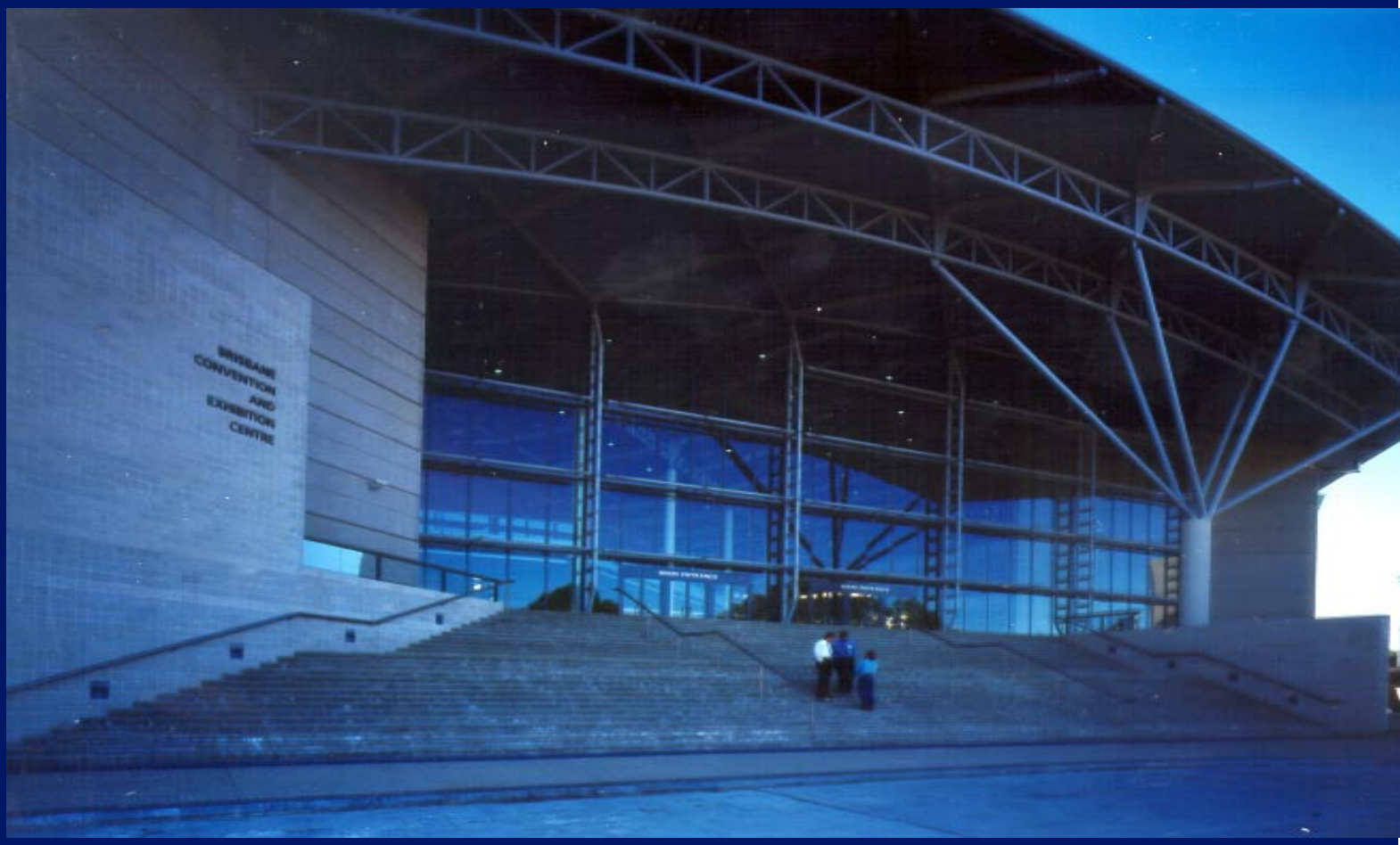
The Professional Engineers NCP Review
Department of Public Works



Queensland Government
Department of Public Works

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October 2000

National Competition Policy Review of *Professional Engineers Act 1988*

I am pleased to announce the public release of the report in relation to the Review of the *Professional Engineers Act 1988*.

The report has been produced as a response to the Queensland Government's obligations under the National Competition Policy to review legislation that potentially restricts competition in a particular market - in this case, for professional engineering services. It does not represent Government policy, nor is it intended to be a comprehensive review of all the issues facing the engineering profession. It does, however, mark the beginning of a process of consultation with the community and the engineering profession to help determine the extent of government regulation of engineering in Queensland.

The review was conducted by independent consultant PricewaterhouseCoopers, under the auspices of a steering committee comprising representatives of the Department of Public Works, Queensland Treasury, Department of Main Roads, a consumer representative and an independent professional engineer. I wish to take this opportunity to thank the committee and PricewaterhouseCoopers for their efforts in producing this report.

Submissions and comments in relation to the review are invited and may be emailed to Engineers.Review@publicworks.qld.gov.au or sent in writing to:

Professional Engineers Review
Legal and Contractual
Department of Public Works
GPO Box 2457
Brisbane 4001

The report is available on the Department of Public Works website at www.publicworks.qld.gov.au.

To enable the broadest range of views to be provided to the Government, submissions to the review are open until Monday 29 January 2001.

Yours sincerely

Robert Schwarten MP
Minister for Public Works and
Minister for Housing

Department of Public Works

Professional Engineers NCP Review
Final Report

February 2000

Executive Summary

Title

Professional Engineers Act 1988
Professional Engineers Regulation 1992

Background

The practice of professional engineering services in Queensland is currently regulated under the *Professional Engineers Act 1988* and the *Professional Engineers Regulation 1992*. The restrictions placed on the practice of professional engineering by this legislation were identified in the Public Benefit Test Plan as:

- registration of professional engineers in the various divisions of the profession
- the quality or technical standards required for registration, in particular that a person must have at least five years experience as an engineer to obtain registration
- the provisions in the Act forbidding the carrying out of professional engineering services for fee or reward other than by registered professional engineers, registered professional engineering companies or units, or other restricted categories of persons.

A review of the legislation which restricts the practice of professional engineering services in Queensland is required to be undertaken to meet the Queensland Government's obligations under National Competition Policy (NCP) which requires the review, and where necessary the reform by the year 2000, of all legislation containing restrictions on competition. The guiding principle of NCP, as set out in Clause 5(1) of the Competition Principles Agreement (CPA), is that legislation should not restrict competition unless it can be demonstrated that:

- the benefits of the restriction to the community as a whole outweigh the costs
- the objectives of the legislation can only be achieved by restricting competition.

The key stakeholders to the review include:

- consumers
- engineers
- para-professionals
- Government Departments
- Board of Professional Engineers of Queensland
- Professional Engineers Disciplinary Panel
- Queensland Building Services Authority
- Institution of Engineers, Australia and other professional associations
- training institutions.

Policy Objectives

The policy objectives of the legislation, as detailed in the PBT plan and refined by agreement with the appointed Steering Committee, are to:

- protect the health and safety of the community by ensuring that only competent persons provide professional engineering services
- provide a means of distinguishing those persons who have achieved competency in the provision of professional engineering services in the various divisions
- ensure accountability of professional engineers by providing for independent disciplinary processes
- ensure that professional engineering companies and units are directed by persons having professional training.

The fourth objective as enunciated by the Department leaves itself open to broad interpretation. Closer reading of the legislation indicates that this objective should be further developed to include reference to the restrictions on persons in management positions of engineering units or companies that are not professional registered engineers.

In regard to the fourth objective, the legislation contains a requirement that professional engineering companies and units are supervised and managed by a registered professional engineer.

The Steering Committee to the Review also indicated that an additional objective should be added to those specified in the PBT Plan to expand upon the first objective regarding protection of the health and safety of the community. This objective was identified as:

- consumer protection in general, including against financial costs.

These are the objectives against which any restrictions on the practice of professional engineering services should be assessed, having regard also to Clause 5(1) of the CPA.

Overview of the Market

A professional engineer can generally be described as a person:

- who has been assessed as meeting the relevant national competency standards, and
- is registered with an approved professional body or association, and
- takes responsibility for delivering professional engineering services.

Professional engineering services, in the absence of a prescriptive standard, require the application of engineering principles and data to a design or production activity, or the provision of advice which is based on engineering principles and data and which relates to such an activity.

The tasks undertaken by professional engineers include a range of activities in a modern community and may include the initial design of engineering work, checking and accreditation of designs and overseeing the implementation of designs. The engineering profession has an enormous impact on the logistical functions of society, and as a result public health and safety has emerged as the primary concern of engineers.

The *Professional Engineers Regulation 1992* details 10 divisions of professional engineering (for which registration under one or more is possible) as:

- aeronautical engineering
- agricultural engineering
- chemical engineering
- civil engineering
- computer systems engineering
- electrical engineering
- mechanical engineering
- metallurgical engineering
- mining engineering
- naval architectural engineering.

The distribution of registered Queensland engineers amongst these categories is detailed below. In some instances RPEQs have more than one area of focus. These areas are identified in columns three and four in the table below.

Table A Registered Professional Engineers of Queensland by Division (1999)

Division	Primary area of focus	Secondary area of focus	Other area of focus
Aeronautical	8		
Agricultural	26		
Civil	2,833		1
Chemical	56	2	
Computer Systems	7	3	
Electrical	574	12	
Mechanical	721		
Mining	32		
Metallurgical	13	3	
Naval Architectural	2	3	
Total	4,272	24	1

Source : Board of Professional Engineers of Queensland

Consultation revealed that due to technological innovation and the highly specialised nature of practice for many professional engineers, the 10 divisions listed in Table A may be outdated and not an accurate representation of the nature of a professional engineer's activities. Furthermore they may be restrictive for new areas of engineering that are not classified as professional engineering services.

It should be noted that the legislative restrictions on practice permit persons to operate under the supervision of a Registered Professional Engineer of Queensland (RPEQ) and hence the distribution of practice areas detailed in Table A is only indicative of actual areas of practice for all relevant persons in Queensland.

The entry requirements for formal university training in engineering are predominantly limited to academic competency rather than ability to pay as tuition fees can be deferred through the HECS scheme.

The restrictions on the practice of professional engineering services in Queensland have not impacted on price competition in the market which exists at a fierce level as evidenced by income, earnings and profitability levels not disparate from other states.[1]

The distribution of engineering businesses across the state is representative of population centres and demand for engineering services. The minimum number of businesses in a single statistical sub division (across 30 in Queensland) is four in the Central Western region. As a result of this distribution and the high mobility of engineers indicated during consultation (including the provision of fly in fly out practices), access to services due to geographical issues can be considered good. Consultation also revealed that consumer's ability to pay is not prohibitive to access.[2]

Information asymmetry[3] is a key characteristic for purchasers of professional engineering services. It emerges as a concern due to the technical nature of services provided relative to the standard level of knowledge of consumers and an adverse timing dimension, whereby potential problems may not emerge until well after the services are provided. Typically large consumers are better educated on products they are purchasing than smaller consumers, this is because larger consumers can dedicate greater resources to obtaining product knowledge.

A high level of risk exists in the services provided by engineers. Risk is variously defined as the "chance of loss or injury"[4]. It refers to the uncertainty of outcomes that may result from a particular action[5]. Risk is inherent in all engineering projects. Specifically, these are risk of harm and financial risk resulting from construction failure and/or operating inefficiencies. Consultation noted that risk manifests itself throughout the lifecycle of engineering projects through construction, operation, and maintenance. The magnitude of risk associated with particular projects varies with the complexity of the project. Typically, the more complex the project the greater the risk of physical harm and/or financial loss.

[1] ABS 8693.0
[2] ABS Business Register, September 1998
[3] This is an economic term that essentially describes the inequality that exists between a supplier and a consumer when one of them has a much greater knowledge than the other of the product/service and/or the industry concerned. In an 'ideal market', suppliers and consumers should both be equally, highly informed about the good/service/industry.
[4] Chambers Mini Dictionary, 1982, University of Edinburgh, Edinburgh
[5] Black, J., 1997, Oxford Dictionary of Economics, Oxford University Press, Oxford

Consultation revealed that high risk services have historically been purchased by informed consumers, indicating that market forces manage this risk. However in light of recent public disasters (in other States) such as the Royal Canberra Hospital implosion, the HMAS Westralia fire and the Esso Longford gas explosion (which have been linked to inappropriate engineering services), the status of Government as an informed purchaser has come under greater scrutiny. A recent paper[6] prepared by Athol Yates for the Institution of Engineers, Australia examined the issue. The paper concluded that the traditionally high level of technical expertise in the public sector is declining with a resulting reduction in the ability of Government to assess projects, reducing the quality of final outcomes.

With the exception of the emerging public sector trend, consultation respondents indicated that the consumers in the market experiencing information asymmetry usually purchase services that are considered low risk (e.g. low complexity residential footing designs).

Para professionals presently practise professional engineering services under the supervision of a Registered Professional Engineer of Queensland (RPEQ). These tasks can range from low to high complexity services. Consultation respondents indicated that a small number of para professionals practice illegally (in their own right) undertaking low complexity works, but in a generally competent manner.

Alternative Options

A number of regulatory alternatives were subjected to the Public Benefit Test process to identify their overall incremental net benefit/cost over the base case and their ability to satisfy the policy objectives of the legislation. For this review, the original full list of options to be considered were:

- Option One – Deregulation
- Option Two – State Government Regulation of Engineers only in the Building Industry
- Option Three – Co-regulation
- Retention of the status quo (base case) – this is implicit as an option should there be no net public benefit from any of the options to be considered.

However after preliminary investigations it quickly emerged that Option 2 was largely unsuitable as this option involves regulation of engineers in the building industry only and therefore the option would not achieve the policy objectives of the legislation in regard to the other industries that engineers operate in, as per the table over leaf.

[6] Yates, Athol, 1999, *Government as an informed buyer : Recognising technical expertise as a crucial factor in the success of engineering contracts*, paper prepared for the Institution of Engineers, Australia.

Table B Regulatory Focus of Option 2

Legislative Objective	**Focus of Regulatory System**	**Objective Achieved?**
1. *protect health and safety of community by ensuring practice by competent persons only*	• Protection of participants in the building industry only. • Other industries afforded no specific protection.	No
2. *provide means of distinguishing persons with competency*	• Competency of building engineers distinguished only. • Other industries afforded no specific ability to distinguish competency of engineers.	No
3. *ensure accountability by providing for an independent disciplinary panel*	• Accountability for building engineers only. • Other industries afforded no specific accountability for engineers.	No
4. *ensure companies and units are managed by an RPEQ*	• Certainty of RPEQ management of building engineering companies and units only. • No certainty of REPQ management for companies and units in other industries.	No
5. *financial protection for consumers*	• Financial protection for consumers in the building industry only. • Other industries afforded no specific financial protection.	No

After consultation with the Steering Committee it was resolved that this option should be omitted from the Public Benefit Test process due to its inability to meet the objectives of the legislation. In addition, a fourth regulatory option emerged from the consultation process. Option 4 is an alternative co-regulatory approach utilising a building industry Board but encompassing the full scope of professional engineering practices. The PBT assessment was limited to options one, three, four and the implicit option of retaining the base case.

The options were assessed against the base case identifying the incremental costs and benefits key affected groups would be expected to experience under each option. Further, each of the options to be considered was assessed with respect to the extent to which they meet the objectives of the legislation under review.

Option 1 – Deregulation at State level

Deregulation of the professional engineering profession in Queensland involves the elimination of all restrictions on persons wishing to undertake professional engineering services other than those covered by other legislation. For example requirements under the Building Code of Australia for certification of engineering design would still hold but could be achieved by recognised industry registration, such as with the National Professional Engineers Register (NPER) of the Institution of Engineers, Australia. Under this model there would be no compulsory state based registration of engineers.

This approach could incorporate a self regulatory approach. Under self regulation, the profession might undertake the roles of accreditor and registrar.

The profession might undertake the following roles and activities:

- accredit applicants in accordance with objectives and fair standards
- develop and disseminate appropriate standards of practice
- audit of compliance with conditions of continuing accreditation
- maintain an open and up to date register
- respond to complaints from consumers
- investigate complaints and, if necessary pursue disciplinary action
- maintain a central database of all registered engineers.

It is important to note that there would be no legal requirement for engineers to become members of a professional association under this option. However, for certain areas of practice, membership of a professional association may continue to be required by other specific legislation.

This option is similar to the way the accounting profession is structured in Australia. There are two professional associations that register accountants and set and monitor competency standards. Accountants are not forced to be members of either body but are encouraged by the associations to become members in return for certain benefits such as recognition of skills and competency. Application of this option requires professional associations to have open and transparent assessment and disciplinary systems to ensure the profession maintains credibility with government, market, and the community.

The role of associated legislation should be considered when describing the option of deregulation. For the practice of professional engineering services to be totally deregulated, all references to RPEQs in associated legislation such as the *Building Act 1975* and the *Mineral Resources Act 1989* would need to be removed. If this occurred, Queensland would move from operating the most comprehensive system of regulation for engineering services in Australia to the least restrictive system.

Option 3 - Co-regulation

Under the co-regulatory approach the profession takes responsibility for assessment of applicants for registration, with government responsible for administration of the legislation including accreditation of professional bodies and disciplinary action where misconduct is identified. Current business licensing of units and associated professional indemnity insurance requirements would remain under option 3. The roles performed by Government and professional associations under this approach are listed below.

The profession would undertake the following roles:

- accreditation of applicants in accordance with objective and fair standards
- development and dissemination of appropriate standards of practice
- audit of compliance with conditions of continuing accreditation
- each professional association would maintain an open and up to date register of its members
- reporting to government on the operation of the accreditation system.

The State Government would be responsible for the following roles:

- accreditation of professional bodies through administration of standards set out in the legislation
- maintenance of a central database of all registered engineers
- respond to complaints from consumers
- investigate complaints and, if necessary pursue disciplinary action
- prosecute non-registered persons breaching the legislation.

This model complies with the principles of mutual recognition by aligning itself with registration schemes in other jurisdictions. Although other jurisdictions utilise a co-regulatory approach for some of their industries (such as the Victorian use of the NPER register with respect to registration of engineers under their *Building Act*) no other state or territory has applied this approach for the comprehensive regulation of engineers. Instead, only engineers in the building industry are subjected to a comprehensive form of regulation whilst subordinate legislation covers other industries.

Option 4 – Alternative Co-Regulatory Approach (Industry Based)

This option is similar to option 3 but has a greater focus on a board structure that governs professions involved in the building design and planning industry. Current business licensing of units and associated professional indemnity insurance requirements would remain under option 4. Under this option, the professional engineering association and the government would perform different roles. Engineering professional associations would perform the following roles:

- accreditation of applicants in accordance with objective and fair standards
- development and dissemination of appropriate standards of practice
- audit of compliance with conditions of continuing accreditation
- each professional association would maintain an open and up to date register of its members
- reporting to government (Board) on the operation of the accreditation system.

The Government would perform the following:

- accreditation of professional bodies (Associations) through administration of standards set out in the legislation
- maintenance of a central database of all registered engineers
- respond to complaints from consumers
- investigate complaints and, if necessary pursue disciplinary action
- prosecute non-registered persons breaching the legislation

It is envisaged that the government role would be provided by a Board Structure. This Board may be constituted by representatives of engineers in the building industry, architects, surveyors and other building industry professionals. Even though the Board would still be responsible for providing the roles above to engineers that are not involved in the building industry, these engineering disciplines are not expected to be represented on the Board under this model. For matters relating to non-building industry engineering disciplines, it is envisaged that the Board would draw in this industry expertise as necessary.

The building industry focus of option 4 is in some respects quite similar to the approach applied under Victoria's *Building Act.* Victoria recognises the National Professional Engineers Register (NPER) as a qualifying requirement for certain building work. Under this co-regulatory approach the Government undertakes the role of disciplinarian and accreditor of professional bodies.

The focus of protection under both option 4 and the Victorian model is directed towards the operation of the building industry. However the Victorian model also relies upon stronger associated legislation (than is presently in place in Queensland) for the regulation of engineering practices in other industries. Option 4 by contrast relies on the co-regulatory registration of engineers outside the building industry under a Board focused primarily towards building issues.

Impact Assessment

The regulatory options above were subjected to the Public Benefit Test process to identify the incremental net benefit or cost over the base case for each of the key affected groups.

Option 1 – Deregulation

Option 1, deregulation of the profession, is expected to result in a significant incremental net cost over the base case.

Consultation respondents anticipate that deregulation of the profession would result in the entry of para professionals into the market place providing increased consumer choice and reduced prices, with respect to low complexity civil tasks, with a small increase in the risk of financial or physical harm. The influx of para professionals would split the market into low cost, low service providers and high quality operators charging a premium for assurance of a quality service. As a result, pricing and demand for services would be well matched.

These benefits to consumers were expected by consultation participants to be offset by the additional costs required to undertake private screening processes necessitated by the removal of the registration requirement, despite the fact it only provides a relatively low level of assurance. These search processes would be costly and impractical for small projects.

Consultation indicated that the greatest risk to consumers would be expected to result from the conduct of a small number of para professionals (practising illegally in their own right) attempting to undertake medium complexity works for which they are not adequately skilled. This would be expected to result, in some instances, in financial and physical harm to consumers from construction failure and operating inefficiencies.

The submission process identified examples of poor designs in the downstream petroleum industry that lead to equipment failure and environmental degradation. These designs were attributed to draughtsmen, construction supervisors, foremen, fitters, electrical engineers, and civil engineers. The appropriate persons to undertake this work were identified as chemical engineers and petroleum experienced mechanical engineers. This situation has arisen through the confusion over the definition of engineering services in the Act and the difficulty in policing these services.

This example would seem to provide evidence that if engineering services were deregulated that the instances of inappropriate persons undertaking professional engineering services would increase with an associated increase in equipment failures and environmental degradation.

Consumers would no longer be afforded the avenue to complain to the Board of Professional Engineers of Queensland regarding the inappropriate delivery of professional engineering services and would instead be forced to rely on common law and *Trade Practices Act* mechanisms. There are also proposed amendments before the Queensland Parliament to allow claims in the Queensland Building Tribunal concerning domestic building disputes and minor commercial building disputes related to engineering issues.

For engineers, the small financial burden of registration fees with the Board of Professional Engineers of Queensland would be lifted. However consultation respondents indicated that for those not already members of a professional association, these costs would be more than matched by the expenses of membership with professional associations for those engineers, companies and units who attempt to demonstrate the quality of their services. The preparation of capability statements and the attainment of quality assurance accreditation may also increase costs to engineers.

Consultation with larger firms revealed that price competition from para professionals for small civil tasks[7] would make their participation in that segment of the market unprofitable and result in a flow on of increased competition for more complex tasks.

It should be noted from previous industry experiences (such as the recent Opal House collapse) that engineers themselves can be placed at risk of physical harm when operating in an on site capacity as a quality assurance agent or to assess rectification works. Under a deregulated environment these instances may increase as a result of the operation of para professionals in medium complexity works.

[7] i.e. small, low complexity road and drainage designs

Para professionals would no longer be constrained to practice in associated fields or under the supervision of a Registered Professional Engineer of Queensland (RPEQ) and would be provided with greater potential employment opportunities and earning capacity.

On the down side, para professionals lack the formal training of an engineer and (unless they have been previously employed under an RPEQ) the supervised professional experience of an engineer. As a result, they would present an increased risk of financial and physical harm when undertaking medium complexity works.

Government departments would largely face the same benefits and costs as other comparably large consumers and service providers. An identified[8] trend of reducing technical skills in the public sector will progressively continue to dilute Government's status as an informed consumer, increasing its exposure to risk. In its regulatory role, the Government would also incur minor costs for repealing the legislation.

The Board of Professional Engineers of Queensland would be dissolved resulting in small employment losses encompassing the registrar and support staff positions and the associated costs of redundancy payments.

The Queensland Building Service Authority would no longer be afforded the option of referring engineering complaints to the Board of Professional Engineers of Queensland and may instead refer matters to professional associations who have lesser powers to discipline.

Professional associations (used as a conduit for NPER membership) may realise an increase in membership levels and fee revenue due to an increased desire by engineers to demonstrate the quality of their services.

Consultation respondents indicated that competitive pressures may emerge amongst professional associations on the basis of membership fee and entry requirements, potentially compromising assessment and disciplinary processes. The activities of multiple professional associations would be expected to generate additional complexity in the system.

Consultation also revealed that the deregulated environment would diminish the professional status of engineers reducing the quality of applicants and graduates in training institutions and ultimately reducing the standard of professional engineering services delivered in the community. Engineers in other states do not appear to have a lower status than Engineers in Queensland, however these states have not previously recognised, in legislation, the title of professional engineer as Queensland has done.

Deregulation could confer greater responsibilities on training institutions. Universities would be expected to instill into graduates a higher level of skills required for sole practice as they may not receive additional vocational training through on the job professional supervision. The demand for associated vocational courses would also be expected to increase reflecting the increased scope of opportunities for those wishing to provide low complexity engineering services.

[8] Yates, Athol, 1999, *Government as an informed buyer : Recognising technical expertise as a crucial factor in the success of engineering contracts*, paper prepared for the Institution of Engineers, Australia.

Option 3 – Co-regulation

Option 3, co-regulation of the profession, is expected to result in a small to medium incremental net benefit over the base case.

Under the co-regulatory option engineers seeking registration would be assessed by a professional association accredited by the Board of Professional Engineers of Queensland or another similar body. Utilising professional associations (such as the Institution of Engineers, Australia/NPER register) to undertake this process would be expected to enhance the effectiveness of the competency assessment process in evaluating the competency of engineers and thereby raise the level of assurance provided by utilising a registered person. Professional associations are also likely to expand or change the present engineering disciplines for registration providing a better representation of an engineer's competencies.

In addition, to be accredited, professional associations would be expected to require registered engineers to undertake continuing professional development to maintain and develop their skills, as is the current practice of professional associations to qualify members. The overall result of these processes would be to reduce the level of risk of physical and financial harm for consumers. The membership requirement to undertake continuing professional development is a key contributor to the overall net benefit expected to result from this option.

At present enacted legislation in other states utilises the assessment processes of professional associations and the privately maintained NPER register. Consultation indicated that utilising a similar approach in Queensland would reduce administrative complexity and barriers to entry for engineers from other states, increasing the range of service providers available to local consumers (e.g. interstate providers would more easily be able to practise in Queensland).

Consultation indicated that to fund this process would require engineers, engineering companies and units to meet higher membership/registration fees charged by professional associations (when providing their assessment process for NPER registration) compared with the Board of Professional Engineer's present schedule of fees. An increased number of engineers would also face a private individual burden of meeting continuing professional development requirements as only 40% of RPEQs in Queensland are presently also members of the Institution of Engineers, Australia.[9]

In their roles as consumers and service providers, Government Departments would be expected to experience similar costs and benefits as other comparably large consumers and service providers. In its regulatory function the Government would also incur costs of establishing the co-regulatory model.

The Board of Professional Engineers of Queensland would face a reduced workload from the removal of the requirement to assess applicants and maintain registers of engineers, companies and units, which would become the responsibility of professional associations. This reduction in activities may be offset from the process of accrediting and assessing the ongoing competency of professional associations.

[9] Consultation with the Institution of Engineers, Australia, 1999.

Professional associations are likely to experience an increase in members which will increase their revenues. This will be needed to fund the additional tasks they are required to undertake. There may also be increased employment opportunities at the associations as a result of their increased roles. The fees charged by the associations will vary depending on whether the increase in members offsets the increase in operating costs.

Option 4 - Alternative Co-Regulatory Approach (Industry based)

Option 4, the alternative industry based approach to co-regulation of the profession, is expected to result in a small incremental net cost over the base case.

In many respects, option 4 achieves similar benefits and costs as the option 3 co-regulatory approach, however its focus on the building industry results in a concentration of these benefits to the building industry at the expense of other industries. A significant up front cost is also incurred in the process of implementation.

For consumers, the enhanced effectiveness of the initial assessment process and continuing professional development requirements provided by professional associations results in a reduced risk of financial and physical harm. The newly formed industry Board is likely to place a focus on building industry issues resulting in a further reduction of risk for consumers within the building industry at the expense of consumers in other industries. In particular, confusion may emerge over the appropriate complaints mechanism.

The use of professional association membership / NPER registration under enacted legislation in other states would reduce administrative complexity and barriers to entry for engineers from other states. Queensland engineers would be required to face a comparatively higher cost of registration than required at present by the Board of Professional Engineers of Queensland. The burden of continuing professional development would also be applied.

As the majority of engineers are not involved in the building industry[10], a high level of alienation would be experienced by the profession due to the new Board's narrow focus. Consultation indicated that grouping engineers with other professions is likely to reduce the professional status of engineering, diluting the quality of new entrants and ultimately the quality of engineering services performed.

In their role as consumers, Government Departments would face the same range of benefits and costs as other comparably large consumers and service providers. However their regulatory role would involve the significant upfront cost of establishing the new Board and amalgamating it with other building industry professional boards.

The Board of Professional Engineers of Queensland would be dissolved in favour of a building design professionals board promoting the realisation of economies of scale by reducing operating costs at the associated expense of employment losses.

[10] Institution of Engineers Australia, *Submission to the Department of Public Works Queensland*, September 1999

The newly formed Board would possess a greater level of building industry knowledge and experience when investigating building industry complaints. The new Board would face the additional costs of accrediting and monitoring the ongoing performance of all building design and engineering professional associations.

The Queensland Building Services Authority is expected to face a reduced level of complaints and payouts due to an improved working relationship with the building industry.

The Institution of Engineers, Australia and other professional associations would benefit from a stimulus to membership levels and fees collected along with the additional burden of an expanded number of competency assessments.

Conclusions

A summary of the overall incremental net benefit/cost and compliance with the policy objectives of the legislation delivered under each of the regulatory options is detailed in the table below.

