng or NPER and does not wish to become an EA member or register on the NPER

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8 More information on CPEng and the NPER can be found in Section 3.4.

- AusIMM the fees are:
  - If the applicant is an AusIMM CP $220 for assessment
  - If the applicant is a member of AusIMM but not a CP $385
  - If the applicant is not a member of AusIMM $420 (this fee could cover new membership of AusIMM, CP and RPEQ application)

3.2.4 Complaints against engineers

The Queensland legislation also provides a process for individuals and entities that are aggrieved by the conduct of a registered professional engineer to lodge a complaint about that engineer's professional conduct.

BPEQ advised ACIL Tasman that there were:

- 36 complaints in 2010-11
  - of these three were cautioned, and another three were disciplined and court proceedings took place.
- 39 complaints in 2009-10
  - of these three were cautioned, and one complaint resulted in court proceedings and disciplinary actions.

In its 2009-10 Annual Report the BPEQ indicated that of the 39 complaints received in that year, 25 related to the conduct of an engineer with RPEQ status, while another 14 related to unregistered engineers. Of these complaints:

- 14 were investigated
- 14 were dismissed
- 11 were undecided.[9]

3.2.5 BPEQ business model

The *Engineers Act* requires that all costs incurred by the Queensland Government in the registration of engineers must be covered by the fees levied on registrants. In the financial year ending 30 June 2010, the BPEQ's income was $1,240,417, with the surplus after expenses only $162,481.

3.3 Voluntary registration with national entities

While there is currently no national mandatory scheme for the registration of engineers, there are a number of voluntary registration and accreditation arrangements in Australia. These voluntary schemes are operated by engineering associations (who also provide assessment services to the BPEQ), specifically:

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[9] BPEQ, *Annual Report 2009-10.*

- Engineers Australia, which offers its suitability qualified members accreditation as a CPEng, and offers qualifying members and non-members registration on the NPER.
- AusIMM, which offers its members a CP program that provides formal recognition of qualified, experienced members who actively engage in CPD. The CP accreditation is open to engineers and other professional members working in the mining industry.
- IFE, offers its suitably qualified members a pathway qualification as a Chartered Engineer (CEng).

We understand that there are a number of other engineering associations active in Australia and many of these have mutual recognition agreements with Engineers Australia.

The qualifications and competencies necessary to achieve accreditation or registration under these voluntary schemes also vary.

3.4 CPEng and registration on the NPER

Although there is no uniform mandatory registration across Australia, a voluntary national registration is in place under supervision of the National Engineering Registration Board (NERB). The NERB was established jointly by Engineers Australia, Consult Australia and APESMA.

Linked with this, Engineers Australia administers three National Engineering Registers that engineering practitioners can be registered on:

1. National Professional Engineers Register (NPER) for professional engineers
2. National Engineering Technologists Register (NETR) for engineering technologists
3. National Engineering Associates Register (NEAR) for engineering associates.

An applicant for registration must meet the Australian Engineering Competency Standards which consists of two stages. The competency standards at Stage 1 assess an applicant's qualifications whereas the competency standards at Stage 2 assess an engineering practitioner's ability to work unsupervised, independently or under general direction (see Box).

Registration on the NPER is linked to obtaining Chartered Status. In most instances, to become registered on the NPER engineers who are members of Engineers Australia must first complete the requirements for competency based assessments for Chartered Status (i.e. they must complete the CPEng).

In terms of Stage 1 and Stage 2, CPEng is Stage 2 – it is considered the 'next step' in developing an engineer's career, with the first step being academic qualifications (Stage 1). In addition to demonstrating that an engineer can work with little or no supervision, CPEng also recognises that an engineer's CPD is essential to maintaining knowledge once formal education is completed.

Box 1 **Professional engineering competencies**

Engineers Australia, on behalf of the profession, sets and assesses competencies to become a professional engineer at two stages. *The Australian Engineering Competency Standards at Stage 1 and Stage 2* are published on Engineers Australia's web site.

Stage 1

Broadly speaking, Stage 1 competencies are obtained at the tertiary level. The benchmark Stage 1 qualification for a professional engineer is the four year Bachelor of Engineering degree.

The Stage 1 competencies represent the profession's expression of the knowledge and skill base, engineering application abilities, and professional skills, values and attitudes that must be demonstrated at the point of entry to practice.

Suggested indicators of attainment provide insight to the breadth and depth of ability expected for each element of competency at Stage 1 and thus guides the competency demonstration and assessment processes as well as curriculum design. Each element of competency is tested in a holistic sense, with the expectation that additional indicator statements could complement those listed in the standard.

The Stage 1 competency standards form the basis of Engineers Australia's accreditation system that is used to accredit engineering programs taught at Australian Universities and other educational providers.

Stage 2

Stage 2 represent the profession's expression of the knowledge and skill base, engineering application abilities, and professional skills, values and attitudes that must be demonstrated in order to practise independently or unsupervised.

To meet the minimum standard of Stage 2 competence, a person must demonstrate that he/she is able to practice competently in his/her practice area to the standard expected of a reasonable professional engineer. The demonstration of competence is through peer review against the background of good engineering practice. Professional competence integrates knowledge, understanding, skills and values. It goes beyond the ability to perform specific tasks. It is the culmination of formal education, further training and supervised experience.

A professional engineer who is assessed by Engineers Australia as meeting the Stage 2 competencies is recognised as a Chartered Professional Engineer (CPEng).

Source: Engineers Australia

3.4.1 Competency based assessments for CPEng

There are eight key steps in preparing a competency based assessment for CPEng. These steps are outlined in Figure 2. We note that the majority of the work required for the assessment is undertaken in Steps 3 and 4 – completion and compilation of multiple Career Episode Reports (CERs) into an

Engineering Practice Report (EPR). The number of CERs required for a complete EPR varies in line with how many competencies can by claimed in one CER. Irrespective of the number of reports, the collection of CERs must provide evidence against 17 compulsory elements and two elective elements.

Figure 2 **Steps in preparing a competency based assessment**

Step 1
- Financial member or eligible to become a financial member of EA
- Have at least three years engineering experience

Step 2
- Determine occupation status (i.e. CPEng, CEngT or CEngO)

Step 3
- Write Career Episode Reports (CERs) which provide evidence of competency against 17 compulsory elements[a] and two elective units[b].

Step 4
- Link CERs together to form an Engineering Practice Report (EPR)

Step 5
- Verify CERs with a senior experienced engineer from the same occupational category in which Chartered Status is sought

Step 6
- Compile relevent documentation including application form, certified photo, certified true copy of appropriate identification, a verified CV, details of continuing professional development and payment of assessment fee

Step 7
- Submit relevant documentation

Step 8
- Attend a professional interview

[a] Compulsory elements relate to engineering practice, engineering planning and design, and self-management in the workplace.

[b] Elective elements relate to engineering business management, engineering project management, engineering operations, materials/components/systems, environmental management, investigation and reporting, research and development a commercialisation, source and estimate materials, change and technical development, and technical sales and promotion.

Source: (Engineers Australia, 2011)

The thorough process to obtain CPEng and register on the NPER currently results in a considerable time impost on applicants. While we recognise that the time taken to prepare applications is reliant on the level of detail the applicant wishes to provide, stakeholders interviewed by ACIL Tasman indicated that the time taken to complete the requirements to obtain CPEng ranged between 28 and 125 hours. It is likely that these two estimates are at the extremes of the most likely time spent by engineers to prepare their applications. What became clear from our discussions with engineers was that the preparation of the competency reports was the most time consuming part of the process, with the majority of engineers consulted indicating that the preparation of these reports could take at least 40 to 50 hours of their time. It was also pointed out by one employer stakeholder that the time could blow out even further for those engineers who did not have English as their first language.

One employer stakeholder provided a detailed breakdown of actual tasks required to achieve CPEng, as well as the time impost generated by the need to undertake these tasks (see Table 10).

Table 10 **Detailed breakdown of CPEng application and associated time impost**

Task	Time impost
• Attend presentation by IEAUST. • Receive Chartered Status Handbook and run through work involved in attaining CPEng and how to go about it.	2 hours (including travel)
• Initial start-up meeting with Mentor to prepare program of CERs deadlines, mentor reviews, meetings to review CERs and question works and responsibilities. • Finalise reports and submission to mentor for final signoff.	2 hours
• Read Chartered Status Handbook, review units to be addressed in reports and select corresponding elements. • Prepare spreadsheet detailing projects undertaken to be addressed in elements/ units.	4 hours
• Prepare CPD spreadsheet. • Fill out throughout CPENG process.	4 hours
• Prepare 5 CERs for mentor review. • Ensure reports cover competency units	10 hours/report = 50 hours
• Review CERs with mentor. – Mentor review includes asking questions about projects and how issues were addressed (i.e. in relation to safety, lessons learnt, challenges solved, design constraints, etc)	1 hour/report = 5 hours
• Mentor reviews of each CER and signoff – Includes review reports/ make comment/ one meeting per report to run through project requirements/ Mock interview) ***This time is incurred by the mentor only.***	5 hours for meetings 5 hours to review reports 2 hours for mock interview = 12 hours
• Liaison with IEAUST and submission of CERs and reviewing feedback, amendments required.	1 hour/ report = 5 hours
• Once CERs approved, send through complete set of documentation including CERs, CPEng application form and fees, CPD Review, spreadsheet detailing where all competencies have been addressed etc.	2.5 hours
• Preparing for interview – Review all projects; prepare Powerpoint presentation, mock interview with mentor.	8 hours
• Interview + travel time	4 hours
Total time taken for all tasks	**86.5 hours for the engineer** **12 hours for the mentor**

Data source: Stakeholder survey conducted by ACIL Tasman.

This estimate was based on the 'average' recent experience of two engineer employees. The breakdown of time recognises the role of mentors as well as the applicant. This breakdown demonstrates the effort required to thoroughly complete the CPEng although we stress that is not necessarily demonstrative of all CPEng applicants. As discussed above it is likely that some applicants may take more time while others may take less time.

The detailed breakdown in this particular case study indicates that on average 86.5 hours is required to obtain CPEng, with a further 12 hours required from a mentor to assist with the application process. If, for example, the opportunity cost of an engineer's time was $100 per hour and the opportunity cost of a mentor's time was $150 per hour, the opportunity cost of the CPEng application process in this case would be $8,650 for the engineer applicant and $1,800 for the mentor. Of course this opportunity cost would vary depending on the applicant's and mentor's professional experience.

3.4.2 Registering on the NPER

Once an engineer has CPEng with Engineers Australia, they have satisfied Stage 2 requirements and hence they eligible for the NPER. However, the requirements for a competency based assessment are also requirements for registration on the NPER under certain circumstances, for example if the applicant is not CPEng. The requirement to complete the assessment as part of registration depends on the individual's status with other professional memberships.

Specifically, an engineer is required to satisfy the competency based assessment criteria in their area of expertise under the following circumstances:

- if an engineer wants to register on the NPER and they are a member of EA but not a CPEng
- if an engineer wants to register on the NPER and they are not a member of EA but would like to join EA
- if an engineer wants to register on the NPER and they are not a member of EA and don't wish to join EA
  - in which case the engineer specifies this on the same form submitted for a competency based assessment (without having to complete the full assessment – only for applicants through MRA) and complete a *Registration Applicant's Declaration*.[10]

If an engineer wants to register on the NPER and already has CPEng status they must submit an *Application for Registration on the NPER* form.

Number of registrations on the NPER

As at 29 September 2011, there were 9,850 professional engineers registered on the NPER. Based on our estimate of the number of practicing engineers (see Section 2.3.2), this suggests that less than seven per cent of practicing engineers are registered on the NPER.

10 This is a legal document in the case of dealing with complaints against a registrant.

Table 11 **Professional engineers on NPER (as at 29 September 2011)**

State	Registrations
Victoria	1,579
New South Wales	2,684
Queensland	2,745
South Australia	514
Tasmania	152
Western Australia	1,202
ACT	321
Northern Territory	106
Total registrations on the NPER	**9,850**

Note: The total number of engineers on the NPER and the combined total of jurisdiction memberships is not equal. This may be caused by the counting coverage on the NPER database, not ACIL Tasman.
Data source: NPER database – *RP Search.*

We have been advised by the NERB that most NPER applicants already hold a CPEng and that EA members normally apply for a CPEng and the NPER at the same time. When a member who has for some time been a CPEng, the NPER application is processed through alternative EA protocols. The NPER application form is submitted with an $88 annual registration fee to the NERB and an administration fee of $275 applies where:

1. the applicant has not had an audit on his CPEng within the last 5 years and an assessment needs to be completed OR
2. an individual is applying for a different/additional discipline (NPER College) and requires an assessment to be completed. Very few people on NPER do not also hold a CPEng.

4 The need for regulation

Historically governments in Australia and around the world have intervened in the workings of their market economies for a variety of reasons including:

- to achieve social and equity goals
- to address chronic failures in the operation of markets.

In a market-oriented economy such as Australia's, the case for regulation such as the national registration of engineers is predicated on the existence of imperfections in the market economy (market failures) and the likelihood of the benefits of regulation exceeding the costs arising from these imperfections. The market imperfections or market failures associated with the engineering profession include:

- information asymmetry
- negative spillovers or externalities.

While the economic rationale for government intervention in markets largely stems from the existence of market failure of this type, it should be noted that from an economic standpoint market failure is a necessary but not a sufficient justification for government intervention. This is because intervention generally is associated with a cost, and importantly there can be regulatory failure.

4.1 Information asymmetry

Information asymmetry exists when one party to a transaction has more information or better information than the other. Information asymmetry can produce poor (inefficient) outcomes. In the case of the engineering profession, the information in question would be the qualifications, competencies and experience of the engineer.

Seven of the stakeholders interviewed in the course of this project drew attention to the need to improve client information on the credentials of engineers. Overall many stakeholders considered that a national registration system will lead to more higher-quality outcomes and clients will have greater assurance that an engineer is competent to undertake the task at hand.

A number of stakeholders pointed out that often the clients, even commercial and government clients, were not always aware of the engineer's competencies. This is because the prime contractor for large projects is often not the engineer. Some stakeholders suggested that the current approach to contracting out infrastructure projects, rather than clients undertaking the work in house has resulted in dollars rather than quality driving decisions to enter into contracts.

The impact of information asymmetries in the engineering profession can range from low impact (e.g. a poorly designed yet fully functional piece of equipment or infrastructure) to very high impact (e.g. a building collapse that causes death and injury), with many variations in between.

A Productivity Commission inquiry into regulation of the architectural profession (a profession with similarities to some parts of the engineering profession, for example its role in building design and related services) found that information asymmetry was a major market failure. The inquiry also discussed why intervention was necessary to address the failure. The inquiry noted that:

> Information problems that consumers may face in the market for building design and related services are typical of the information deficiencies found in markets for services where the provider also acts as adviser and agent. That is, consumers may know broadly what they want when seeking a provider of building design services; for example, a house renovation. However, they may not know how it should be done or who is best qualified to provide it. In addition, it may be difficult for consumers to identify faults until a long time after work has been completed and, indeed, other parties (for example, subsequent owners) may bear these costs.[11]

The Productivity Commission also drew attention to the fact that the information asymmetry problem is likely to be greatest amongst consumers who use the professionals experience infrequently. For example, this is more likely to be the case amongst residential consumers or perhaps first time importers of Australian professional services, rather than commercial or government sector consumers. The Commission noted:

> The degree of information asymmetry in this [architectural] market is likely to differ according to the type of consumer. Consumers in the commercial and government sectors are more likely to be frequent users of the services and have the resources and knowledge to research and evaluate the merits of building design providers. Inexperienced and uninformed consumers are likely to be more prevalent in the residential and lower value commercial sectors of the market. Consumers in overseas markets also may lack information about Australian providers.[12]

As noted by the Productivity Commission, the source of the information asymmetry problem is that information is costly to obtain or, in some cases, unobtainable:

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[11] Productivity Commission, *Review of Legislation Regulating the Architectural Profession: Inquiry Report*, Report No. 13, 2000, p.xxiv.

[12] Ibid, p.xxiv.

- Consumers may not be able to identify the attributes of the product or service before purchase, without a significant amount of expensive research.
- Consumers may not able to assess the true quality or attributes of the good or service until after it is consumed. That is, they may only learn about the qualities of the good or service through experience.
- Consumers may not be able to judge readily the quality of the service, even after the purchase. Problems may only surface over time and be difficult to attribute to the original work. And if the provider of the service is also the provider of information about the consumer's needs, the consumer needs to place trust in the reliability of the provider.

In summary:

- The engineer and the client relationship constitutes what economists term as a principal-agent problem. The client (the principal) relies on the engineer (the agent) to undertake tasks on his or behalf; however, the interests of the engineer and client may not always be convergent or in alignment.
- Exacerbating this problem is the imbalance in the amount of information held by each party – the engineer typically has a much greater amount of pertinent information than the client, particularly if the client is an infrequent consumer of engineering services. Consumers in overseas markets also may lack information about Australian providers.
- Unscrupulous engineers may exploit the information asymmetry to confer financial gains upon themselves at their client's expense. They may have an incentive to recommend unnecessary services (or a higher standard than required) or provide a lower standard than is optimal (and agreed), particularly when the consequences of poor service may only become apparent over time.
- The information asymmetry problem can result in less competent and lower quality engineers driving out more competent engineers from the profession by offering lower priced services to consumers who are unable to distinguish between the two groups (the famous Akerlof 'lemons' problem). As noted above, some stakeholders suggested that this situation was currently arising in commercial and government sector markets, because price rather than quality was driving decisions and quality was often assumed to be consistent across tenders.

4.2 Negative spillovers or externalities

Spillovers or externalities arise when the parties in a transaction do not take into consideration the impact that the transaction has on a third party or third parties.

The provision of professional services often involves spillovers. In the case of engineering, a safety externality arises because the consequences of poor engineering may be experienced by people other than those who directly purchase the engineering services. For example, the collapse of a bridge may result in the deaths of bystanders beneath the bridge who were unconnected with its construction.

Another example is the environmental impact of an oil spill that might be caused by poor engineering decisions and/or practices. The oil spill might also negatively affect the livelihoods of fishermen and other persons not affiliated with the oil industry, and the cost of the resulting clean-up is often borne by the general taxpayer.

Overall many stakeholders were of the view that a national registration scheme has the potential to ameliorate the information asymmetry problem and to some extent improve the quality of engineering outcomes and thus potentially reduce the incidence of negative externalities. This is because national registration was seen as a means of enabling an engineer to signal to potential clients that he/she is qualified, experienced, continually undertakes professional development, is regularly audited and abides by an ethics code. The registration system may provide assurance that the engineer will be competent and hold the client's interest above any opportunity to achieve unscrupulous financial gain, and will be diligent in providing the contracted services.

5 The proposed national registration scheme

ACIL Tasman and the proponents of the national registration scheme for engineers in Australia have considered alternative models for such a scheme. The preferred model is described in some detail in the rest of this chapter while the other models considered are briefly summarised in Box 2.

5.1 Background to the proposed model

The proposed model for the national scheme is summarised in *The Regulation of Engineers* report produced by NERB in conjunction with Principled Public Relations and Public Affairs. As previously explained, the proposed model is broadly based on the Queensland's current system of mandatory registration (refer to Section 3.2).

Under the proposed model there would be seamless inter-jurisdictional recognition of new legislation to be introduced in each state and territory. The *Engineers Act* would be the legislation supporting the registration system. The legislation would:

- require registration of engineers offering engineering services (excluding engineers working under supervision)
- restrict the title 'registered engineer' to those engineers who are on the register
- require mandatory professional development for ongoing registration
- set criteria for approving assessment entities
- set up a framework for the operation of Board and a register of engineers.

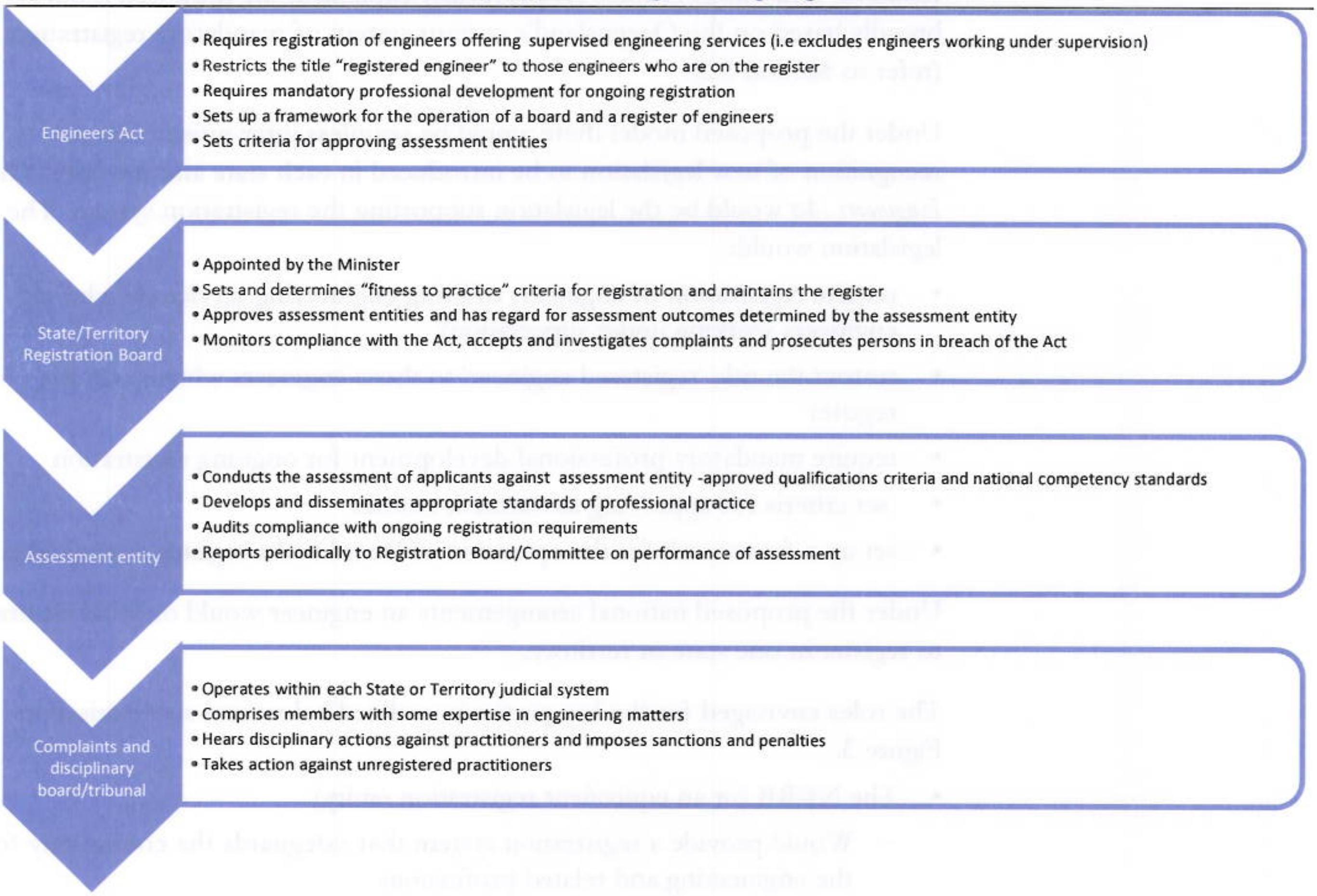
Under the proposed national arrangements an engineer would only be required to register in one state or territory.

The roles envisaged for the key parties is outlined below and summarised in Figure 3.

- The NERB (or an equivalent registration entity)
  - Would provide a registration system that safeguards the community for the engineering and related professions.
- State/Territory Registration Boards
  - Appointed by the relevant state/territory minister, the state/territory Registration Boards will set and determine "fitness to practice" criteria. These Boards will approve assessment entities and have regard for their outcomes, as well as monitor compliance with the *Engineers Act*, and act on any complaints and possible breaches.

- Assessment entities
  - Assessment entities (such as EA, AusIMM and IFE) will assess applicants against approved criteria and standards, as well as develop and disseminate appropriate standards of professional practice. The entities will audit compliance with the ongoing registration requirements and report to the Registration Board on the performance of assessments.
- Complaints and Disciplinary Boards/Tribunals
  - Operating within the judicial system in each state/territory and comprising members with engineering expertise, these tribunals will hear disciplinary actions against practitioners and impose appropriate punishment. They will also take action against unregistered engineers.

Figure 3 Functions of parties in the proposed engineering registration model



Data source: Engineers Australia.

Box 2 **Alternative models for national registration of engineers**

The preferred model described in this chapter is a co-regulatory one, where the qualifications, competencies and performance standards required for registration are assessed by professional associations accredited by a statutory board or another similar body. Government is responsible for administering the legislation, including the authorisation of professional associations, and taking disciplinary action where misconduct or incompetence is identified.

Alternative models that have been considered are summarised below.

Mandated regulated system

This option is similar to co-regulation but has a greater focus on the structure and responsibilities of the board that regulates the profession. Under this model the government's regulatory role is provided through the board structure. The board may comprise representatives of the industry and other relevant professionals and could draw in industry expertise as necessary.

In this model the statutory board is given responsibility for establishing and applying criteria for the qualifications and competencies required for registration. Professional associations do not have a direct role in the registration process, but may help to establish standards of professional practice. It is believed that this approach to the regulation of the profession has less flexibility than under co-regulation and will likely be less responsive to professional trends.

Hybrid model

This is a combination of various aspects of co-regulation and a mandated regulated system, described above.

Federal model

A federated model would involve a central Board with a moderate bureaucracy and require much smaller registration units in each State and Territory. A "centralist" model would require adoption by each State and Territory Government, much as the Building Code of Australia is adopted into building regulation in each jurisdiction. However, complaints handling, investigation and disciplinary action would have to be done locally, each in accordance with the prevailing judicial system.

The federal model is expected to have lower costs than the preferred model due to the presence of scale economies. However, Commonwealth legislation providing for a federal model is highly unlikely for a number of reasons:

- The Commonwealth has limited powers under the Australian Constitution to legislate in this area. The only relevant constitutional power is the corporations power, which may not be an appropriate vehicle for national legislation of this nature.
- Changing the Australian Constitution is extremely difficult and can only occur by referendum. Without constitutional change, a federal model would require the States to refer their powers to regulate the profession under section 51 (xxxvii) of the Constitution, and is also unlikely to happen.
- Another way to introduce nationally consistent laws is through mirror legislation: where one State introduces legislation and all the other States adopt it in full. In relation to trades, template legislation to be adopted by different jurisdictions is generally proposed by COAG. However, in practice it could prove difficult to achieve absolute agreement between jurisdictions.

Source: NERB and PPRPA, *The regulation of engineers: Finding the right approach for a national economy*

5.2 Coverage

The proposed national registration scheme is intended to cover all sectors of the economy which utilise engineering services. This would be a major change from the arrangements that exist in most states and territories, with the exception of Queensland.

During the stakeholder consultation process the issue of coverage for the proposed national registration was raised. Overall there was no consistent view on the most appropriate level of coverage for the scheme.

Four stakeholders believed that any engineer wishing to practice should be registered, with one commenting that associates and technologists should also be included. One stakeholder noted that the categories under which they are registered should be defined by EA, with another noting that the consequences of getting things wrong can be high across all disciplines.

Four stakeholders were only familiar with the building industry. Among them, these stakeholders believed that structural, mechanical, civil, electrical, hydraulic, fire safety, energy efficiency and geotechnical engineers should be registered.

Two stakeholders believed that only engineers in the "fundamental disciplines" that are exposed to the public, such as civil, structural, mechanical, electrical and chemical engineering should be registered.

There are mixed views on whether mineral engineers should be registered. For example, there are some concerns that the rigorous testing undertaken via the competency board assessment system in NSW would be lost under the proposed national registration system. It was suggested that if the competency boards became approved assessors under the national scheme this could be a way forward. Another reason for non-inclusion related to the mixed nature of mining teams, with engineers and non-engineers working together, and the problems associated with some professionals in these mining teams not subject to registration. For example, geologists on mine sites would not require registration, with additional complications caused by engineers not being able to sign off on a geologist's work. The nature of mining insofar as it is removed from the public was also considered a reason for non-inclusion.

One stakeholder specialising in infrastructure delivery commented that only engineers in the areas where decisions and input can have a substantial impact on quality and cost or either design or construction, such as civil, structural, environmental, mechanical and electrical engineers, should be registered.

Some other stakeholders suggested that it is not so much the type of engineering that should be considered so much as the level of responsibility held – people who want to work independently should be registered as they have responsibility for the outcome. There should be no need for registration if an engineer is working under the supervision of another engineer registered as competent in the area of work being undertaken. This view is largely in line with the proposed scheme.

5.3 Changes to the CPEng application process

Under the existing scheme, there were eight steps for applicants to complete to obtain CPEng. As discussed in Section 3.4.1, these steps had the potential to create a considerable time impost on applicants.

ACIL Tasman was advised by the Engineers Australia that it is currently working to address widely-held concerns regarding the time it takes applicants for CPEng status to prepare evidence of competence, which is the crucial component of any application. It is proposed that the assessment of competence for NPER registration will generally follow identical procedures.

ACIL Tasman was also advised that the Australian Engineering Competency Standards – Stage 2 are currently being revised in accordance with a long-standing policy to review them every five years. It is expected that the 2012 revision will clarify the competencies and make them more user friendly. Applicants will be able to identify and provide the required evidence of their competence more flexibly while maintaining the standards for Chartered members and registered engineers.