Table C Conclusions

Option	**Net Benefit/Cost**	**Compliance with Legislative Objectives**
Base Case	Base for comparison	• largely meets objectives • some violations without significant costs
Option 1 *Deregulation*	Large net cost	• does not meet objectives of the legislation
Option 3: *Co-regulation*	Small to moderate net benefit	• largely meets objectives through similar mechanisms to base case • improved assessment of competency for initial and ongoing registration enhancing consumer protection
Option 4: *Alternative co-regulatory approach (Building industry based)*	Small net cost	• largely meets objectives through similar mechanisms to base case • improved assessment of competency for initial and ongoing registration enhancing consumer protection particularly in the building industry • alienation of non building industry engineering participants

Analysis of the base case revealed that the legislation largely meets its intended objectives in practice. However, it is not possible to conclude whether the legislation is solely responsible for achieving the objectives or whether the commercial practice of operators in the market is assisting in this regard. A small number of violations of the legislation do occur in practice resulting in a small cost to the community.

Analysis of Option 1 – deregulation, revealed an incremental net cost over the base case. Many of the general attributes of the industry would remain unchanged, however this option does not meet the objectives of the legislation.

Analysis of Option 4 – alternative co-regulatory approach (industry based), revealed a small incremental net cost over the base case. While this approach largely meets the objectives of the legislation (via similar mechanisms to the base case) it incurs significant upfront costs from the establishment and amalgamation of building design industry practitioner boards. As a result, the objectives of the legislation are only fully realised for the building industry whilst engineering practitioners in other industries are largely alienated.

The PBT process identified the Option 3 - co-regulatory approach as offering the greatest incremental net benefit over the base case in addition to a slight enhancement of the compliance with the policy objectives of the legislation.

The regulatory environment and market outcomes would be largely unchanged under Option 3 - co-regulatory approach as compared with the base case. The overall net benefit is primarily expected to accrue from the involvement of professional associations (in the competency assessment process) who should be better in touch with industry developments than the Board of Professional Engineers of Queensland. The regulatory approach would thereby provide greater assurance of the competency of registered engineers, reducing risk of physical and financial harm to consumers.

This option does not precisely mirror any arrangements in other states. In comparison, it is not considered more restrictive than other states as although other states do not have 'registration specific' legislation they do regulate the practices of engineering through associated legislation. The Institution of Engineers Australia has noted that there appears to be an increase in the amount of associated legislation in other states as governments respond to engineering related project failures such as the Sydney Water outbreak of crytosporidium in 1998 and the 1997 Canberra Hospital implosion.

This option also has the potential to be more tailored to each engineering discipline and individual engineer and hence generally less restrictive than the present situation in Queensland or any other state. The registering professional bodies would have the ability to change the current qualification based registration system to a competency based one. This would provide a more rigorous basis for registration thereby generally raising the standard of engineering services. This model would also allow different competency levels to be set for different engineering disciplines, which may allow a decrease in registration requirements for engineers undertaking low complexity work.

The transition to a professional association based competency assessment process introduces a higher level of dynamism into the registration system. Professional associations are well suited to staying abreast of market changes across the full spectrum of present and emerging engineering disciplines and are well placed to tailor assessment processes. The increased flexibility provided by this approach avoids the need for re-skilling of engineers to meet a common generalist level of knowledge when their effective field of practice lies in a niche area. This option would also provide an opportunity to reclassify the divisions of engineering, as the 10 divisions listed in the current legislation may be outdated.

There is still a continuing role for Government in regulating the professional associations' ability to fulfil their competency assessment functions. Direct involvement by Government would also remain in the area of disciplinary processes as professional associations may be seen as protecting their members' interests, rather than performing objective investigations and undertaking disciplinary action.

A co-regulatory approach for engineers (utilising the NPER register) presently exists in other states, such as Victoria, where it is used with reference to the building industry. Given its successful application in this setting and the substantial number of members in the Queensland market, the uncertainties surrounding implementation and transitional arrangements are small.

During this review an additional restrictive area of legislation was identified involving Part 5 of the *Professional Engineers Act 1988* which sets out conditions for registration of professional engineering companies. This part imposes restrictions on the ability of companies or individuals that are not RPEQs to control professional engineering companies. Investigations undertaken by the Board of Professional Engineers of Queensland discovered that stand alone companies could be registered as units under Part 6 of the legislation, with unit registration being far less restrictive than company registration.

Further consultation undertaken with key affected groups identified a consensus that the restrictions imposed by Part 5 of the *Professional Engineers Act 1988* were impractical and ineffectual as this requirement can be easily bypassed by Part 6. Therefore, Part 5 imposes additional restrictions that do not strengthen the legislation's ability to meet its objectives. Therefore, in line with the principles of the Competition Principles Agreement, Part 5 of the *Professional Engineers Act 1988* should be removed from the legislation.

Transitional Issues

If Option 3 – co-regulation was adopted, the severity of adjustment for each of the key affected groups would be small. Government would face the initial responsibility of altering legislation and informing the community of the prospective changes. The Board's functions would need to be re-focused from registration of engineers to accrediting the professional associations to undertake the registration function. The initial process of accrediting professional associations may take up to 6 months to complete.

It would be useful to provide engineers, who are not presently assessed by the relevant professional associations, with a two year grace period to undertake the competency assessment process. A two year period is thought to be necessary as approximately 60% of RPEQs in Queensland are not members of the largest engineering professional association. This grace period would also assist the relevant professional associations to manage the competency assessment process of a significant number of engineers over a realistic period of time. If an engineer did not act within this time frame or did not meet the registration requirements of the relevant professional associations then they may be forced to find employment under the supervision of another RPEQ. This may result in some employment and earning losses which could be rectified by the registration process. If the engineer was not competent then their exclusion from unsupervised practice would be beneficial in the interests of public health and safety.

Other key affected groups are not expected to face any transitional issues other than requirements that they be educated of the changes in the system.

Consultation

Targeted consultation was undertaken with representatives from each of the key affected groups as a part of the review. The broader community was afforded the opportunity to have input through written submissions which were called through newspaper advertising and direct letters to all registered professional engineers. Due to the qualitative nature of the assessment a high level of importance was placed on the consultation process and responses.

Over 120 written submissions were received (predominantly from engineers) and reviewed during the consultation process. The vast majority of the submissions received supported continuing the requirement for registration of engineers in order to protect public health and safety. The issue of registration for engineering companies and units carried equal support for and against. A clear majority supported the notion of registration on a nationally consistent basis although no single regulatory option received clear support.

Face to face consultation was undertaken with:

- Board of Professional Engineers of Queensland
- Professional Engineers Disciplinary Panel
- Brisbane Consumer Association and the Queensland Consumer Association
- consulting engineering businesses
- Government Departments including the Department of Public Works, Department of Main Roads and the Department of Mines and Energy
- professional associations including the Institution of Engineers, Australia, the Association of Professional Engineers, Scientists and Managers, Association of Consulting Engineers Australia, Queensland Master Builders Association
- Queensland Building Services Authority
- local governments including Brisbane City Council, Gold Coast City Council (phone consultation), Townsville City Council (phone consultation), Mt Isa City Council (phone consultation)
- training institutions.

In summary, the key stakeholders indicated:

- almost unanimous opposition was expressed to option 1- deregulation of the industry, due to the financial and public health and safety risks resulting. It was acknowledged however that some low complexity civil tasks may be competently undertaken by persons other than registered professional engineers
- the present regulatory environment provided a low barrier to entry and did not discernibly impact upon competition or prices
- the registration process was an easily achievable standard providing limited protection to the community and little assistance in differentiating between the skill levels of engineers
- competency based assessment was a necessary and desirable feature of a regulatory system promoting greater levels of protection from public health and safety and financial risks

- business licensing was not a significant issue. Opposing opinions were expressed highlighting the danger of non engineers placing excessive time pressure on engineers, increasing potential risks. Other stakeholders indicated the constraints it places on employment opportunities and utilisation of management specialists
- option 2 – regulation of engineers involved in the building industry only, was almost unanimously opposed due to its inability to meet the objectives of the legislation for participants outside the building industry
- option 3 – co-regulation, was viewed as very similar to the base case and received widespread support as a natural progression to the use of professional associations, who are better suited to competency assessment, whilst independent government mechanisms are retained and empowered by legislation to monitor, assess charges and discipline the profession
- option 4 – the alternative co-regulatory approach (industry based), received support predominantly from the Queensland Building Services Authority. The majority of other stakeholders highlighted that although the building sector was most vocal in lodging complaints, the majority of engineering practice and the potential for costly incidents are in other industries. Therefore the level of alienation that consumers and engineers alike would receive from this option is likely to be unacceptably high
- if option 4 were to be pursued, it was expressed that a broadly applicable Professional Standards Board, to be administered by the Office of Fair Trading, be considered to ensure the needs of non building industry issues were addressed.

Sunset/Review

For those restrictions recommended to be retained on the basis of there being net public benefit, it is recommended that a review of the necessity of the restriction continuing be performed within 10 years.

Contents

1

Introduction and Background

1.1 Introduction

PricewaterhouseCoopers has been engaged as an independent consultant to the Department of Public Works to undertake a Public Benefit Test (PBT) of the current legislative restrictions and other proposed regulatory options applying to the practice of professional engineering services in Queensland.

Undertaking the PBT process requires a review of potential anti-competitive practice restrictions contained within the Queensland *Professional Engineers Act 1998* (Engineers Act) and the Queensland *Professional Engineers Regulation 1992* (Engineers Regulation).

The review of the restrictions on the practice of professional engineering services has been initiated as a consequence of the Queensland Government's obligations under National Competition Policy (NCP). It is required that a NCP review of all relevant legislation be undertaken where it potentially restricts competition in a market.

Clause 5(1) of the Competition Principles Agreement (CPA) outlines the guiding principle of legislation review. It stipulates that legislation should not restrict competition unless it can be demonstrated that:

- the benefits of the restriction to the community as a whole outweigh the costs
- the objectives of the legislation can only be achieved by restricting competition.

The Engineers Act and the Engineers Regulation impose restrictions upon the practice of professional engineering services including prohibitions on who may undertake professional engineering services. These restrictions have been reviewed and subjected to a PBT in accordance with Clause 5(1) of the CPA to determine the costs and benefits associated with the potential implementation of regulatory and non-regulatory options. These options are discussed in Chapter 6 of this report. Both quantitative and qualitative costs and benefits have been taken into account.

This report provides findings of the PBT assessment. Information from the PBT assessment should assist the review to develop recommendations for an appropriate legislative framework for the regulation of professional engineering services.

1.2 Background

The PBT Plan compiled by the Department of Public Works details the background to the review:

In 1992 the Commonwealth Heads of Government agreed to establish a scheme for implementation of mutual recognition principles for occupations throughout Australia. This commitment was endorsed by State Cabinet in 1992. Following a review of occupations at that time, it was recommended that the engineering profession in Queensland be deregulated.

In 1993, Cabinet considered the deregulation of the profession, but deferred any decision pending further investigation and report back to Cabinet in 1994. In 1994, Cabinet considered alternative proposals for the regulation of the profession and endorsed an option whereby the engineering profession largely regulated itself within a statutory framework. A lack of consensus on the approach to be taken for implementation of the Cabinet decision resulted in the matter not being further progressed at that time.

In June 1997, the Board of Professional Engineers of Queensland produced a report to Government on proposals to regulate the engineering profession. This report favored a co-regulatory approach, under which:

- *a Queensland Act would establish a statutory board or council which would accredit professional bodies according to standards set out in the Act*
- *engineers who are registered with the accredited bodies would be automatically registered under the Act, whether residing in Queensland or elsewhere*
- *disciplinary proceedings for a breach of professional standards would be the responsibility of either a disciplinary panel under the Act, or carried out by the accredited body, for instance, the body constituted for that purpose by the Institution of Engineers, Australia.*

Since June 1997, alternative proposals for the future of the engineering profession have been formulated. However, a proposal for amendment of the Act has not yet been considered by the Queensland Government.

Queensland is the only State or Territory in Australia with comprehensive regulation of the engineering profession.

The Queensland Government has now instigated a review of the regulation governing the practice of engineering in the State in line with its National Competition Policy obligations.

1.3 Objectives of the Legislation

The PBT Plan compiled by the Department of Public Works (the Department) notes that the objectives of the Professional Engineers Act are not articulated in the legislation. Through careful reading of the Engineers Act, the Department has identified its objectives as to:

- protect the health and safety of the community by ensuring that only competent persons provide professional engineering services
- provide a means of distinguishing those persons who have achieved competency in the provision of professional engineering services in the various divisions
- ensure accountability by professional engineers by providing for disciplinary processes via an independent disciplinary panel
- ensure that professional engineering companies and units are directed by persons having professional training.

The fourth objective as enunciated by the Department leaves itself open to broad interpretation. Closer reading of the legislation indicates that this objective should be further developed to include reference to the restrictions on persons in management positions of engineering units or companies that are not professional registered engineers.

In regard to the fourth objective, the legislation contains a requirement that professional engineering companies and units are supervised and managed by a registered professional engineer.

The Steering Committee to the Review also indicated that an additional objective should be added to those specified in the PBT Plan to expand upon the first objective regarding protection of the health and safety of the community. This objective was identified as:

- consumer protection in general, including against financial costs.

These are the objectives against which any restrictions on the practice of professional engineering services should be assessed, having regard also to Clause 5(1) of the Competition Principles Agreement (CPA).

1.4 Scope of the Review

The Terms of Reference for this assignment, as defined by the Department of Public Works, outlines that the Review has been undertaken to meet the Government's obligations under NCP, that requires all legislation containing restrictions on competition to be reviewed, and where appropriate reformed, by the year 2000.

The PBT Plan identified the following restrictions contained in the Engineering Act and Regulations:

- *registration of professional engineers in the various divisions of the profession*
- *the quality or technical standards required for registration, in particular that a person must have at least five years experience as an engineer to obtain registration*
- *the provisions in the Act forbidding the carrying out of professional engineering services for fee or reward other than by registered professional engineers, registered professional engineering companies or units, or other restricted categories of persons.*

During this review an additional potentially restrictive area of legislation was identified. This involves Part 5 of the *Professional Engineers Act 1988* which sets out conditions for registration of professional engineering companies. This restriction was also evaluated during the review.

These considerations have been identified as potentially placing restrictions on the practice of professional engineering services in Queensland.

2

Review Methodology

2.1 Review Methodology

The review has been undertaken over a three month period commencing in late September 1999. A Steering Committee was appointed to oversee the review and meetings were held at agreed milestones during the review, where the consultancy team provided feedback on project developments and sought agreement on the project process. The Steering Committee consisted of representatives from Government, industry and consumer associations as detailed in the table below.

Table 2.1 Steering Committee Members

Person	Organisation
Mr Boyd Backhouse (Chair)	Manager, Legal Services, Department of Public Works
Mr Drew Ellem	Principal Treasury Analyst, Queensland Treasury
Ms Val Cocksedge	Advisor for Consumer Affairs, National Council of Women (Queensland)
Mr Dennis Wogan	Executive Director (Roads Delivery Division), Department of Main Roads
Mr Ian Wood	Ian Wood & Associates Pty Ltd

The PricewaterhouseCoopers' team assembled to undertake the review presented a combination of legal and economic skills. Technical knowledge of the practice of professional engineering services, was provided by an expert independent professional engineer, Mr John Maclean.

The independent technical expert participated in workshops to ensure the validity and technical appropriateness of data collected, and to provide expert advice on the base case and the impacts likely to arise from the nominated options.

Queensland Treasury has developed guidelines for undertaking a PBT and PricewaterhouseCoopers has adopted and utilised a methodology consistent with these guidelines.

The review process involved the following steps.

1 Project initiation meeting with the Steering Committee to clarify issues of project scope, timing and reporting milestones.

2 Identification of the impacts to be assessed as part of the review. This step ensured potential impacts were addressed as part of the information collection and analysis tasks of the review. Once identified, the impacts formed the basis for the analytical framework for the review. The analytical framework required the costs and benefits associated with each potential impact to be assessed from each key affected group's perspective and the overall community perspective in relation to the base case situation and each alternative proposed. The analytical framework is discussed further in Chapter Six of this report.

3 Research and data collection of industry statistics and national and selected international regulatory models that govern the practice of professional engineering services.

4 Review of over 120 written submissions received by the Department of Public Works from interested parties.

5 Face to face consultation with a representative sample from each of the key affected groups. Phone consultation was undertaken to survey the views of a random sample of remote and regional representatives. Consultation participants were agreed with the Steering Committee and are listed in Appendix A.

6 Analysis of the information collected and development of findings regarding the Base Case situation and the expected impacts associated with the nominated options.

7 Preparation of draft and final reports and a Competition Impact Statement (CIS).

3

Industry Profile

3.1 Professional Engineering Services in Queensland

This review relates to the practice of professional engineering services in Queensland. The following passages provide a definition of what constitutes a professional engineer and professional engineering services.[11]

A professional engineer can generally be described as a person:

- who has been assessed as meeting the relevant national competency standards, and
- is registered with an approved professional body or association, and
- takes responsibility for delivering professional engineering services.

Professional engineering services, in the absence of a prescriptive standard, require the application of engineering principles and data to a design or production activity, or the provision of advice which is based on engineering principles and data and which relates to such an activity.

The Engineering Regulation details 10 divisions of professional engineering (for which registration under one or more is possible)[12] as:

- aeronautical engineering
- agricultural engineering
- chemical engineering
- civil engineering
- computer systems engineering
- electrical engineering
- mechanical engineering
- metallurgical engineering
- mining engineering
- naval architectural engineering.

The distribution of Queensland engineers amongst these categories is detailed in Table 3.1.

[11] Institution of Engineers, *Submission to the Department of Public Works*, September 1999

[12] Consultation revealed that due to technological innovation and the highly specialised nature of practice for many professional engineers, the 10 divisions listed may be outdated and not an accurate representation of the nature of a professional engineers activities. Furthermore they may be restrictive for new areas of engineering that are not classified as professional engineering services.

Table 3.1 Registered Professional Engineers of Queensland by Division (1999)

Division	Primary area of focus	Secondary area of focus	Other area of focus
Aeronautical	8		
Agricultural	26		
Civil	2,833		1
Chemical	56	2	
Computer Systems	7	3	
Electrical	574	12	
Mechanical	721		
Mining	32		
Metallurgical	13	3	
Naval Architectural	2	3	
Total	4,272	24	1

Source : Board of Professional Engineers of Queensland

It should be noted that the legislative restrictions on practice permit persons to operate under the supervision of a Registered Professional Engineer of Queensland (RPEQ) and hence the distribution of practice areas detailed above is only indicative of actual areas of practice for all relevant persons in Queensland.

The table above shows that more than 66% of the registered engineers in Queensland are civil engineers, who deal with a range of clients from large organisations to smaller consumers such as a members of the general public who may purchase engineering services in relation to residential dwellings.

The adoption of appropriate titles for various professional engineering disciplines is a complex task due to the potentially large scope of activities undertaken by each discipline. For instance, civil engineers may be involved in tasks as diverse as the design, construction, operation and maintenance of dams, roads, bridges, rail, wharves, subdivisions, hydraulics, buildings, water supply and sewerage.

An alternative source showing the practices performed by professional engineers in Queensland is provided by the APEC Engineer Register Australia, as detailed in Appendix B.

To provide an overview of the services provided by engineers, some of the many fields in which professional engineers commonly practice are detailed in the following table.

Table 3.2 Professional Engineering Fields of Practice

acoustics	electric power	mining and tunneling
aeronautics	engineering education	petroleum and gas
agriculture	engineering survey	pipelines
arbitration	environment	process control
automation and control	fire safety	public health
building survey	foundations and footings	quality management
bridges and viaducts	fuels and energy	railways
building services	geomechanics	risk
coasts and oceans	industrial	roads and highways
communications	local government	space
computing	manufacturing	structures
construction management	maintenance	telecommunications
dams	materials	transport
electronics	military	water resources

Source: Institution of Engineers, Australia, *Submission to the Department of Public Works*, September 1999

The tasks undertaken by professional engineers in these fields may include the initial design of engineering work, checking and accreditation of designs and/or overseeing the implementation of designs.

In a report, by the Board of Professional Engineers of Queensland[13], the important functions, tasks and other duties performed by practitioners in the industry are described. Their report details that the engineering profession has an enormous impact on the logistical functions of society and that engineers hold as their primary concern, the health and safety of the public.

The report also documents a survey of engineers, in which 100% of respondents believed that the role of professional engineers impacts significantly on the health and safety of the public. An illustration is provided of the many levels at which engineering services contribute in simple actions that are often taken for granted in the community.

For instance, in activating an electric light, engineers are involved in:

- an environmental impact study (EIS) of resources
- extraction of the resources
- transportation of the resource (road and rail etc), design and construction
- design of the power station
- power generation
- power distribution
- power maintenance.

[13] Board of Professional Engineers of Queensland, *A Report on Mutual Recognition*, 1992 : 40

Likewise when turning on a tap:

- an environmental impact study (EIS) for dam sites
- design of dams
- flood studies
- water reservoirs and pump stations
- water treatment and testing
- water distribution to commercial and home sites.

3.2 Formal Tertiary Training in Engineering

Tertiary education in engineering is popular and accessible through most universities in Queensland including major campuses in the South East corner such as:

- the University of Queensland (UQ)
- Queensland University of Technology (QUT)
- Griffith University (GU).

3.2.1 University of Queensland

The University of Queensland has offered a Bachelor of Engineering since its inception in 1911. The course structure currently provides scope for study in any one of eleven disciplines. Specific subject details for the civil engineering stream at UQ are contained in Appendix C. Details of the intended employment destination for these graduates are also contained in Appendix C.

The tertiary entrance system in Queensland primarily evaluates applicants on the basis of their overall position score (OP) where an OP1 is the best possible score and an OP25 the poorest score attainable. The minimum requirement to achieve admission to the Bachelor of Engineering degree at UQ in 1999 was an OP8. This score is relatively easily achieved as compared with the difficulty of university coursework required upon entry. (Comparative scores for other degrees with UQ are contained in Appendix C.)

The minimum entry requirements are equivalent for QUT and Griffith University which required an OP9 for entry to the Bachelor of Civil Engineering in 1999.

Dean of the Faculty of Engineering at the University of Queensland, Professor John M. Simmons, indicated that tertiary courses in engineering are designed to meet the requirements for registration as a member of the Institution of Engineers, Australia.

It has been noted in journals of engineering education that much of the training provided in universities in the English speaking world (including Australia) has not necessarily been linked with the practice of engineering in the recent past. The literature further relates that it is not surprising to find that many of the assumptions behind the current structure and content of university training programs including preparation for entry, career structure and opportunities for further education are not appropriate.

The inclusion of this issue in academic journals of engineering education provides support for the requirement that graduate engineers undertake five years supervised experience under a professional engineer before becoming eligible for registration in Queensland. [14]

3.2.2 Engineering Competency Requirements

The Engineering profession has determined that the training gained through a four year university course is not enough to operate as a professional engineer. This premise is supported by the training institutions, the legislation in Queensland, and the professional associations. The training institutions recognise they do not have the time to adequately prepare a student to meet the full requirements to operate as a professional engineer and therefore focus their training on providing the technical and scientific grounding to form the base of training as a professional engineer. A review of the competencies required for membership of the Institution of Engineers, Australia and recognition as a Chartered Professional Engineer (CPE) highlights the amount of practical experience required under the supervision of a senior engineer.

To gain the qualification of a CPE there are three core areas of competence that must be met and seven elective areas of competence (for specialist competence recognition). The following table shows the individual competencies for one of the three core areas of competence required for CPE qualification.

[14] Clyde, D, *Challenges for the Future Engineer,* Australasian Journal of Engineering Education, 1995, Vol. 6, No.2

Table 3.3 Professional Engineer: Core Units for Stage 2

Area of competence	Graduate skills	Engineer with 5 years experience
Engineering Practice		
Presents and develops a professional image	No	Yes
Pursues continuing professional development	Yes	Yes
Integrates engineering with other professional input	No	5 + years
Develops innovative engineering solutions	No	10 years
Identifies constraints on potential engineering solutions	No	Yes
Engineering Planning and Design		
Interprets and scopes design requirements	No	5-10 years
Prepares concept proposal and seeks advice on latest technology	No	Yes
Implements planning and design process	No	Yes
Reviews the design to achieve acceptance	Yes – simple design	5-10 years for complex design
Prepares and maintains documentation during the design process	Yes	Yes
Reviews design outcomes in operation	Yes – low complexity	Yes
Self Management in the Engineering Workplace		
Manages self	Yes	Yes
Works effectively with the team	Yes	Yes
Manages information	Yes	Yes
Manages work priorities and resources	No	Yes
Facilitates and capitalises on change and innovation	No	Yes
Establishes and maintains business relationships with clients/ stakeholder/ supplier/ regulator	No	5-8 years

Source: Institution of Engineers Australia, December 1999

The table highlights the areas of competence of graduate engineers and those with five years experience. It clearly demonstrates that graduates are competent in only a few areas required to qualify for CPE status and thus operate as a professional engineer.

3.2.3 Costs of Entry

University expenses are payable via the Higher Education Contribution Scheme (HECS).

Prior to 1 January 1997, a flat rate of HECS was applied to all full time courses equivalent of $2,560 for a full year or $1,280 per semester. For a four year engineering course, the total cost equates to $10,240.

Studies commencing after this date face a three tiered differential rate of HECS dependent upon the type of course studied ranging from $3,409 to $5,682 per annum. Engineering now attracts an intermediate rate of $4,855 per annum equating to $19,420 for a four year degree.

3.2.4 Employment & Earnings

GRADSTATS, the Graduate Careers Council of Australia's Graduate Destination Survey, provides details of the status of university graduates approximately four months after the completion of their qualifications. Results of this survey of engineering graduates available for work in 1998 is detailed below.

Table 3.4 Graduate Engineer Employment Status

Engineering Discipline	Employed full time	Seeking employment
Aeronautical Engineering	87.5%	12.5%
Chemical Engineering	75.0%	25.0%
Civil Engineering	88.3%	11.7%
Electrical Engineering	88.4%	11.6%
Electronic and Computer Engineering	84.2%	15.8%
Mechanical Engineering	86.5%	13.5%
Mining Engineering	93.8%	6.3%
Other Engineering	80.1%	19.9%
Engineering Disciplines Average	85.5%	14.5%
All Tertiary Courses Average	79.6%	20.4%

Source : GRADSTATS December 1998

The average employment level for graduates of engineering was 85.5% versus the average for all tertiary courses of 79.6%. Corresponding salary earnings for engineers was $35,000 versus the all tertiary courses average of $30,000.

3.3 Engineering Business Localities

The Board of Professional Engineers of Queensland presently holds 481 registered companies and units on its rolls. The location of the registered head offices is detailed by state in the following table.

Table 3.5 Professional Engineering Companies & Units by State

State	Number of Firms
TAS	1
ACT	2
WA	2
NSW	13
VIC	15
QLD	444
Total	481

Source : Board of Professional Engineers of Queensland

Not surprisingly, the location of the head offices of registered professional engineering companies and units is concentrated in Queensland with 444 from a total of 481.

The majority of the total number of functioning offices (as distinct from head offices) operated by the 444 registered engineering companies and units in Queensland are located in the Brisbane area (1,128). The minimum number of consulting engineering functioning offices in a single area across 30 statistical sub divisions in Queensland was four, for the Central Western region. The actual distribution of consulting engineering business offices within Queensland is detailed in Appendix D.

Although, in some cases, statistical sub divisions may traverse reasonably significant geographical areas, the general mobility of engineering firms and the low cost of transport within these regions indicates that, even with as few as four firms, a good level of access to engineering services in rural and remote areas exists.

Access to professional engineering services is also strong with regard to ability to pay considerations. Consumers of high complexity, high cost professional engineering services are almost exclusively large private and public entities with an ability to pay. The consultation process revealed that small consumers do not usually require high complexity services and although they may not fully recognise the value of the low cost services they require, are able to meet the expense of these services.

In regard to access to regional and remote areas, feedback from the consultation process indicated that large private and public entities are well placed to afford the travel and associated costs passed on from professional engineers providing services to these areas. It was felt that small consumers in regional and remote areas do not usually need to import specialised professional engineering services and hence the transport and associated costs were less relevant.

3.4 Economic Conditions

High levels of competition and the resulting economic climate in which engineers practice is a major issue for the industry. Table 3.6 below details national performance indicator statistics including operating profit margins for consulting engineering firms in Australia.[15]

3.4.2 Price Competition

Price competition is evident in the industry in Queensland illustrated by:

- engineering businesses providing profit margins that are considered normal when compared with other service industries by in-house PricewaterhouseCoopers business analysts
- the income of consulting engineering businesses per employee is close to the national average
- the average salary per employee of an engineering business is only slightly higher than the national average
- the average salary for an engineer in Queensland is close to the national average.

These points are discussed further below.

Table 3.6 below provides key statistics for engineering practices nationally. This table shows that average profitability is 12% which, in the opinion of PricewaterhouseCoopers, is considered a normal profit margin in a business services market.

Table 3.6 National Performance Indicators

Key Performance Indicator (National)	Average Profile	Low Range	High Range
Fees per FTE person	$87,000	$70,000	$98,000
Wages and salaries costs	45%		
Occupancy costs	6%	3%	9%
Total Expenses	88%		
Net Profit	12%	7%	16%
Charged hours to available	65%		
Average hourly charge rate	$100	$75	$135

Source : *PRACDEV Key Indicator Reports 1999/2000*

[15] The Institution of Engineers, Australia, *Review of the Professional Engineers Act : Submission to the Department of Public Works Queensland*, September 1999, indicated that consulting engineering services represent some 44% of professional engineering in Queensland and hence it can be considered as representing a major proportion of the overall practice in the State.