In addition Engineers Australia is building an online application and assessment system (called eChartered) which will reduce paperwork and shift online the ability of:

- applicants to present evidence of competence briefly against the revised standards
- mentors and supervisors to verify the experience presented as evidence of competence
- assessors to review and assess the evidence of competence.

eChartered will retain the professional interview as an essential component of the competency assessment.

ACIL Tasman understands that some of the proposed improvements to the application process as identified include:

- revised competency standards where all elements are mandatory
- more accessible guidelines
- 500 word limits to address each element
- self-appraisal exercises in addition to reports

- reduced need to liaise with EA as material is online
- online verification and record documents printed only at time of interview.

The implementation of the revised competency standards in conjunction with eChartered (initially, by mid 2012) is expected to:

- halve the time taken by applicants to understand requirements
- reduce to about one third (from an estimated 50 hours to an estimated 15 hours) the time taken to write up experience that demonstrates competence
- halve the time taken by mentors or verifiers to review and confirm the much briefer accounts of experience applicants use to demonstrate competence
- eliminate much of the administration associated with collating diverse components of applications by linking them within the online system.

Using our earlier case study of the time impost of the existing system in Table 10 (in Section 3.4.1) and comparing it with the revised time imposts suggested by NERB, there are potentially significant time savings under the proposed system.

Table 12 provides Engineers Australia's revised estimates of the time impost of particular tasks in the CPEng application process. Under the existing system, the applicants in the case study took on average 86.5 hours to complete the process, but under the new process the time impost is expected to fall by 51 per cent to 42 hours. The resultant opportunity cost of the application process for a new registrant assuming an opportunity cost of $100 per hour drops from $8,650 to $4,200. The opportunity cost of the mentor's time has also dropped, by 41 per cent from 12 hours to seven hours. The resultant opportunity cost of the mentor drops from $1,800 (based on $150 opportunity cost per hour) to $1,050. These lower estimates of the opportunity costs of the application process have been used in the assessment of the costs of the proposed mandatory registration scheme in Chapter 6.

Table 12 **Detailed breakdown of time impost under revised CPEng application process**

Task	Existing time impost	Revised time impost
• Attend presentation by IEAUST. • Receive Chartered Status Handbook and run through work involved in attaining CPEng and how to go about it.	2 hours (including travel)	2 hours
• Initial start-up meeting with Mentor to prepare program of CERs deadlines, mentor reviews, meetings to review CERs and question works and responsibilities. • Finalise reports and submission to Mentor for final signoff.	2 hours	2 hours
• Read Chartered Status Handbook, review units to be addressed in reports and select corresponding elements. • Prepare spreadsheet detailing projects undertaken to be addressed in elements/ units.	4 hours	2 hours
• Prepare CPD spreadsheet. • Fill out throughout CPENG process.	4 hours	4 hours
• Prepare 5 CERs for mentor review. • Ensure reports cover competency units	10 hours/report = 50 hours	15 hours
• Review CERs with Mentor. – Mentor review includes asking questions about projects and how issues were addressed (i.e. in relation to safety, lessons learnt, challenges solved, design constraints, etc)	1 hour/report = 5 hours	2.5 hours
• Mentor reviews of each CER and signoff – Includes review reports/ make comment/ one meeting per report to run through project requirements/ Mock interview) ***This time is incurred by the mentor only.***	5 hours for meeting 5 hours to review reports 2 hours for mock interview = 12 hours	2.5 hours for meetings 2.5 hours to review reports 2 hours for mock interview = 7 hours
• Liaison with IEAUST and submission of CERs and reviewing feedback, amendments required.	1 hour/ report = 5 hours	2.5 hours
• Once CERs approved, send through complete set of documentation including CERs, CPEng application form and fees, CPD Review, spreadsheet detailing where all competencies have been addressed etc.	2.5 hours	0 hours
• Preparing for interview – Review all projects; prepare Powerpoint presentation, mock interview with mentor.	8 hours	8 hours
• Interview + travel time	4 hours	4 hours
Total time taken for all tasks	• **86.5 hours for the engineer** • **12 hours for the mentor**	• **42 hours for the engineers** • **7 hours for the mentor**

5.4 Stakeholder views on costs of a national registration scheme

Most stakeholders consulted consider the move to a national mandatory registration scheme would bring benefits rather than costs. However, six of the stakeholders interviewed pointed out that the change would involve some additional costs, particularly for engineers. In some cases questions were raised about who would ultimately pay for these costs – the individual engineer, the engineer's employer, the government and/or the customer.

For example, three stakeholders considered that administrative costs incurred by the state regulators and the approved assessors will rise under a national mandatory system. This increase in costs would likely arise due to the need to assess more applications, renewals and auditor etc. It was suggested, that this additional workload would require more staff (including volunteers). Further, one of these stakeholders pointed out that the increase in administration costs will in part be determined by the new regulation's level of complexity.

Another stakeholder argued that engineering consulting companies will incur a significant increase in their costs as these companies traditionally pay their registered engineers registration fees. It was pointed out that these costs would increase significantly if all professional engineers had to be registered in a national scheme.

One state government agency that is currently not engaged in mandatory registration of professional engineers questioned: "Who will pay? How will it be funded? Where is the problem now (i.e. where is the market failure)?"

On the other hand, another jurisdiction currently working towards mandatory registration in considering the additional regulatory costs indicated the government may "pick up" a cost of running a more regulated system. However, a view was expressed that with the underlying system currently in place, the additional costs for the regulator are unlikely to be huge.

5.5 Stakeholder views of potential benefits

As noted above, stakeholders generally recognised more potential benefits to a national scheme than costs. The benefits identified by stakeholders are discussed in the following sections.

5.5.1 Interstate mobility

Interstate mobility was seen as a major benefit of a national scheme by a majority of stakeholders interviewed. Several stakeholders noted difficulties relating to interstate mobility in the current environment. For example:

- One mining industry stakeholder pointed out that, from a mining company point of view, they want their skilled workforce to move across borders. However, this may be extremely difficult because workers may not have become registered in a particular state. As a result, it can be time consuming and difficult to get them to move. This stakeholder commented that anything to eliminate this problem would be excellent and should be a priority.
- One stakeholder suggested that national registration would make it easier to 'build' teams using specialists from any jurisdiction. This stakeholder noted that the business had to forego potential projects in the past because

specialists weren't registered in a particular jurisdiction and registration could not be completed before the project tender period closed.

- Another stakeholder relayed a similar experience that required them having to turn down work with a multi-national company because it only had one registered engineer. Another stakeholder noted that registration to win jobs takes time and money and the process of interstate registration would not be undertaken at the time of tendering in case the company doesn't win the job.
- Another stakeholder noted that profit on work to be undertaken in a jurisdiction requiring registration was sometimes not high enough to make registration or accreditation worthwhile.
- Another stakeholder noted that during the Global Financial Crisis (GFC), many engineers had to change jurisdictions to find work. If they were not registered in these jurisdictions, they had to go through the process before they could commence work, which often took considerable time. The same stakeholder recalled firms being called to Queensland to undertake reconstruction works also having to register workers before they could commence work.
- Another stakeholder noted that despite red tape in jurisdictions, engineers found a way to get around the requirement, for example asking an engineer registered in Jurisdiction A to accredit a design completed by an engineer in Jurisdiction B and who isn't registered in Jurisdiction A.

Under the proposed national system, an engineer would only be required to undertake a competency assessment once, as well as pay one registration fee. Once registered, the engineer can immediately practice in any jurisdiction. This would be expected to benefit both engineer and employer. In the case of the engineers, they would not need to spend time completing more than one application. In the case of the employer, it appears to be common practice to pay for at least one professional registration or membership. National registration would mean that employers would save on additional registration fees. This saving would of course be transferred to the engineer if they are required to pay for subsequent registrations. On the flip side, national registration could mean that employers are required to pay for more engineers to be registered than is currently the case (see Section 5.4).

5.5.2 Skills shortages

Kaspura points out that skills shortages are multi-dimensional. For example, there can be shortages in particular specialisations, in particular geographic regions or at particular levels of work experience. Further, Kaspura observes that responding to skills shortages will need to be a two pronged attack – new domestic graduations and skilled migration, which, at the current level can sustain growth in the demand for engineers at about 10,000 – 11,000 per year.

When compared to average demand growth of 13,000 per year (with 22,000 even considered) presents a considerable shortage of engineers[13].

Many stakeholders interviewed failed to draw a link between national mandatory registration and addressing skills shortages. Nine stakeholders did not believe that a national registration system would reverse professional skills shortages, whereas only three thought it would. Two were uncertain.

The points of concern raised by those not believing the skills shortage would be improved by national registration include:

- the skills shortage is purely a shortage of people and national registration will not get students to study engineering at university
- training and education issues will remain despite national registration
- it will set a bar that may not permit some engineers to practice.
- it could exacerbate the skills shortages as it may restrict competent engineer substitutes (i.e. those with proven experience in certain 'engineering' fields however not holding an engineering qualification) from providing services. One stakeholder commented that other pathways to competency other than a university needed to be considered, that is the system would need to recognise engineering substitutes.

Despite not believing that national registration would address skill shortages, these stakeholders did draw some indirect links towards addressing skills shortages:

- it would make the profession more visible.
- it would identify the skills shortages more
- it may improve the productivity of existing engineers due to less red tape.

Mandatory registration and the pool of capable workers

There was concern expressed during the stakeholder interviews that mandatory national registration could actually reduce the pool of workers capable of providing services usually undertaken by qualified engineers. One stakeholder noted the common practice of using competent individuals to provide services that would otherwise be provided by an engineer, for example design. This stakeholder stressed that competence did not necessarily mean equivalently qualified, however it did mean that the individual performing the task had significant proven experience despite not having a Stage 1 engineering qualification. For this stakeholder, the mandatory registration may not give due consideration to a person's competency, and this stakeholder doesn't want these workers frozen out.

[13] Kaspura, Andre, *The Engineering Profession: A Statistical Overview, Eighth Edition, 2011*, 2011.

One engineering stakeholder commented that the company often employed non-engineers with skills and competency in specialist areas such as mechanical services, transport safety and some environmental sciences. With respect to the latter, most of the non-engineers were working under a suitably qualified environmental engineer. Further, many of these non-engineers were working in the field or testing rather than making decisions which made them relatively easy to manage. When it came to building services, the business's non-engineering employees were trained internally in the elements they needed to be wary of. Finally, it was company practice to have engineering elements checked before they were finalised.

This view was loosely supported by another stakeholder who noted that consideration needs to be given to the other pathways to competence as an engineer other than a Stage 1 engineering qualification. This stakeholder also noted, however, that there was not a willingness among engineers in the state to "set the bar low".

5.5.3 Migrant engineers

Linked into the issue of skills shortages is the role migrant engineers may play in addressing the problem. As discussed above, skilled migration is one means of reducing skills shortages. Stakeholders were asked for their views on how national registration would affect a company's access to migrant engineers, however most feedback related to time saved by the company rather than indicating strong benefits.

Some stakeholders believed that there would be considerable time savings in assessing migrant engineers for employment as the relevant assessment entity will use their resources (specifically knowledge) to check equivalence across qualifications. For example, it has been presumed that assessment entities will have detailed information on the equivalence of qualifications between international universities, building up a comprehensive database in the process. It is assumed that this database would be an easier reference point that an employer conducting their own investigations into equivalence of qualifications.

5.5.4 Benefits for clients and users

The provision of an engineering service can affect one person or family (e.g. a new house) or it can affect millions of people (e.g. a new bridge). Either way, engineering services are purchased by a client who may be an individual, an organisation, such as a company, or a government.

Several benefits of mandatory registration that extend to clients were noted by stakeholders, with the benefits observed generally related to peace of mind and security. According to the stakeholders interviewed, clients could expect the following from mandatory registration:

- greater certainty that the engineer engaged has been assessed and audited to ensure they undertake continuing professional development, and has the necessary experience and observes a code of ethics
- greater certainty that a competent engineer has been commissioned
- knowledge of robust education and training undertaken by the engineer
- certainty that the engineer is registered nationally.

It is apparent from stakeholder consultation that a mandatory national registration scheme with the rigorous assessment of an engineer's qualifications and experience, and the requirement for ongoing professional development, will ensure that all supervising engineers are proven to be competent or for those that are not registered, they are working under a competent engineer.

It was noted by one stakeholder that most clients did not understand the importance of the NPER or CPEng, and that many clients struggle to make a merit based selection of tenders. This stakeholder believes that once a registration standard is in place, clients will be in a position to demand certain levels of competency.

In our view, mandatory registration will (to a certain extent) protect clients whether they understand the importance of NPER/CPEng or not. Clients who do not have the means, knowledge, ability and/or finances to independently undertake rigorous competency assessments of an engineer will still receive services provided by a fully competent engineer. Put another way, by default, any engineering projects will be overseen by a competent engineer.

Linked to the perceived benefit of a competent engineer undertaking projects is an additional benefit of not having to rework engineering mistakes. One stakeholder referred to the significant hidden costs of reworking poor engineering in the defence industry. Another stakeholder noted that poor advice in the first instance often leads to engineering mistakes. In this stakeholder's experience, rectifying such mistakes often cost 250 per cent of the original project cost.

Examples of major engineering disasters experienced in Australia, along with the cost of having to rework or fix engineering mistakes is discussed in greater detail Chapter 7.

While there was a widespread view among stakeholders that a national registration system will benefit clients (and other users) because it will ensure that a competent engineer is providing the service, some stakeholders raised concerns about how the proposed national system may fail clients. Specifically, these stakeholders felt it may fail where evidence of certain elements of business administration are concerned, such as insurance and financial acumen.

One stakeholder was concerned that registering an individual only does not take into account the ability of that individual to trade, provide services or operate finances. On the other hand, registration of a company would require demonstration of these capabilities. Further, one stakeholder commented that the proposed system may not require proof of insurance, which also has the potential to fail clients. However, this concern can be addressed by clearly indicating on any database that clients should confirm insurance remains valid.

5.5.5 Benefits to firms

Increased productivity

Irrespective of the registration scheme in place, it is inevitable that there will be paperwork. This relates to engineers completing the necessary requirements (e.g. forms, reports) for registration on either the NPER or at the state level. Sometimes firms assist with this process by allowing administrators to assist engineers with their registration requirements. Three stakeholders commented that a direct consequence of this time spent on registration is lost productivity.

The extent of lost productivity cannot be easily estimated with the time demands for registration varying by jurisdiction and by engineer. One stakeholder estimated that his time spent on registration paperwork was at least 10 hours per year, plus any time spent by his administrative staff. This engineer estimated that if all engineers spent a similar amount of time on paperwork each year, the cost to the Australian economy would be in the order of one million hours in lost productivity of engineers. This of course is an estimate that would be further compounded if there was compulsory registration administered independently by each jurisdiction and if administrative support was provided to all engineers. Suffice to say, the productivity losses would be significant.

Under the proposed scheme, paperwork would still be necessary. However, some stakeholders pointed out that productivity will be improved as there will no longer be separate jurisdictional requirements.

Internal vetting

Before employing an engineer, employers will typically vet the qualifications, experience and claims of the engineer. Stakeholders revealed that a considerable amount of time was spent undertaking these checks. Further, stakeholders suggested that the time spent vetting could be considerably reduced under a national registration system. For example:

- One stakeholder owned of a small firm vets graduates that may be employed. Consideration is given to the graduate's background, qualifications, results and referees. This process takes about 1-2 days and is followed by a three month probation period (requiring half workday contact for three months). It was suggested that if the national registration system was implemented for all professional engineers (i.e. Level 1 to Level 5) and requested the right information, the time spent by this company could be cut back significantly.
- Another stakeholder in a medium sized firm vets engineers coming into the company. The company requires a copy of the engineer's degree and where this is not available, then a letter from the university stating course completion is acquired. If the company is taking on a post-graduate engineer, then they require the engineer's relevant thesis or writings. The company will then undertake a reference check. In total, around 2-3 hours are spent vetting incoming engineers, with an additional 1.5 hours for an interview. This company employs about 10 people each year. It was considered that if a national system was implemented the vetting process for this company would be quicker – the interview could be reduced by approximately 20 minutes, with all other vetting work taking about 20 minutes.
- Another stakeholder from a large company where one component of its operations involved an engineering focus advised that any engineer coming into the company is vetted for a suitable degree, which is followed by an interview which focuses on skills and training. Depending on the role of the engineer, there is a requirement that they should be able to complete a CPEng (this is not compulsory and usually becomes an employment goal). The internal assessment takes approximately 8-10 hours per engineer, with around 12 assessments each year. If a national system was implemented, the vetting process for this company could be reduced to 1-2 hours per engineer.

While we do not expect that firms will no longer vet incoming employees, we do expect there to be a considerable time saving as demonstrated by three engineering companies. However, we note that if as proposed, the national scheme only requires supervising engineers to be registered, the time savings for graduates or non-supervising engineers would not be achieved.

Savings on registration fees

Some stakeholders commented that there may be savings to companies who pay registration for their employees. It was suggested that these companies will no longer be required to pay employees' registration fees in multiple jurisdictions and will only need to pay one registration fee per employed engineer. One stakeholder commented that this may be of particular benefit to fire safety engineers as there is considerable skills transfer across states in this discipline.

However, as the proposed arrangements would result in many more engineers being registered it is highly likely that in total registration payments will increase (see Section 5.4)

6 Estimating the costs of registration

This chapter considers the costs to Government and engineers of the current legislated registration/ accreditation requirements (as discussed in Section 3.1), as well as the cost of the proposed national mandatory registration system for professional supervising engineers.

6.1 Costs of the existing arrangements

The costs of the current arrangements have been estimated using a range of information sources including:

- annual reports of relevant agencies
- data provided by agencies and engineers as part of the stakeholder consultation process
- ACIL Tasman's best estimates.

Key assumptions used include:

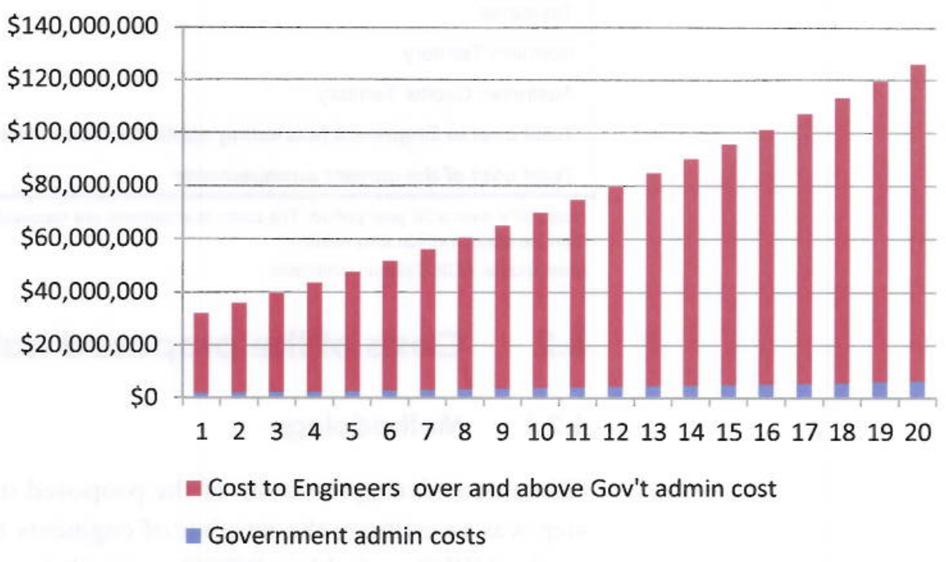
- the number of engineers currently mandatorily registered or accredited by the jurisdictions (Table 6)
- the new application growth rate is assumed to be four per cent, which is based on the average growth rate for engineering graduates over the period 2001 to 2009[14]
- retirements from each jurisdiction's register is assumed to be two per cent, which reflects the annual retirements from the NPER
- Current administrative costs
  - in NSW and Tasmania administrative costs per application and renewal were based on costs provided by the state regulators, however, a cost to deal with complaints was assumed to be additional to these costs and consistent with cost incurred in Queensland
  - as the BPEQ operates on a cost recovery basis and thus revenues from application and renewal fees were assumed to equal current costs
  - in Victoria's case the estimate of administrative costs was based on the proportion of Building Commission employees that support the Building Practitioners Board prorated by Building Commission expenses
  - the Northern Territory system was assumed to operate on a cost recovery basis (i.e. application and renewal fees were assumed to cover costs

[14] See Kaspura, The Engineering Profession, A Statistical Overview, Eighth Edition, Table 5.11

- Engineers compliance costs and related were based on our consultations
- the opportunity cost of an engineer's time was assumed to be $100 per hour, which was based on the average hourly rate paid to Level 3 to Level 5 engineers
- the opportunity cost of CPD is only included if the CPD is mandatory rather than voluntary.

Based on these assumptions, we estimate the annual cost of the current regulatory arrangements to be $32.2 million (2011 dollars). The cost to engineers of $30.3 million (2011 dollars), which is over and above the application and renewal fees paid by them to the relevant government agency, makes up the bulk of these costs. Under the current arrangements the costs incurred by the various state and territory regulators of administering the regulations are in large part covered by the application and renewal fees paid under the arrangements. These administrative costs are estimated to be currently in the order of $1.9 million (2011 dollars). Figure 4 shows the stream of the estimated costs.

Figure 4 **Estimated cost of the current regulatory arrangements (2011 dollars)**



Source: ACIL Tasman estimates

Over a twenty year period and assuming no change in the current regulatory arrangements, the Net Present Value (NPV) of this stream of costs using a seven per cent discount rate would be $681 million. The majority of this cost is incurred by the BPEQ and the engineers registered under the Queensland system. Note that under the current arrangements individual engineers can be incurring costs in more than one jurisdiction (see Table 13).

Table 13 **NPV of the cost of the current regulatory arrangements**

NPV = 7%	$ million
Cost to Government	
New South Wales	$0.3
Queensland	$29.1
Victoria	$4.4
South Australia	$0.0
Western Australia	$0.0
Tasmania	$1.7
Northern Territory	$1.3
Australian Capital Territory	$0.0
Total cost to Government (application and renewal fees are assumed to cover all or the majority of these costs in the majority of jurisdictions)	**$36.8**
Cost to Engineers by state of registration	
New South Wales	$6.3
Queensland	$612.3
Victoria	$6.1
South Australia	$0.0
Western Australia	$0.0
Tasmania	$18.2
Northern Territory	$1.2
Australian Capital Territory	$0.0
Total cost to Engineers (excluding application and renewal fees)	**$644.1**
Total cost of the current arrangements	***$681.0***

Note: NPV over a 20 year period. The costs to engineers are reported in the state where they are registered rather than the state in which they reside.
Data source: ACIL Tasman estimates.

6.2 Costs of the proposed national arrangements

6.2.1 Methodology

When considering the costs of the proposed national arrangements, the first step was to estimate the number of engineers that are currently not registered on the NPER or holding RPEQ status that would have to be registered under the proposed arrangements. The starting point was to assume that there are currently 150,169 practicing engineers in the engineering labour force (this figure coincides with the estimate reported in Table 2). However under the proposed national system, it would not be necessary for all these engineers to be registered. This is because only supervising engineers would be required to register under the proposed scheme.

The Queensland model provides us with the best indication of the proportion of engineers requiring registration. Based on discussions with the BPEQ, we have estimated that just under 46 per cent of engineers would need to be registered under the proposed arrangements. This estimate suggests that around 68,800 of the 150,169 practicing engineers would require registration under the proposed scheme. However, some of these practicing engineers are already registered on the NPER and/or have RPEQ status. In all we estimate that:

- 9,850 are registered on the NPER (see Table 11)
- 2,960 are registered on the BPEQ but not on the NPER.[15]

Assuming that the registration of these 12,810 engineers would be rolled over to the new scheme, another 55,990 (68,800 minus 12, 810) would need to be registered under the proposed arrangement.

We have assumed that these additional engineers would be registered over a period of three years. Meanwhile those currently registered would require mandatory renewal under the proposed national arrangements.

In addition, consistent with the current arrangements we have assumed:

- the new applicant growth rate is four per cent per annum
- engineers retire from the register at a rate of two per cent per annum.

In estimating the costs of the proposed national arrangements we have worked with Engineers Australia to estimate the likely typical costs of an approved assessment entity. These costs are summarised Table 14. It has been assumed that the assessment entity (entities) costs would be subject to a cost recovery arrangement.

Table 14 **Estimated unit costs incurred by an assessment entity**

Item	Unit	Cost
Cost of application assessment	$ per application	$1,058.00
Cost of administering a registration	$ per application	$48.00
Travel cost of rule setting	$ per year	$8,000.00
Time cost of volunteers on applications	$ per application	$900.00
Time cost of volunteers on disciplinary action	$ per action	$1,650.00

Data source: Engineers Australia and ACIL Tasman estimates.

15 This estimate is based on Engineers Australia advice that in December 2006 45.4 per cent of engineers registered by the BPEQ were not associated with Engineers Australia. In 2007-08 (the last year of the old Queensland assessment arrangements) there were 5,792 engineers registered on the BPEQ (see Table 7). We have therefore assumed that 2,630 were not associated with Engineers Australia at that time. In addition, new arrangements commenced in July 2008 and we understand that the other two assessment entities (AusIMM and IFE) have together assessed 330 engineers for registration on the BPEQ. This takes the number of engineers registered on the BPEQ but not on the NPER to 2,960.

In considering the costs to government (that would be recouped from application fees) of the proposed national arrangements we have assumed:

- a one off cost of $500,000 to develop the *Engineers Act* which would be subsequently legislated in all states and territories
  - in considering this cost we have taken into account that Queensland legislation could be a starting point for the development of the legislation
- a one off cost of $600,000 in set up costs, including the cost of developing a new national registration database
  - in considering this cost we have taken into account that a national NPER database already exists as does a BPEQ database
- the annual operating costs of the national database would be in the order of $47,000
  - which reflects the current operating cost of the existing BPEQ database
- state boards would operate with a similar arrangement to the BPEQ, i.e. all costs including the registration of the engineers and including all board costs associated with the administration of the Act would be recovered through the fees levied on the registrants.
  - the BPEQ fees are $227 per new application and $179 per renewal
  - these fees currently levied by the BPEQ are on top of the assessment entity fees. While there is some disagreement about the adequacy of these fees to effectively cover costs, we note that the BPEQ's 2011 Annual Report stated:

  'The major influence on the Board's financial position is the number of complaints in any given year that require investigation and disciplinary action. Based on historical patterns for the last few years, at present the fees are adequate to maintain the financial viability of the Board. This will enable the Board to meet its responsibilities to remain self-funded, to act independently, impartially and in the public interest.'[16]

- Given there is some uncertainty about future disciplinary action and given the importance of complaints in achieving cost recovery, this analysis has assumed a cost for complaints and disciplinary action over and above the assumed $227 per new application and $179 per renewal
  - based on the BPEQ's experience we have assumed an average cost per complaint (ranging from unjustified through to disciplinary action required) of $16,317 (2011 dollars) with a likely frequency 0.004.

The cost of the proposed scheme as expected increases the cost to the engineering profession as many more engineers would need to be registered. The assumptions used are largely consistent with those used under the current

[16] BPEQ, 2011, Annual Report, p.5.

arrangements costing. The main difference reflects the fact that all engineers registering for the first time under the proposed national scheme will be required to undergo a process to prove their competencies. Whereas under the current arrangements, only those engineers registering in Queensland are required to do so. Certainly some engineers not registered in Queensland have voluntarily elected to undergo similar process to become Chartered (with Engineers Australia, AusIMM or IFE) and/or have registered on the NPER. However, the decision to incur the related costs was a voluntary one. Further as explained in Chapter 3, under the current arrangements, if a CPEng or NPER registered engineer applies to Engineers Australia as an assessment entity for RPEQ, the assessment is undertaken at no charge to the applicant. Thus under the cost estimate for current arrangements, these additional costs were only estimated for those applicants who at the time of applying for RPEQ had no industry association or affiliation with the assessment entity or NPER registration.

Under the proposed national scheme the decision to undergo the process becomes mandatory and hence these application opportunity costs must be included for *all new applicants* as by assumption they have not already achieved CPEng, NPER or RPEQ registration. The cost to the individual engineers (excluding application and renewal fees paid) under the proposed national registration arrangements are estimated to be:

- cost to engineer on application for initial registration $4,200
- cost at application to engineer's mentor $1,050.

Under the current regulatory arrangements the requirement to undertake CPD varies across the states and territories. For example, as discussed in Chapter 3 (Table 6) the BPEQ has aligned its CPD policy with those of the approved assessment entities and CPD is mandatory. However, in some other states CPD is not currently a mandatory requirement. For example, in Victoria the Building Practitioners Board encourages CPD, but participation is voluntary. Voluntary participation in CPD has not been included as a cost under the current regulatory arrangements, though mandatory CPD such as in Queensland and Tasmania was included. The proposed national registration scheme involves a mandatory requirement to undertake 150 hours of CPD over a three year period (modelled as 50 hours per year).

In considering the opportunity cost of CPD we have assumed that that 90 hours of the CPD activity over a three year period is undertaken "on the job" as part of a professional engineer's normal work place activities. Indeed the NERB has argued that engineers could not provide professional services without undertaking this activity. As the industry is already bearing the cost of their engagement in this type of CPD, we have concluded that mandatory registration would not add to this cost. However, it is less clear that engineers would voluntarily undertake a total of 150 hours of CPD every three years. We have therefore assumed that an opportunity cost of $100 per hour is associated with the remaining 60 hours of CPD activity over three years. We have also assumed an annual cost of $2,000 would be expended to attend approved CPD activities, such as conferences. We have therefore assumed that the annual cost of CPD under the mandatory registration scheme would be:

- cost to engineer to qualify for annual renewal including annual CPD requirements $4,100, comprising
  - $2,000 covering the opportunity costs associated with 20 hours of CPD
  - $2,000 for expenses associated with undertaking 20 hours of CPD
  - $100 covering the opportunity cost associated with renewal activity.