The table also shows that wages and salaries consume 45% of all revenue derived. This result represents the highest cost centre. Not surprisingly, engineering firms have attempted to reduce this cost centre through the substitution of supervised para professionals (who command average weekly total earnings of $972) in place of registered professional engineers (who command an average of $1,041).[16]

This outcome has been reflected in the composition of consulting engineering firms full time equivalent personnel numbers of which non qualified professional technical staff represent 29.3% versus 28.5% for qualified professional staff (16.6% are principals, who may also be engineers).[17]

ABS research provides an insight into the state profiles of consulting engineering practices in Australia.[18] Featuring 943 businesses and 5,564 staff delivering $591.7 million in total income, Queensland is the third largest absolute supplier of consulting engineering services in Australia behind Victoria and NSW respectively (full details are contained in Appendix E).

Queensland consulting engineering businesses service an average population of 3,540 each, which is some 319 persons greater than the national average. This result is reflected in a slightly higher average number of employees per business in Queensland at 5.91 persons versus a national average of 5.57 persons.

The income of consulting engineering businesses per employee in Queensland is $106,340 which is close to the national average of $105,190.[19] The average salary of engineers in Queensland is $39,040 which is slightly higher than the national average of $36,040.[20]

The Association of Professional Engineers, Scientists and Managers, Australia (APESMA) undertakes Australia's largest survey of engineering salaries[21] on a biannual basis. The national weighted average of mean salaries across Australia was reported as $75,794 as compared with $75,366 for Queensland indicating a $428 shortfall.

These statistics provide evidence of a competitive market in Queensland in its own right and relative to the rest of Australia. This would indicate that the current regulatory environment governing the Queensland market is not presenting a barrier to competition nor is it maintaining artificially high prices.

3.4.3 Consequences of Competition on Design Quality

A highly competitive market place translates to reduced fees for services and an increased pressure on time budgets and the quality of product delivered. National survey research (conducted by the CSIRO in 1999) into design fees and quality of documentation by engineers, architects, landscape architects, quantity surveyors and land surveyors examines this issue.[22]

[16] ABS 6306.0
[17] *FRMC Business Benchmarks 1988*
[18] ABS 8693.0
[19] ABS, 8693.0
[20] ABS, 8693.0
[21] The APESMA survey uses a broader measure for total package and hence a noticeable difference from ABS data results.
[22] CSIRO, *Design and Documentation Quality and its impact on the Construction Process,* 1999

The CSIRO research indicates that although the level of fees required to provide a proper service has only declined marginally over the past 12 to 15 years (falling by 5% at most for simple projects), the indicated fee needed to be submitted to actually win the work experienced an average 21% decline over the past 12 to 15 years.

The study notes that reduced design fees have the following negative impacts on the quality of designs:

- proper examination of design proposals and innovation are negatively impacted to detrimental levels
- documentation completeness, certainty, coordination and final checking are negatively impacted to detrimental levels
- a reduction in the quality of service being provided
- insufficient personnel to carry out the work, causing an overload on those available
- a greater use of junior and inexperienced staff
- a lack of profit, that leads directly to a reduction in the levels of in-house training and research and development.

From a contractor's perspective, the most common problems occurring relate to a lack of coordination, documentation clarity and the use of catch all clauses which require contractors to make allowances for items not designed or specified. The following table provides a summary of contractor perceptions of the incidence of construction inefficiency attributable to design issues.

Table 3.7 Contractors' Perceptions of Construction Inefficiencies

Construction inefficiency	**Proportion of incidents attributable to design issues**
Requests for Information	58.0%
Variations	51.6%
Contractors Disputes	50.3%
Cost Overruns	45.6%
Program Delays	38.1%
Extension of Time	38.0%
Rework	37.6%

Source : CSIRO, *Design and Documentation Quality and its impact on the Construction Process,* 1999

The table above indicates the proportion of incidents for each construction inefficiency attributable to design issues. Requests for information are the primary concern with 58.0% of all requests for information attributed to design issues.

This survey evidence indicates a strong contractor perception that design issues are attributable for a significant proportion of construction inefficiencies. It should be noted however that contractors carry a vested interest in attributing construction inefficiencies to design problems rather than their own inefficiencies.

3.4.4 Information Asymmetry

A key characteristic of the industry for professional engineering services is the existence of information asymmetry.

This is an economic term that essentially describes the inequality that exists between a supplier and a consumer when one of them has a much greater knowledge than the other of the product/service and/or the industry concerned. In an 'ideal market', suppliers and consumers should both be equally, highly informed about the good/service/industry.

The technical aspect of the engineering profession and the heterogeneous (differential) style of potential services delivered creates difficulty for lay people to asses the quality of workmanship undertaken.

Deficiencies in engineering work undertaken may not manifest themselves until 10 or 20 years after the work has been performed. This further restricts the ability of consumers, who are infrequent purchasers, to assess the quality and competency of service providers.

Influence on Risk

The existence of information asymmetry for consumers of engineering services increases the potential for the purchase of inappropriate services. For major entities, be they private corporations or Government Departments, technical knowledge and financial scope for independent assessment of bids reduces information asymmetries and risks associated with purchasing inappropriate services.

For smaller entities, be they non-technical Government Departments or smaller private consumers, the existence of greater information asymmetry increases the potential risk of purchasing inappropriate services. This is evidenced by building services estimates suggesting that foundation failure due to poor site investigation and inadequate foundation design is costing in excess of $10 million per annum in Queensland.[23]

Sources of Information of Risk

Enhanced information levels can act to combat information asymmetry. The Board has suggested[24] that:

in Queensland because of registration, Government Departments, Local Authorities and registered professional engineers are not only aware of the physical risks associated with engineering but also the disciplinary powers associated with the Act of incompetent practice.

[23] Consultation with the Queensland Building Services Authority, Nov 1999
[24] Board of Professional Engineers of Queensland, *A Report on Mutual Recognition*, December 1992.

The Board …has conducted a series of seminars to keep professionals and clients abreast of recent trends and the need to practice in ones area of competence.

At the present time there is no concerted effort to inform the general public of the potential risks of using unqualified engineers for various engineering works.

While the Board's comments continued to mention a planned publicity effort for 1993, no significant publicity efforts have been undertaken in the past six years and awareness of the Board's existence by consumers is limited.

3.5 Regulatory Framework

3.5.1 Registration & Business Licensing

Registration

The key regulation governing the conduct of professional engineering services in Queensland is the Engineers Act and the Engineers Regulation; and is enforced by the Board of Professional Engineers of Queensland. The Board's key role is to register engineers. Section 21 of the Engineers Act entitles a registered person to use the words "Registered Professional Engineer of Queensland" or the abbreviation "RPEQ".

The Engineers Act also provides for the registration of professional engineering companies which are managed by suitably qualified professional engineers and also provides for the registration of a professional engineering unit within a corporation, where the person in charge of professional engineering services for the company or unit is a registered professional engineer.

Registered companies are required to hold the prescribed professional indemnity insurance. Typically, such insurance is "claims based" and provides cover only if it is held when a claim is made, as opposed to "run out" cover.

Section 32 of the Engineers Act entitles registered professional engineering companies to use the words "Registered Professional Engineering Company of Queensland" or the abbreviation "RPECQ".

The Engineers Act prohibits unregistered persons from undertaking professional engineering services for fee or reward. However, the Engineers Act permits certain unregistered persons to carry out these services under the supervision of a registered professional engineer.

Despite exemption from the registration requirement, numerous private and public sector employees operating under the supervision of an RPEQ maintain their own registration with the Board as per the following table.

Table 3.8 RPEQs Registered Since 1 January, 1991

Employment Sector	RPEQs
Public Sector	829
Private Sector	1,775
Total	2,604

Source : Board of Professional Engineers of Queensland

Table 3.8 (above) indicates that a majority of RPEQ's operate in the private sector. The geographical distribution of private sector RPEQs detailed in table 3.9 (below), indicates that a number reside interstate and overseas.

Table 3.9 Interstate & Overseas RPEQs, Registered Since 1 January 1991

Geographical Location	Number of RPEQs
QLD	2,100
NSW	233
VI C	150
TAS	7
SA	17
WA	30
NT	8
ACT	8
Overseas	26
Total	2,599

Notes : Interstate and overseas RPEQs are exclusively from the Private Sector.
Source : Board of Professional Engineers of Queensland

Interstate and overseas registration indicates a mobile workforce, many of whom compete for work in Queensland.

Business Licensing

The issue of business licensing requires consideration for potential anti-competitive elements and excessive use of regulation. Business licensing of engineering companies and units refers to the requirement for companies or units that undertake professional engineering services to be registered with the Board of Professional Engineers of Queensland.

The legislation sets out the requirements for a company or unit to be eligible for registration. For a company to be registered, three fifths of Directors and Shareholders are required to be RPEQs. The Board acknowledges that this could be considered to be intrusive and anti-competitive.

Registration of units within organisations is less intrusive and requires that:

- the business is incorporated
- a senior engineer (who is an RPEQ) is authorised to be responsible for engineering at each office in Queensland or for Queensland operations if there is no office
- the business carries professional indemnity insurance.

The requirement to carry professional indemnity insurance was noted by stakeholders, consulted as part of the review, to be particularly non-intrusive as cover of only $350,000 is required which was considered by the consultation participants to be insufficient to cover anything more than minor claims. The Board also noted during the consultation period that consumers and practitioners were exposed to financial risk through the lack of a requirement for sole practitioners to carry professional indemnity insurance. The Board felt this should be addressed in any amendment or change to the legislation.

It has been noted[25] that the reason for registering companies and units is to ensure that professional engineering services are carried out under the direction of registered professional engineers. However the specific mechanism used to ensure that supervision by professional engineers results in desirable practice outcomes, has been diluted through an enforcement approach which does not provide for accountability of the person in charge of the company or unit but rather makes the company (or unit) liable for any misconduct.

The Board of Professional Engineers of Queensland has noted that the requirements for registration of companies and units under the legislation could be considered anti-competitive. As such it has put forward, as part of the Red Tape Taskforce, a proposal to eliminate reference to registration of companies and only refer to registration of units. Alternative propositions raised during consultation involved eliminating both company and unit registration as it was believed that individual registration covered this. However, this is not the case as was noted above. The legislation prohibits persons from undertaking professional engineering services for fee or reward where "person" includes individuals and corporations.[26] Where a company or unit undertakes professional engineering services there is no recourse against the individual. Registration of the company or unit provides some assurance of the integrity of the work of the organisation, thereby providing some protection for the consumer.

Through the public submission process a questionnaire was sent to a large number of engineers and related parties. This questionnaire raised the issue of regulating engineering companies and units. Of the 45 that responded to this question, 56% felt that companies and units should be registered while 44% felt they should not. This compared to 99% of respondents who thought individual professional engineers should be registered. There is a perception amongst RPEQs that registration of companies and units is a doubling up and therefore unnecessary regulation. The legislation requires companies or units to be registered but does not require engineers within that company or unit to be registered if they are operating under an RPEQ. The only requirement for RPEQs in a company or unit then are those necessary to meet the company or unit registration requirements (Directors/Senior Managers) as noted above. The easiest way for a company or unit to meet the standards of competency implied

[25] Institution of Engineers, Australia, *Submission to the Department of Public Works*, 1999
[26] *Queensland Acts Interpretation Act 1954*, Section 36

under the legislation is to be managed by one or a number of RPEQs (which is how the legislation has catered for this).

A final point, raised by the Board, is that the current legislation prohibits partnerships other than where all partners are RPEQs. This acts as a disincentive for persons to form partnerships to offer engineering services. It does not overly restrict existing partnerships in offering engineering services as they could register themselves as units and therefore avoid the requirement that all partners be RPEQs.

The removal of the category of company registration is considered more fully in Chapter 8, titled 'Company Registration – Restriction to competition.'

3.5.2 Complaints Lodged to Board of Professional Engineers of Queensland

Generally the peak bodies in the engineering profession receive a low number of complaints on an annual basis. Over the past five years the Institution has received a total of only 150[27] complaints on its members throughout Australia. This has been increasing and there have been 85 complaints over the past two years (1998-99). In comparison the Board of Professional Engineers of Queensland has received 65 complaints over the past two years. It is unclear why the level of complaints on engineering services is so low. It may be that the level of service is so high that the majority of purchasers are satisfied, or alternatively it may be that purchasers are unaware of the appropriate complaints mechanisms. Either way, the Board compares favourably with the Institution as a complaints mechanism in Queensland. Comparisons on the number of complaints as indications of the effectiveness of the different regulatory systems in each state are meaningless as actual figures on all complaints against engineers are not available. What is of interest is the nature of the complaints lodged against engineers.

The table below details the nature of complaints received by the Board of Professional Engineers since 1 January 1998.

Table 3.10 Complaints to the Board of Professional Engineers of Queensland

Nature	% of Total
Failure of Footings/Foundations/Slab	48%
Certification incorrect	8%
Advice deficient	8%
Failure of structure	6%
Unethical conduct	6%
Person practising without registration	6%
Other	17%
Total	100%

Source: Board of Professional Engineers of Queensland

[27] Correspondence received from the Institution of Engineers, Australia, National Office, Jan 2000

Of the 65 complaints received during the period, 48% related to the failure of foundations / footings / slabs. Engineers claim the failures are the result of pressures from builders to reduce costs. Of the complaints received by the Institution of engineers over the last five years, 90% have been related to footings and foundations. These statistics can be deceptive as they do not take into account the costs relating to the complaint. Footings failures on residential buildings may only be a fraction of the cost of a mine accident. Similarly, the footings complaints predominantly come from residential building construction which is a highly emotive area and likely to draw greater complaints than many commercial projects where purchasers may negotiate rectification works and financial settlements directly with the service provider.

The Board also undertakes monitoring activities on unregistered engineers, companies and units. These monitoring activities are undertaken primarily via a review of the Brisbane Yellow Pages under the Engineers – Consulting and Mining Engineers category.

Of the 378 listed entries for consulting engineers in the 1999 edition, 291 were registered with the Board. Of the remaining unregistered firms, standard letters were sent to 51 firms who listed for the first time and a stronger letter was sent to 36 firms who had previously listed. Of the unregistered firms, 8 gained formal registration, 17 employed principals who were registered despite a lack of company or unit registration, 24 withdrew their listing and 39 remain unregistered for reasons as yet not ascertained by the Board of Professional Engineers of Queensland.

With respect to mining engineers, there were 60 listed entries of which only 5 were registered. Of the remaining unregistered firms, 3 were identified as being exclusively contractors, and definitely not providing professional engineering services, and standard letters were sent to the remaining 52 firms.

Proactive monitoring was also undertaken through the delivery of standard letters to 130 local governments requesting that they confirm that their senior engineers were RPEQs and advising that if they were providing a professional engineering service, that they required registration as a company/unit. A Board representative also visited major Queensland Government Departments and business units employing professional engineers to confirm that the same requirements had been met.

While the 'sending of letters' may not be considered an effective means of deterrence, it should be noted that the Board is restricted by resources and it is not within the scope of the Board's jurisdiction to discipline unregistered persons advertising or providing professional engineering services. A negotiated cessation to their actions is the most common response. If negotiations fail to cease the actions of these persons, the matter can be referred to Crown Law for prosecution.

3.5.3 Professional Engineers Disciplinary Panel

Under Part VIII of the Engineers Act, the Board oversees the investigation and prosecution of disciplinary charges against registered persons via charges referred to the Professional Engineers Disciplinary Panel.

The Professional Engineers Disciplinary Panel (the Panel) was established in 1997 removing the function of 'assessing charges' from the Board. The Panel reports to the Department of Public Works and is in no way accountable to the Board.

Members of the Panel are appointed by the Governor in Council for a specific period. The Panel is to consist of a chairperson and at least two other members. Currently, the chairperson must (and other members may be) a retired judge of an Australian court or a lawyer of at least 5 years standing. Other members may also be appointed if they are a registered professional engineer of at least 5 years standing. The table below details statistics of the Disciplinary Panel's activities.

Table 3.11 Disciplinary Panel Activities

Item	1997/98	1998/99	1999/00**
Number of Complaints	60	20	28
Number of Investigations	14	3	12
Charges Heard	7*		
Charges Pending	1		
Expenses			
Investigations	$97,904	$31,607	$8,070
Legals		$35,230	$22,961
Disciplinary Panel		$601	$3,328
Income			
Penalties		$13,000	$28,000
Net Outlay	$97,904	$54,438	$6,359

Source : Board of Professional Engineers of Queensland
Notes : * Relates to four registered persons. ** First five months only.

Since 1 July 1998, six RPEQs have been charged by the Board of Professional Engineers of Queensland relating to complaints from activities during 1996/97 and 1997/98. The response time indicates a lag of at least one year between the alleged inappropriate behavior and the laying of disciplinary charges.

The net outlays incurred from the investigation, legal and disciplinary costs average $55,868 per year over the three year period. Given the seriousness of the investigation and disciplinary procedures, this does not represent a high level of cost.

To date, the Panel has dealt with 6 cases. The nature of these cases related to improper practice by registered engineers. The complaints focused on improper certification of building foundations, certification without inspection, negligence and recklessness.

In some instances, after the Disciplinary Panel has convened a tribunal hearing, the Board and the charged engineer have resolved to make a joint submission to the Disciplinary Panel for a period of temporary deregistration. In these cases, the Disciplinary Panel has accepted the submission and the assessment of charges has ceased in favor of the voluntary deregistration.

Under section 60 (1) of the Engineers Act, the disciplinary powers of the Panel are described as including:

- taking no action
- cautioning the person
- reprimanding the person
- ordering the person to pay the Board a financial penalty of 75 units ($40 per unit)
- ordering that the person's registration be cancelled
- ordering that the person be disqualified from obtaining registration under the Act indefinitely or for a specified period.

If the registered person is the executive officer of a registered professional engineering company or if the person is in charge of a registered professional engineering unit, then the disciplinary action may also include:

- disqualification of the person from holding office as an executive officer or person in charge for an indefinite or specified period of time
- withdrawal of the company's or unit's certificate of registration until such time as the Board is satisfied that the registered person is no longer involved in their former supervisory role.

A significant additional penalty levied against those parties deemed guilty of inappropriate action is the requirement for the offending engineer to pay the costs of an independent expert's investigation.

The Panel does not possess the ability to award financial damages to consumers of engineering services.

In a recent case[28] heard by the Panel, a registered professional engineer pleaded guilty to a disciplinary charge of misconduct in a professional respect. The charge related to site classification and footing design of 19 houses in South-East Queensland where many of the houses had suffered damage caused by movement of footings. The offending engineer was fined $3,000, his registration has been cancelled for two years and he must also meet investigative costs of $25,000.[29]

As an ultimate avoidance of discipline, registered professional engineers possess the avenue of resignation of their registration prior to any investigations or disciplinary hearings.

3.5.4 Costs of Regulatory Framework

Schedule 1 of the Engineers Regulation details the Fees applicable for application and renewal of registration with the Board and range from $30 for an individual to $100 for an engineering company or unit. Full details are contained in Appendix F.

Utilising these fee structures the Appendix also contains details calculating the total financial burden to the engineering profession in Queensland as $250,065 per annum.

[28] Board of Professional Engineers of Queensland Media Release, 25 November 1999
[29] Information on the number of deregistrations in other states is not presently available.

The Board of Professional Engineers of Queensland is self funded through the collection of annual registration fees. Its total expenses for the 1998/1999 financial year were $220,395.

3.6 Professional Associations

As with most industries, there are a number of professional associations fulfilling different roles for their members. The table below provides details of a number of these organisations and indicative measures of their membership levels.

Table 3.12 Professional Engineering Associations

Organisation	Jurisdiction	Membership
Institution of Engineers, Australia	Australia	47,466
Association of Professional Engineers, Scientists and Managers, Australia	Australia	17,369
Australasian Institute of Mining and Metallurgy	Australian and New Zealand	5,500
Australian Water and Wastewater Association	Australia	3,000
The Australian Institute of Refrigeration	Australia	2,500
Association of Consulting Engineers, Australia	Queensland	866
Professional Officers Association	Queensland	200
Institution of Refrigeration and Air Conditioning Service Engineers		113

Source: The Board of Professional Engineers of Queensland, 1992 : 19

Of those bodies detailed in the table above, the peak professional association (as indicated by its leading membership status) is the Institution of Engineers, Australia (IEAust).

A core activity of IEAust is to express its opinion on policies, inquiries and other initiatives of governments. The rationale being that such high level representation raises the profile of engineers and ensures that the views of practicing engineers are considered when governments develop policies.

A key function of the Institution has been to maintain, develop and promote the National Professional Engineers Register (NPER). The NPER was established jointly in 1989 by the Institution of Engineers, Australia (IEAust), the Association of Consulting Engineers, Australia (ACEA) and the Association of Professional Engineers, Scientists & Managers Australia (APESMA). A Board, with representation from State and Territory Governments, the IEAust, ACEA, APESMA, and a number of other national organisations, is responsible for ensuring that NPER is administered in the community interest.

The purpose of the NPER is to maintain the technical standards and ethical practices of members and to provide a mechanism for the public to identify an appropriate competent engineer.

The NPER identifies engineers (not limited to IEAust members) who have:

- academic qualifications from an accredited training institution and/or
- accumulated experience as an engineer of 5 years for accredited graduates or 7 years for those without qualifications but who possess sufficient industry experience
- commitment to ethical conduct
- commitment to the continuous professional development (CPD) of their professional skills

the combination of which enable them to practice as an independent engineer in their field of expertise.

To monitor adherence to the commitment for CPD, IEAust requests an annual self assessment by members (when paying registration fees) that the person will comply with CPD requirements over the coming year. In addition, IEAust conducts a formal random auditing process of its members compliance with the CPD requirements. Those selected would be asked to forward records of their CPD to IEAust for checking. Should it appear that false claims have been submitted, action would be taken under the Institution's Disciplinary Regulations. The ultimate sanction for a proven breach is de-registration and loss of IEAust membership where appropriate.

It is important to note that the initial competency assessment and ongoing CPD audits of the NPER result in a greater level of assurance of its members competency compared to the RPEQ registration process.

Acceptance to the NPER also requires compliance with a strict code of ethics and an agreement to be bound by the IEAust's disciplinary regulations despite an absence of legislative requirements.

Nine general disciplines of practice (referred to as categories) are currently available to those registered on NPER:

- civil
- structural
- mechanical
- electrical
- chemical
- environmental
- building services
- biomedical
- management.

In response to government and industry demand, five much more specific areas of practice have been made available to practitioners registered in one of the general areas of practice (categories) on NPER:

- fire safety
- pressure equipment design verification
- subdivisional geotechnics
- project management
- energy management.

At present there are almost 10,000 engineers registered on the database.

The IEAust gives the following certification in respect of those on NPER:

Engineers listed on NPER have met stringent criteria as to their qualifications and experience, have committed themselves to engage in continuing professional development, and have thereby substantially enhanced their competence to deliver particular professional engineering services from their general area or areas of practice.

Taken as a group, registered professional engineers can be expected to have more advanced knowledge and skills, and thus to be able to be more competent and effective practitioners than engineers who have not been able to meet the specified entry standards or to commit themselves to ongoing study and professional development.

Obviously the Institution does not certify the competence of an individual to carry out any specific engineering task.

The register is run on a purely cost recovery basis and recognises, with assessment discounts, the services provided by IEAust and other bodies who provide an input to the assessment and record keeping processes.

Total ongoing fees to maintain listing on the NPER register range from $200 to $355 (full details are contained in Appendix F). These fee structures are comparable to other profession's associations such as the Institution of Surveyors, Australia whose full membership fees are $395 per annum.

3.7 Interstate Regulatory Approaches

There are presently three regulatory systems in Australia:

- comprehensive government regulation, as is the case in Queensland
- Government regulation, as in the case of Victoria, but only in respect of the building industry
- Government controlled, but privately administered accreditation of development type activities, with different models in New South Wales and South Australia.

The trend amongst the other States and Territories is for licensing in the building and local government certification areas. Where the profession is regulated in other professional areas it typically involves registration with a nominated or accredited professional engineering body.

Table 3.13 Comparison of Interstate Approaches

State	Key Legislation	Comprehensive Regulation of Engineers	Direct Regulation of Engineers in Building Industry	Co-regulation of any industries
Queensland	*Professional Engineers Act 1988* & *Professional Engineers Regulation 1992*	Yes	Yes	No
Victoria	*Building Act 1993*	No – associated legislation only	Yes	Yes
NSW	No specific legislation	No – associated legislation only	No	Yes
South Australia	*Development Act 1993*	No – associated legislation only	Yes	Yes
Western Australia	*Professional Standards Act*	No – associated legislation only	No – under development	Yes
ACT	*Construction Practitioners Act 1988*	No – associated legislation only	Yes	Yes
Northern Territory	*Building Act 1993*	No – associated legislation only	Yes	Yes
Tasmania	*Building Act*	No – associated legislation only	Yes	Anticipated

Source : Institution of Engineers, Australia

As detailed above, the key differential between Queensland's regulatory approach and that utilised in other states is the unique requirement for the registration of all engineers with a statutory body. As a consequence, legislation governing the works of engineers in other states utilises the term "competent persons" rather than "engineer" or "professional engineer" in various pieces of legislation.

The assessment criteria for a competent person is often undefined thereby enabling persons who are neither registered, nor specifically qualified as engineers, to practice. In other instances detailed requirements are specified including accredited bodies competent to undertake the necessary assessment.

The IEAust has indicated that there is a growing trend in other States and Territories of Australia to regulate the practice of professional engineering services through associated legislation rather than direct restrictions on engineering practices.

For example, the New South Wales Government has introduced state wide environmental legislation governing engineering practices. Under the legislation, state wide engineering standards would be imposed on all local governments that do not have suitable environmental standards incorporated into their laws.

The use of associated legislation rather than direct restrictions on the practice of all engineering services increases the level of complexity of the regulatory environment but also provides the ability to specifically prohibit or allow certain practices which may be competently practiced by persons other than just engineers.

At present, Queensland utilises a combination of direct regulation via the Engineers Act and Engineers Regulation and associated legislation.

The Institution of Engineers, Australia submitted the following comments with respect to the trend of interstate regulatory models.[30]

State and Territory governments are introducing piecemeal registration or licensing of engineers as and when an area of significant risk arises, usually brought to their attention by serious incidents. For instance, as a result of the Canberra Hospital implosion, the ACT government in particular (and other governments) are looking at licensing practitioners involved in high risk demolition work (this necessarily includes structural engineers). As a result of the Westralia incident, the Naval Board of Inquiry recommended that a competent professional engineering authority be established as part of the procedure for authorising work. The Sydney Water and the New Zealand Electricity incidents also involved an engineering aspect. As a result of the Thredbo disaster, the NSW government will have to consider the level of geotechnical engineering expertise it has access to. Pressure vessel design was seen as an area of high risk, and those engineers registered on NPER can certify design for pressure vessels. Many more high-risk situations exist. However, it is unlikely that a holistic approach to regulation of engineering practice will be undertaken, due to the current trend to deregulate.

Instead of imposing regulatory regimes for professionals, including professional engineers, both NSW and WA have introduced professionals standards legislation. This is intended to provide a means to ensure a certain standard of professional practice. The Act provides that persons who accept conditions on their practice standards may become part of a scheme to limit the quantum of their liability from alleged professional negligence. Such conditions include membership of an approved professional organisation, compliance with a risk management program and carrying a set level of professional indemnity insurance. The Professional Standards Council has approved NPER to be the registration standard (for initial registration and continuing professional development requirements) for professional engineers who wish to use the limitation of liability provisions under the Professional Standards Act.

There are many Acts, regulations and standards that specify that only a qualified engineer is able to undertake certain types of work. These include Commonwealth legislation concerning aircraft engineering, mining safety legislation in each State and Territory relating to work of mining engineers, etc. The problems arise when consumers (the public and government alike) who do not have the expertise, are required to determine who is a qualified and competent professional engineer.

Some areas that have not required regulation of engineering practitioners is the manufacturing and automotive, petroleum and biomedical sectors, as the end product is usually covered by many safety standards and rules

[30] A detailed explanation of regulatory approaches associated legislation applied across Australia is contained in Appendix G.

Building regulation

Over the last decade, governments have become focussed on licensing of practitioners in the building sector. This is primarily in the domestic market, although some governments have extended this to include major building work. The focus is on consumer protection, generally of a financial nature, imposing mandatory insurance, financial backing and management ability criteria. The focus has generally been on builders and other tradespeople.

Coupled with this has been a move to mandatory certification of certain aspects of building, and this has included the registration and licensing of professions, such as engineers. Almost all jurisdictions impose some form of registration/licensing for engineers in the building sector, as outlined below. The description relates to the use of the National Professional Engineers Register in legislation.

Victoria

Building Act 1993 - requires building practitioners to be registered with a Statutory Authority (Building Practitioners Board). The Board uses the National Professional Engineers Register (NPER), as the benchmark for the criteria for qualifications and experience required of professional engineers who work in the building sector in Victoria. This includes structural, civil, fire safety, electrical and mechanical engineers. About 25% of the registered building surveyors in Victoria are professional engineers.

South Australia

Development Act 1993 - requires certain types of building practitioners to be registered with a State Government Department. The Department uses NPER as the benchmark for the criteria for qualifications and experience required of professional engineers.

NSW

Environmental Planning and Assessment Act - allows for a private certification of work previously undertaken by local councils relating to Building Act compliance, subdivision work and some other specified complying development. A scheme has been established that allows professional associations to register, monitor ongoing compliance with professional standards and discipline accredited certifiers. The Institution of Engineers is an approved accrediting body, using NPER as the basis for a registration system, with specialised areas of practice.

ACT

Construction Practitioners Act 1998 - requires building certifiers to be registered with the Building, Electrical, and Plumbing Control (BEPCON) section of the Department of Urban Services. The regulations authorise registration on the National Professional Engineers Register (NPER), as managed by the Institution of Engineers, Australia, as sufficient for practitioners to act as Building Certifiers and as Plumbing Plan Certifiers.

Tasmania

Building Act - the Government is currently considering changes to its Building Act with respect to registration of building practitioners and private certifiers. The Tasmanian Government has indicated that the Institution of Engineers (using NPER) will be considered an appropriate registering body.

Western Australia

WA is currently in the process of drafting legislation to regulate building surveyors and other professionals in the building sector. They already regulate builders under separate legislation.

The Western Australian Professional Standards Act is very similar to the Professional Standards Act of New South Wales. It has been indicated by the Western Australian Government that the IEAust will be an approved professional organisation under the scheme.

Northern Territory

Building Act 1993

The Building Act 1993 allows for certification by private building practitioners as authorised by a State authority. The NPER is used as the benchmark for qualifications criteria for persons wishing to undertake such work.

The regulatory approaches applied in other states and territories are not capable of meeting the objectives of Queensland's legislation primarily due to their heavy focus on engineering registration for the building industry only, relying on associated legislation for other industries. As a result, these approaches have not been subjected to the review process as potential regulatory options.

The co-regulatory technique used in many instances for their application may however illustrate a more flexible and less restrictive means of achieving the objectives of the regulatory regime and has been investigated in two forms (option 3 and option 4), under the PBT framework.

3.8 International Regulatory Approaches

International regulatory approaches indicate a trend movement towards the implementation of broad registration of engineers for all disciplines under a statutory framework. A discussion of these regulatory approaches is contained in Appendix G.

4

Risk of Harm from Professional Engineering Services

Potential for Adverse Engineering Outcomes

As indicated in previous sections, the work of engineers ranges from the highly complex to the simple. A level of risk is implicit in all engineering designs and depending on its application it may vary from a 1 in 10 to a 1 in 1000 year probability of a negative outcome.

The application of engineering designs is associated with a broad range of public and private services including design, construction, and operation of major infrastructure, industrial equipment, residential housing, mines, waste treatment and disposal, water catchment, treatment, and distribution, and energy supply. In some form, this work affects all members of the community. It is quite often third parties to the original transaction who may directly consume services resulting from professional engineering work. Therefore, incidents of inadequate engineering have the potential to affect large numbers of people and be associated with high costs. These costs can be classified under three headings:

- risk of physical harm
- financial costs
- environmental costs.

4.1 Risk of Physical Harm

A written submission from the Board of Professional Engineers of Queensland refers to survey research from which 100% of respondents indicated their belief that the role of professional engineers impacts significantly on the health and safety of the public. These health and safety impacts cover a range of consequences from personal stress, through to illness, injury and at the extreme end, death. The risk of these consequences occurring, termed the risk of physical harm, involves both the probability of an event happening and the consequence of the event happening. Physical harm risk is always present but varies in magnitude. For adverse events it is often associated with small probabilities. Where these small probabilities are associated with catastrophic consequences, the risk cannot be ignored.[31] The following matrix shows the relationship between risk and the probability and consequence of an event occurring.

Table 4.1 Risk Framework

	Consequences				
Probability	**Extreme**	**High**	**Medium**	**Low**	**Negligible**
High	High Risk	High Risk	Medium Risk	Medium Risk	Low Risk
Medium	High Risk	High Risk	Medium Risk	Medium Risk	Low Risk
Low	High Risk	Medium Risk	Medium Risk	Low Risk	Low Risk

[31] Department of Premier and Cabinet (Victoria), *Guidelines for the Review of Professional Regulation*, February 1999.

It is important to note, in undertaking this Review that media focus can distort the public's perception of the risk associated with certain events. For example, the recent cryptosporidium scare with the Sydney water supply received massive media attention and created the impression of being a major or high risk event. However, the consequences of mild illness and the fact that there were no reported associated illnesses would place it in the medium to low risk category in terms of physical harm.

For the purposes of this Review, work undertaken by engineers has been categorised as either high complexity, medium complexity, or low complexity. Table 4.2 in this section identifies examples of these different types of work, the potential consequences of inadequate engineering in this work, and the probability of these consequences occurring. This table has been compiled from information provided during consultation and the advice of the expert consultant to the Review.

There are no specified definitions of what constitutes high complexity work, medium complexity work, or low complexity work for an engineer. Issues that assist in the definition process include the time involved in the design of projects, the level of skill involved in the work (design, construction, or operation and maintenance), and the experience required to undertake the work to the appropriate level of competency.

Engineers participate in the three stages of the development of the built environment – design; construction; and operation and maintenance. It is difficult to separate the consequences of inadequate engineering in these stages, therefore they have been considered together from a project's total life cycle.

High Complexity Work

High complexity work involves a significant amount of time in the design phase, and a high level of skill and experience in undertaking the engineering work. Understandably the consequence of inadequate engineering on high complexity work can range from catastrophic to a low level. For example, a total of 22 people have died in only two mine accidents at Moura in 1986 and 1994.[32] At the other end of the scale, a minor design flaw in a high rise building may result in only cosmetic cracking that poses no structural problems.

The inadequate use or inappropriate use of engineering services can specifically lead to risk of physical harm situations. In the May 1998 collapse of Opal House (Ann Street, Brisbane) it was alleged by the Division of Workplace Health and Safety[33] that the constructor "did not adequately consult with the geotechnical or structural consultants during critical stages of the underpinning work". This resulted in the failure to identify and adhere to appropriate underpinning methodologies during the performance of the work.

[32] Department of Mines and Energy, Mines Inspectorate Branch, 24/11/99
[33] QA Document No. IAS-FRM-1007.008.v1

The Division of Workplace Health and Safety claim that the collapse of Opal house endangered the health and safety of the site workers, the occupants of Opal House, and the pedestrians and vehicular users of Ann Street. The Workplace Health and Safety Act 1995 requires a constructor in these circumstances to "take reasonable precautions and exercise proper diligence to ensure workplace health and safety.[34] The Engineers Act complements the *Workplace Health and Safety Act 1995*, by providing a mechanism to identify appropriate persons to undertake the specialised work necessary in this situation.

Consequences of inadequate engineering range from death and disability to personal injury, ill health, to visual displeasure and personal stress from cosmetic cracks in a building resulting from a design flaw. In most instances the probability of the more extreme events occurring is low or unlikely. The exceptions are mining accidents which are considered to have a high probability of occurrence.

The Minerals Council of Australia produces a fatal injury frequency rate (FIFR) which measures the risk of fatalities in the mining sector. Over a 40 year period these rates have been equivalent to:

- one death in the underground metalliferous mining industry for every 24 workers over a 40 year working period
- one death in the underground coal mining industry for every 28 workers over a 40 year working period.[35]

Although there are no statistics to benchmark these figures against, they are regarded as unacceptably high by the Safety and Health Division of the Queensland Department of Mines and Energy. It should also be noted that there was no information available to determine the number of fatalities specifically attributable to inadequate engineering services.

The more minor consequences of inadequate engineering, such as minor structural damage and cosmetic cracking of residential buildings with high probabilities of occurrence are considered to be of medium to low risk.

As indicated above, all members of the community can be impacted by inadequate engineering in high complexity work. The major impacts generally fall on the consumers or purchasers, the employees working on the project, and the owner of the project. However, the public is also at substantial risk from inadequate engineering on high complexity projects. In the case of the recent hospital implosion in Canberra it was a bystander who was tragically killed. The ACT coroner found that the structural engineer was found to have contributed to the death of the bystander.[36]

The complexity of this work requires that significantly experienced persons control and supervise such work. This involves a professional engineer with specialised experience in the particular type of work. Status as a professional engineer in general was not considered by consultation participants as sufficient to undertake this type of work. In virtually all cases, persons consulted indicated that specialist expertise was required to work in areas of high complexity and that engineering service providers were sensible enough to not operate in areas where they were not suitably experienced.

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[34] Division of Workplace Health and Safety, QA Document No. IAS-FRM-1007.008.v1
[35] Minerals Council of Australia, *Safety and Health Performance Report of the Australian Mining Industry 1996-97*
[36] Institution of Engineers Australia, *Submission to the Department of Public Works Queensland*, September 1999

There is a range of associated Queensland legislation that is designed to assist in the management of the risks associated with high complexity engineering work. This legislation includes the *Coal Mining Act 1925*, the *Explosives Act 1952*, the *Environmental Protection Act 1994*, and the aforementioned Workp*lace Health and Safety Act 1995*, to name a few.

Medium Complexity Work

Medium complexity engineering work involves a moderate level of professional skill in design, construction supervision, or operation and maintenance supervision/guidance. The design phase would not normally take as long as that for high complexity work but is not a firm determinant on the level of complexity. Some medium complexity work may take a considerable amount of time to design if it is a particularly large project such as a major road design. Other examples of medium complexity work include air conditioning design, air conditioning maintenance, pipeline/pump design, storage vessels and heat and pressure vessel design.

It is important to note medium complexity work can occur across all engineering disciplines. Although the consequences of medium complexity work are likely to be less significant, on average, than those for high complexity work, this work can be associated with very serious consequences. In the example of major road design the consequences of inadequate engineering are road accidents that may lead to death. Similarly, inadequate engineering in relation to air conditioning maintenance can lead to potentially fatal diseases such as Legionnaires Disease. Consequences can be similarly extreme in the cases of inadequate engineering for pipeline/pump design and vessel design. The former may lead to leaks and explosions and the latter may lead to poisoning or contamination; all are potentially fatal.

The examples of medium complexity work (provided in Table 4.2) highlight the potentially extreme consequences that may result. The independent expert to the Review has advised that events with lesser consequences have a higher probability of occurrence. For instance cracking from poor road engineering design may result in personal stress for individual drivers. Other issues include discomfort from poor air conditioning design, stress and compromised safety associated with the failure to deliver proposed volumes from inadequate pipeline/pump design, and contamination from inadequate engineering in vessel design.

A recent example of medium complexity engineering work that experienced failure occurred when a rock wall collapsed at a block of townhouses on Manly Road, Manly in Queensland. No physical injury was sustained to any person but significant personal stress resulted to the occupants of the adjacent townhouses and the owners and customers of the golf driving range below the wall. Preliminary investigations by the Brisbane City Council indicated that the design and construction of the retaining wall were totally inadequate for the intended purpose.[37] No official approval appears to have been given for the retaining wall. Although the consequences of this incident were only moderate they had the potential to be much worse. Had the retaining wall collapsed further and brought the townhouses down with it, personal injury and even death of the occupants may have resulted.

[37] FOI Release: Brisbane City Council Memorandum from Mark Williamson (Coordinator Licensing and Compliance) to Cr A Bennison (Chairperson Customer and Local Services Committee), 9/8/99.

The persons or groups potentially affected by inadequate engineering with medium complexity engineering work are similar to those affected by high complexity work, that is, consumers, purchasers, owners, Government, the public, and employees. With this level of work it is felt that, in general, less of the public are exposed to the consequences of inadequate engineering.

There are exceptions to this, notably major road design such as the widening of the South East Freeway between Brisbane and the Gold Coast. A huge number of South East Queensland residents and tourists would be exposed to inadequate engineering if it occurred on this project.

Low Complexity Work

Less complex engineering work involves a base level of skill and experience and the design phase can often be completed in a short amount of time. This work is often repetitious and low in cost. The majority of low complexity engineering work involves structures built to the Building Code of Australia. Other low complexity engineering work includes minor road design, and electrical domestic power supply design.

The consequences of inadequate engineering associated with this type of work include accidents, injury, personal stress associated with cosmetic damage and minor structural damage, fire and trauma. Some of these consequences can have a high probability of occurrence such as personal stress from cosmetic damage in residential housing not to mention the reduced asset value. More major consequences, such as fire, have a low probability of occurrence. The remainder of examples of low complexity work shown in the table in this section are considered to have a medium probability of occurrence.

Low complexity engineering work such as footings design for residential buildings is the area that receives the greatest number of consumer complaints; 48% of complaints to the Board of Professional Engineers of Queensland over the past two years were from this type of work.

The major persons or groups impacted by these types of incidents include consumers and insurers for residential housing works. Poor design in minor roads tends to impact road users and Local and State Governments.

Table 4.2 provides examples of high, medium and low physical harm risks.

Table 4.2 Examples of physical harm risk

	Consequences				
Probability	**Extreme** *Death*	**High** *Major illness/ disability*	**Medium** *Minor illness/ injury*	**Low** *Personal stress*	**Negligible** *Minor personal stress*
High	***High Risk*** - Mine collapse/ explosion	***High Risk*** - Mine explosion resulting in major injury	***Medium Risk*** - Inadequate design of sewerage main and reticulation	***Medium Ris***k - Minor structural damage on residential buildings	***Low Risk*** - Cosmetic cracking from poor residential footings design
Medium	***High Risk*** - Road accident caused by poor road design - Legionaries disease from poor air conditioning maintenance	***High Risk*** - Operator injury from shiploader/ conveyor work	***Medium Risk*** -Building deflections - Pipeline failure to deliver proposed volumes - Road accidents from minor road design	***Medium Risk*** - Cosmetic cracking on commercial buildings - Road cracking and disintegration	***Low Risk*** -Discomfort from poor air-conditioning design
Low	***High Risk*** - Collapse of building - Power plant explosion - poisoning from vessel design failure	***Medium Risk*** - Illness from sewerage service failure - Pipeline explosion - Storage vessel explosion	***Medium Risk*** - Power station transmission malfunction	***Low Risk*** - Functional failure or breakage on shiploader/ conveyor	***Low Risk*** - Minor road or pavement cracking from poor design

A significant feature associated with the work of the engineering profession is the irreversibility of costs that result from the inappropriate delivery of some professional engineering services. For many transactions in the economy, including many associated with professional engineering services, there is recourse available through legal proceedings to recover financial costs which occur as a result of the failure of goods and services delivered. However, where the failure of engineering services results in personal injury or the loss of life, financial remuneration does not adequately compensate those affected by the incident. This further highlights the impact that engineering services can have on the community.

4.2 Financial Costs

The result of failure of structures or other works dependent upon professional engineering works may include financial costs. These costs may not only relate to funds lost in original design and construction work but also in litigation, lost production, and rectification expenses. These financial costs occur across the three levels of complexity of engineering work.

For example a mining accident is associated with a high complexity of engineering requirements and has significant financial costs beyond the loss of life that may occur. Industry research[38] has concluded that costs were incurred up to several years after the explosion of a mine, and depended on whether the explosion resulted in the closure of the mine. Initial costs in this case were estimated to be in the order of $6 million including direct incident costs, equipment overhaul and mine repairs, capital equipment replacement, enquiry costs, and common law liability. This did not include the ongoing production losses.

The incident of the collapsed retaining wall reviewed above, is an example of an accident associated with medium complexity engineering work. Rectification costs for this project were estimated at $250,000, but the Brisbane City Council believed it could be more when loss of business to the golf range is taken into account.

Low complexity engineering work such as footings design for residential buildings appears to have the greatest number of incidents. The Queensland Building Services Authority estimate that between $5-$10 million of payouts last year were for complaints associated with engineering work of this nature[39]. Although many claims are small, when combined they sum to a significant amount.

Financial costs can also include indirect costs that occur to the public as a consequence of bad design or constitution. For example, road users may incur costs from direct vehicle damage or opportunity costs from time delays relating to the failure of the infrastructure.

While many studies can identify the direct costs incurred as a result of an incompetent engineer's actions, indirect costs also need to be recognised.

4.3 Environmental Costs

Inadequate engineering at all levels of complexity has the potential to cause environmental costs. These may include chemical leaks, oil spills, sewerage outflows, air pollution, noise pollution, and visual pollution. The risk of these events occurring from inadequate engineering is a product of the level of the consequence and the probability of the event occurring.

The consequences of these events have for the environment can range from significant to negligible. Failure of a sewerage treatment works may have widespread effects on the quality of water supply and local habitat of native species. A chemical leak may be devastating to the local environment causing irreversible damage. At the other end of the scale, more minor consequences can be seen in air, water, noise, and visual pollution.

Measuring these consequences is difficult. One of the central issues[40] in environmental economics is that there are usually no prices that can be attached to environmental loss. This does not mean there is no value associated with these situations. These values can be great in part due to the fact that human life depends upon services derived from the environment.

[38] A paper by J. Sleeman (1990), at the request of The Review Committee for the Coal Mine Explosions Research Report, investigated the true cost of a colliery explosion.
[39] Matt Miller, QBSA, Consultation Oct 1999
[40] Hodge, I, *Environmental Economics*, 1995.

The probabilities of these events occurring are also difficult to measure and statistics are not readily available.

Environmental legislation including the *Environmental Protection Act 1994* is the main instrument used to protect the environment from all forms of abuse including inadequate engineering.

5

Specification of the Base Case

5.1 Introduction

The base case assessment discusses:

- how the legislation is administered in practice
- if the practice matches the requirements of the legislation
- if the practice meets the objectives of the legislation
- the economic and social impacts from the current practices.

The base case specification discusses the above in relation to each of the following key affected groups:

- consumers
- engineers
- para-professionals
- Government
- Board of Professional Engineers of Queensland
- Professional Engineers Disciplinary Panel
- Queensland Building Services Authority
- Institution of Engineers, Australia and other professional associations
- training institutions.

It is necessary to specify the base case for each key affected group to determine the impacts experienced in the current market and the degree to which current practices meet the objectives of the legislation. Once the base case is specified, it provides the platform for the incremental analysis of the impacts associated with the other regulatory and non-regulatory options to be reviewed.

5.2 Consumers

A key issue raised from consultation has been that consumers of professional engineering services are not limited to the initial purchasers of the designs or related work. Engineering works may also be consumed by third parties to whom works may be sold, or 'walk by' consumers including pedestrians or couriers whom have no control over the initial purchase of engineering services and should be afforded protection from sub-standard works.

An important example of consumers who were not the initial purchasers of engineering services are residential property developers. It has been noted in consultation that these persons will typically opt for the lowest cost form of engineering services. Unfortunately if negative outcomes result, the developer who initially purchased the services may have relocated providing no recourse for the long term consumers of the services. Therefore provision of engineering services needs to consider the safety of the initial consumer and the ultimate consumer.

Consumers of professional engineering services may also include building/construction and other professionals as well as the final consumers of engineering products. The Opal House collapse discussed in Chapter 4 highlights the significant ramifications which may result for workplace health and safety from inadequate considerations of engineering principles.

As discussed in Chapters 3 and 4, sub-standard engineering services have the potential to deliver multiple impacts to the community ranging from construction and operation inefficiencies to outright failures resulting in financial costs and personal injuries (including death). Typically these costs are directly associated with the complexity of works undertaken. A significant proportion of potential personal injuries (loss of limbs/death) is an irreversible cost which can not be restored by financial compensation from legal actions.

The unfortunate reality (exposed during consultation) that at least some persons in the market will act in a negligent or reckless manner potentially resulting in loss of human life, is sufficient on its own to warrant some form of protection of the public[41], be that delivered through measures established by market mechanisms (i.e. professional associations) or by government intervention of some form. The current regulatory framework appears to be providing this protection, as complaints received by the Board, discussed in Chapter 3, are not significant.

Consultation also revealed that the profile of purchasers of professional engineering services varies with the style of works undertaken. The key explanatory determinant for profiling purchasers is the level of expenditure and complexity of the project and therefore the resulting expenditure on engineering services.

For instance, expenditure on a large mining operation by the Broken Hill Proprietary Company Limited (BHP) will be associated with a large level of expenditure on engineering design services. BHP was described by consultation participants as an informed purchaser of high cost and high complexity engineering services who is able to identify their technical requirements and assess the credentials of applicants to meet these requirements. The importance to BHP to be informed of the quality of their providers was identified during consultation with reference to the potential financial costs of operating inefficiencies or outright failure if BHP utilised sub standard providers.

Consultation revealed that for large and sophisticated consumers of engineering services, RPEQ status is considered as a key (though not exhaustive) screening requirement when assessing potential suppliers. Indeed significant additional screening activities for potential suppliers occur. Due to the size of the contracts involved, suppliers will happily comply and provide free of charge technical capability and previous experience information to large clients. In some instances, as an RPEQ is only required for final approval of works, non registered persons may be employed under supervision if their other key qualifications are sufficient.

By contrast, obtaining advice on engineering footings for a residential house is expected to be associated with a low level of expenditure on engineering services. Consultation revealed that in most instances the persons buying these services will not be informed purchasers of engineering services. This style of consumer is likely to have a poor understanding of the relevance of engineering principles in their ultimate objectives and may select a provider largely on the basis of lowest price. On the supply side, the number of persons with or without the skills, but possessing the ability to win work in this area are plentiful in the Queensland market.

[41] Information asymmetries arising from the technical nature of the profession and other considerations discussed later are also significant concerns for the efficient operation of the market in the absence of professional association or government based regulation of the profession.

It was identified during the consultation process that some unregistered persons, and/or persons with inappropriate skills, are presently tendering their services or attempting to undertake projects outside their area of expertise, particularly in relation to low cost civil works. This is supported by statistics provided by the Board that 23% of engineers advertising for this type of work in the yellow pages were not RPEQs (This is discussed in more detail in the next section).

While larger projects/purchasers will possess sufficient knowledge to identify and screen these providers from their selection process, smaller consumers are less likely to be able to do the same. This is consistent with the fact that 48% of the complaints (since 1 January 1998) to the Board of Professional Engineers of Queensland related to residential footings and slab designs. Therefore a greater level of protection may be warranted for small purchasers seeking engineering services for the purpose of low budget, low complexity works.

It should also be noted that consultation responses from representatives of key affected groups and the input of our technical expert indicate that there is scope for para professionals and non registered professional engineers to undertake simple civil works such as low level water, sewerage and road works without significant risk of harm. The combination of large educated users of these services and the low complexity of these works indicates that a lower level of protection may be required for these areas.

The registration requirement itself, to allow for the practice of professional engineering services in Queensland, does not always provide protection to the smaller consumers due to the information assymetry experienced by this group, ie. they do not always realise the differences between an unregistered operator calling themselves an 'engineer' or another person who is legally permitted to use the title RPEQ.

As discussed in chapter 4, the ramifications of sub standard engineering services may feature operating cost inefficiencies for third party users. In the case of transport freeways, lifetime operating costs for users of the infrastructure may be many times the initial capital cost of the project. The magnitude of this cost reflects the potential high sensitivity and costs of inefficient designs. Therefore although risk of physical harm may be mitigated, the level of financial cost may be borne by third party consumers. This is not likely to be a major issue as these persons are only likely to be commissioned to undertake work on a small scale or low risk projects. The legal requirement to use an RPEQ could not be overlooked for high profile projects where third party user costs are a major consideration.

As discussed in Chapter 3, the market for engineering services is characterised by high levels of price competition as evidenced by business income and individual earnings results which are not significantly disparate from other states[42] and national average profit margins of 12% which are not considered by PricewaterhouseCoopers to be excessive.[43] Price competition in specialised markets (such as mining engineering) is reduced due to the capacity and willingness of the relevant purchasers (usually larger organisations) to pay for high quality engineering services.

[42] CSIRO, *Design and Documentation Quality and its impact on the Construction Process*, 1999 & ABS 8693.0
[43] ABS 8693.0

Indeed consultancy fees for design services have declined in real terms (in a number of professions including professional engineering services) over the past 12 to 15 years.[44] This market outcome has been linked to numerous construction inefficiencies (for example, a cheaper design may be more costly to construct). Therefore, although the initial price of engineering services may have fallen, the long term cost to the purchaser and consumers of the services may have increased due to higher construction and operating costs.[45]

Price competition is sourced not only from registered individuals, companies and units but also unregistered engineers and para professionals. This result is reflected by the Board of Professional Engineers of Queensland's examinations of the 1999 yellow pages entries which identified that 23% of consulting engineering businesses listed were not registered and that 87% of mining engineering businesses listed were not registered.

According to consultation responses, the activities of para professionals in the market appears to be limited to low complexity civil works, predominantly undertaken under the supervision of an RPEQ. Few examples of project failures have been identified as a result of work by para professionals on this level of work. However, consultation results indicated that para professionals were at risk of over engineering medium complexity projects if they worked outside their recognised areas of specialisation. Although the designs may be safe they may have been over engineered such that they incur higher than required construction costs or they may be under engineered in the sense that they can not achieve full operating efficiencies. Either of these impacts may result in an increased net cost from the use of their services. In general however, the style of projects which para-professionals undertake usually do not require the same level of technical skills as a fully qualified RPEQ, and many para-professionals in these industries have similar skill levels to RPEQs gained through years of operating experience. Therefore the risks associated with para-professionals undertaking work on their own would be considered low.

However, due to legislative prohibitions on the activities of para-professionals, consumers are not given the option of utilising their services for low cost civil works for which they may be well suited.

Limited non price competition is evidenced in the market reflecting a highly competitive structure. Non price competition is important when tendering for large projects where the relevance of market reputations and previous experience is perceived to reflect the high level of skills required.

Access to services for consumers in regional and remote areas is generally good with a solid distribution of consulting engineering businesses spread across the state (see statistics on distribution in Appendix D) with the majority of the larger firms maintaining regional offices.

There is a slight concentration of businesses in the Brisbane area reflecting the population base and related demand for services. For instance the Brisbane statistical sub division features 61% of businesses but only 44% of the population of Queensland.[46] This concentration is not thought large enough to impact the supply of services to regional or remote areas.

[44] Chapter 3 discusses the pertinant CSIRO research
[45] CSIRO, *Design and Documentation Quality and its impact on the Construction Process*, 1999.
[46] ABS, *Business Register September 1998*, unpublished Business Register Counts.

The smallest distribution of providers for other areas of the state is the Central Western region with four consulting engineering businesses. However, areas such as this can also access engineering services from numerous firms offering fly in fly out services in regional and remote areas.

Geographical considerations therefore do not prohibit access to services, however travel costs incurred in more remote areas are passed on to consumers in higher prices. Consultation did not indicate that cost of services was an impediment to access, however it did reveal that in some instances low level civil works may be undertaken by local para professionals rather than meeting the travel costs of engineers when the overall cost of the project may not be particularly large. No adverse outcomes were identified with this practice.

Where engineering services are supplied in an inappropriate manner, the complaints mechanism available by reporting problems to the Board of Professional Engineers of Queensland is not well known by smaller consumers. Most smaller consumers complain to the Queensland Building Services Authority which passes engineering complaints onto the Board. Larger consumers, by contrast, possess sufficient in-house resources to prohibit further usage or pursue legal action of these individuals.

5.3 Engineers

The registration requirement for the practice of professional engineering services in Queensland was considered (by consultation respondents) as an easily achieved standard for participation in the market place and not a significant barrier to entry.

The requirements for registration feature a recognised four year university degree and five years relevant experience or five years spent in the acquisition of professional engineering knowledge and seven years practical experience. The investment in a degree qualification is significant as discussed in Chapter 3.

Consultation respondents indicated that the five year qualifying period successfully precludes graduates from undertaking complex tasks which are outside their area of skills. Chapter 3 discusses the differences in skill levels between graduate and experienced engineers and demonstrates the need for additional skills for most areas of engineering. However, low complex civil works may not require the same standards as currently enforced under registration.

A further short coming of the existing registration process is that it does not offer a competency based approach to the assessment of candidates for registration, instead relying on the attainment of university qualifications and supervised experience. This approach is out of step with international practice where rigorous practical, technical and ethical exams are required.[47]

[47] Requirements for registration in New Mexico (USA) include an approved four year degree, at least a four year internship, successful completion of the required fundamentals exam (8hours) and the principles and practices exam (8 hours). These requirements are similar in several other states of the USA.

Registration also requires the payment of an initial and ongoing fee for individuals ($30 and $30) companies ($160 and $100) and units ($160 and $100). The administrative requirements for application are estimated to incur a half days equivalent professional time. Appendix F contains calculations of the estimated costs of registration to the engineering profession at approximately $250,000 per annum.

The barrier to entry provided by the registration requirement is very low. Competition does exist in the current Queensland market. Business profitability (as evidenced by business income and private earnings per employee) is not abnormally high nor significantly disparate from other states that have less restrictive regulatory regimes.[48]

Registration requirements permit non registered persons to practice professional engineering services under the supervision of an RPEQ. As salary costs consume 45.4% of total firm revenue, consulting engineering businesses have taken advantage of this registration exemption to substitute para professionals and graduate engineers who command $972 per week for RPEQ's, who command a comparatively higher $1,041 per week in the market. [49]

This outcome has been reflected in the composition of consulting engineering firms of which non qualified professional technical staff presently represent 29.3% of employees versus the 28.5% qualified professional staff (16.6% are principals who may also be engineers).[50]

Consultation responses indicate that the utilisation of para professionals under RPEQ supervision is often undertaken on a 'rubber stamp' basis with potentially very little review provided by the RPEQ. Advice from the industry expert to the Review has indicated that this is common practice in the Industry where the RPEQ has developed trust in the employee's ability. As previously discussed, no adverse outcomes from this practice can be identified.

The consultation process highlighted that there is often a breach of the requirements for engineering companies and units to be supervised and managed by a registered professional engineer and that 60% of voting rights be held by these persons. The written submissions provided to the Review emphasised that some non engineering managers are presently placing pressures on engineers to reduce the professional time spent designing projects which may compromise safety considerations. While this conceptually represents a higher risk of harm, thus far no significant negative consequences can be identified from this process.

5.4 Para Professionals

As discussed previously, para professionals work under the supervision of professional engineers and compete with them (on an unregistered basis), primarily for low complexity civil work, thereby providing a source of price competition.

Consultation respondents indicate that the activities of para professionals in the market have resulted in slight reductions in the cost of low level civil engineering works and a slight reduction in demand for registered professional engineers.