The opportunity costs associated with audits under the proposed mandatory arrangement were estimated to be $500. This cost is lower than reported by some stakeholders but reflects the fact that under the mandatory arrangements engineers will have access to online CPD recording applications. Further, we understand that the development of smart phone applications to link with the online records is also under consideration by Engineers Australia.

These CPD and audit costs have been allocated to all engineers currently registered under the state and territory based regulations.[17] They have also been allocated as opportunity costs to the assumed 55,990 engineers that are not currently registered, but who would be registered under the proposed mandatory registration arrangements.

6.2.2 Estimating the costs of the proposed national scheme

Table 15 reports the estimated total annual costs of the scheme over a 20 year period in 2011 dollars. As the number of practicing engineers on the national register increases during the three year transition phase, the annual cost of the scheme increases from $176.2million (2011 dollars) in year one to $357.2 million (2011 dollars) in year three, at which time all 55,990 additional engineers had been registered. The future annual cost of the proposed national scheme then increases over time with this cost increase being largely driven by the assumed net growth in the supply of professional registered engineers.

[17] Recall that our estimate of the opportunity cost of CPD activity included in the cost of the current arrangements only covered CPD activity if it was mandatory rather than voluntary.

Table 15 **Estimated annual cost of the proposed national arrangements (2011 $ million dollars)**

Year	1	2	3	4	5	6	7	8	9	10
Cost to Government	9.3	13.6	18.3	17.3	17.7	18.0	18.3	18.7	19.0	19.4
Cost to Assessment entities	37.7	43.1	43.5	6.2	6.0	6.1	6.2	6.3	6.5	6.6
Cost to Engineers	129.2	219.0	295.5	280.0	285.4	291.1	296.9	302.9	308.9	315.1
Total cost	176.2	275.8	357.2	303.6	309.1	315.2	321.5	327.9	334.4	341.1
Year	11	12	13	14	15	16	17	18	19	20
Cost to Government	19.7	20.1	20.5	20.9	21.3	21.7	22.1	22.5	22.9	23.4
Cost to Assessment entities	6.7	6.9	7.0	7.1	7.3	7.4	7.6	7.7	7.9	8.0
Cost to Engineers	321.4	327.9	334.4	341.1	347.9	354.9	362.0	369.2	376.6	384.1
Total cost	347.9	354.8	361.9	369.1	376.5	384.0	391.6	399.4	407.4	415.5

Note: *Cost to Government and cost to assessment entities is assumed to be covered by fees paid by Engineers. The cost to engineers excludes fees and charges paid to Government or assessment entities.*

Data source: ACIL Tasman estimates.

Over this twenty year period, the NPV of this stream of costs using a seven per cent discount rate would be just over $3.4 billion. Of this cost, around 90 per cent is incurred by the individual engineers or their employers through the opportunity cost of time spent completing applications, and paying for and attending continuing professional development activities and the like. As the national scheme is assumed to be cost neutral for government and the assessment entities, the remaining 10 per cent of costs is also paid out by engineers or their employers as application and/or renewal fees.

Table 16 **NPV of the cost of the proposed national arrangements**

NPV = 7%	$ million
Cost to Government (assumed recovered through fees)	$191.8
Cost to Assessment entities (assumed recovered through fees)	$161.8
Cost to Engineers (excluding fees)	$3,096.6
NPV total cost of proposed system	**$3,450.3**

Note: NPV, seven per cent discount rate over a 20 year period

Data source: ACIL Tasman estimates.

7 Estimating the benefits of national registration

The proposed national registration system for engineers is intended to:

- improve risk management and consumer protection
- enhance the skills and status of engineers while also building community awareness of the engineering skills required to protect community safety, health and welfare
- enhance public safety and ensure that qualified and competent professionals observe statutory codes of practice
- deliver greater efficiency by cutting red tape via consistent legislation and allowing engineers to register just once to practise across Australia.
- address skills shortages and enhance professional mobility.

This chapter outlines the exercise undertaken by ACIL Tasman to develop indicative estimates of some of the potential benefits associated with the proposed national registration system.

7.1 Avoided costs associated with the current system

The benefits from avoided administrative and compliance costs associated with the current ad-hoc system were previously quantified in Chapter 6.

7.2 Reduction in large engineering failures

Mistakes by poorly qualified and/or incompetent engineers have the potential to lead to catastrophic engineering failures. In Australia, there have been numerous catastrophic engineering failures in the last several decades.

7.2.1 Examples of large engineering failures in Australia

The collapse of the West Gate Bridge is perhaps the most costly of these failures in terms of the loss of human life. The West Gate Bridge is a steel box girder cable-stayed bridge spanning the Yarra River in Melbourne. Two years into the construction of the bridge on 15 October 1970, the 112 meter span between piers 10 and 11 collapsed and fell 50 meters to the ground and water below.

Thirty-five construction workers were killed. Many of those who perished were on lunch break beneath the structure in workers' huts, which were crushed by the falling span. Others were working on and inside the girder when it fell.

A Royal Commission into the collapse subsequently attributed the failure of the bridge to the structural design by designers Freeman Fox & Partners as well as an unusual method of erection by World Services and Construction, the original contractors of the project. It cost $31 million to rebuild the collapsed section of the bridge.

Other notable bridge failures in Australia include:

- the collapse of the Swan River railroad bridge in Fremantle in 1926
- the collapse of King Street Bridge in Melbourne in July 1962
- the collapse of a section of the Tasman Bridge in Hobart in January 1975 which resulted in 12 fatalities
- the collapse of the Somerton Bridge in New South Wales in December 2008
- the collapse of the formwork during a concrete pour for the half-built Gungahlin Drive Extension Stage 2 Barton Highway bridge in Canberra in August 2010, which injured 15 workers.

The devastating consequences of engineering failure can also be seen in incidents such as:

- The Thredbo landslide in 1997 that killed 18 persons in the collapsed Bimbadeen and Carinya Lodges
  - a road embankment constructed as a construction access during the construction of the Snowy Mountains scheme was marginally stable but was incorporated in post construction infrastructure servicing the ski resort built post construction of the scheme
  - at a later time a water main was constructed in the marginally stable embankment of materials that were unable to withstand the movement occurring in the embankment (presumably this decision was made without adequate risk assessment or reference to professional geotechnical advice)
  - leakage from the damaged water main saturated the embankment resulting in catastrophic failure and demolition of a number of ski lodge buildings downslope of the road.
- The Canberra Hospital implosion in July 1997 that killed a 12-year old girl and injured nine others
  - planned as a single demolition by explosive removal of support columns
  - the contractor was not competent in terms of structural engineering knowledge or handling explosives
  - there was no independent assessment undertaken by a structural engineer (as there was no regulatory requirement to do so).

- the Esso Longford Gas Plant explosion in 1998 that resulted in two fatalities and eight injuries and seriously affected gas supplies to 1.3 million Victorian households for two weeks, resulting in industry closure (impacting 89,000 businesses and 150,000 workers), estimated to have cost over $1 billion (including insurance costs of $150 million). The Royal Commission into the explosion found the contributing causes included:
  - poor design of the Longford plant
  - inadequate training of personnel in normal operating procedures of a hazardous process
  - the relocation of plant engineers to Melbourne had reduced the quality of supervision at the plant.[18]
- The Opal House collapse in Brisbane in 1998, where the contractor apparently failed to act on professional engineering advice (probably because the site supervisor was not a professional engineer) and carried out the excavation in one pass instead of the alternating "hit and miss" method.
- The collapse of the roof of the Riverside Golf Club in South Australia in 2002, which resulted in the death of two people. The Coroner's report found:

  …..neither the builder nor the architect, engineer, software designer, truss manufacturer, roof contractor, roof tiler or Local Government authority took any responsibility for the overall integrity of the roof structure.[19]
- The collapse of a $11 million hangar being built at the Fairbairn RAAF base at Canberra Airport in 2003, which resulted in the injury of 12 workers.
- The Lane Cove tunnel roof collapse in 2005 that damaged a 3-storey residential building.
- The Montara oil spill in the Timor Sea off the northern cost of Western Australia in 2009, which cost the rig operator more than $170 million and an environmental clean-up cost exceeding $5.3 million.

The primary causes of engineering disasters are usually considered to be:

- human factors (including both 'ethical' failure and accidents)
- design flaws (many of which are also the result of unethical practices)
- materials failures
- extreme conditions or environments
- most commonly and importantly combinations of these reasons.

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[18] Hopkins, Andrew. 2000, *Lessons From Longford: The Esso Gas Plant Explosion*, CCH Australia Limited

[19] SA Development Act, Advisory notice, December 2005, http://dataserver.planning.sa.gov.au/publications/1099p.pdf

A study on the causes of engineering failure by the Swiss Institute of Technology in 1976 reported 800 cases of structural failure. These structural failures cost the lives of 504 people, injured 592 people and incurred millions of dollars' worth of damage to property. [20]

The study found that when an engineer was at fault, the failure could almost always be attributed to a lack of competency with the breakdown as follows:

- insufficient knowledge – 36 per cent
- underestimation of influence – 16 per cent
- ignorance, carelessness and negligence – 14 per cent
- forgetfulness and error – 13 per cent;
- relying upon others without sufficient control – nine per cent
- objectively unknown situation – seven per cent
- imprecise definition of responsibilities – one per cent
- choice of bad quality – one per cent
- other reasons – three per cent.

Statutory registration arrangements enable appropriate standards of competence to be set and assessed, and incompetent engineers to be removed from the system, thus protecting the public from harm. The removal of incompetent engineers from a supervision role is not feasible under voluntary registration regimes.

The ability to ensure engineering competence through assessment in Australia is currently limited by voluntary arrangements (such as through Engineers Australia's CPEng and NPER registration, AusIMM's Chartered status and IFE registration) and via the state and territory system, which ranges from mandatory registration of all supervising engineers in Queensland, to registration of accredited certifying engineers in NSW to no registration of engineers in South Australia and Western Australia (see Chapter 3)

7.2.2 Estimating the benefits of reducing large engineering failures

To quantify the potential benefits of the proposed national registration system in reducing the likelihood and occurrence of large engineering failures, ACIL Tasman has made the following assumptions:

- national registration once fully implemented will prevent one large engineering failure every four years

[20] M. Matousek and Schneider, J., (1976) Untersuchungen Zur Struktur des Zicherheitproblems bei Bauwerken, Institut für Baustatik und Konstruktion der ETH Zürich, Bericht No. 59, ETH.

- each of these failures result in one fatality and five serious injuries
- the average response and rectification costs associated with each of these failures is $50 million.

Assuming that each fatality results in 40 years of life lost due to premature mortality, a real discount rate of seven per cent and the Value of a Statistical Life Year of $168,000 (following advice from the Office of Best Practice Regulation), the value of each life lost is approximately $2.24 million.

Assuming the average value of each serious injury to be $339,000 per hospital admission (based on a 2009 Victorian Department of Transport discussion paper[21]), the benefit of the national registration system in reducing the incidence of large engineering failures would be **$13.20 million per annum**.

7.3 Reduction in botched engineering projects

While spectacular but sporadic large-scale engineering failures command considerable public attention, the insidious potential losses to the economy from myriad engineering projects that are executed less than optimally because of incompetent and inadequately qualified engineers are likely to be far greater.

According to Engineers Australia, a national registration system will accelerate the introduction of a national performance standard for all engineers. A national performance standard, which focuses on how the engineer carries out and accomplishes an engineering task professionally, is expected to introduce an aspect of professionalism to engineering that is fundamental to other professions.

Recent research indicates that the engineering profession's early moves to corporatisation, the deskilling of the public sector of engineers and other such systemic issues have, in the absence of a national performance standard for engineers, resulted in regular and preventable failures to deliver engineering services with commercially efficient and predictable outcomes.[22]

In its review of the *Queensland Professional Engineers Act 2002*, the Queensland Department of Public Works identified an example where poor design in the petroleum industry led to equipment failure and environmental degradation. The report found that appropriately qualified and experienced engineers were not engaged to undertake the works.

[21] Department of Transport, Discussion Paper on Improving Marine Safety in Victoria: Review of the Marine Act 1988, July 2009, p.156

[22] The Warren Centre at the University of Sydney, the PPIR Protocol – www.ppir.com.au

Anecdotal evidence presented to ACIL Tasman during our stakeholder consultations also suggests that a significant proportion of engineering projects are affected by poor engineering practices and decisions, leading to rectification costs (including legal costs) and/or additional maintenance costs.

For example, it was brought to our attention that a 900 ML farm dam that had cost $2.9 million to construct failed on first filling due to the earthworks contactor's inappropriate response to observed seepage. The contractor did not have appropriate engineering qualifications and failed to consult a design engineer to obtain competent engineering advice. The costs resulting from the failure included:

- cost of permanent rectification – estimated at $1 million
- direct cost of loss of water and temporary rectification works - $1.3 million
- professional costs - $0.75 million (legal) and $0.25 million (engineering).

It is believed by Engineers Australia that performance standards for engineering could be integrated within competency standards and an appropriate code of practice under a statutory registration system in order to improve the reliability of engineering services.

According to the ABS, the value of engineering construction projects in Australia totalled $83.04 billion in 2010-11.[23]

Assuming that the proposed national registration system, once fully operational, results in one per cent fewer engineering construction projects being botched (say, from 20 per cent to 19 per cent or from 15 per cent to 14 per cent) and that the cost of rectifying such projects is equal to 25 per cent of the value of the original project, the benefits that can be attributed to the proposed system is estimated to be **$207.08 million per annum.**

7.4 Benefits relating to migrant engineers

A national statutory registration process would also assist engineers to have international mobility and could help to integrate engineers from overseas.

Studies have shown that migrants with foreign qualifications in engineering are considerably less likely to work as engineers than native-born Australians with engineering qualifications.[24] In addition, migrants are likely to face a lengthier job search and to earn less than Australians with similar qualifications and experience levels.

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[23] ABS 8762.0 Engineering Construction Activity, June Quarter 2011

[24] Trevelyan J. and S. Tilli, International Students' Employment Outcomes: Causes for Concern, Proceedings of the 2010 AaeE Conference, Sydney

It has been argued by Engineers Australia that the development of a statutory national registration system would allow the engineering profession to more easily access international markets where registration is essential. [25] It would also provide a framework within which engineers coming to Australia from overseas could be assessed and recognised more easily where they are appropriately qualified and competent. This is particularly important for migrant engineers from source countries which are not signatories to the six multilateral international agreements governing seamless recognition of engineering qualifications and professional competence that Australia participates in.