[48] ABS 8693.0 & APESMA, 1998
[49] *PRACDEV Key Indicator Reports 1999/2000*
[50] *Financial Management Research Centre (FMRC) Business Benchmarks 1998.*

At present the employment and earning potentials of this group of suppliers are limited by the legislative prohibitions on their participation in the market, limiting the extent and publicity of their activities.

The risk associated with the activities of para professionals is predominantly regulated by market forces. For low level civil tasks, the majority of para professionals appear to possess sufficient skills to undertake these tasks with little risk of physical or financial harm to themselves or others. At the other end of the scale, highly complex tasks preclude their usage as only a small number of highly skilled firms will be able to undertake and sell their skills in these areas. In addition, more complex tasks usually are purchased by informed consumers who can assess the competency of the provider.

The primary area for concern with para professionals is where they attempt to undertake medium complexity works. In most instances para professionals do not possess the skills to engineer these works to achieve optimum construction and operating efficiencies and may this may present a risk of physical harm or financial loss. As evidenced through the consultation process and the absence of failures of a number of medium complexity works, the present legislative prohibitions appear successful in restricting para professionals from undertaking more complex works.

5.5 Government

In almost all respects Government faces the same issues as other consumers and providers of professional engineering services.

In the main part the same relationship exists between project cost, complexity, risk and purchaser knowledge within Government agencies similar to the issues experienced by larger, more informed consumers. For example, the Department of Public Works possess technical in house skills and screening mechanisms such as the Pre Qualification System (PQC). However, the consultation process indicated that the same can not be said for all Government Departments, particularly in relation to non technical agencies who do not possess the internal skills and do not enlist other agencies when selecting engineering services.

In light of recent public disasters (in other States) such as the Royal Canberra Hospital implosion, the HMAS Westralia fire and the Esso Longford gas explosion (which have been linked to inappropriate engineering services), the status of Government as informed purchaser has come under greater scrutiny. A recent paper[51] prepared by Athol Yates for the Institution of Engineers, Australia examined the issue, concluding that the traditionally high level of technical expertise in the public sector is declining with a resulting reduction in the ability of Government to assess projects reducing the quality of their final outcomes.

[51] Yates, Athol, 1999, *Government as an informed buyer : Recognising technical expertise as a crucial factor in the success of engineering contracts*, paper prepared for the Institution of Engineers, Australia.

5.6 Board of Professional Engineers of Queensland

The activities of the Board are independent of the Department of Public Works and are self funded through registration fees. Expenditure by the Board for the 1998/99 financial year was approximately $220,000. The operations of the Board were widely regarded during the consultation process as being cost effective.

The role of the Board in the regulatory process involves maintenance of the rolls of registered professional engineers, companies and units which it publishes on an annual basis.

Prior to the establishment of the Professional Engineers Disciplinary Panel (two years ago) the Board convened its own hearings to assess charges against registered engineers. The hearing of disciplinary charges is now undertaken by the Disciplinary Panel with the Board providing the preliminary investigation and screening function.

The Board's role in the regulatory process is now limited to the reactive collection and screening of complaints from the general public for potential referral to the Disciplinary Panel and the proactive scanning of listed yellow pages advertisements to identify any unregistered suppliers. Any unregistered companies or units advertising receive a standard letter indicating their breach of the Act.

The Board possess no specific powers to prohibit or discipline unregistered engineers, companies or units and must refer such issues to Crown Law for prosecution. Historically the Board has opted for continued negotiations with the offender to voluntarily cease their activities.

During the entire period in which the Board itself possessed assessment powers for charges faced by professional engineers, no enforced deregistrations were ever pursued. However on a number of occasions its was mutually agreed with an engineer that they would undertake a period of voluntary deregistration often followed by a period of audits and the development of quality assurance procedures.

Consultation indicated that the Board is widely considered to be under resourced and therefore unable to undertake a more active role in monitoring the practice of professional engineering services in the State. This may be due to the fact that fees for registration as an RPEQ with the Board of Professional Engineers of Queensland are only $30 per annum; which is considered low in comparison to registration fees charged by other Professions' Boards in Queensland.

The low public profile of the Board may be responsible for the low number of complaints received (65 since 1 January 1998). If aggrieved persons are unaware of the Board it logically follows that they are also unaware of their ability to lodge complaints to the Board.[52] It should also be noted that the low number of complaints received by the Board in Queensland appears to be consistent with the low number of complaints received by the Institution of Engineers, Australia which received only 85 complaints for all of Australia over the same period.

[52] Consultation with the Board of Professional Engineers of Queensland.

5.7 Professional Engineers Disciplinary Panel

The Disciplinary Panel reports directly to the Minister for Public Works and maintains no funding or managerial ties to the Board of Professional Engineers of Queensland.

Consultation revealed that the disciplinary powers of the Panel are not considered a major deterrent for inappropriate conduct by engineers. Section 3.5.3 details specific options for disciplinary action available to the Disciplinary Panel.

5.8 Queensland Building Services Authority

The Queensland Building Services Authority (QBSA) carries a greater public profile than the Board of Professional Engineers. Each year the QBSA receives a number of complaints related to engineering services.

One problem (revealed in consultation) regarding the Professional Engineers legislation in Queensland is the lack of a clear definition of the term "professional engineering services". This is open to interpretation by key affected groups and leads to confusion when determining the appropriate body to deal with complaints. Due to this uncertainty and the relatively higher profile of the QBSA, numerous complaints are initially lodged to the QBSA before being referred to the Board for investigation.

This administrative referral process represents an inefficiency in the complaints mechanism of the present system which should ideally enable the direction of complaints to the appropriate authority in the first instance.

5.9 Institution of Engineers, Australia

Initial and ongoing corporate membership requirements for the Institution of Engineers, Australia, and the NPER register it maintains, are more comprehensive than the requirements for registration with the Board of Professional Engineers of Queensland. Membership of the association also requires compliance with a code of ethics and the completion of continuing professional development requirements.

Only 40% of RPEQ's in Queensland are members of IEAust versus a national average of 60%, reflecting a view expressed during consultation that the benefits of membership are outweighed by the annual fees of $355.[53]

[53] Consultation with the Institution of Engineers, Australia, 1999.

5.10 Training Institutions

Consultation revealed that the level of skills delivered by university training in engineering is designed to meet the standards set by the Institution of Engineers, Australia. Graduate engineers are not expected to possess the full range of skills required for sole practice. They are educated on the theoretical engineering principles which can be enhanced with supervised practical experience upon entering the workforce. Upon graduation some persons may possess the skills to undertake simple civil engineering tasks.

Skills required to undertake highly complex engineering tasks can only be gained through years of on the job experience.

University engineering training in Queensland was discussed in Chapter 3.

5.11 Base Case Summary

The market for engineering services in Queensland is characterised by a number of registered practitioners, and a small number of non-registered practitioners, that provide services to all metropolitan, regional and rural areas of Queensland. The quality of these services appears satisfactory evidenced by the low number of complaints.

Price competition within the market is significant, despite the restrictions of the current legislation. While the legislation provides some protection to the consumer against risk of physical and financial harm, larger users of high to medium complex work do not rely on it. Residential and other small consumers in general may not understand the difference between 'registered' and 'unregistered' engineers. They usually purchase low complex engineering services that have a low risk of physical harm but a potential financial risk of reasonably significant magnitude.

Engineers within the industry do not consider registration a significant barrier to entry (as registration fees are not high), although only 40%[54] of RPEQs in Queensland choose to be a member of IEAust. Consultation revealed that the perceived cost of membership of IEAust is believed to outweigh the associated benefits.

The general activities of the Board of Professional Engineers of Queensland provides a low level of assurance regarding the competency of registered professional engineers, units and companies and the appropriateness of the practice of engineering services in Queensland. This is largely due to the Board's lack of resources which limits its ability to undertake a high level of auditing and enforcement.

Neither market forces nor the Board are able to provide a comprehensive level of monitoring, regulation and discipline (via the Professional Engineers Disciplinary Panel) to ensure that the objectives of the legislation are being enforced.

The table below provides a summary of the level of achievement of each of the legislative objectives.

[54] 1999 consultation with Institution of Engineers, Australia

Table 5.1 Base Case Summary

Legislative Objective	Base Case	Level of Achievement
1. *protect health and safety of community by ensuring practice by competent persons only*	• the registration process provides some protection to consumers • consumers of high risk services are well informed to be able to select a quality provider • Governments traditional status as an informed consumer is declining	High
2. *provide means of distinguishing persons with competency via the RPE/CUQ register*	• the Board and the register of engineers, units and companies provides some recognition for larger consumers but the Board is not well known in the general community	Medium
3. *ensure accountability by providing for an independent disciplinary panel*	• the professional engineers disciplinary panel is independent • accountability of engineers is slightly limited due to: – the general public's lack of knowledge of the Board thereby undermining the complaints mechanism – engineers possess the avenue of resignation before investigation – serious penalties have not been historically delivered • jurisdictional problems exist in relation to unregistered engineers, companies and units	Medium
4. *ensure companies and units are managed by an RPEQ*	• in the majority of cases, professional engineering companies and units are supervised and managed by a registered professional engineer	High
5. *financial protection for consumers*	• the registration process ensures competency and large consumers are informed. However, smaller consumers are more exposed to financial risk.	High

Note : see section 1.2 for full descriptions of the legislative objectives.

The base case summary portrayed above indicates that the present application of the regulatory provisions under the Engineers Act and Regulation generally achieve the legislative objectives.

6

Assessment Methodology & Option Descriptions

6.1 Introduction

Fundamental to the NCP legislation review process is the requirement to compare and contrast the economic impacts of various regulatory or non-regulatory options against the existing regulatory regime and to determine the extent to which the options meet the objectives of the legislation. This analysis is undertaken in order to determine the net impacts (either positive or negative) of the options on the key affected groups.

6.2 Options to be Considered

A number of regulatory alternatives were subjected to the PBT process to identify their overall incremental net benefit/cost over the base case and their ability to satisfy the policy objectives of the legislation. For this review, the original full list of options to be considered were:

- Option One – Deregulation
- Option Two – State Government Regulation of Engineers only in the Building Industry
- Option Three – Co-regulation
- Retention of the status quo (base case) – this is implicit as an option should there be no net public benefit from any of the options to be considered.

However after preliminary investigations it quickly emerged that Option 2 was largely unsuitable as this option involves regulation of engineers in the building industry only and therefore the option would not achieve the policy objectives of the legislation in regard to the other industries that engineers operate in as per the table below.

Table 6.1 Regulatory Focus of Option 2

Legislative Objective	Focus of Regulatory System	Objective Achieved?
1. *protect health and safety of community by ensuring practice by competent persons only*	• protection of participants in the building industry only • other industries afforded no specific protection	No
2. *provide means of distinguishing persons with competency*	• competency of building engineers distinguished only • other industries afforded no specific ability to distinguish competency of engineers	No

3. *ensure accountability by providing for an independent disciplinary panel*	• accountability for building engineers only • other industries afforded no specific accountability for engineers	No
4. *ensure companies and units are managed by an RPEQ*	• certainty of RPEQ management of building engineering companies and units only • no certainty of RPEQ management for companies and units in other industries	No
5. *financial protection for consumers*	• financial protection for consumers in the building industry only • other industries afforded no specific financial protection	No

After consultation with the Steering Committee it was resolved that this option should be omitted due to its inability to meet the objectives of the legislation. In addition, a fourth regulatory option emerged from the consultation process. Option 4 is an alternative co-regulatory approach utilising a building industry Board but encompassing the full scope of professional engineering practices. The PBT assessment was limited to options one, three, four and the implicit option of retaining the base case.

The options were assessed against the base case identifying the incremental costs and benefits key affected groups would be expected to experience under each option. Further, each of the options to be considered was assessed with respect to the extent to which they meet the objectives of the legislation under review.

Option 1 – Deregulation at State level

Deregulation of the professional engineering legislation in Queensland involves the elimination of all restrictions on persons wishing to undertake professional engineering services other than those covered by other legislation. For example requirements under the Building Code of Australia for certification of engineering design would still hold but could be achieved by recognised industry registration, such as with the National Professional Engineers Register (NPER) of the Institution of Engineers, Australia. Under this model there would be no compulsory state based registration of engineers.

This approach could incorporate a self regulatory approach. Under self regulation, the profession might undertake the roles of accreditor and registrar.

The profession might undertake the following roles and activities:

- register applicants in accordance with objectives and fair standards
- develop and disseminate appropriate standards of practice
- audit of compliance with conditions of continuing accreditation
- maintain an open and up to date register
- respond to complaints from consumers
- investigate complaints and, if necessary pursue disciplinary action
- maintain a central database of all registered engineers.

It is important to note that there would be no legal requirement for engineers to become members of a professional association under this option.

This option is similar to the way the accounting profession is structured in Australia. There are two professional associations that register accountants and set and monitor competency standards. Accountants are not forced to be members of either body but are encouraged by the associations to become members in return for certain benefits such as recognition of skills and competency. Application of this option requires professional associations to have open and transparent assessment and disciplinary systems to ensure the profession maintains credibility with government, market, and the community.

The role of associated legislation should be considered when describing the option of deregulation. For the practice of professional engineering services to be totally deregulated, all references to RPEQs in associated legislation such as the *Building Act 1975* and the *Mineral Resources Act 1989* would need to be removed. If not a form of quasi-deregulation would result if the Engineers Act and Engineers Regulation were only repealed.

In other states and territories around Australia, associated legislation plays a larger role than in Queensland. If the Engineers Act and Engineers regulation were repealed without the strengthening of associated legislation then Queensland would move from operating the only comprehensive system of regulation to the least restrictive system of regulation in Australia.

Option 3 - Co-regulation

Under the co-regulatory approach the profession takes responsibility for assessment of applicants for registration, with government responsible for administration of the legislation including accreditation of professional bodies and disciplinary actions where misconduct is identified. Current business licensing of units and associated professional indemnity insurance requirements would remain under option 3. The roles performed by Government and professional associations under this approach are listed below:

The profession would undertake the following roles:

- registration of applicants in accordance with objective and fair standards
- development and dissemination of appropriate standards of practice
- audit of compliance with conditions of continuing registration
- each professional association would maintain an open and up to date register of its members
- reporting to government on the operation of the accreditation system.

The State Government would be responsible for the following roles:

- accreditation of professional bodies through administration of standards set out in the legislation
- maintenance of a central database of all registered engineers
- respond to complaints from consumers
- investigate complaints and, if necessary pursue disciplinary action
- prosecute non-registered persons breaching the legislation.

This model complies with the principles of mutual recognition by aligning itself with registration schemes in other jurisdictions. Although other jurisdictions utilise a co-regulatory approach for some of their industries (such as the Victorian use of the NPER register with respect to registration of engineers under their *Building Act*) no other state or territory has applied this approach for the comprehensive regulation of engineers. Instead, only engineers in the building industry are subjected to a comprehensive form of regulation whilst subordinate legislation covers other industries.

Option 4 – Alternative Co-Regulatory Approach (Industry Based)

This option is similar to option 3 but has a greater focus on a board structure that governs professions involved in the building design and planning industry. Current business licensing of units and associated professional indemnity insurance requirements would remain under option 4. Under this option, the professional engineering association and the government would perform different roles.

Engineering professional associations would perform the following roles:

- accreditation of applicants in accordance with objective and fair standards
- development and dissemination of appropriate standards of practice
- audit of compliance with conditions of continuing accreditation
- each professional association would maintain an open and up to date register of its members
- reporting to government (Board) on the operation of the accreditation system.

The Government would perform the following:

- accreditation of professional bodies (associations) through administration of standards set out in the legislation
- maintenance of a central database of all registered engineers
- respond to complaints from consumers
- investigate complaints and, if necessary pursue disciplinary action
- prosecute non-registered persons breaching the legislation

It is envisaged that the government role would be provided by a Board Structure. This Board may be constituted by representatives of engineers in the building industry, architects, surveyors and other building industry professionals. Even though the Board would still be responsible for providing the roles above to engineers that are not involved in the building industry, these engineering disciplines are not expected to be represented on the Board under this model. For matters relating to non building industry engineering disciplines, it is envisaged that the Board would draw in this industry expertise as necessary.

The building industry focus of option 4 is in some respects quite similar to the approach applied under Victoria's *Building Act.* Victoria recognises the NPER as a qualifying requirement for certain building work. Under this co-regulatory approach the Government undertakes the role of disciplinarian and accreditor of professional bodies.

The focus of protection under both option 4 and the Victorian model is directed towards the operation of the building industry. However the Victorian model also relies upon stronger associated legislation (than is presently in place in Queensland) for the regulation of engineers in other industries. Option 4 by contrast relies on the co-regulatory registration of engineers outside the building industry under a Board focused primarily towards building issues.

6.3 Assessment Methodology

In the following chapter the assessment methodology focuses upon the impacts (costs and benefits) upon the key affected groups of the potential change of moving from the current regulatory framework to each of the options to be considered; and the ability of each of the regulatory options being considered to meet the objectives of the legislation.

During this review an additional potentially restrictive area of legislation was identified. This involves Part 5 of the *Professional Engineers Act 1988* which sets out conditions for registration of professional engineering companies. The impacts on competition of this section of the legislation are discussed in detail in chapter 8.

This section provides an overview of the methodology used to undertake the PBT assessment. The methodology identifies key affected groups that are expected to be impacted upon by a change to the regulatory framework, and the assessment issues that will be focused on when determining the costs and benefits associated with each option for these key affected groups. The assessment is tailored to delivering a thorough analysis of the costs and benefits of all options with employment, social, consumer, regional and environmental impacts all taken into full account.

Evidence Supporting Conclusions

Wherever possible, quantitative evidence has been utilised and referenced in the development of conclusions regarding the market outcomes witnessed under the present application of the legislation and those anticipated under the various reform options investigated.

Qualitative input was also utilised to supplement the quantitative details. In particular, 120 written submissions were received from the key affected groups (mainly RPEQ engineers) following a public advertisement and a letter sent to all RPEQ engineers in Queensland. In addition, PricewaterhouseCoopers undertook face to face consultation with representatives from each of the key affected groups. Phone consultation was also utilised to obtain input from remote and rural consultation participants.[55]

The use of qualitative input enhances the detail provided by quantitative information. Unfortunately in many instances qualitative input has been unavoidably used as a substitute for quantitative information where such data is not available. Whilst a high level of quantitative data is always desirable, the use of qualitative information in this study was not prohibitive in the development of the findings in this report.

[55] Details of the consultation participants and a summary of the views provided are contained in Appendix A.

Key Affected Groups

In performing an assessment of the base case against the options being considered, each of the assessment criteria are applied, where appropriate, to the following key affected groups:

- consumers
- engineers
- para-professionals
- Government Departments
- Board of Professional Engineers of Queensland
- Professional Engineers Disciplinary Panel
- Queensland Building Services Authority
- Institution of Engineers, Australia and other professional associations
- training institutions.

Assessment Issues

For the purposes of the PBT assessment, key assessment issues have been formulated to determine the impact from the perspective of all key affected groups, and these are discussed below.

- Protection of the public through the provision of safe and competent services, including safety risks inherent in the practice of engineering; risks inherent in practice by unqualified providers; quality of service; appropriateness of service (e.g. providing additional unnecessary services); risks can be relevant for the consumer of the service provider.

- Price and non-price competition.

- Business impacts, this includes the cost to business; profitability; the implications of reform/no change on business structures; the ability to realise economies of scale; compliance costs; management qualifications; small business issues.

- Employment, including extent and level of employment.

- Training / skills / competency requirements, including initial training; continuing professional development; demand for training generally; demand for specific training; the pressures to change training to meet market needs.

- Access to services including consumer choice; rural and regional service provision; differences in the provision of services between the public and private sectors.

- Information asymmetry – This is an economic term that essentially describes the inequality that exists between a supplier and a

consumer when one has a much greater knowledge than the other of the product/service and/or the industry concerned. In an 'ideal market', suppliers and consumers should both be equally, highly informed about the good/service/industry.

- Regulation impact, including benefits and costs of registration; the effectiveness of the regulatory framework in achieving the objectives of the legislation; costs of administration and enforcement; disciplinary procedures; complaints mechanisms for consumers; extent of restriction of competition.

6.4 Discussion and Presentation of Impacts

For each of the regulatory options to be considered, the assessment issues have been evaluated with reference to the key affected groups to determine the costs and benefits of the option. These costs and benefits are determined by reference to the base case that underlies the PBT assessment. This process is undertaken in the next chapter – the impact analysis chapter of this report.

Where there are impact results that do not have any quantifiable outcomes, the report highlights the result through qualitative discussion. Further, where information has been secured from interested parties' submissions to the review, this information has been highlighted as such.

In undertaking the PBT assessment the focus has been upon determining the economic and social impacts for each of the key affected groups. This assessment has been facilitated through a comparison of the base case (without change) against each of the options to be considered (with change). The economic impacts referred to include all forms of net impacts such as access, employment, profitability, training, consumer safety etc.

The options to be considered have also been assessed with respect to the policy objectives of the legislation.

The costs and benefits expected under each option and the base case, have been discussed in detail in the next chapter and presented in summary form in an 'impact matrix' at the end of the chapter. This matrix provides a clear overview of the major impacts across all key affected groups. Further, it provides a good outline of the extent to which the regulatory options being considered meet the policy objectives established by the present legislation.

6.5 Note Regarding Restrictions on Company Registration

During this review an additional potentially restrictive area of legislation was identified. This involves Part 5 of the *Professional Engineers Act 1988* which sets out conditions for registration of professional engineering companies. This issue is evaluated separately in chapter 8.

7

Impact Analysis and Impact Matrix

7.1 Introduction

This chapter of the report outlines the assessment of the potential impacts for each key affected group if the options were introduced in place of the base case.

The assessment methodology discussed in Chapter 7 of this report has been used for this assessment.

7.2 Option One – Deregulation

The first regulatory option to be subjected to the PBT assessment process is the deregulatory option. The deregulation option involves the elimination of the monitoring, investigation and assessment of the engineering profession by government or other agents empowered by legislation.

It should be remembered however that in order for the practice of professional engineering services to be totally deregulated it would require the removal of all references to RPEQs in associated legislation such as the *Building Act 1975* and the *Mineral Resources Act 1989*. This would be different to other states of Australia that are deregulated where associated legislation is in place.

The outcomes (incremental to the base case) discussed in this section will be the result of market forces and what can be termed quasi deregulation due to the existence of associated legislation. The key market forces influencing transactions relate to consumer and producer incentives and the voluntary involvement of individuals with professional associations who would undertake an unofficial regulatory role.

7.2.1 Impacts on Consumers

Under the deregulation option the practice of professional engineering services would be permitted to be undertaken by any person regardless of their formal training or professional experience levels. The key question governing the impact of this relaxation on the market place is whether or not persons other than competent engineers could successfully sell their skills in the market place. If incompetent persons offer their services but are unable to gain the trust of purchasers, they will have no impact on the market.

Consultation indicated that without regulation, it is likely that purchasers would be forced to undertake additional private screening processes to determine the quality of potential suppliers. It was also indicated that although professional association membership would provide a screening mechanism, it is likely to apply to only 60% of engineers[56] as the membership costs involved (although not excessive when comparable to other professional associations), may be considered by engineers to exceed the benefits received. This deficiency will place the burden of search costs back on to the purchaser.

For low cost projects this information may be costly or impractical to acquire producing a level of uncertainty in consumer minds. For medium and high complexity works it is likely that suppliers will develop generic capability statements (as seen under present tendering processes) to inform consumers of their skills and previous experience. Search costs are not expected to increase significantly for

[56] Consultation with the Institution of Engineers, Australia, 1999, indicated that the national average membership levels are approximately 60% of all engineers.

larger consumers as they currently use other mechanisms to assess the competency of the provider, and do not rely solely on registration.

A key impact under Option 1 is an expected increase in risk of physical harm and financial risk, particularly to the smaller consumers.

This is expected to accrue from a greater number of unqualified practitioners entering the market. Risks associated with practitioners who are not competent were discussed in Chapter 4. Consultation findings identified a strong belief that unqualified practitioners present a greater risk of financial and physical harm.

While the larger consumers of engineering services are more informed and would still be able to seek out competent providers in the market, the increase in risk is likely to be greater for smaller consumers. It can be argued that smaller consumers usually purchase engineering services with low risk of physical harm. The probability of these risks is likely to increase under option one because of the greater information asymmetry experienced by small consumers. The probability of financial risks would also be expected to increase for smaller consumers. Poor engineering services are often related to longer-run expenses and other indirect costs caused from flow-on effects which may not be immediately visible.

For example, (as discussed in chapter 4) the ramifications of sub standard engineering services may feature operating cost inefficiencies for consumers of the infrastructure who may not have been involved in the initial purchase of the engineering services. Examples include purchasers of housing estate homes and road users driving on a freeway where they did not participate in its construction.

For example, in the case of transport freeways, consultation revealed that lifetime operating costs for users of the infrastructure may be 12 times the initial capital cost of the project. This reflects the potential high sensitivity and costs of inefficient designs. Therefore although risk of physical harm may be mitigated, the level of financial cost may be borne by third party consumers.

However, in general, operating inefficiencies are not likely to be a major issue as the scale and importance of work undertaken by less than fully competent persons is not likely to be significant. For small projects any operating inefficiencies will have small repercussions. For large projects protection is provided by the internal screening mechanisms of major private and public entities which, due to the public nature of major projects, are not likely to be circumvented.

The increase in risks does not only accrue from unqualified practitioners entering the market, it also accrues from partially trained providers performing services beyond their ability. This issue is particularly relevant to para-professionals currently operating in the market either under the supervision of an RPEQ or illegally in their own right.

Consultation responses clearly support the likely outcome that if professional engineering services were deregulated, para professionals could successfully sell their services in the market by offering lower prices than engineers, a result which is consistent with the present involvement of para professionals in the current market.

The scope of para professionals operations under a deregulated market was anticipated, by consultation respondents, to be limited to low level civil engineering tasks. The probability of failure and the magnitude of the negative consequences from their operations in the market place would be low indicating that consumer health and safety is unlikely to be compromised from para professionals undertaking these tasks. However, the key area for concern under the deregulated market place is where para professionals attempt to undertake medium complexity works which present a higher physical harm risk. Consultation indicates that it is very possible for para professionals to sell their services to undertake these tasks (albeit with reduced success compared to less complex civil works). Para professionals do not undertake the same level of formal training (that equips them with knowledge of the subtle differences in engineering principles). In addition, unless they have been employed in engineering firms, they are unlikely to have benefited from the guidance provided by engineers through supervised professional experience.

The submission process identified examples of poor designs in the downstream petroleum industry that lead to equipment failure and environmental degradation. These designs were attributed to draughtsmen, construction supervisors, foremen, fitters, electrical engineers, and civil engineers. The appropriate persons to undertake this work were identified as chemical engineers and petroleum experienced mechanical engineers. This situation has arisen through the confusion over the definition of engineering services in the Act and the difficulty in policing these services. This example would seem to provide evidence that if engineering services were deregulated that the instances of inappropriate persons undertaking professional engineering services would increase with an associated increase in physical harm and financial harm (costs).

Increased choice in providers may impact positively on regional or remote areas that could use competent para professionals for low complex work, rather than fly-in an RPEQ, which is happening in the current market on a small scale. The magnitude of this benefit would only be expected to be small.

Under economic theory, price would also be expected to decrease as more entrants come into the market. However the market is currently very competitive and engineering businesses do not experience high profits. Therefore the current cost structures of an engineering practice would not be expected to allow major scope for price decreases. Therefore significant price reductions for engineering services would not be expected under Option 1.

While deregulation would provide pricing and consumer choice improvements for purchasers of low complexity civil works, as these persons will be provided the opportunity to select para professionals to undertake simple civil tasks, it may expose the consumer to a higher level of risk if the practitioner is not competent in the relevant areas.

Where problems do arise in the market under Option 1, consumers would no longer be able to complain to the Board of Professional Engineers of Queensland. Instead, where the Institution of Engineers, Australia or other professional membership is applicable, consumer complaints may be lodged directly to the professional association. However the discipline provided by these organisations is not legally enforceable.

Consumers would still possess general avenues for legal recourse provided for under common law and *Trade Practices Act* protection. The only impediment to pursuing these options is the financial costs involved, which may be excessive for small to medium sized consumers. Currently proposed amendments to the *QBSA Act 1991* may also provide an avenue for consumer recourse.

7.2.2 Impacts on Engineers

The base case discussion of the Opal House collapse highlights the impact of engineering designs on the workplace health and safety conditions of engineers themselves. As discussed with reference to consumers, the greatest concern for risk of physical harm under a deregulated environment will materialise from para professionals undertaking medium complexity works. Engineers may be placed at risk when acting in an on-site capacity to perform a quality assurance role for design/construction or where assessing rectification work required for inadequate designs undertaken by practitioners with inappropriate qualifications and experience.

Under a deregulated environment, registration fees with the Board of Professional Engineers of Queensland would cease to apply. For less reputable low cost operators this would result in the removal of a minor burden of individual registration ($30 per annum) and company/unit registration ($100 per annum).

However, under a deregulated environment, respectable small, medium and large firms would be forced to incur costs to differentiate themselves from less reputable operators.

To some extent professional membership will fill this void however the costs involved in obtaining and maintaining membership ($355 per annum)[57] are above the present costs for registration with the Board of Professional Engineers of Queensland. It should be noted however that professional association memberships are a tax deductible item and therefore a recoverable amount in the long run.

In addition to professional memberships, consultation indicated that businesses may also be forced to prepare capability statements and achieve recognised quality assurance accreditation. Capability statements are not unusual in any professional services industry, however quality assurance accreditation is a costly exercise which would not be economical for small firms.

The key impact on profitability is not expected to be the business costs discussed above, but the additional competitive pressure for operators in lower complex activities arising from new market entrants or a take-up of market share from para-professionals.