In essence, the national registration scheme would reassure potential employers that such migrant engineers have the appropriate qualifications, skills and prior experience to successfully fulfil the demands of the jobs for which they are applying for. This could be a further way to address the skills shortage in Australia while ensuring high standards of competence.

7.4.1 Estimating the benefits to new migrant engineers

To estimate the potential benefits of a national registration system to migrant engineers, ACIL Tasman assumed the following:

- 25 per cent of new migrant engineers would enjoy the credentialing benefits offered by the proposed national registration system
- national registration would reduce the duration of job search for these new migrant engineers by one month on average
- there is a 20 per cent wage gap between the salaries of new migrant engineers and that of equivalent native-born engineers
- this gap would close by approximately 50 per cent for the 25 per cent of new migrant engineers who benefit from the proposed system.

Using Department of Immigration and Citizenship data that indicate there were 6,712 engineers in the 2009-10 permanent migration intake and information from *mycareer.com.au* showing that the average salary of Australian engineers is currently $121,513 per annum, the benefits of the proposed national registration system to new migrant engineers is estimated to be **$29.91 million per annum**.

[25] However, it is difficult to quantify the benefits from increased engineering exports that may result from national registration as the ABS does not collect data on Australian services exports in sufficient detail.

7.4.2 Benefits from reducing the skills shortage

The skills shortage in relation to engineers in Australia is well documented. A survey of businesses employing engineers conducted in January 2008 by Engineers Australia indicated:

- 73 per cent of businesses reported skills shortages
- 80 per cent of businesses could not recruit the required skill set
- 82 per cent of businesses reported there were moderate to severe consequences of skills shortages, including monetary problems and project delays.

According to the Australian National Engineering Taskforce:

> In 2010, skills shortages in engineering have been highlighted as a key constraint on a resources-led economic recovery, with the National Resources Sector Employment Taskforce hearing industry's concerns of a major labour market shortfall. Skills Australia has also designated engineering as a skillset requiring structured workforce development interventions to ensure that community need is met, particularly around climate change infrastructure adaptation. Engineers are globally in short supply, with Australian higher education providers producing only around half of the graduates needed to fill domestic demand, and in this environment systemic cultural issues, low numbers of women in education and in the workforce and an aging workforce have produced widespread issues with retention and sustainability.[26]

– A recent report by the Department of Education, Employment and Workplace Relations has reported the extent of skills shortages in March 2011. The report found that there was a fall in the proportion of engineering vacancies filled between 2009-10 and 2010-11. However, the number of suitable applicants per vacancy remained stable (see Figure 5). This report identified shortages in nine of the engineering disciplines recorded and recruitment difficulties in one other (see Table 17). Electronics engineering and electrical engineering draftspersons technicians were at that time the only engineering disciplines not experiencing a skill shortage or some degree of recruitment difficulty.

This report made several other key observations, including that:

- shortages were mainly apparent for experienced professionals however some new graduates experience difficulty gaining initial employment
- there was a fall in the number of engineering professional vacancies in 2010-11 however there was no change in the number of suitable applicants per vacancy
- there were significant differences across the engineering labour market that depended on experience, specialisation and location

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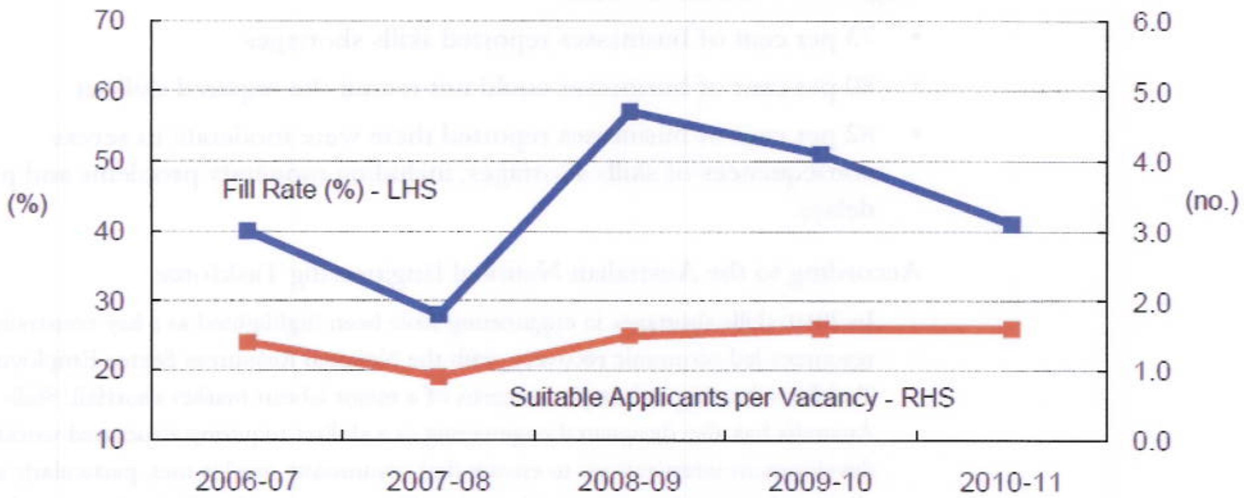
[26] Australian National Engineering Taskforce, *Scoping our Future: Addressing Australia's Engineering Skills Shortage*, p.3

Figure 5 **Proportion of vacancies filled and number of suitable applicants per vacancy, engineering professionals, 2006-07 to 2010-11**



Data source: DEEWR Survey of Employers who have Recently Advertised results, report in Skill Shortages Australia (June 2011)

- there was a tightening in the market for engineering managers and mechanical engineers (in terms of vacancies filled and suitable applicants per vacancy)
- the market for chemical, structural and transport engineers eased (in terms of more vacancies filled and more suitable applicants)
- recruitment for structural and mining engineers is particularly hard but electronics engineering usually has a strong field of suitable applicants

- engineering had the lowest proportion of vacancies filled for any occupational cluster assessed (41 per cent compared to 60 per cent for all professions). However, the number of suitable applicants per vacancy was near the average for all professions assessed, which suggested disparity in the response to advertising.[27]

[27] Australian Government, *Skills Shortages Australia*, June 2011, p.26.

Table 17 **Engineering professions and associates, March quarter 2011**

Occupations in cluster	Rating
1332-11 Engineering manager	Shortage
2331-11 Chemical engineer	Recruitment difficulty
2332-11 Civil engineer	Shortage
2332-14 Structural engineer	Shortage
2332-15 Transport engineer	Shortage
2333-11 Electrical engineer	Shortage
2334-11 Electronics engineer	No shortage
2335-12 Mechanical engineer	Shortage
2336-11 Mining engineer	Shortage
2336-12 Petroleum engineer	Shortage
3122 Civil engineering draftspersons and technicians	Shortage
3123 Electrical engineering draftspersons technicians	No shortage

Data source: Skill Shortages Australia (June 2011)

The impact of skills shortages in the profession has been observed by Kaspura[28]. Engineers Australia's survey of skills shortages has identified a growing trend in the proportion of respondents reporting moderate problems over the past five years as consequence of recruitment difficulties, with the proportion reporting this problem growing 46 per cent between 2006 and 2010. On the other hand, there were downward trends in the proportion of respondents reporting minor irritation (dropping by 16.7 per cent), the proportion reporting major problems (dropping by 32.6 per cent) and the proportion reporting that they did not proceed with the project (dropping by one third).

Table 18 **Consequences of recruitment difficulties, 2006-2010**

Consequence	2006	2007	2008	2009	2010	5-year change
Minor irritation but no monetary issues	12	10	16	21	10	-16.7%
Moderate problems with some monetary problems	39	40	43	43	57	46.2%
Major problems, including project delays and costs	43	42	33	28	29	-32.6%
Did not proceed with available project	6	7	8	8	4	-33.3%

Data source: Kaspura, *The Engineering Profession, A Statistical Overview, Eighth Edition, 2011 (Table 9.4)*

Forecasts by leading industry professionals predict that over the next 10 years more than $500 billion will be spent on infrastructure projects in Australia. Such projects, in areas like road, rail, electricity, water and telecommunications, are expected to require significant engineering resources. Through the GFC,

[28] Kaspura, Andre, *The Engineering Profession: A Statistical Overview, Eighth Edition, 2011*, 2011.

demand for engineering services remained high, particularly in the resource-rich States of Queensland and Western Australia. According to Engineers Australia, Australia is facing a potential shortage of some 20,000 engineers.[29] This situation is exacerbated by the ageing nature of the profession, with almost a quarter of the current membership of Engineers Australia aged over 50.

If the national registration system induces an additional five per cent of foreign engineers to migrate permanently to Australia each year (approximately 336 engineers), this would increase the existing pool of approximately 150,169 practising engineers in Australia by 0.22 per cent.

Assuming that the value of engineering construction activity is proportional to the number of practising engineers in the country, this small reduction in skills shortage is estimated to generate an additional **$185.58 million per annum** in engineering construction activity alone in Australia.

ACIL Tasman has not attempted to quantify the general reduction in skills shortage arising from the introduction and implementation of the proposed national registration scheme. The majority of stakeholders consulted by us on this issue believed that such a scheme by itself would not have a major impact on the skills shortage problem (see Section 5.5.2).

7.5 Efficiency gains

As discussed in Chapter 3, engineers operating throughout Australia are currently covered by over a dozen Acts and regulations that contain various competency standards and processes for (mostly voluntary) registration. In addition, the regulatory and quasi-regulatory regimes maintained by local and state/territory governments impose various performance-based standards. Engineers must work in accordance with these, or provide for certification by professional engineers or other persons with engineering qualifications. This creates complexity as well as added compliance costs.

A uniform national statutory registration scheme for engineers would drive efficiencies for the entire system and improve productivity for engineers by reducing their compliance costs. Under a national scheme the non-productive time spent in preparing applications and the fees currently paid by engineers to various registration and other bodies around the country could be consolidated to cover one mandated registration process. This would also significantly reduce the current administrative burden for engineers of registering with

[29] Engineers Australia, *The Regulation of Engineers: Finding the right approach for a national economy*

various bodies in different jurisdictions and complying with a raft of different regulatory requirements.

Additional efficiency gains from a national registration system include reduced search costs for clients associated with acquiring information on the competency and skills of engineers they are potentially entering into contracts with.

The proposed national registration system would also ensure existing Australian engineers have mobility of trade. The increased portability of the profession across jurisdictions would allow professional labour to flow freely across state/territory borders and respond to demand without having to comply with the different requirements in each jurisdiction. It would also ensure that, as different parts of the Australian economy grow, engineers would be able to travel to meet demand without added compliance costs.

Assuming that the national registration system would lead to an efficiency gain of 0.25 per cent, based on the current value of engineering construction projects, such benefits would amount to **$207.60 million per annum**.

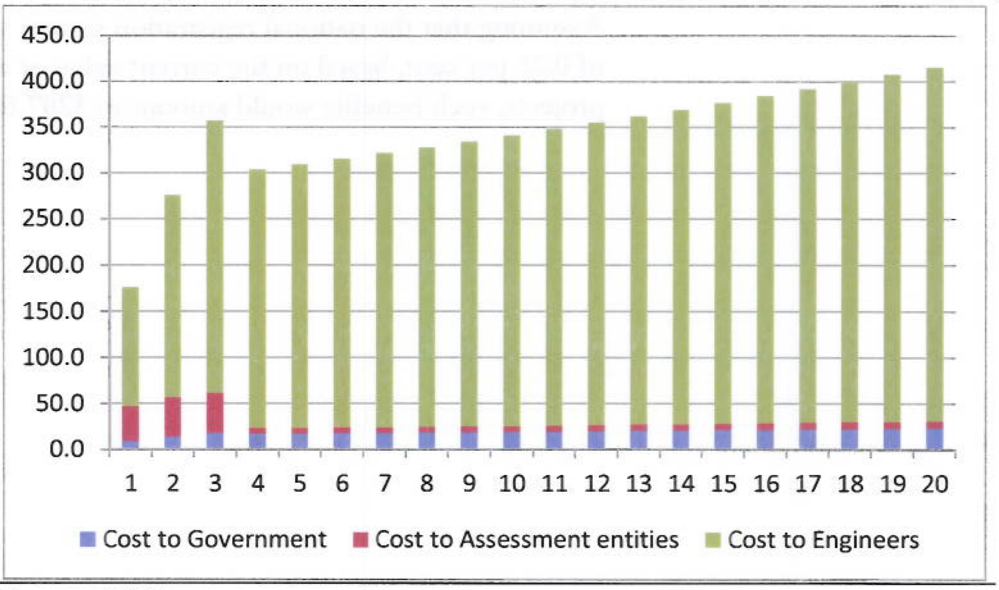
8 Cost-benefit analysis

This chapter presents the key results of ACIL Tasman's cost-benefit analysis of the proposed national registration scheme for engineers in Australia.

8.1 Present value of costs

The methodology for estimating the costs of the proposed national registration scheme was previously described in Chapter 6. Figure 6 shows the annual costs of the scheme to engineers, assessment entities and government over the 20-year time horizon of the cost-benefit analysis.

Figure 6 **Annual costs of the proposed national registration scheme, Year 1 to Year 20 ($ million, 2011 dollars)**



Data source: ACIL Tasman

The total annual cost of the scheme is estimated to rise from $176.2 million in Year 1 to $415.5million in Year 20. The compliance costs incurred by engineers and engineering firms are expected to be by far the largest component of total annual costs.

Over the 20-year time horizon of the cost-benefit analysis, the present value of the total costs of the proposed national registration scheme is:

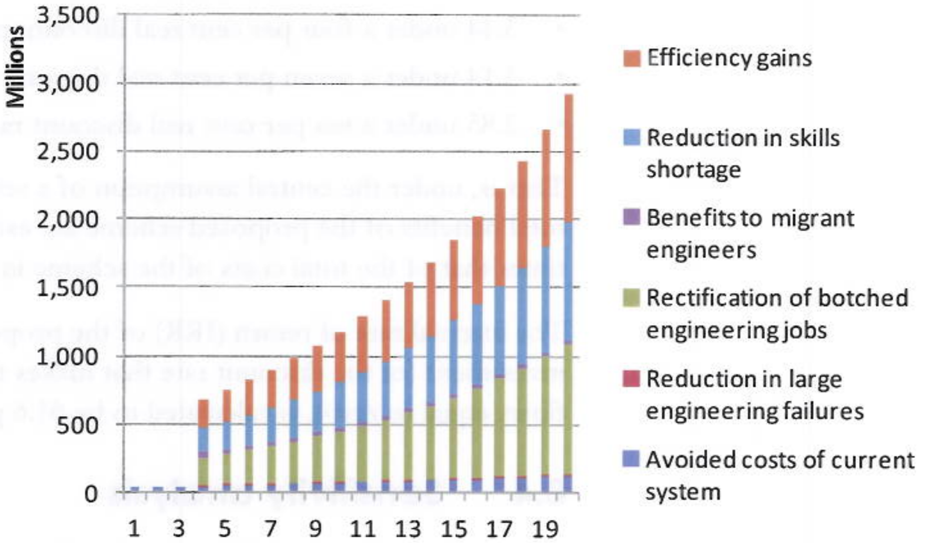
- $4.53 billion under a four per cent real discount rate
- $3.45 billion under a seven per cent real discount rate
- $2.71 billion under a ten per cent real discount rate.