Larger firms will no longer find it profitable to operate in this area potentially leading to reduced employment within these businesses. Employment impacts would be expected to affect not only engineers, but para-professionals and support staff within an engineering business. It should be noted that this impact is likely to represent a transfer effect as employment for these groups would also be created by new market entrants or the para-professionals increasing the level of business undertaken in the market.

[57] Corporate membership of the Institution of Engineers, Australia and NPER listing

Under option one, current RPEQs would lose an element of "professionalism" that is usually associated with their title and would also lose mutual recognition of skills nationally. This later issue may be addressed if members join IEAust, however only 40% of RPEQs are currently IEAust members in Queensland, indicating that many current RPEQs would consider this issue a cost that outweighs associated benefits.

7.2.3 Impacts on Para Professionals

Para professionals would be expected to have increased employment opportunities under option one. Para professionals also would only be expected to face an increased risk of harm if they undertook moderate complexity tasks without having all the required competencies.

Consultation widely supported the notion that para professionals may be competent to undertake simple civil engineering tasks and achieve market share at the expense of engineers. Higher earnings would be expected to result for these practitioners who are no longer constrained to undertaking works under the supervision of an RPEQ. These increased earnings would result from both an increased market share and the ability of the para professionals to charge more for their services as they compete against the higher paid engineers.

7.2.4 Impacts on Government

In a regulatory role, the Government will incur costs in repealing the present legislation. As the Board of Professional Engineers of Queensland is self funded through registration fees, no net change in Government revenue or expenditure will result from deregulation.

In a role as a consumer, Government departments face the same issues as other large consumers in the market and would not be able to use 'registration' as a mechanism of assessing a providers competency. The Government would need to develop alternative selection criteria for providers.

It is interesting to note that the Federal government in the USA has enacted the *Brooks Act* legislation, one dimension of which focuses tendering processes on the quality of applicants. All engineering tenders lodged to the Federal government are required to be assessed on the basis of quality and previous experience only. Fair pricing considerations are introduced as the final negotiating stage once a suitably qualified applicant has been identified. The purpose of the legislation is to avoid compromising the quality of designs through undesirable levels of price competition.

7.2.5 Impacts on the Board of Professional Engineers of Queensland

Under Option 1 the Board of Professional Engineers would be dissolved eliminating the employment opportunities provided for the registrar and support staff. The magnitude of this impact is considered small. The Board members themselves are voluntary part time members and hence face no potential impact to their employment status.

7.2.6 Impacts on the Professional Engineers Disciplinary Panel

Option 1 would require the Panel to be dissolved. Membership of the Professional Engineers Disciplinary Panel is also a part time position paid on an "as required" basis. Members of the Panel hold legal and engineering positions elsewhere and hence no impacts on their employment status are expected.

7.2.7 Impacts on the Queensland Building Services Authority

Under this option the Queensland Building Services Authority would have no avenue to refer engineering complaints to a body with legislative powers and may instead refer the issues to less powerful professional associations. This issue may be addressed by currently proposed amendments to the *QBSA Act 1991* that would allow consumers to make claims against a range of providers' work, including engineers.

7.2.8 Impacts on the Institution of Engineers, Australia and Other Professional Associations

Consultation indicated that deregulation would prompt service providers to differentiate themselves on quality which can be partially recognised through membership of professional associations. Hence membership of professional associations is expected to increase under this option.

Consultation participants anticipate that competition may emerge amongst professional associations on the basis of membership fee pricing and entry requirements. The drive for membership fees may compromise the resources, thoroughness and independence of assessment procedures. As a result the level of consumer protection afforded from membership status was expected, by consultation participants, to be reduced.

It is possible that competitive pressures and the drive for membership levels would bias disciplinary procedures in these organisations. Also, as membership of a professional association will not be a legislative requirement, practitioners will not be bound by disciplinary penalties.[58]

7.2.9 Impacts on Training Institutions

Consultation respondents indicated that removing the legislative standards and requirements for registration would lessen the image of engineering as a respected profession. Consultation participants raised the concern that as a result of its diminished status, the quality of persons wishing to enter the profession may be diluted, ultimately reducing the quality of engineering works.

Consultation revealed that the combination of expected reduced intake to formal university training and the removal of requirements to gain supervised professional experience will increase the burden on university institutions to equip graduates with a greater level of skills (both theoretical and practical) and to instill a higher level of ethics to ensure that trained professionals could operate in a safe and competent manner as soon as they entered the market. University consultation participants indicated that meeting these demands would increase the length and cost of university courses.

[58] Consultation also highlighted the complexity associated with multiple associations wishing to lodge complaints surrounding the conduct of engineers.

At the other end of the spectrum will emerge demand for vocational orientated courses focused at preparing graduates for immediate practice in low complexity civil disciplines. This would be expected to have a small positive impact on vocational education and training providers such as TAFE. However, this may represent a transfer effect as universities would be expected to experience a decrease in demand for places.

7.2.10 Option One Summary

Option 1 is expected to result in an overall net cost presented by key impacts including:

- a slight increase in risk of physical harm to smaller consumers
- a significant increase in financial risk to smaller consumers
- an increase in risk for both practitioners and consumers where inadequately trained practitioners undertake medium complexity tasks
- engineers may need to incur costs for membership of professional associations to maintain mutual recognition and other benefits of the "professionalism" attached to their title. This cost is significantly greater than the savings incurred through the removal of registration fees
- reduction in costs due to the removal of the statutory panel and its related disciplinary powers.

The table below provides a summary of how option one would achieve the legislative objectives.

Table 7.1 Option 1 – Deregulation Summary

Legislative Objective	**Net Benefit Cost – Deregulation**	**Level of Achievement (incremental to the base case)**
1. *protect health and safety of community by ensuring practice by competent persons only*	• increased risk of physical harm mainly to smaller consumers	Worse than the base case
2. *provide means of distinguishing persons with competency*	• the RPEQ & RPECUQ registers would no longer exist	Does not meet the objectives of the legislation
3. *ensure accountability by providing for an independent disciplinary panel*	• an independent disciplinary mechanism would not exist	Does not meet the objectives of the legislation

4. *ensure companies and units are managed by an RPEQ*	• the title of RPEQ would no longer exist	Does not meet the objectives of the legislation
5. *financial protection for consumers*	• increased financial risk, particularly to smaller consumers	Worse than the base case

Note : see section 1.2 for full descriptions of the legislative objectives.

7.3 Option 3 – Co-regulation

The co-regulatory approach proposed under option 3 involves a sharing of the burden for registration between professional associations who assess the competency of engineers for membership/registration and the Board of Professional Engineers who accredit the professional associations competency to assess engineers.

The complaints mechanism, assessment of charges and disciplinary measures would be undertaken by the Board of Professional Engineers and the Disciplinary Panel of Professional Engineers in a manner unchanged from the present system.

Under this option engineers would be required to be accredited by an approved professional association. It is likely that membership of the National Professional Engineers Register (NPER) would be sufficient.

This option does not precisely mirror any arrangements in other states. In comparison, it is not considered more restrictive than other states as, although other states may not have 'registration specific' legislation, they do regulate the practices of engineering through associated legislation. The Institution has noted that associated legislation in other states of Australia appears to be increasing, creating a more restrictive environment.

This option also has the potential to be less restrictive than the present situation in Queensland or any other state. The registering professional bodies would have the ability to change the current qualification and years of experience focused registration system (applied by the Board) to a competency based one. This would allow persons capable of competently practising engineering to obtain recognition through registration, even though they may not have a base qualification or numerous years of experience. This model would also allow different competency levels to be set for different engineering disciplines, which would be expected to decrease registration requirements for engineers undertaking low complexity work.

To ensure the professional association developing the above standards is accountable, an independent accreditation role should be provided by Government.

7.3.1 Impacts on Consumers

The co-regulatory approach maintains the majority of the costs and benefits of the base case situation. The primary difference from the present arrangements is an enhanced effectiveness of the assessment/ accreditation process and higher standards for continued education and registration.

Consultation respondents supported the notion that professional associations are better in touch with industry and interstate events than the Board of Professional Engineers. As a result, they possess an enhanced ability to assess the competency of engineers. By doing so, professional associations can offer consumers a slightly improved assurance of competency than is delivered under the base case.

Requirements for membership/registration on the NPER presently feature a commitment to a code of ethics and completion of continuing professional development requirements. Consultation participants informed that it is likely under a co-regulatory approach that professional associations would pressure providers for better quality service to enhance the reputation of the members of the professional association.

The end result of these measures is a reduced risk to the consumers of engineering services and an enhanced quality of service.

Consultation respondents also supported the notion that professional associations have the potential to raise consumers' awareness of the availability and quality of engineering services as organisations such as the Institution of Engineers, Australia carry a comparatively higher profile than the Board of Professional Engineers. Slight benefits may therefore accrue to consumers through reduced information asymmetry.

Professional associations are better in touch with industry than the Board and would be well placed to adopt competency measures as the basis for registration in the future. If this occurred, consumers would be expected to experience a greater choice in providers compared to the present Board system of registration which is mainly focused on qualifications and years of experience. This issue is discussed further in the next section.

7.3.2 Impacts on Engineers

To fund both the professional association accreditation operations of the Board of Professional Engineers of Queensland and the membership/registration assessment processes of accredited professional associations will require a greater level of funding than under the base case. Individual engineers, units and companies would be required to pay for professional association membership/registration fees of $250 for NPER plus a fee of no greater than $30 to cover the expenses for the activities undertaken by the Board of Professional Engineers of Queensland. The Disciplinary Panel of Professional Engineers would continue to be funded from registration fees. The net result would be an increased business cost to engineers although it should be noted that professional association memberships are tax deductible expenses and therefore partially recoverable in the long run.

Enacted legislation in other states (i.e. Victoria's *Building Act*) presently utilises the NPER as a sufficient measure of competency. Utilising a similar approach to the general practice of engineers in Queensland would reduce administrative complexity and compliance costs, which currently act as barriers to entry for interstate engineers.

NPER listing requirements stipulate that continuing professional development must be undertaken. Satisfying this requirement is a private cost faced by individual engineers and will place a greater cost on individual engineers to complete and maintain a log of their compliance.

Consultation respondents supported the notion that it is also highly likely that professional associations will pressure providers for better quality service to enhance the reputation of the members of the professional association. This requirement will place an additional cost on the operation of engineering businesses.

Although not presently a feature of the NPER or professional association membership in general, a co-regulatory approach may, in the future, allow professional associations to determine the competencies required for registration. This would be expected to benefit some operators in the market who have the same competencies as engineers in the current market, but not necessarily the appropriate qualification. Many para-professionals in the current market would be expected to fall into this category. This option would also allow the development of a code of practice regarding how para-professionals would work with engineers, which would be expected to be more in touch with industry practice and have a slight positive impact on both parties involved in this working relationship.

It is also feasible that the requirements to display competencies for different disciplines of engineering may become more specific. For example, engineers undertaking only lower complex civil works may not need to demonstrate the same level of competencies as a mining engineer. This would be a more efficient process for the engineer obtaining registration. Further, competency based assessment may allow the professional association to change the categories of engineers used in the current legislation to more accurately reflect operators skills in the market.

7.3.3 Impacts on Para Professionals

Para-professionals would be expected to have slightly greater employment opportunities if registration included competency measures, rather than just qualifications, and may experience greater role clarification and responsibility if the above discussed code of practice was developed.

7.3.4 Impacts on Government

The co-regulatory approach would carry the same impacts for Government as other consumers and service providers.

The Government will also incur the legislative and other structural costs required in establishing the co-regulatory model. An ongoing cost to consider is the funding requirements for the Board of Professional Engineers of Queensland. Its activities would be primarily reduced to accrediting and monitoring of professional associations charged with registering engineers. This could be funded through a proportion of fees paid to professional associations, or Government may be required to meet the shortfall. Government would also face the costs of operating an independent Disciplinary Panel which is presently funded from the budget of the Board of Professional Engineers of Queensland.

7.3.5 Impacts on the Board of Professional Engineers of Queensland

Under the co-regulatory approach some administrative functions, particularly relating to assessment and registration, would be transferred to professional associations, reducing the operating costs of the Board; however this may be offset by an increase in activities related to the accreditation of professional associations. The change in workload would not be expected to impact the employees of the Board as staff numbers are minimal and the Board is currently considered to be under-resourced.

7.3.6 Impacts on the Professional Engineers Disciplinary Panel

The proposed co-regulatory approach would carry no noticeable impacts above the base case for the Professional Engineers Disciplinary Panel.

7.3.7 Impacts on the Queensland Building Services Authority

The co-regulatory approach will carry no noticeable impacts above the base case for the Queensland Building Services Authority.

7.3.8 Impacts on the Institution of Engineers, Australia & Other Professional Associations

Due to an increased scope of activities, the Institution and other professional associations will face additional administrative and assessment costs and this would be expected to stimulate a small demand for employment.

Consultation participants anticipate that competition may emerge amongst professional associations (that receive accreditation from the Board) on the basis of membership fee pricing and entry requirements. However this is not expected to be a significant issue as splitting membership across multiple professional organisations would limit the ability to realise economies of scale, increasing the individual membership fees required to sustain operations.

7.3.9 Impacts on Training Institutions

The proposed co-regulatory approach would carry no noticeable impacts above the base case for training institutions.

7.3.10 Option Three Summary

The market operation is expected to be largely unchanged under Option 3. An overall net benefit is expected to accrue from the approach, as professional associations are better in touch with industry developments than the Board, thereby providing greater assurance of the competency of members which should slightly reduce the risk of physical and financial harm faced by consumers. This industry knowledge would assist in adopting a competency based registration system rather than qualifications and years of experience (a focus of the present system). This adjustment would provide a more efficient model for consumers and engineers.

Membership of professional associations would also require meeting continuing professional development requirements and higher quality of service standards also delivering benefits to consumers. However, compliance costs to engineers (not currently on the NPER or a member of an approved professional association) would significantly increase. However, costs for registration via professional association membership are not expected to be prohibitive and are ultimately a tax deductible expense.

Table 7.2 shows how Option 3 meets each of the legislative objectives.

Table 7.2 Option Summary

Legislative Objective	**Net Benefit/Cost – Co-regulation**	**Level of Achievement (incremental to the base case)**
1. *protect health and safety of community by ensuring practice by competent persons only*	• Continued professional development requirements and quality assurance issues would be expected to provide a slightly greater protection against financial and physical risk of harm	Slight increase above base case
2. *provide means of distinguishing persons with competency*	• A change to the registration process to include competency measures would provide real recognition of competent providers, not just people with qualifications	Slight increase above base case
3. *ensure accountability by providing for an independent disciplinary panel*	• No change expected above the base case	No change
4. *ensure companies and units are managed by an RPEQ*	• No change expected above the base case	No change
5. *financial protection for consumers*	• Marginal increase in quality of persons registered through increased emphasis on professional development and continuing quality assurance expected to reduce risk to consumers.	Slight increase above the base case

Note : see section 1.2 for full descriptions of the legislative objectives.

7.4 Option 4 – Co-regulation : alternative structure

The alternative co-regulatory structure proposed under Option 4 is virtually the same as the structure detailed under Option 3 except that the Board of Professional Engineers of Queensland and the Professional Engineers Disciplinary Panel are replaced with a multi profession building industry Board and disciplinary panel. The new Board would undertake accreditation of professional associations who would in turn assess the competency of applicants for registration. While the new Board would be expected to only include building industry profession representatives, it would still be responsible for providing its role regarding all engineering disciplines. The disciplinary panel would comprise representatives from the Building professions and appropriate legal representatives.

The rationale for this option is to achieve greater interaction between the profession and the building industry with an aim to reduce complaints associated with services provided by the building industry. Technical experts would be utilised to provide non building industry advice to the Board when relevant.

The issues discussed below are termed as costs and benefits in addition to those incremental changes over the base case, expressed with reference to the co-regulatory approach under Option 3.

7.4.1 Impacts on Consumers

For the main part, consumers would retain the net incremental benefits over the base case described with reference to co-regulatory Option 3. The obvious difference is that the emphasis of this approach is a focus on building industry issues. Consultation respondents support the notion that a Board of this nature would reduce confusion regarding the complaints process and provide improved standards of service delivery to consumers in the building industry through streamlined Board / QBSA / professional association interaction, and thereby provide increased consumer protection from risk of physical and financial harm. It should be noted that this issue may not present an increased benefit above the base case as new building legislation that allows consumers to make claims on a variety of operators in the building industry, including engineers, would be expected to produce similar benefits when implemented.

Although the new Board would retain access to the same range of technical experts utilised under the base case Board, consultation respondents have expressed the concern that the building industry emphasis would inevitably result in an excess focus on building issues at the expense of consumer protection in other industries. It should be noted that risks associated with engineering practices are spread over numerous industries and the higher risks are usually associated with industries other than the building industry (e.g. mining). These ‘higher risk’ industries do not always provide services to informed customers. As discussed in the base case assessment, Government’s ability to purchase engineering services on an informed basis is declining.

7.4.2 Impacts on Engineers

The primary difference between the Option 3 and Option 4 co-regulatory approaches is the anticipated alienation of engineers not involved in the building industry and the potential lack of a proper focus across engineering disciplines by the Board. Consultation respondents identified this issue as the largest disadvantage of the approach given that the majority of engineers in Queensland are not involved in the building industry. IEAust provided estimates that approximately 80-90% of members worked in industries other than the building industry.

No benefits are expected to accrue to engineers above those discussed under Option 3. Engineers may experience a reduction in registration fees as membership of the Board would increase significantly through incorporation of members from other professions, however current registration fees are low and this is not thought to be a real benefit.

7.4.3 Impacts on Para Professionals

The proposed alternative co-regulatory approach will carry no noticeable impacts above those expected under Option 3 for para professionals.

7.4.4 Impacts on Government

In a role as consumers, Government Departments will face the same incremental benefits over the base case as other consumers, however may be more disadvantaged as consumers of high risk engineering services if the new Board fails to adequately address engineering services outside the building industry. As service providers, Government will experience the same incremental costs and benefits over the base case as other service providers.

In a regulatory role, Government will face an upfront costs from changing legislation to dissolve the present engineering Board and Disciplinary Panel and establish a new Board for amalgamation with the Boards from other building industry professions (architects, surveyors etc).

An ongoing cost to consider is the funding requirements for the newly established Board. Its activities (as compared with the present Board) would be primarily reduced to the new functions of accrediting and monitoring professional associations charged with registering engineers, and (as under the present system) continuing to pursue disciplinary actions. This may be funded through a proportion of fees paid to professional associations. If not then the Government may be required to meet the shortfall.

7.4.5 Impacts on the Board of Professional Engineers of Queensland & Disciplinary Panel

The Board of Professional Engineers and the Disciplinary Panel may be dissolved in favor of the building industry Board and building industry Disciplinary Panel. Amalgamating multiple building industry Boards would deliver economies of scale and reduce overall operating costs and employment opportunities as compared with the original Boards.

Consultation respondents indicated that the newly formed Board would possess a greater level of industry knowledge. This would deliver benefits when investigating, assessing and disciplining

persons acting improperly in the building industry. This would not be the case when dealing with engineers outside the industry, in these cases external technical expertise would be required.

Consultation also identified that the focus of the Board may confuse some persons with engineering complaints unrelated to the building industry. This may result in the delivery of complaints to professional associations who do not have the resources or statutory empowerment to effectively pursue them, thereby reducing the effectiveness of the complaints mechanism.

7.4.6 Impacts on the Queensland Building Services Authority

Under this option the Queensland Building Services Authority (QBSA) would be expected to receive a reduced level of complaints and claims for insurance payouts due to improved working relationships between the regulatory Board and building professions. This is considered to be a significant benefit to the QBSA.

7.4.7 Impacts on the Institution of Engineers, Australia and other Professional Associations

Consultation revealed that the only additional difference for professional associations as compared with the Option 3 co-regulatory approach is the increased requirement for co-ordination by engineering professional associations with those in other building industry professions. The increased burden on the associations is not likely to be excessive but is expected to create additional operating costs.

7.4.8 Impacts on Training Institutions

The proposed alternative co-regulatory approach is not expected to impact on training institutions above the base case.

7.4.9 Option Four Summary

While Option 4 presents a small benefit for consumers of building industry services, it should be noted that these efficiencies may be achieved with the planned implementation of the new Queensland Building Tribunal legislation which will allow claims against engineers in the Queensland Building Tribunal concerning domestic building disputes and minor commercial building disputes. Option 4 presents a potentially significant cost of alienating engineers that work in other industries and may increase the risks associated with higher complexity engineering practices that usually occur in other industries.

The primary additional costs and benefits from the alternative co-regulatory approach versus the one described under Option 3 relate to the focus of the industry Board on building issues. This approach is likely to deliver customer service and complaints efficiencies for consumers and practitioners in the building industry.

Another significant cost is the upfront costs of altering legislation, dissolving the Board of Professional Engineers of Queensland in favor of a new Board created by the co-ordinated amalgamation of other professional Boards in the building industry. While it is not possible at this stage to determine the actual upfront cost, the impact of this upfront cost, and the ongoing alienation

of non-building industry engineers, is expected to deliver an incremental net cost over the base case, and over Option 3.

Table 7.3 shows how Option 4 meets the objectives of the legislation.

Table 7.3 Option Summary

Legislative Objective	**Net Benefit/Cost – Co-regulatory alternative approach**	**Level of Achievement (incremental to the base case)**
1. *protect health and safety of community by ensuring practice by competent persons only*	• Same benefits as those for Option 3 but has the potential to lose focus on non-building industry engineers' practices	Slight increase over base case (but lower than Option 3)
2. *provide means of distinguishing persons with competency via the RPE/CUQ register*	• Same benefits as for Option 3	Slight increase over the base case
3. *ensure accountability by providing for an independent disciplinary panel*	• This model would maintain accountability through the newly created Disciplinary Panel	No change
4. *ensure companies and units are managed by an RPEQ*	• No change expected above the base case	No change
5. *financial protection for consumers*	• Similar benefits as expected under Option 3, however has the potential to lose focus on non-building industry engineer's practices	Slight increase above base case (but lower than Option 3)

Note : see section 1.2 for full descriptions of the legislative objectives.

7.5 Impact Matrix

The following pages present a summary of the costs and benefits of the base case and each of the options for regulatory reform. Costs and benefits are presented by key affected groups.

Key Affected Groups	Base Case		Option 1 - Deregulation		Option 2 – Co-regulation		Option 3 – Alternative co-regulation	
Consumers	* Legislation helps to manage physical harm risks and financial risks * Screening process and technical knowledge of large consumers avoids information asymmetries * RPEQ supervised para-professionals significantly reduce business costs and competently perform simple civil design tasks * High level of price competition * All remote, regional and metro areas access engineering services	* Small consumers face information asymmetries when selecting suppliers creating uncertainty surrounding the final product * Excessive price competition has resulted in significant construction inefficiencies and higher long run costs * Consumers are not provided the option of utilising para professionals for low complexity civil works in which they are competent, limiting choice of providers and slightly increasing prices * Complaints mechanism through Board is largely unknown limiting its ability to monitor engineering practice * Soft disciplinary record of the Board and Disciplinary Panel weaken incentive for suppliers to act responsibly	* Para-professionals would be able to undertake simple civil tasks, moderately increasing consumer choice without a significant increase in risk	* Required to undertake additional private screening processes due to the removal of the low level assurance provided by registration which, for small low complexity projects, may be excessive and impractical * Increase in incompetent operators significantly increases physical harm and financial risks * Paraprofessionals may attempt to undertake work outside their competencies resulting in moderate increases in financial and physical harm risks * Para professionals that are not fully competent may over engineer designs resulting in small construction and operating inefficiencies * Avenue to complain to the Board of Professional	* Potential enhancements in the effectiveness of the competency assessment process and requirements for continuing professional development will moderately raise the quality of practicing engineers and reduce the risk of financial and physical harm to consumers * Professional associations are likely to attempt to slightly raise consumers awareness of engineering services reducing information asymmetries and uncertainty surrounding final products	* No incremental impact expected	* Same benefits as for option three * Board emphasis on building industry will moderately reduce the risk of physical and financial harm to consumers in the building industry	* Board may alienate consumers of non-building industry engineering services and create confusion over complaints mechanism. This has the potential to be a significant impact

Key Affected Groups	**Base Case**		**Option 1 - Deregulation**		**Option 2 – Co-regulation**		**Option 3 – Alternative co-regulation**	
				Engineers of Queensland is removing statutory monitoring of engineering. This is expected to be a small cost				
Engineers	* Profit margins are average for a service industry * Low registration fees of $30 per individual and $100 for companies and units indicating low compliance costs	* High levels of price competition from other engineers and unregistered practitioners * Registration requirements qualification and experience not competency based, potentially allowing not fully competent persons to practice and potentially excluding competent persons from practice * Companies and units are not always supervised by an RPEQ and RPEQ voting rights are not always maintained at 60% breaching legislation but causing no notable problems	* Registration fees with the Board of Professional Engineers of Queensland and related costs ($250,065) are eliminated	* Increased competition from less than fully competent providers slightly increases competitive pressure * Engineers face a moderate increase in risk when occasionally on site and inspecting designs developed by less competent practitioners * Membership of professional associations will increase (in an effort to demonstrate quality) incurring moderate costs above present Board registration fees * Moderate loss of 'professionalism' of title and mutual recognition	* Enacted legislation in other states utilises the NPER standard resulting in significant reductions in administrative complexity and barriers to entry for engineers from other states * Registration could include competency measures rather than a qualifications and experience focus, increasing recognition of skills * Different competencies could be required for different disciplines making the registration process significantly more efficient * Could clarify roles of engineers and para-professionals to reflect efficient industry practice to produce a moderate benefit	* Engineers, companies and units will be required to meet the expenses of professional associations when undertaking assessment procedures through moderately higher membership/registration fees as well as the Board's role in accrediting professional associations * Engineers will face the moderate additional burden of continuing professional development requirements * Engineers may face a moderate increase in competition if para-professionals can be registered through having competencies recognised, reducing already low profits of engineers	* Same benefits as option three * Small reduction in administration costs per applicant as more members are present to share costs	* Same costs as option three * The vast majority of engineers are not involved in the building industry and will become significantly alienated by this option's narrow focus

Key Affected Groups	Base Case		Option 1 - Deregulation		Option 2 – Co-regulation		Option 3 – Alternative co-regulation	
					in this regard			
Paraprofessionals	* Employment is benefited significantly as practice is legal under RPEQ supervision * Some para professionals unlawfully undertake low level civil works for higher returns	* Para professionals unlawfully undertaking medium complexity work present a risk of financial and physical harm * Para professionals showing same competencies as engineers cannot be registered unless have the relevant qualifications or substantial experience	* Moderate increase in general employment opportunities and earning potential	* Where not fully competent, para-professionals may undertake activities that present a significant risk of physical harm	* Para-professionals could become registered if display relevant competencies, significantly increasing employment opportunities, recognition of skills and earning potential	* No incremental impact expected		
Government	* Registration provides mechanism for determining competency of supplier * Engineering services create relatively significant flow-on employment * No net outlay required to fund Board of Professional Engineers of Queensland activities	* Excessive price competition has resulted in significant construction inefficiencies and higher long run costs * Government funds Disciplinary Panel	* As per consumers * Saving on funding of the Disciplinary Panel of approximately $55,868 a year	* As per large consumers * Would require other competency assessment mechanisms when selecting providers which is expected to incur a small cost * In a regulatory role, Government will face small costs of repealing present legislation	* As per large consumers	* As per large consumers * In a regulatory role, Government will face the moderate upfront costs of establishing the co-regulatory model * It a portion of registration fees paid to professional associations are not provided to fund Board operations, a relatively small level of government funding may be required	Same benefits as option three	Same costs as option three In their regulatory role, Government will face significant upfront costs in establishing the new Board and amalgamating it with other building industry professional boards

Key Affected Groups	Base Case		Option 1 - Deregulation		Option 2 – Co-regulation		Option 3 – Alternative co-regulation	
Board of Professional Engineers of Queensland	* Collates and screens relatively small number complaints for potential referral to the Professional Engineers Disciplinary Panel * Provides some limited monitoring of illegal practice * Self funded through registration fees	* Under-resourced for promoting profile and undertaking a greater monitoring role * Unable to directly regulate unregistered persons practicing and must refer problems to Crown Law.	* No incremental impact expected	* Board is dissolved eliminating minor number of employment opportunities of registrar and support staff (very small impact)	* Small costs incurred in assessing and maintaining registers of professional engineers, units and companies will be transferred to professional associations	* Board will not be required to incur registration processing costs but are expected to incur slightly lower costs in accrediting and monitoring the standards of professional associations	* Newly formed Board will possess significantly more building industry knowledge, flexibility and independence when investigating building complaints * Significantly greater revenue from larger member base	* Same costs as option three * Board will be dissolved in favour of multi-profession building industry Board which would be expected to have significantly more members and therefore significantly increase total costs of operation
Professional Engineers Disciplinary Panel	* Provides independent assessment of charges	* is funded by the Government * Complaint investigation, legal and Panel expenses average $55,868 per year	* No incremental impact expected	* Disciplinary Panel would be dissolved removing independent assessment mechanism which is expected to have small impact on engineers	* No incremental impact expected	* Disciplinary Panel may or may not be dissolved	* No incremental impact expected	* Disciplinary Panel may or may not be dissolved
Queensland Building Services Authority	* Passes small number of engineering complaints to Board	* Unable to establish causality of building problems to engineers or other building professions involved	* No incremental impact expected	* QBSA is no longer able to refer engineering complaints to the Board and may incur a small increase in costs in addressing these complaints by other means	* No incremental impact expected	* No incremental impact expected	Moderately reduced level of complaints and payouts due to	* No incremental impact expected
Institution of Engineers, Australia and other professional Associations	* Provides professional association benefits	* RPEQ requirement reduces value of membership reducing membership levels to 40% of RPEQ's and membership fees collected	* Demands for mechanisms to signal quality to the market will significantly increase membership levels and fees collected	* Competition may emerge among professional associations on price and entry requirements, which is expected to moderately compromise assessment and	* Membership levels and registration fees may increase moderately due to legislative requirement, however some economies of scale may offset	* Burden of assessment and ongoing monitoring of competency may cause of moderate increase in operating costs and demand for employment	* Same benefits as option three	* Same costs as option three

Key Affected Groups	Base Case		Option 1 - Deregulation		Option 2 – Co-regulation		Option 3 – Alternative co-regulation	
		* Professional association membership considered expensive in comparison to benefits received		disciplinary processes * Multiple professional associations may generate significant additional complexity in the system	these increases			
Training Institutions	* Provides degree training	* Postgraduate training costs are expensive reducing their uptake	* Demand for practical courses may increase moderately	* Reduced image of profession will moderately reduce quality of new entrants and ultimately their engineering work * Universities will be required to provide a higher level of practical skills and ethics potentially increasing course durations and slightly increasing delivery costs	* No incremental impact expected	* No incremental impact expected	* No incremental impact expected	* Grouping engineers with other building industry practitioners will moderately reduce the image of the profession, moderately lowering the quality of new entrants and ultimately the quality of engineering work in the community

8

Company Registration - Restriction on competition

8.1 Company Registration – Restriction on competition

During this review an additional potentially restrictive area of legislation was identified. This involves Part 5 of the *Professional Engineers Act 1988* which sets out conditions for registration of professional engineering companies.

Clause 30 (ba) (iv) which states that for companies that do not have constitutions

"if the company has more than 2 directors, at least three-fifths of the directors are registered professional engineers and the others each hold a qualification prescribed under a regulation".

and

Clause 30 (c) (iii) (iv) and (v) which state for companies that have a constitution

"(iii) if the company has more than 2 directors, at least three-fifths of the directors are to be registered professional engineers and the remaining directors are to each hold a qualification prescribed under a regulation; and

(iv) at least three-fifths of the total voting rights of all directors of the company entitled to vote at a meeting of directors of the company are to be held by registered professional engineers;

(v) at least three-fifths of the total voting rights of all persons entitled to vote at a general meeting of members of the company are to be held by registered professional engineers".

These clauses impose restrictions on the ability for companies or individuals that are not RPEQs to control professional engineering companies. For example, this impacts most of the major consulting engineering companies in Queensland that have multinational parents. If the Board of these companies is made up of persons from other countries it may not be possible for these companies to become Registered Professional Engineering Companies of Queensland (RPECQs).

However, in reality Part 5 of the legislation has not proven to be a restriction to competition. This is because companies have been able to register themselves as units under Part 6 of the legislation. Unit registration is far less restrictive than Part 5. There is no requirement for three-fifths of directors (or shareholders) of a unit to be RPEQs. The Board of Professional Engineers of Queensland obtained legal advice on this matter and it was confirmed to them that it was indeed within the legislation for stand alone companies to register as units. There are numerous examples of this occurring including BHP Engineering, Snowy Mountains Engineering Company (SMEC), and Hyder Consulting (Board of Professional Engineers of Queensland, 10/12/99).

To test the effectiveness of this element of the Engineers Act, consultation was undertaken with the Board, the Institution, three major consulting engineering companies (service providers) and the Department of Main Roads (major customer). There was general agreement that Part 5 was ineffectual. The restriction of voting rights to RPEQ Directors was considered impractical to multinational consulting engineering firms who have the majority, if not all, of their Directors residing in countries other than Australia. The large consulting engineering companies have already bypassed this legislative requirement by registering as units.

One of the large service providers noted that restricting the management of consulting engineering companies to RPEQs was an archaic requirement and prevented a number of persons with other useful backgrounds, such as scientists, finance managers, or marketers, from participating in senior management.

Some form of registration of these organisations was considered necessary to ensure responsibility for engineering work in organisations is not carried solely by individuals. It would appear that unit registration meets this need. Respondents also noted that it was important to maintain unit registration as this was the only means of covering sole practitioners.

No significant costs can be identified from removing this current restriction. Consultation with key stakeholders supported this finding.

In reviewing Part 5 of the legislation it has shown to be ineffectual. It can be easily bypassed by Part 6 and as such is unnecessary as legislation to meet the objectives of the Act. Therefore, Part 5 of the *Professional Engineers Act 1988* should be removed from the legislation.

9

Conclusions

9.1 Conclusions regarding Regulatory Options

The PBT guidelines require that the results for the various regulatory options be assessed against:

- the objectives of the legislation
- the overall net benefit from each option
- that the objectives of the legislation can only be met by restricting competition.

The following table demonstrates the net benefits/costs of the base case, Option 1 (deregulation), Option 3 (co-regulation) and Option 4 (alternative co-regulation) and whether they meet the objectives of the legislation.

Table 9.1 Conclusions

Option	Net Benefit/Cost	Compliance with Legislative Objectives
Base Case	Base for comparison	• largely meets objectives • some violations without significant costs
Option 1 *Deregulation*	Large net cost	• does not meet objectives of the legislation
Option 3: *co-regulation*	Small to moderate net benefit	• largely meets objectives through similar mechanisms to base case • improved assessment of competency for initial and ongoing registration enhancing consumer protection
Option 4: *Alternative co-regulatory approach (industry based)*	Small net cost	• largely meets objectives through similar mechanisms to base case • improved assessment of competency for initial and ongoing registration enhancing consumer protection particularly in the building industry • alienation of non building industry engineering participants

Analysis of the base case revealed that the legislation largely meets its intended objectives in practice. However, it is not possible to conclude whether the legislation is solely responsible for achieving the objectives or whether the commercial practice of operators in the market is assisting in this regard. A small number of violations of the legislation do occur in practice resulting in a small cost to the community.

Analysis of Option 1 – deregulation, revealed an incremental net cost over the base case. Many of the general attributes of the industry would remain unchanged, however this option does not meet the objectives of the legislation.

Analysis of Option 4 – alternative co-regulatory approach (industry based), revealed a small incremental net cost over the base case. While this approach largely meets the objectives of the

legislation (via similar mechanisms to the base case) it incurs significant upfront costs from the establishment and amalgamation of building design industry practitioner boards. As a result, the objectives of the legislation are only fully realised for the building industry whilst engineering practitioners in other industries are largely alienated.

The PBT process identified the Option 3 - co-regulatory approach as offering the greatest incremental net benefit over the base case in addition to a slight enhancement of the compliance with the policy objectives of the legislation.

The regulatory environment and market outcomes would be largely unchanged under Option 3 - co-regulatory approach as compared with the base case. The overall net benefit is primarily expected to accrue from the involvement of professional associations (in the competency assessment process) who should be better in touch with industry developments than the Board of Professional Engineers of Queensland. The regulatory approach would thereby provide greater assurance of the competency of registered engineers, reducing risk of physical and financial harm to consumers.

This option does not precisely mirror any arrangements in other states. In comparison, it is not considered more restrictive than other states as although other states do not have 'registration specific' legislation they do regulate the practices of engineering through associated legislation. The Institution of Engineers, Australia has noted that there appears to be an increase in the amount of associated legislation in other states as governments respond to engineering related project failures such as the Sydney Water outbreak of crytosporidium in 1998 and the 1997 Canberra Hospital implosion.

At present enacted legislation in other states utilises the assessment processes of professional associations and the privately maintained NPER register. Consultation indicated that utilising a similar approach in Queensland would reduce administrative complexity and barriers to entry for engineers from other states, increasing the range of service providers available to local consumers (e.g. interstate providers would be able to practise in Queensland).

This option also has the potential to be more tailored to each engineering discipline and individual engineer and hence generally less restrictive than the present situation in Queensland or any other state. The registering professional bodies would have the ability to change the current qualification based registration system to a competency based one. This would provide a more rigorous basis for registration thereby generally raising the standard of engineering services. This model would also allow different competency levels to be set for different engineering disciplines, which may allow a decrease in registration requirements for engineers undertaking low complexity work.

The transition to a professional association based competency assessment process introduces a higher level of dynamism into the registration system. Professional associations are well suited to staying abreast of market changes across the full spectrum of present and emerging engineering disciplines and are well placed to tailor assessment processes. The increased flexibility provided by this approach avoids the need for re-skilling of engineers to meet a common generalist level of knowledge when their effective field of practice lies in a niche area. This option would also provide an opportunity to reclassify the divisions of engineering, as the 10 divisions listed in the current legislation may be outdated.

There is still a continuing role for Government in regulating the professional associations' ability to fulfil their competency assessment functions. Direct involvement by Government would also remain in the area of disciplinary processes as professional associations may be seen as protecting their members' interests, rather than performing objective investigations and undertaking disciplinary action.

A co-regulatory approach for engineers (utilising the NPER register) presently exists in other states, such as Victoria, where it is used with reference to the building industry. Given its successful application in this setting and the substantial number of members in the Queensland market, the uncertainties surrounding implementation and transitional arrangements are small.

Conclusions regarding Restrictions on Company Registration

During this review an additional restrictive area of legislation was identified involving Part 5 of the *Professional Engineers Act 1988* which sets out conditions for registration of professional engineering companies. This part imposes restrictions on the ability of companies or individuals that are not RPEQs to control professional engineering companies. Investigations undertaken by the Board of Professional Engineers of Queensland discovered that stand alone companies could be registered as units under Part 6 of the legislation, with unit registration being far less restrictive than company registration.

Further consultation undertaken by PricewaterhouseCoopers with key affected groups identified a consensus that the restrictions imposed by Part 5 of the *Professional Engineers Act 1988* were impractical and that Part 5 of the legislation was ineffectual. In conclusion, Part 5 can be easily bypassed by Part 6 and as such is unnecessary as legislation to meet the objectives of the Act. Therefore, in line with the principles of the CPA, Part 5 of the *Professional Engineers Act 1988* should be removed from the legislation.

9.2 Transitional and Implementation Issues

If Option 3 – co-regulation was adopted the severity of adjustment for each of the key affected groups would be small. Government would face the initial responsibility of altering legislation and informing the community of the prospective changes. The Board's functions would need to be re-focused from registration of engineers to accrediting the professional associations to undertake the registration function. The initial process of accrediting professional associations may take up to 6 months to complete.

It would be useful to provide engineers, who are not presently assessed by the relevant professional associations, with a two year grace period to undertake the competency assessment process. A two year period is thought to be necessary as approximately 60% of RPEQs in Queensland are not members of the largest engineering professional association. This grace period would also assist the relevant professional associations to manage the competency assessment process of a significant number of engineers over a realistic period of time. If an engineer did not act within this time frame or did not meet the registration requirements of the relevant professional associations then they may be forced to find employment under the supervision of another RPEQ. This may result in some employment and earning losses which could be rectified by the registration process. If the engineer was not competent then their exclusion from unsupervised practice would be beneficial in the interests of public health and safety.

Other key affected groups are not expected to face any transitional issues other than requirements that they be educated of the changes in the system.

10

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Appendix A

Consultation Results

Table A1 Face to Face Consultation

Organisation	Persons
University of Queensland	Professor John Simmons, Dean, Faculty of Engineering.
Connel Wagner	Professor Charlie Tranberg
Hyder Consulting	Les Louis
Kinhills	Bruce Derrick, Regional GM Mike Fordyce, Principal Engineer
Board of Professional Engineers of Queensland	Board
Professional Engineers Disciplinary Panel	John Cooper, Partner, Allen Allen & Hemsley
Department of Public Works	Ross Bell, Chief Engineer Don Allen, Industry Policy Unit
Department of Main Roads	Dennis Wogan
Department of Mines & Energy	David Mackie, Safety & Health Inspector, Mines
Brisbane City Council	Chris Thorley, Group Manager Miles Finamore, Principal Structural Engineer
Association of Professional Engineers, Scientists & Managers, Australia	Hal Richards
Institution of Engineers, Australia	Board
Association of Consulting Engineers Australia	Dennis Sheehan
Queensland Building Services Authority	Matt Miller, CEO
Queensland Master Builders Association	Greg Quinn
Brisbane & Queensland Consumers Associations	Justin Malbon, Senior Law Lecturer, Griffith University

Table A2 Phone Consultation

Organisation	Persons
Australian Institute of Building	Peter Fardoulys, President
Gold Coast City Council	Warren Day, Director of Engineering Services
Townsville City Council	Dawson Wilkie, Director of Engineering Services
Mt Isa City Council	David Mason, Manager Works & Property
Mt Isa Mines	Ron Foster, Senior Project Engineer

Consultation Summary

The findings from the consultation process have been summarised into the following table. During consultation, a selection of representatives from each of the key affected groups were interviewed regarding the status of a range of issues under the base case and how they might be affected under each of the options. Table A3 below presents feedback received from the first round of face to face consultations.

Table A3 Initial Consultation Summary

Impact	Base Case	Option 1 - Deregulation	Option 2 - Building Industry Regulation	Option 3 - Co-Regulation
Public Protection ***Safety***	• Professional associations, the Board and engineers indicated that registration protects consumers and public from health and safety risks by ensuring competent persons undertake work – Engineers have the ability to cause major fatalities and environmental damage • Engineers indicated that regulation reduces insurance premiums	• Professional associations, the Board and engineers indicated that deregulation is likely to result in an increase in industrial accidents – injuries, deaths • Professional associations, the Board and engineers indicated that more structural collapses would occur	• It was unanimously indicated that concern arises for safety impacts in non - building areas of engineering work	• It was unanimously indicated that no significant impact over the Base Case would occur
Quality	• It was unanimously indicated that regulation provides a minimum level of quality to consumer – it does not help consumer differentiate between providers • Professional associations, the Board and engineers indicated that regulation reduces costs from over engineering by unqualified persons	• Professional associations, the Board and engineers indicated that higher costs from over engineering, and rectification works would result • Professional associations, the Board and engineers indicated that reduced innovation would result • Engineers indicated that increased information requirements by consumers leading to higher tendering costs	• Engineers indicated that larger firms are likely to exit building industry	• Professional associations indicated that they would be likely to pressure providers for better quality and service
Convenience	• Large consumers indicated that registration does not assist when they are selecting suppliers			
Price	• Professional associations, the Board and engineers indicated that the cost of regulation to consumer is incidental • Professional associations, the Board	• Engineers indicated that a rise in insurance premiums would be likely • Professional associations, the Board and engineers indicated that an expected fall in	• Professional associations, the Board and engineers indicated similar price impacts for non-building industry work • Professional associations, the Board	• Professional associations, the Board and engineers indicated no significant net impacts on price over the Base Case

Impact	Base Case	Option 1 - Deregulation	Option 2 - Building Industry Regulation	Option 3 - Co-Regulation
	associations, the Board and engineers indicated that price competition is fierce which has put downward pressure on quality	that an expected fall in prices but greater fall in quality of services provided would result	associations, the Board and engineers indicated that no impact for building industry work would result	
Non price	• Professional associations, the Board and engineers indicated minimal non price competition – reputation, experience, CPD	• Professional associations, the Board and engineers indicated even less non price competition would result at the low end of the market		
Business Impacts ***Cost to business***	• Engineers indicated no significant costs to business	• Professional associations, the Board and engineers indicated a cost to business through increased provision of information	• Engineers indicated a cost to business through increased provision of information	• Professional associations, the Board and engineers indicated minimal impacts to business from this option
Profitability	• Engineers indicated a low industry level of profitability (4-5%) due to competitive environment not Regulation	• Engineers indicated a small decline in firm profitability due to increased costs	• Engineers indicated a likely decline in firm profitability due to increased costs	
Economies of scale	• Engineers indicated that low profitability has lead to large scale consolidations			
Management qualifications	• Engineers indicated that this would place a restriction on available management pool			
Small Business issues			• Engineers indicated a potential barrier to entry for small firms if assets test required to insure workmanship	
Employment	• Engineers indicated that regulation has no significant impact on employment in this profession/industry	• Engineers indicated no significant impact	• Engineers indicated no significant impact	• Engineers indicated no significant impact
Training/Skills/ Competency ***Initial training***	• Universities and engineers indicated that the current system works well with university providing fundamentals and industry providing practical training • Universities indicated that tertiary training is not competency based assessment		• Universities indicated a similar impact to the deregulation option would result except for the building industry which would remain much the same	

Impact	Base Case	Option 1 - Deregulation	Option 2 - Building Industry Regulation	Option 3 - Co-Regulation
Continuing professional development (CPD)	• The Board and engineers indicated poor control of CPD • The Board and engineers indicated low level CPD which minimises innovation and cost savings for consumers			• Professional associations and engineers indicated a higher standard of CPD • Professional associations and engineers indicated more widespread CPD would be undertaken
Demand for Training	• Universities indicated that demand for university places exceeds supply but entry requirements have been falling • Professional associations and engineers indicated that there is no requirement to update and monitor skills	• Universities and engineers indicated that it is likely to reduce demand for university places and quality of students		
Pressure to meet market needs	• Engineers indicate that training bodies respond well to market needs through links with industry			
Competence measures	• Engineers indicated no differentiation between standard of 5 years experience required to be registered			

Impact	Base Case	Option 1 - Deregulation	Option 2 - Building Industry Regulation	Option 3 - Co-Regulation
Access ***Rural and Regional services*** ***Consumer choice***	• Professional associations and engineers indicated good access to competitively priced services • Professional associations and engineers indicated that the competitiveness of industry ensures provision of variety of services and consumer choice	• Professional associations, the Board and engineers indicated that it would be possible access to greater range of services at cheaper prices but at lower quality	• It was unanimously indicated that a similar impact to the deregulation option would occur except for the building industry	• It was unanimously indicated that there would be no significant impact over the Base Case
Information Asymmetry	• It was unanimously indicated that there is a lack of appreciation and understanding for work of engineers by public, small consumers, builders	• Professional associations, the Board and engineers indicated a tendency by the public to adopt low priced (low quality) services due to lack of understanding of role and importance of engineers • It was unanimously indicated that higher costs would be involved in information searches	• Professional associations and engineers indicated a possible increase in consumer knowledge in building industry but not in other engineering areas	• The Board indicated that public promotion of the engineers role and importance by IEAust is currently poor. There is no reason to indicate this might change under this option
Regulation ***Effectiveness in achieving Objectives of Act***	• The Board, professional associations and engineers and Government indicated that regulation does not prevent Engineers practising outside their area of expertise – people still sell engineering services without being an RPEQ • Engineers indicated that it does not require them to be present for on site construction works • The Board, professional associations and engineers indicated that the industry is so competitive that quality has been compromised • Engineers indicated that the legislation provides for limited accountability • Engineers and Government indicated that Government has some units that are not registered • Engineers and professional associations indicated that legislation doesn't differentiate on areas of	• The Board and professional associations indicate that overseas examples indicate value of regulation – Fiji cyclone, Turkey earthquake, Israel bridge	• It was unanimously indicated that inequity between engineers in building industry and engineers working in other industries would emerge • Engineers, professional associations and the Board indicated that there are other industries which are far more risky than building industry	• Engineers indicated that it removes the need to be registered in every state • Engineers and professional associations indicated that the accrediting body likely to be more in touch with industry and educational bodies – but would not have statutory power to pressure educational bodies to maintain or increase standards • Professional associations indicated better links to international associations for standards conformity • Professional associations and engineers indicated the potential to make registration competency based • Engineers and Government indicated that professional associations may not be able to ensure independence

Impact	Base Case	Option 1 - Deregulation	Option 2 - Building Industry Regulation	Option 3 - Co-Regulation
	expertise – current divisions are outdated			
Costs of administration and enforcement	• The Board indicated expenses in the order of $300,000	• Professional associations indicated that costs of privatising the Board would result in increase in standard membership of $150 • It was unanimously indicated that a likely duplication of de-centralised registration lists would occur		• Board and engineers indicated higher registration costs • Professional associations indicated higher marketing costs • Engineers indicated economies of scale would result from using a common national register
Disciplinary procedures	• Engineers indicated that the disciplinary system is too lenient – 1 forced deregistration ever • Engineers indicated that penalties are weak • Engineers indicated that the Board has limited powers and scope – cannot penalise engineers for poor workmanship • The Board and engineers indicated no checks on backyard operators	• The Board indicated that there would be no statutory backing to enforce breaches of registration		• Engineers indicated the IEAust's record for discipline is soft
Complaints mechanism	• Professional associations and the Board indicate that consumers can complain to the Board (not available in other states) but this does not often produce an outcome			
Other issues	• Engineers indicated that the Board is not impartial as it sits under Public Works which is a client/competitor • The Board indicated that regulation protects the environment which cannot defend itself			

Impact	Base Case	Option 1 - Deregulation	Option 2 - Building Industry Regulation	Option 3 - Co-Regulation
Business Licensing	• Engineers indicated that it provides some restraint to non-engineering managers bringing financial pressure to bear on engineers • Engineers indicated that it is important to have professional competence up to sign off level • Engineers, the Board and professional associations indicated an element of overlap as units don't need to be licensed if individuals are licensed	• Engineers indicated that it would remove requirement for business licensing and marginally reduce costs to companies and units	• Engineers indicated that there would be no requirement to license business units and companies under this option if individuals were licensed in the building industry	• Engineers, professional associations and the Board indicated that this option could be implemented (in the absence of business licensing) without without effecting quality or safety of work

Option 4 – Alternative Co-regulatory approach (industry based)

During the consultation period a fourth option was raised, this being a variation on the co-regulatory approach where instead of having a Board of Professional Engineers there would be a Board of Building Design Professionals. Additional consultation was undertaken with a selected number of key affected groups as to the impacts of this option over the Base Case and Option 3 (Co-regulatory approach). These results are summarised below.

Public Protection

- Little positive impact on health and safety risks. Risks in other industries would be catered for less under this option.
- No impact on quality standards. You may have situations where a builder is commenting on practices of an electrical engineer which could lead to inappropriate disciplinary measures.
- It would have no impact on policing of unregistered engineering activities/work.

Costs

- Administration costs would be split across a number of professions which would give rise to potential economies of scale.
- There could be significant implementation costs involved with this option as it would take some time to gain agreement from the relevant professions and then amalgamate into one Board. It is likely that there would be strong objections from the Engineering profession.

Complaints mechanism

- Complaints in the building industry could be dealt with more effectively. However, complaint in other areas of engineering would be dealt with less effectively and efficiently.
- There could be time delays in dealing with complaints as less matters would be able to be dealt with by the Board and would need to be forwarded to expert panels.

Information Asymmetry

- This option would create confusion in the marketplace.

Specific Impacts on Engineers

- Non-building industry engineers would feel a loss or downgrading of their professional status – it ignores majority of engineers.
- Non-building industry engineers would feel a loss of representation.

General

- There would be difficulties in amalgamating professions that have cultural differences. Problems in getting different Boards to work together.
- This option appears to be designed entirely for complaints.
- Engineers cover a very broad range of activities across a number of industries, unlike say Architects.
- Residential building creates a high level of emotion but issues/impacts are often small in comparison to other areas of engineering.

Appendix B

Description of Engineering Disciplines

The following definitions for engineering disciplines was obtained from the meeting summary of the APEC Engineer Project : Expert advisory group meeting, 28-29 July 1999:

Building Services Engineering

Building Services Engineers are concerned with aspects of the built environment, involving air conditioning and mechanical ventilation, electrical light and power, fire services, fire safety engineering, water and waste services, data and communications, security and access control, vertical transportation, acoustics in building and energy management.

Chemical Engineering

Chemical Engineers are concerned with research, teaching, design, development, economics, manufacture, installation, operation, sales, maintenance and management of commercial scale chemical plants and process systems, industrial processing and fabrication of products undergoing chemical and/or operations. In addition they mush have experience in two of the following functions involving process systems and equipment: design, evaluation, operation, materials selection and fabrication.

Civil Engineering

Civil Engineers are concerned with materials such as steel, concrete, timber, earth and rock, and with their application in the research, design, development, manufacture, construction, operation, maintenance and management of hydraulic, structural, environmental and systems aspects of infrastructure works and services such as water, sewerage, transport, urban development and municipal services, and with building and construction for other infrastructure industries.

Electrical Engineering

Electrical Engineers are concerned with research, design, development, manufacture, installation, operation, maintenance and management of equipment, plant and systems within the electrical, electronic, communication and computer systems areas. Electrical engineering is applied to electrical power generation, transmission, distribution and utilisation, manufacture and control in industry, communications networks, electronic plant and equipment, integration and control of computer systems.

Environmental Engineering

Environmental Engineers use their specialised training and experience to work closely with professional engineers from other disciplines to achieve environmentally sustainable outcomes. Collectively and holistically, they apply an integrated approach to technical, economic, social, legal and scientific considerations.

Environmental Engineers work on new or existing projects that require some form of improvement, remediation or rehabilitation in the natural and built environment. Environmental engineers work in many areas of environmental protection including water quality, waste water and storm water management, waste management, contaminated land remediation, natural resource management, air

quality, noise management, greenhouse gas emission reduction, environmental management systems, environmental information systems, social impact analysis and environmental risk assessment.

While all engineers have a duty of care to the community on environmental matters and effects, environmental engineers approach issues on a multidisciplinary and integrative basis and involve other professionals where necessary.

Mechanical Engineering

Mechanical Engineers are concerned with research, design, development, evaluation, manufacture, installation, testing, operation, maintenance and management of machines, machine and thermodynamic processes, and manufacturing and materials, transport, electricity generation, and in works and services using machine systems, including the environment of building interiors. Applicants must have experience in the safety aspects of design and/or operation of machines, plant, systems or processes.

Structural Engineering

Structural Engineers have expertise in research, planning, design, construction, inspection, monitoring, maintenance, rehabilitation and demolition of permanent and temporary structures and structural systems and their components and with associated technical, economic, environmental, aesthetic and social aspects. Structures might include buildings, bridges, in-ground structures, footings, frameworks and space frames, including those for motor vehicles, space vehicles, ships, aeroplanes and cranes, composed of any structural material including composites and novel materials.

Appendix C

Tertiary Education Issues

Bachelor of Engineering : Employment Destinations[59]

Chemical Engineering graduating students work in areas such as:

- environmental protection, management and safety
- natural resource utilisation
- the chemical, petroleum and petrochemical industries
- biochemical and biomedical engineering
- processing of electronic and photonic devices
- computer aided process and control engineering
- advanced materials manufacture.

Civil Engineering graduates work for:

- private enterprises such as consulting firms, construction managers and contractors, and mining companies
- commonwealth, state and local authorities
- semi-government and independent government authorities and commissions
- research establishments
- self-employment.

Computer Systems Engineering graduates are qualified to work not only in the mainstream computer industry, but also in most other areas of electrical engineering. Employers include:

- multinational computer companies
- state and federal government departments
- consultancy companies
- telecommunications companies.

Electrical Engineering graduates may work in the following areas:

- electrical power systems and apparatus manufacture
- robotics and electrical control systems
- bioengineering, electromedicine and medical signal processing,
- power electronics
- optical fibre communications
- semiconductor electronics
- microwave and antenna engineering
- signal processing
- satellite communications.

[59] www.uq.edu.au

Environmental Engineering graduates are sought by:

- consulting firms
- processing companies
- other areas of industry
- state and federal government departments.

Materials Engineering opportunities for graduates exist in:

- materials producing industry
- utility industries, including electricity, gas and water
- transport industries
- research and development organisations.

Mechanical Engineering employment is typically in industries such as:

- consulting
- automotive
- manufacturing
- power production
- transport
- mineral
- mining
- chemical
- government services.

Mechanical and Space Engineering current employment opportunities in space-related areas are limited in Australia but include:

- consulting practices
- postgraduate research
- manufacturers of aeronautical and aerospace equipment.

Minerals Process Engineering opportunities are available in:

- mineral processing
- pyrometallurgy
- hydrometallurgy
- electrometallurgy.

Mining Engineering Mining engineers find employment as:

- planners and managers with mining companies
- specialist fields such as tunneling, excavation engineering and geomechanics.

Software Engineering job opportunities for Software Engineering graduates continue to grow as computer usage in society increases. graduates find work in a wide range of industries and organisations including:

- banks and financial institutions
- federal and state governments
- companies supplying communications and control systems
- computer systems suppliers and consultants.

Bachelor of Engineering (UQ) Course Subject List[60]

Before enrolling in any subject listed in the Course Subject List, you are required to:

- have obtained credit for any subjects listed as prerequisite subjects and
- have obtained credit for, or be enrolled in, all subjects shown as companion subjects.

# indicates credit points.

All Engineering — Year 1

Students are required to complete or be granted exemption for all the compulsory subjects listed below.

Students are required to complete or be granted exemption for all compulsory subjects & 4 subjects from — 9E101, 9E102, 9E103, 9E104 & CS181.

Compulsory

Code # Title
9E100 12 Introduction to Professional Engineering
MT150 [a] 12 Mathematical Foundations
MT151 12 Calculus & Linear Algebra I
MT152 12 Multivariate Calculus & Ordinary Differential Equations

Elective

9E101 12 Applied Mechanics
9E102 12 Physics & Engineering of Materials
9E103 12 Electrical Physics & Electronics
9E104 12 Applied Chemistry for Engineers
9E107 12 Sustainable Development of Resources
CS181 12 Introduction to Software Engineering

Note:

a. Compulsory for students without at least a Sound Achievement in Maths C; elective for students with Sound Achievement in Senior Maths C; not available for students with a High Achievement or higher in Senior Maths C.

[60] www.uq.edu.au

Civil Engineering[61]

Credit may be gained for not more than #10 of arts subjects approved by the Head of Department. Credit may also be gained for subjects not listed in the schedule shown below, with the approval of the Dean on the recommendation of the Head of Department.