8.2 Present value of benefits

ACIL Tasman's approach to estimating the key benefits of the proposed national registration scheme was previously described in Chapter 7. Figure 7 shows the annual benefits of the scheme associated with the following:

- avoided costs associated with the current system
- reduction in fatalities and serious injuries due to large engineering failures
- reduction in the number of botched engineering jobs that require rectification
- benefits to new migrant engineers from reduced job search duration and higher salaries
- reduction in skills shortage due to an increase in the annual cohort of new migrant engineers
- efficiency gains due to
  - a reduction in administrative burden in engineers practising in multiple jurisdictions
  - increased mobility of trade for engineers
  - a reduction in search costs for clients associated with acquiring information on the competency and skills of engineers they are potentially entering into contracts with.

Figure 7 **Annual benefits of the proposed national registration scheme, Year 1 to Year 20**



Data source: ACIL Tasman

The total estimated annual benefits of the proposed scheme is projected to be between $32.2 million and $39.8 million in the first three years, jumping to $687.1 million in Year 4 when the scheme becomes fully operational and then rising progressively to $2.93 billion in Year 20 due to assumption that the value of engineering construction projects will be rising by ten per cent per annum in real terms.

(According to the ABS, the 20-year historical growth rate of engineering construction projects in Australia has been just under eight per cent per annum while the 10-year historical growth rate has been over 12 per cent per annum.)

Over the 20-year time horizon of the cost-benefit analysis, the present value of the total benefits of the proposed national registration scheme is:

- $15.59 billion under a four per cent real discount rate
- $10.83 billion under a seven per cent real discount rate
- $7.74 billion under a ten per cent real discount rate.

8.3 Key results of the cost-benefit analysis

Combining the present value of total costs and total benefits associated with the proposed national registration scheme, the NPV of the scheme is estimated to be:

- $11.06 billion under a four per cent real discount rate
- $7.38 billion under a seven per cent real discount rate
- $5.03 billion under a ten per cent real discount rate.

The benefit-cost ratio (BCR) of the scheme (obtained by dividing the present value of total benefits by the present value of total costs) is:

- 3.44 under a four per cent real discount rate
- 3.14 under a seven per cent real discount rate
- 2.85 under a ten per cent real discount rate.

That is, under the central assumption of a seven per cent real discount rate, the total benefits of the proposed scheme are estimated to be more than three times that of the total costs of the scheme in present value terms.

The internal rate of return (IRR) of the proposed scheme, the yield on the investment (or the discount rate that makes the net present value of all cash flows equal to zero), is calculated to be 51.6 per cent.

8.4 Sensitivity analysis

To test the robustness of the cost-benefit analysis results and recognising that they may be highly sensitive to assumed parameter values, ACIL Tasman undertook sensitivity analysis using Monte Carlo simulations (see Box 3).

Box 3 **Monte Carlo simulations**

Monte Carlo simulation is a computerized mathematical technique that accounts for risk in quantitative analysis and decision making. The technique was first used by scientists working on the atom bomb; it was named for Monte Carlo, the Monaco resort town renowned for its casinos. Since its introduction in World War II, Monte Carlo simulation has been used to model a variety of physical and conceptual systems.

Monte Carlo simulation performs risk analysis through building models of possible results by substituting a range of values—a probability distribution—for any factor that has inherent uncertainty. During a simulation, values are sampled at random from the input probability distributions. Each set of samples is called an iteration, and the resulting outcome from that sample is recorded.

Monte Carlo simulation does this hundreds or thousands of times (depending upon the number of uncertainties and the ranges specified for them), and the result is a probability distribution of possible outcome values. In this way, Monte Carlo simulation provides a much more comprehensive view of what may happen. It shows not only what could happen, but also how likely it is to happen.

Source: Palisade Software

In conducting these simulations, assumptions were made regarding the underlying statistical distributions of key parameters. The chosen statistical distributions are shown in Table 19.

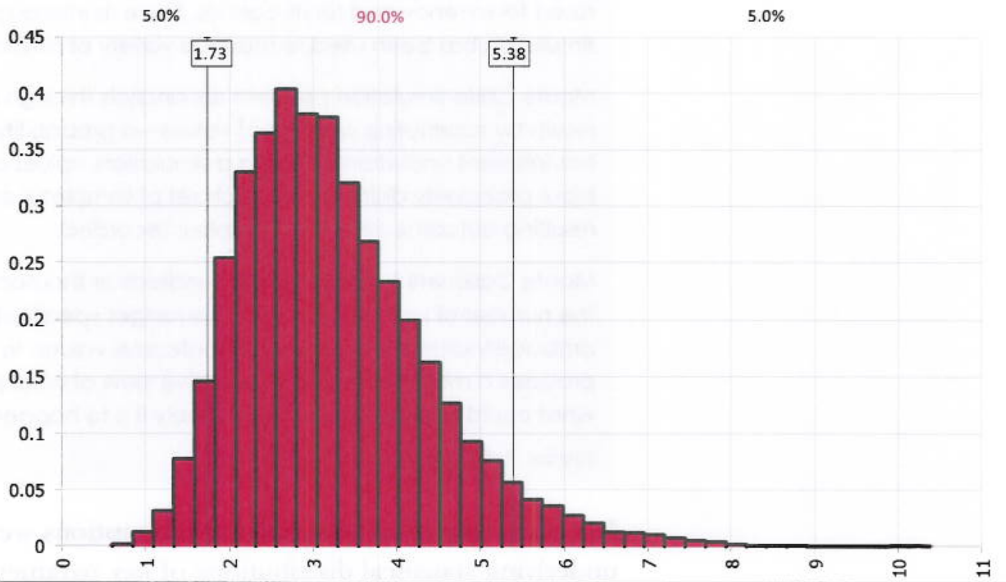
Table 19 **Assumed statistical distributions of key parameters**

Parameter	Central estimate	Statistical distribution
Number of large engineering failures per year preventable by national registration	0. 25	Triangular (min = 0, max = 0.5)
Proportion of botched projects preventable by national registration	1%	Triangular (min = 0%, max = 2%)
Rectification cost of botched jobs as proportion of project value	25%	Triangular (min = 0%, max = 50%)
Reduction in migrant engineer job search duration due to national registration	1 month	Triangular (min = 0 months, max = 2 months)
Percentage increase in new migrant engineers per year due to national registration	5%	Triangular (min = 0%, max = 10%)
Efficiency gain due to national registration	0.25%	Triangular (min = 0%, max = 0.5%)
Annual growth rate of engineering construction	10%	Triangular (min = 5%, max = 15%)
Present value of cost of national registration scheme	$3.45 billion	Triangular (min = $2.07 billion, max = $4.83 billion)

Data source: ACIL Tasman.

Based on the chosen statistical distributions for the key parameters, ACIL Tasman generated a 90 per cent confidence interval around the central estimate of the BCR (which, as reported previously, was 3.14 under a seven per cent real discount rate). After 10,000 iterations using the Palisade @Risk software package, the 90 per cent confidence interval was found to be (1.73, 5.38), as can be seen in Figure 8. That is, there is a 90 per cent probability that the 'true' BCR lies within this interval.

Figure 8 **90% confidence interval for BCR**



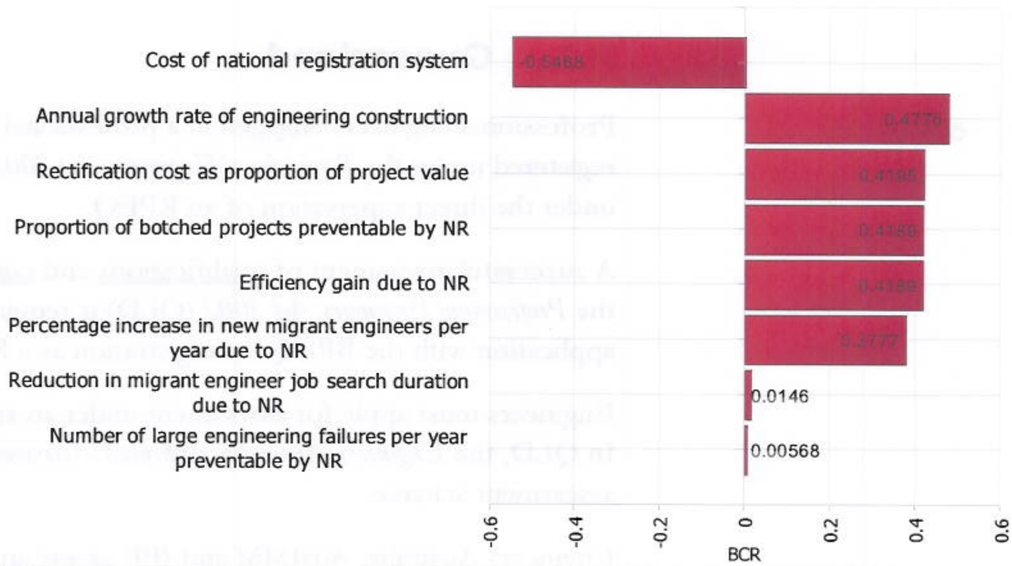
Data source: ACIL Tasman

In addition, ACIL Tasman used the @Risk software package to generate Tornado diagrams that illustrate that relative importance of each assumption in determining the BCR (and hence the economic viability) of the proposed national scheme.

As can be seen in Figure 9, the key assumptions in decreasing order of importance are:

- present value of cost of national registration scheme
- annual growth rate of engineering construction
- rectification cost of botched jobs as proportion of project value
- efficiency gain due to national registration
- proportion of botched projects preventable by national registration
- percentage increase in new migrant engineers per year due to national registration
- reduction in migrant engineer job search duration due to national registration
- number of large engineering failures per year preventable by national registration.

Figure 9 **Tornado diagram illustrating the impact of key assumptions on BCR**



Data source: ACIL Tasman

A Current regulatory arrangements

A.1 Queensland

Outline

Professional engineers engaged in a professional engineering service must be registered under the *Professional Engineers Act 2002* (QLD), unless they work under the direct supervision of an RPEQ.

A successful assessment of qualifications and competencies under Part 2 of the *Professional Engineers Act 2002* (QLD) is required before lodging an application with the BPEQ for registration as a RPEQ.

Engineers must apply for assessment under an approved assessment scheme. In QLD, the *Engineers Australia Approved Assessment Scheme* is the approved assessment scheme.

Engineers Australia, AusIMM and IFE assess an engineer's qualifications and competencies and issues a *Letter of Assessment* to be sent to BPEQ to be sent when applying for registration.

Coverage

The areas of engineering covered by registration, and who has been approved to assess competencies include:

- Competences assessed to Engineers Australia:
  - General: aerospace, biomedical, building services, chemical, civil, electrical, environmental, ITEE, management, marine, mechanical, naval architecture, structural.
  - Specific: fire safety, heritage and conservation, in-service inspection of amusement rides and devices, pressure equipment design verification, subdivisional geotechnics.
- Competencies are assessed by AusIMM
  - Mining, environmental, geotechnical/geological, metallurgical.
- Competencies assessed by Institution of Fire Engineers, Australia
  - Fire engineering.

Assessment of qualifications

- Engineers Australia members have the qualification that meets the requirements of Part 2 of the Act.
- Non-Engineers Australia members must:
  - provide certified copies of degree certificates and academic records as evidence of an engineering qualification listed as accredited by Engineers Australia or an engineering qualification listed as accredited by another Signatory to the Washington Accord.

- if the primary engineering qualification is no accredited by Engineers Australia or another signatory to the Washington Accord then engineers must:
  - … provide a copy of the Migration Skills Assessment letter from Engineers Australia
  - … provide a copy of the Stage 1 Assessment letter from Engineers Australia

Assessment of competencies

- Engineers Australia members who have a current CPEng or are registered on the NPER meet the requirements of Part 2 of the Act.
- Non- Engineers Australia members must prepare competencies. How to prepare evidence in outlined in the *Chartered Status Handbook*.

Fees

- Pay application fee ($48.45) and a registration fee $178.90. If applying for registration in a second area of engineering (or changing to another area), no fee is required.[30,31]

Renewal

An annual renewal fee of $178.0 is payable.

Continued professional development

The Board has aligned its CPD policy with those of Approved Assessment Entities – Engineers Australia, AusIMM and IFE. If you are following the policy guidelines of these professional engineering organisations, you will be seen to be fulfilling your obligations for CPD to the Board.

- Engineers Australia requires 150 hours of CPD over three years[32]
- AusIMM requires 50 hours each year over a three year period.[33]
- IFE recommends 75 hours over a period of three years.[34]

A.2 New South Wales

Outline

Applicants are required by the *Building Professionals Act 2005* (BP Act) to make an application for accreditation in the form approved by the Building Professionals Board (the Board) and to provide the documents and information the Board requires to determine the application.

Coverage

- Category A: Accredited certifier for:
  - A1: builder surveying grade 1
  - A2: builder surveying grade 2
  - A3: builder surveying grade 3

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30 http://www.engineersaustralia.org.au/nerb/regulatory-schemes/assessment-for-rpeq.cfm

31 http://www.bpeq.qld.gov.au/AM/Template.cfm

32 http://www.engineersaustralia.org.au/professional-development/cpd/cpd_home.cfm

33 http://www.ausimm.com.au/content/docs/cpd_guidelines2010.pdf

34 http://www.ifeaustralia.org.au/BPEQ/FORM%205.1%20-%20CPD%20GUIDANCE.pdf

- A4: building inspector
- Category B: Accredited certifier for:
  - B1: subdivision certifier
- Category C: Accredited certifier for:
  - C1: private road and drainage design compliance
  - C2: private road and drainage construction compliance
  - C3: stormwater management facilities design compliance
  - C4: stormwater management facilities construction compliance
  - C5: subdivision and building (location of works as constructed compliance)
  - C6: subdivision road and drainage construction compliance
  - C7: structural engineering compliance,
  - C8: electrical services compliance
  - C9: mechanical services compliance
  - C10: fire safety engineering compliance
  - C11: energy management compliance (Classes 3, 5 to 9)
  - C12: geotechnical engineering compliance
  - C13: acoustics compliance
  - C14: building hydraulics compliance
  - C15: stormwater compliance
  - C16: speciality hydraulic services compliance
- Category D: Accredited certifier for:
  - D1: strata certification.