Compulsory

Year 2, Semester 1
E2221 10 Structural Mechanics I
E2222 5 Engineering in History
E2223 5 Ideal Fluid Flow
E2224 5 Structural Design I
E2225 5 Civil Computing I
5E201 5 Engineering Materials
ME210 10 Engineering Mathematics IIA

Year 2, Semester 2
E2226 5 Concrete Structures I
E2227 10 Real Fluid Flow
E2228 5 Structural Design II
GM143 10 Earth Processes & Geological Materials [a]
ME211 5 Engineering Mathematics IIB
ME214 5 Statistics for Engineers

Year 3, Whole Year
E2316 7 Structural Design II

Year 3, Semester 1
E2301 8 Structural Analysis I
E2303 8 Structural Mechanics II
E2312 10 Contemporary Issues & Communications Skills
E2317 4 Concrete Technology
E2320 9 Introduction to Catchment Hydraulics
GN381 8 Measuring Systems IE

Year 3, Semester 2
E2302 8 Structural Analysis II
E2308 8 Fluid Mechanics III
E2310 7 Transportation Engineering I
E2315 8 Introductory Soil Mechanics
E2321 8 Open-Channel Hydraulics & Design
GN384 5 Surveying Systems IC
GN385 4 Surveying Project IC

[61] www.uq.edu.au

Year 4, Whole Year
E2441 7 Structural Design III [c]

Year 4, Semester 1
E2411 9 Transportation Engineering IIA
E2413 3 Civil Engineering Seminars
E2419 3 Civil Engineering Project
E2431 8 Applied Soil Mechanics
E2442 6 Concrete Structures II
E2444 3 Structural Design IIIA [c]
E2447 5 Environmental Issues [d]
E2448 5 Civil Management & Economics
E2449 5 Research Thesis Design [b]
E2453 5 Thesis [b]
E9301 3 Engineering Economics

Year 4, Semester 2
E2432 6 Geotechnical Engineering
E2435 8 Construction
E2443 4 Structural Design IIIB [c]
E2449 5 Research Thesis Design [b]
E2453 5 Thesis [b]

Electives

Year 2, Semester 1
5 Unspecified Elective Subject

Year 2, Semester 2
E2229 5 Civil Computing II
ME213 5 Engineering Mathematics IID

Year 3, Semester 1
ME302 4 Numerical Analysis IIIA (Numerical Linear Algebra)

Year 3, Semester 2
E2319 7 Surface & Subsurface Hydrology

Year 4, Semester 1
E2427 8 Structural Analysis III
E2429 8 Coastal & Estuarine Processes
E2450 10 Thesis & Seminar [b]

Year 4, Semester 2
E2402 8 Advanced Structural Design

E2412 8 Transportation Engineering IIB
E2422 8 Public Health Engineering
E2437 8 Engineering for Small Buildings
E2445 8 Selected Soil Mechanics Topics
E2450 10 Thesis & Seminar [b]
E2461 7 Applied Environmental Soil Mechanics
ME303 4 Numerical Analysis IIIB (Numerical Techniques)

Notes:

b. Students will enrol in E2449, normally in the second last semester of study, followed by either E2450 or E2453 in the following semester of study.

Table C1 1999 Entry Score Cut Off : St Lucia Campus

Course	QLD OP and FP	QLD RANK	Interstate Tertiary Index	Lowest UQ GPA gaining entry into course
Agricultural Science - Animal Science - Plant & Soil Science	10	82	81.25	3.50
Arts	10	80	79.20	3.25
Arts (Architecture)	9	83	82.35	3.50
Arts (Planning)	10	80	79.20	3.25
AppScFood Sci&Nut	12	79	78.10	3.00
Business Management	6	90	89.55	4.00
Commerce	7	88	87.55	3.75
Dentistry	-	99.28	-	5.85
Economics	8	85	84.50	3.50
Engineering	7	88	87.55	3.75
Env Man (Sus Dev)	10	81	80.20	3.25
Environmental Sc	8	86	85.55	3.50
Food Technology	10	80	79.20	3.25
Health Science (IPHC)	-	-	-	-
Info Tech	8	85	84.50	3.50
Journalism	6	91	90.60	4.00
Laws (and all courses combined with Law)	3:1:1	97.9	97.60	4.98
Music	-	-	-	-
Nat Res Economics	10	80	79.20	3.25
Occupational Therapy	3:2:2	97.8	97.60	4.95
Oral Health	9	83	82.35	3.50
Pharmacy	2:2:2	98	97.60	5.00
Physiotherapy	1	99	98.65	5.40
Physiotherapy (sub-quota)	-	99:99.17	-	5.67
Psychological Science	4:1:1	95:95.8	95.65	4.47
Speech Pathology	3:2:1	97:97.6	97.60	4.90
Science/Applied Science	8	85	84.50	3.50
Social Science	10	80	79.20	3.25
Social Work (U/G)	9	83	82.35	3.50
Social Work (P/G)	-	98	-	5.00
Vet Science	2:1:1	98:98.83	97.60	5.33

Source : www.uq.edu.au

Table C2 HECS Fees

Courses	Annual HECS Fee
Arts, Humanities, Social Studies/Behavioral Sciences, Education, Visual/Performing Arts, Nursing, Justice and Legal Studies	$3,409
Mathematics, Computing, other Health Sciences, Agriculture/Renewable Resources, Built Environment/ Architecture, Sciences, Engineering/Processing Administration, Business and Economics	$4,855
Law, Medicine, Medical Science, Dentistry, Dental Services and Veterinary Science	$5,682

Source : www.detya.gov.au

Appendix D

Location of Consulting Engineering Firms

Table D1 ABS Business Register September 1998

Consultant Engineering Firms by number of employees	<5	5 to 9	10 to 19	20 to 49	50 to 99	100 to 199	200 to 499	Total
Brisbane City	953	83	44	31	11	5	1	1,128
Gold Coast City Part A	15	2						17
Beaudesert Shire Part A	6							6
Caboolture Shire Part A	34	1		1				36
Ipswich City (Part in BSD)	52	3		1				56
Logan City	73	4	1	1				79
Pine Rivers Shire	56	4	1					61
Redcliffe City	18	2						20
Redland Shire	74	1	3					78
Gold Coast City Part B	212	19	8	6				245
Sunshine Coast	89	26	2	3				120
Moreton SD Bal	61	4						65
Bundaberg	13	1	1	3				18
Wide Bay-Burnett SD Bal	35	5	2	1				43
Toowoomba City	25	9	6	2				42
Darling Downs SD Bal	14	5	4					23
South West	4	2		1				7
Rockhampton	18	2	1		1			22
Gladstone	44	3	4	1				52
Fitzroy SD Bal	21	1	2					24
Central West	1	2	1					4
Mackay City Part A	49	2	4	3			1	59
Mackay SD Bal	17	1						18
Townsville City Part A	50	9	4	1	1			65
Thuringowa City Part A	12	1	1					14
Northern SD Bal	19	3						22
Cairns City Part A	55	10	4	2	2			73
Far North SD Bal	25	5						30
North West	14	3	1					18

Source : ABS unpublished Business Register Counts

Appendix E

State Statistical Profiles of Engineers

Table E1 Absolute Profile of Consulting Engineers

State	Businesses at end June[(a)]	Employment at end June		Wages and salaries		Total income	
		#	%	$m	%	$m	%
QLD	943	5,564	18.1	217.2	19.4	591.7	18.3
NSW	1,938	9,868	32.1	379.2	33.9	899.8	27.8
VIC	1,657	8,476	27.6	251.5	22.5	931.4	28.8
SA	217	1,086	3.5	39.7	3.5	121.2	3.7
WA	840	4,675	15.2	186.1	16.6	565.2	17.5
TAS	44	290	0.9	14.4	1.3	31.3	1.0
NT	35	204	0.7	9.3	0.8	32.5	1.0
ACT	85	573	1.9	21.2	1.9	60.4	1.9
Total	5,514	30,736	100.0	1,118.7	100.0	3,233.3	100.0
Average	689	3,842	12.5	140	12.5	404	12.5

Source : ABS 8693.0

Notes : (a) Multi-state businesses are counted in each State and Territory in which they operate. Hence, the counts of businesses for States and Territories do not sum to the total for Australia.

Table E2 Relative Profile of Consulting Engineers

State	Population serviced per business[(a)]	Average number of employees per business[(a)]	Income per employee	Wages & Salaries per employee	Income minus wages and salaries per employee
QLD	3,540	5.91	$106,340	$39,040	$67,300
NSW	3,201	5.09	$91,170	$38,420	$52,750
VIC	2,752	5.11	$109,890	$29,670	$80,220
SA	6,792	5.00	$111,460	$36,560	$74,900
WA	2,102	5.56	$120,900	$39,810	$81,090
TAS	10,794	6.59	$107,930	$49,650	$58,280
NT	5,200	5.83	$159,310	$45,590	$113,720
ACT	3,623	6.74	$105,410	$37,000	$68,410
Average	3,321	5.57	$105,190	$36,040	$68,790

Source : ABS 8693.0, IEAust submission

Notes : (a) Multi-state businesses are counted in each State and Territory in which they operate. Hence, the counts of businesses for States and Territories do not sum to the total for Australia.

APESMA Survey Research

Table E3 Mean State Remuneration Packages Across all Engineering Disciplines

State	Responses	Mean total package	Total magnitude of packages
QLD	419	$75,366	$31,578,354
NSW	783	$78,305	$61,312,815
VIC	789	$73,219	$57,769,791
SA	209	$68,392	$14,293,928
WA	281	$83,986	$23,600,066
TAS	62	$66,053	$4,095,286
ACT	77	$78,751	$6,063,827
NT	27	$70,872	$1,913,544
Total	2,647		$200,627,611
		weighted average:	**$75,794**

Source: APESMA, 1999 & PricewaterhouseCoopers analysis

Appendix F

Registration Fees

Table F1 NPER Listing Fees

Category	Fees
Non member with accredited Australian qualification	
Administration Fee	$90
Assessment Fee	$450
Annual Fee	$250
Initial Total Fee	$790
Ongoing Total	$250
Corporate membership applicant with accredited Australian qualification	
Administration Fee	$40
Assessment Fee	$250
Annual Fee	$355
Initial Total Fee	$645
Ongoing Total	$355
Member of recognised international professional association:	
Administration Fee	$90
Annual Fee	$120
Initial Total Fee	$210
Ongoing Total	$120
Member of APESMA	
Administration Fee	$90
Assessment Fee	$250
Annual Fee	$200
Initial Total Fee	$540
Ongoing Total	$200

Source : Institution of Engineers, Australia

Table F2 Board of Professional Engineers of Queensland Fees

Application/Registration Type	Fee
For registration as a registered professional engineer	$30
Registered professional engineers' role fee	$30
For restoration of registration as a registered professional engineer	$30
For registration as a registered professional engineering company	$160
For renewal of registration as a registered professional engineering company	$100
For restoration of registration as a registered professional engineering company	$100
For registration as a registered professional engineering unit	$160
For renewal of registration as a registered professional engineering unit	$100
For restoration of registration as a registered professional engineering unit	$100
For issue of duplicate certificate	$30

Source : *Professional Engineers Regulation 1992*

Table F3 Costs of Registration Faced by Engineering Profession

Cost Item	Calculation	Cost
Professional time incurred preparing application (individuals)	3 hours x $100 per hour x 225 applications	$67,500
Professional time incurred preparing application (companies)	4 hours x $100 per hour x 14 applications	$5,600
Professional time incurred preparing application (units)	½ hour x $100 per hour x 81 applications	$4,050
Processing renewal of registration fees (individuals)	4,047 RPEQ's x $10 per renewal x 1/3[(a)]	$13,490
Processing renewal of registration fees (companies and units)	½ hour x $50 per hour x 459 companies/units	$11,475
Application fees (individuals)	$30 per application x 225 applications	$6,750
Application fees (companies and units)	$160 per application x 95 applications	$15,200
Annual renewal fees (individuals)	$30 per renewal x 4,047 RPEQ's	$121,410
Annual renewal fees (companies and units)	$100 per renewal x 459 companies/units	$4,590
Total		**$250,065**

Notes : (a) Board reports that only 33% of payments are made by companies.
Source : Institution of Engineers, Australia

Appendix G

Other Legislation & Alternative Regulatory Systems

Queensland

Building Act 1975
Chemical Usage Control Act 1988
Coal Mining Act 1925
Electricity Act 1994
Environmental Protection Act 1994
Explosives Act 1999
Fire and Rescue Authority Act 1990
Gas Act 1965
Local Government Act 1993
Mineral Resources Act 1989
Mutual Recognition (Queensland) Act 1992
Queensland Building Services Authority Act 1991
Queensland Heritage Act 1992
Transport Operations (Marine Pollution) Act 1995
Transport Operations (Road Use Management) Act 1995
Workplace Health and Safety Act 1995

Victoria

Boilers and Pressure Vessels Act 1970
Building Act 1993
Dangerous Goods Act 1985
Domestic Building Contracts and Tribunal Act 1995
Electric Light and Power Act 1958
Electricity Industry Act 1993
Environment Protection Act 1970
Equipment (Public Safety) Act 1994
Gas Industry Act 1994
Heritage Act 1995
Local Government (Miscellaneous) Act 1958
Local Government Act 1989
Marine Act 1988
Mineral Resources Development Act 1990
Mines Act 1958
Mutual Recognition (Victoria) Act 1993
Occupational health and Safety Act 1985
Planning and Environment Act 1987
Project Development and Construction
Management Act 1994
Road Safety Act 1986
Water Act 1989
Soil Conservation and Land Care Act 1989
Water Resources Act1997

New South Wales

Building Code
Building Services Corporation Act 1989
Bush Fires Act 1949
Clean Air Act 1961
Clean Waters Act 1970
Coal Industry Act 1946
Coal Mines Regulation Act 1982
Coastal Protection Act 1979
Construction Safety Act 1912
Dams Safety Act 1978
Electricity and Safety Act 1945
Environmental Hazardous Chemicals Act 1985
Environmental Planning and Assessment Act 1979
Fire Brigades Act 1989
Gas and Electricity Act 1935
Heritage Act 1977
Irrigation Act 1912
Local Government Act 1992
Marine Pollution Act 1987
Marine Services Act 1935
Mines Inspection Act 1901
Motor Traffic Act 1909
Mutual Recognition (NSW) Act 1992
Noise Control Act 1975
Occupational Health and Safety Act 1983
Ozone Protection Act 1989
Professional Standards Act 1994
Rail Safety Act 1993
Sustainable Energy Development Act 1995
Waste Disposal Act 1970
Waste Minimisation and Management Act 1995
Water Act 1912

South Australia

Boiler and Pressure Vessels Act 1968
Builders Licensing Act 1986
Building Code
Building Work Contractors Act 1995
Coast Protection Act 1972
Development Act 1993
Electricity Act 1996
Environment Protection Act 1993

Explosives Act 1936
Gas Act 1997
Harbours and Navigation Act 1993
Heritage Act 1993
Local Government Act 1934
Marine Act 1936
Marine Environment Protection Act 1990
Mines & Works Inspection Act 1920
Mining Act 1971
Motor Vehicles Act 1959
Mutual Recognition (SA) Act 1993
Occupational Health, Safety and Welfare Act 1987
Plumbers, Gas Fitters and Electricians Act 1995
Public Environmental Health Act 1987
Rail (Operations and Access) Act 1997
Rail Safety Act 1996
Sewerage Act 1929
Ozone Protection Act 1991
Plumbers, Drainers and Gas Fitters Board Act 1982
Water Pollution Act 1984

Western Australia

Builders Registration Act
Building Code
Land Drainage Act 1925
Local Government Act 1960
Machinery Safety Act 1974
Occupational Health and Safety Act

Northern Territory

Building Act 1993
Construction Safety Act 1975
Dangerous Goods Act 1981
Electricity Act
Inspection of Machinery Act
Local Government Act
Marine Act
Mine Management Act
Mines Safety Control Act 1977
Motor Vehicles Act 1949
Mutual Recognition (NT) Act 1992
Occupational Health and Safety Act
Planning act 1992
Plumber and Drainers Licensing Act 1983

Soil Conservation and Land Utilisation Act 1970
Uranium Mining (Environment Control) Act 1993
Water Act 1993
Water Supply and Sewerage Act 1983

Tasmania

Building Code
Environmental management and Pollution Control Act 1994
Ground Water Act 1985
Homes Act 1935
Land Use Planning and Approvals Act 1993
Living Marine Resources Management Act 1995
Local Government (Building Miscellaneous Provisions) Act 1993
Local Governments (Highways) Act 1982
Marine Act 1967
Mutual Recognition (Tasmania) Act 1992
Occupational Health and Safety Act
Plumbers and Gasfitters Registration Act 1951
Tasmanian Development Act 1993
Water Act 1957

Australian Capital Territory

Air Pollution Act 1984
Building Act 1972
Dangerous Goods Act 1984
Electricity Act 1971
Energy and Water Act 1988
Environment Protection Act 1997
Gas Act 1992
Land (Planning and Environment) Act 1991
Motor Vehicles (Dimension and Mass) Act 1990
Mutual Recognition (ACT) Act 1992
Noise Control Act 1988
Occupational Health and Safety Act 1989

Commonwealth

Air Services Act
Australian Heritage Commission Act 1975
Civil Aviation Act 1988
Motor Vehicle Standards Act 1989
Mutual Recognition Act 1992

Submission from Institution of Engineers, Australia on Interstate Regulatory Trends

IEAust membership represents approximately 70% of all professional engineers in Australia.

Recently, there has been a substantial shift in the employment sector for professional engineers. Based on IEAust membership statistics:

- In the past, approximately 70% of IEAust members were employed by government.
- The percentage of IEAust members currently working in the public sector is 24%.

This change has come about because of the move to smaller government, downsizing, contracting out, privatisation, etc.

Infrastructure (such as roads, water, power transmission, rail, buildings, water and wastewater) is one of the biggest areas of engineering practice that is affected by this trend.

- Reliable and safe infrastructure requires a skilled and competent workforce to design, build and maintain it.
- Infrastructure was primarily controlled by government, with employment of engineers by government.
- Government "self regulated" by having strict selection criteria for employment and undertook significant training of engineers, thereby ensuring a high quality of practice.
- With the move to move to smaller government, downsizing, contracting out, privatisation, etc., a significant proportion of infrastructure is now owned, managed, and contracted to the private sector.
- The private sector does not invest the same time and money in training and selection of engineers as governments has done in the past.
- This has significant implications for public health and safety – as government does not have the oversight role that it has previously held.

State and Territory governments are introducing piecemeal registration or licensing of engineers as and when an area of significant risk arises, usually brought to their attention by serious incidents. For instance, as a result of the Canberra Hospital implosion, the ACT government in particular (and other governments) are looking at licensing practitioners involved in high risk demolition work (this necessarily includes structural engineers). As a result of the Westralia incident, the Naval Board of Inquiry recommended that a competent professional engineering authority be established as part of the procedure for authorising work. The Sydney Water and the New Zealand Electricity incidents also involved an engineering aspect. As a result of the Thredbo disaster, the NSW government will have to consider the level of geotechnical engineering expertise it has access to. Pressure vessel design was seen as an area of high risk, and those engineers registered on NPER can certify design for pressure vessels. Many more high-risk situations exist. However, it is unlikely that a holistic approach to regulation of engineering practice will be undertaken, due to the current trend to deregulate.

Instead of imposing regulatory regimes for professionals, including professional engineers, both NSW and WA have introduced professionals standards legislation. This is intended to provide a means to ensure a certain standard of professional practice. The Act provides that persons who accept conditions on their practice standards may become part of a scheme to limit the quantum of their liability from alleged professional negligence. Such conditions include membership of an approved professional organisation, compliance with a risk management program and carrying a set level of professional indemnity insurance. The Professional Standards Council has approved NPER to be the registration standard (for initial registration and continuing professional development requirements) for professional engineers who wish to use the limitation of liability provisions under the Professional Standards Act.

There are many Acts, regulations and standards that specify that only a qualified engineer is able to undertake certain types of work. These include commonwealth legislation concerning aircraft engineering, mining safety legislation in each State and Territory relating to work of mining engineers, etc. The problems arise when consumers (the public and government alike) who do not have the expertise, are required to determine who is a qualified and competent professional engineer.

Some areas that have not required regulation of engineering practitioners is the manufacturing and automotive, petroleum and biomedical sectors, as the end product is usually covered by many safety standards and rules

Building regulation

Over the last decade, governments have become focussed on licensing of practitioners in the building sector. This is primarily in the domestic market, although some governments have extended this to include major building work. The focus is on consumer protection, generally of a financial nature, imposing mandatory insurance, financial backing and management ability criteria. The focus has generally been on builders and other tradespeople.

Coupled with this has been a move to mandatory certification of certain aspects of building, and this has included the registration and licensing of professions, such as engineers. Almost all jurisdictions impose some form of registration/licensing for engineers in the building sector, as outlined below. The description relates to the use of the National Professional Engineers Register in legislation.

Victoria

Building Act 1993 - requires building practitioners to be registered with a Statutory Authority (Building Practitioners Board). The Board uses the National Professional Engineers Register (NPER), as the benchmark for the criteria for qualifications and experience required of professional engineers who work in the building sector in Victoria. This includes structural, civil, fire safety, electrical and mechanical engineers. Additionally, about 25% of the registered building surveyors in Victoria are professional engineers.

South Australia

Development Act 1993 - requires certain types of building practitioners to be registered with a State Government Department. The Department uses NPER as the benchmark for the criteria for qualifications and experience required of professional engineers.

NSW

Environmental Planning and Assessment Act - allows for a private certification of work previously undertaken by local councils relating to Building Act compliance, subdivision work and some other specified complying development. A scheme has been established that allows professional associations to register, monitor ongoing compliance with professional standards and discipline accredited certifiers. The Institution of Engineers is an approved accrediting body, using NPER as the basis for a registration system, with specialised areas of practice.

ACT

Construction Practitioners Act 1998 - requires building certifiers to be registered with the Building, Electrical, and Plumbing Control (BEPCON) section of the Department of Urban Services. The regulations authorise registration on the National Professional Engineers Register (NPER), as managed by the Institution of Engineers, Australia, as sufficient for practitioners to act as Building Certifiers and as Plumbing Plan Certifiers.

Tasmania

Building Act - the Government is currently considering changes to its Building Act with respect to registration of building practitioners and private certifiers. The Tasmanian Government has indicated that the Institution of Engineers (using NPER) will be considered an appropriate registering body.

Northern Territory

Building Act 1993 - allows for certification by private building practitioners, as authorised by a State authority. The Authority uses NPER as the benchmark for the criteria for qualifications and experience required of professional engineers.

Western Australia

WA is currently in the process of drafting legislation to regulate building surveyors and other professionals in the building sector. They already regulate builders under separate legislation.
Professional Standards Act

The Western Australian *Professional Standards Act* is very similar to the *Professional Standards Act* of New South Wales. It has been indicated by the Western Australian Government that the IEAust will be an approved professional organisation under the scheme.

Applied International Regulatory Approaches

New Zealand

The *Engineering Registration Act 1924* regulates the practice of engineering services in New Zealand.

At present, engineers are not required to register in order to practice engineering services. However only persons registered with the Engineers Registration Board of New Zealand may call themselves registered engineers.

Membership of the Engineers Registration Board requires that the applicant has practiced engineering services for at least one year in New Zealand and that they successfully complete a full day professional review examination. If the applicant successfully completes the professional review exam, they are eligible to apply for membership which is voted upon at the next monthly meeting of the Engineers Registration Board.

It is possible for membership to be revoked on the grounds of malpractice or other indiscretions.

Under mutual recognition provisions, engineers practising in New Zealand are able to register in Queensland.

United States of America

Regulation of the practice of engineering services in the United States is governed by the legislation of each State's Government with a requirement for registration prevailing in each of the States.

The Federal Government has also introduced the *Brooks Act* featuring conditions on the procurement of engineering services from private tenders.

Section 902 [40 U.S.C 542]

The Congress hereby declares it to be the policy of the Federal Government to publicly announce all requirements for architectural and engineering services, and to negotiate contracts for architectural and engineering services on the basis of demonstrated competence and qualification for the type of professional services required at fair and reasonable prices.

In an effort to promote the importance of quality of services, the Act precludes price from the assessment of tenders before a final applicant is selected. Upon selection, a one-on-one negotiation process begins to secure a mutually agreeable price. If negotiations fail they are permanently terminated with the tenderer and pricing negotiations commence with the next highest ranked tenderer.

Numerous States have introduced mini Brooks Acts reflecting the Federal equivalent.

National Professional Association

The National Society of Professional Engineers developed as a result of the complexity created by a highly mobile engineering profession whom may practice in numerous jurisdictions each with unique regulations.

Membership of the society is restricted to delegates from statutory boards regulating the practice of engineering services. The purpose of the society is to coordinate information between the boards of licensure.

Florida

The Florida Legislature concluded that if incompetent engineers performed services, physical and economic injury to the citizens of the State would result. As a result the *Engineering Registration Law* was introduced to protect the health, safety and welfare of the citizens. Under the law, the Florida Board of Professional Engineers controls the registration and practice of engineering services throughout the State.

California

It is specified that the purpose of California's *Professional Engineers Act* is to safeguard the life, health, property and public welfare of the people of California. The Act is administered by the Board for Professional Engineers and Land Surveyors.

To become registered with the Board, the applicant must have completed three or more years of accredited engineering curriculum or three or more years of engineering related work experience and successfully complete the National Council of Examiners for Engineers and Surveying examination.

Only those persons registered with the Board may practice or offer to practice civil, electrical or mechanical engineering services or use the relevant engineering title. Registration is also required to enable a person to use the title of professional engineer, registered engineer or consulting engineer.

Unregistered persons are allowed to perform engineering services for a client only if they are working under the responsible charge and direct supervision of a registered professional engineer.

A genuine non resident civil engineer may practice civil engineering services in California if they legally qualify to practice engineering services in their home state.

California law allows persons not licensed as architects or registered as engineers to design non elaborate residential and non residential constructions.

New Mexico

New Mexico's engineering profession is regulated by the *Engineering and Surveying Practice Act*.

The indicated purpose of the Act is to regulate the practice of engineering and surveying in order to safeguard life, health and property and to promote the public welfare with the State Board of Registration of Professional Engineers and Surveyors charged with its administration.

Its activities include licensing of qualified engineers and surveyors, development of rules, regulations and professional standards of practice, enforcement of the law and rules, development of continuing professional competency requirements for licensees and public information.

A license is required to present an engineers skills to the public.

Requirements for registration include an approved four year degree, at least a four year internship, successful completion of the required fundamentals exam (8hours) and the principles and practices exam (8 hours). Ongoing requirements include adhering to a code of professional conduct established by the Board.

Persons registered as licensed engineers in other states are eligible to apply for a license but may be required to undertake additional examination(s), internship or education if the initial license is determined not to have been issued under equal or exceeding requirements.

Currently, there are over 6,500 licensed engineers practicing in 15 disciplines, and over 600 licensed surveyors.

Texas

The Texas *Engineering Practices Act* regulates the engineering profession in the State. The Texas Board of Professional Engineers administers the Act including issues of licensing, enforcement, continuing professional competency and public information.

Eligibility to practice engineering services in the State requires registration with the Board. The registration requirements include successful completion of an approved curriculum, successful completion of the Board set exam and at least four years practical experience.

Alternately entry is also possible through completion of a related but non accredited qualification, at least eight years practical experience and successful completion of the Board set exam.

Canada

Persons wishing to provide engineering services in Canada must be licensed. Licensing is undertaken by 12 territorial associations who set standards and regulate the profession within their geographical boundaries. An engineering license is only valid within a given jurisdiction however the transfer of licenses is made possible through mobility agreements.

The Canadian Council of Professional Engineers acts as a national coordinating body for the provincial engineering authorities.

The licensing requirements include an undergraduate degree, two to four years work experience (of which twelve months must be in North America to familiarise the applicant with Canadian codes and standards), successful completion of a professional practice examination regarding technical, ethical, legal and liability issues, be of good character and reputation and be proficient in the relevant language skills.

Unlicensed engineers may work in Canada if a licensed engineer takes responsibility for their work.

United Kingdom

In the United Kingdom the Engineering Council is formally recognised by Government, through a memorandum of understanding, as the voice of the engineering profession. As such they provide oral evidence to the House of Lords on innovations in the profession and provide private briefings to the Chancellor of the Exchequer.

There is no direct engineer registration with the Council. To be eligible for registration, an individual must first obtain membership with a Council nominated engineering institution who in turn will nominate the person for registration with the Council.

Registration with the Council requires completion of an approved engineering course, a requisite period of practical experience and a minimum age requirement.

The Council licenses its member institutions to assess and accredit academic courses at universities and colleges such that their graduates will be eligible for membership of the respective institution and ultimately the Council itself.

In 1998 there were 196,948 chartered engineers, 49,975 incorporated engineers and 15,267 engineering technicians registered with the Engineering Council.

Japan

Japan requires practicing engineers to be registered, through the successful completion of examinations. Nearly 90% of successful candidates are university graduates although possession of a degree is not required to sit the exams. (APEC, 1999 : 3)

Korea

Registration is required for practicing engineers in Korea. Requirements for registration include successful completion of a professional engineer test assessing academic and professional capacities of candidates. The pass rate for the exam is 12%.

Prior to sitting the exam the candidate must meet requirements for practical experience dependent on their initial qualification, being four years experience for the holder of an engineer license (which entitles them to practice in association with a professional engineer), seven years for a graduate and 11 years for a non graduate. (APEC, 1999 : 3)

Malaysia

The *Registration of Engineers Act* requires that all graduates register with the Board before taking up employment. Successful completion of the professional assessment for Professional Engineer status or attainment of the grade of Member of the Institution of Engineers, Malaysia is required for individual practice. (APEC, 1999 : 3)

Philippines

Engineers must be licensed by the Professional Regulatory Board of the Professional Regulation Commission. By doing so they automatically become a member of an accredited professional organisation. A system of professional assessment featuring provisions for validating claimed qualifications and experience is required in addition to a formal interview. (APEC, 1999 : 4)