Requirements

- Engineers must demonstrate that they meet Core Performance Criteria (comprising 14 Core Skills Criteria, five Knowledge Criteria and Core Underpinning Knowledge.
  - Applicants can demonstrate that they have satisfied the requirements of the Core Performance Criteria in one of four ways:
    - … successfully completing all of the requirements of the Certification Short Course offered by the University of Technology, Sydney **OR**
    - … completing a course that is equivalent to the Certification Short Course. To do this, applicants must provide evidence to satisfy the Board that the course they seek to do is equivalent to the Certification Short Course. Applicants must provide this evidence, and obtain the Board's approval of the course, before undertaking the course. **OR**
    - … successfully passing the Accreditation exam. Applicants seeking to undertake the Board's Accreditation exam must contact the Board to make arrangements to do the Accreditation exam. **OR**

… alternative testing to the Accreditation Exam. This must be applied for.

- Must demonstrate Specialty Performance Criteria relevant to the category of registration sought have been met.
  - If engineers are registered on the NPER (in the relevant registration field), they automatically meet the Specialty Performance Criteria and Experience Requirement.
  - Engineers not registered on NPER or don't have all the Specialty Performance Criteria are not covered must complete an Annotated Performance Criteria Report. If this provides insufficient evidence, the engineer may have an interview, undertake an oral exam or provide a demonstration of their skills.
- Must hold a specialty qualification listed in the Accreditation Scheme.
  - Not applicable to engineers with relevant NPER registration.
  - Applicants with a specialty qualification must complete a verification form.
  - Applicants without a specialty qualification must provide evidence that they hold an equivalent qualification.
- Must provide evidence of practical experience by completing an annotated resume and have it verified by referees.
  - Not applicable to engineers with relevant NPER registration.

Fees

Pay an application fee ($1,500 for categories A1, A2, A3 or B, or $750 for categories C1-C16 or D). If accreditation is sought in another category, a further accreditation fee must be paid for consideration of a new application ($750 to $1,500 depending of classification sought).[35]

Renewal

Pay a renewal fee ($1,500 for categories A1, A2, A3 or B, or $750 for categories C1-C16 or D).[36]

Thus engineers are required to pay an application fee and renewal fee of $750.

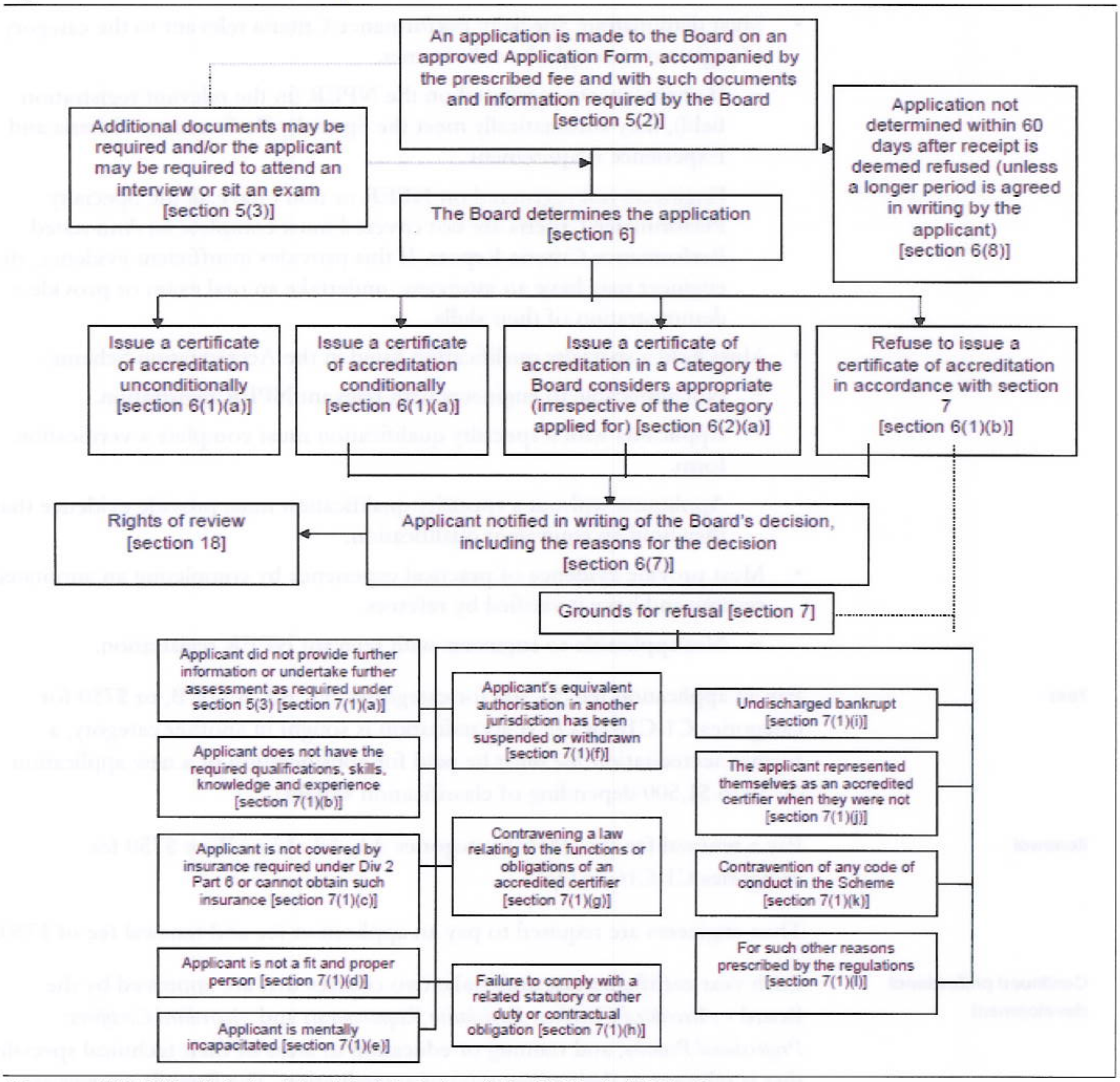
Continued professional development

Each year certifiers must undertake two courses that are approved by the Board - *Accredited Certifiers: Legislative Requirements* and *Accredited Certifiers: Professional Practice*, and training or education in areas of their technical speciality that is relevant to their category(s) of accreditation. The Board's courses are mandatory for all accredited certifiers.

[35] http://www.bpb.nsw.gov.au/resources/678/Applying%20for%20accreditation%20-%20a%20guide%20JL%20Ver%200.3%201%20April%202011.pdf

[36] http://www.bpb.nsw.gov.au/resources/702/Application%20to%20renew%20accreditation%20private%20standard30052011

Figure 10 **NSW accreditation process**



Data source: NSW Building Professionals Board, *Applying for Accreditation: A Guide, April 2011, p.43.*

A.3 Victoria

Outline

To become a registered building practitioner, an application must be lodged with the Building Practitioners Board (the Board).

Initially, a staff member of the Board will ensure that all the required information is provided with the application. When complete, this person forwards the application for assessment to the Board member responsible for the registration category for final review and decision.

There are four classes of Engineer registration: Civil Engineer (EC) – Structural; Mechanical Engineer (EM) – Hydraulics; Electrical Engineer (EE) and Fire Safety Engineer (EF).

Coverage

Only engineers who are engaged in the building industry are required to be registered. Building practitioners carrying out domestic building work over $5,000, or any commercial building work must be registered as a Registered Building Practitioner (RBP) with the Board. An engineer must be registered as an RBP for demolition and house removal works regardless of project cost.

Process

Further to an application for registration being lodged, and prior to registration being approved, an applicant may need to be assessed by a Board member / industry expert or qualified workplace assessor /industry expert. The assessment may include:

- an interview, involving questions and answers based on the competencies
- the tabling of documentation, including examples of work carried out and a business plan or financial plan.[37]

Requirements

- A University Degree in Engineering or another qualification that the Building Practitioners Board (the Board) regards as equivalent, or a current certificate of registration from the NPER **OR**
- Understanding of the laws relating to the building industry and be familiar with current engineering practices in the specific field **OR**
- At least three years of practical experience to the satisfaction of the Board.[38]
- Interview (if requested).

Fees

Pay an application fee of $90 and an annual renewal fee of $90.[39] If a practitioner were to hold a registration in one category for example, building surveying (initial fee $ 90.00) and were to apply for an additional registration in a category of engineering the fee is $ 30.00.

Continued professional development

RBPs are encouraged to continue learning throughout the lifetime of their registration. However, participation is voluntary.

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37 http://www.buildingcommission.com.au/resources/documents/EngineerComp20051.pdf

38 http://www.buildingcommission.com.au/resources/documents/Engineer_Info_20051.pdf

39 http://www.buildingcommission.com.au/resources/documents/RAB_App_Form_28.pdf

A.4 Tasmania

Outline

The *Building Act 2000* (the Act) together with the *Building Regulations 2004* and *Plumbing Regulations 2004* are laws regulating building and plumbing work in Tasmania.

Engineers Australia advises that accreditation is valid for three years, unless circumstances change that affect eligibility, and pay an annual subscription. Engineers must also meet CPD requirements under the *Building Act 2000* and maintain the required insurance cover.[40]

The Building Control Branch of Workplace Standards Tasmania assesses applicants for accreditation to ensure they meet the requirements of the accreditation Scheme. Accreditation fees paid by applicants are used to pay for administration of the Scheme and include:

- accreditation of practitioners and renewal of practising certificates
- monitoring of practitioner's performance and compliance with the Act through auditing
- investigating complaints against Accredited Building Practitioners (e.g. of unsatisfactory professional conduct or professional misconduct)
- managing the CPD requirements of practitioners.

Coverage

Accreditation is for building designers, including engineers.

Requirements

- Listing on the NPER **OR**
- Recognition by Engineers Australia as a CPEng in the relevant area **OR**
- Appropriate tertiary or other qualifications
  - Engineer (Fire Safety): an appropriate degree (AQF 7) with a Graduate Diploma or higher qualification in Fire Safety such as *the Graduate Diploma of Building Fire Safety & Risk Engineering* from Victoria University or *Master of Fire Safety Engineering* from the University of Western Sydney and three years design experience in the area of fire safety engineering attested to by a senior engineer within the area of practice of Fire Safety. In addition to engineering degrees, 'an appropriate degree' may include degrees in Architecture or Building Surveying.
  - Engineer (Building Services): A degree in engineering (AQF 7) with a graduate certificate (or higher post graduate qualification) in building services, building mechanical services, air conditioning, building electrical services, building hydraulic services, fire safety systems, building acoustics or energy management in buildings, and three years experience as a design engineer within the scope of work for Engineer – Building Services **OR**

[40] http://www.wst.tas.gov.au/__data/assets/pdf_file/0004/81751/IS100.pdf

A degree in engineering (AQF 7) and five years experience practising as a design engineer within the scope of work for Engineer – Building Services attested to by a senior engineer within the area of practice of Building Services.

– Engineer (Civil): A degree in engineering (AQF 7) and a graduate certificate (or higher post graduate qualification) in civil, structural, geotechnical or environmental engineering, or soil science, and three years experience practising as a design engineer within the scope of work for Engineer – Civil **OR**

A degree in engineering (AQF 7) and five years experience practising as a design engineer within the scope of work for Engineer – Civil attested to by a senior engineer within the area of practice of civil, structural, geotechnical or environmental engineering. [41]

Fees

Pay an application fee ($168 per category applied for) and an annual accreditation fee ($336).[42] Accreditation is valid for three years, with a renewal form and invoice sent each year.

Continued professional development

Undertake 30 hours of professional development each year (for each category an engineer is registered under).

A.5 Australian Capital Territory

Outline

Under the ACT's Construction Practitioners Act 1998, building certifiers must be registered with the Building, Electrical & Plumbing Control Section of the Department of Territory and Municipal Services. Persons who certify building work or plumbing and drainage plans must be licensed. An engineer to be licensed as building certifier must be either:

- accredited as a building surveyor with the Australian Institute of Building Surveyors **OR**
- registered with Engineers Australia on the NPER as a Principal Certifier - Building.

However, we have been advised that there are currently no engineers licensed to certify building work or plumbing and drainage plans in the ACT.

ACIL Tasman during the consultation process was advised that the ACT Government is currently planning to adopt an engineer registration scheme along the lines of the Queensland model. However, as no documentation or draft legislation is available there is currently no detail available on the precise coverage or the proposed commencement date.

41 http://www.wst.tas.gov.au/__data/assets/pdf_file/0009/107865/BPA_scheme_08.pdf

42 http://www.wst.tas.gov.au/__data/assets/pdf_file/0006/81753/IS077.pdf

A.6 Northern Territory

Outline

The Building Practitioners Board's principle role is the registration of Building Practitioners, which includes Mechanical, Hydraulic and Structural Engineers as well as Plumbers, Builders, Certifying Architects and Building Certifiers. The Board is not directly involved in complaints about engineers, which are handled by the Director of Building Control. However the Board does conduct inquiries into Practitioners' work and conduct when required to by the Director.

Trades persons and certifying engineers carrying out prescribed residential building work in the Northern Territory (as specified in Part 4A of the *Building Act*) must be registered. Companies undertaking prescribed residential building work must also be registered with the Board.

Coverage

Registration can be made for Certifying Engineer (Hydraulic), Certifying Engineer (Mechanical) and Certifying Engineer (Structural).[43]

Qualifications

- A qualification required for membership of the Institution of Engineers, Australia as a professional engineer eligible to use the post nominals MIEAust **OR**
- A Certificate of Registration in the relevant category (structural engineer, building services engineer or mechanical engineer) on the NPER

Experience

- Three years practical experience, including 12 months practical experience in design and 12 months practical experience in supervision, relevant to the sub-category applied for.
  - If registered on the NPER, evidence of experience does not need to be provided.

Fees

Individuals and companies pay an application fee of $235 and an approval fee of $704.[44] Every two years individuals and companies pay a renewal fee of $939.

Continued professional development

At present, no continuing development requirements have been determined by the Minister. The Board, however, encourages all registered practitioners to embark on a program of activity that continues to maintain and develop their personal skills and knowledge of the building industry.[45]

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43 http://www.nt.gov.au/bpb/practitioners.shtml

44 http://www.nt.gov.au/bpb/documents/AppCertEng.pdf

45 http://www.nt.gov.au/bpb/documents/AppRenewalIndividual.pdf

A.7 South Australia

There is currently no registration or accreditation system for engineers in South Australia. In terms of the building industry (which was the extent of ACIL Tasman's consultation in this state), the onus is on the building surveyor to have any engineering calculations independently verified. As the result of a major engineering disaster (the Riverside Golf Club roof collapse), strong concerns were raised about the assessment of structural engineering calculations in the state, with a select committee in the SA Parliament considering options. It is understood that one recommendation is for some form of registration of engineers. However, the nature and extent of registration if it goes ahead is currently not known.

A.8 Western Australia

A draft discussion paper regarding the registration of engineers was released in 2005, with a final discussion paper released in 2008. The paper discussed the basis for registration, e.g. building engineers only or broader registration.

In August 2011, the Western Australian Government established a Building Commission to administer building practice registration, building controls (i.e. acts and standards) and complaints processes. The Commission also provides advice to government. The new arrangements do not specifically cover engineers.