STRATEGIC STATEMENT ON ENGINEERING EDUCATION

INTRODUCTION

This strategic statement assesses engineering education in New Zealand, as perceived by Engineering New Zealand' Standards and Accreditation Board (SAB), using a Strengths / Weaknesses / Opportunities / Threats framework, divided into three areas – graduate attributes, supply and demand, and education levels and the articulation between them. For each area, this statement proposes a response by Engineering New Zealand to reinforce strengths, take advantage of opportunities and address weaknesses and threats. The actions to be taken by the SAB to implement those responses are proposed in the last section of this statement.

GRADUATE ATTRIBUTES

Strengths

New Zealand has three main levels of tertiary education in engineering. Each level is based on international standards: 4-year degree programmes (leading to professional engineer outcomes per the Washington Accord - WA), 3-year degree programmes (leading to engineering technologist outcomes per the Sydney Accord - SA), and 2-year diploma programmes (leading to engineering technician outcomes per the Dublin Accord - DA).

Unlike many other professions, these international standards mean our graduates are accepted for entry into the profession in many jurisdictions around the world.

NZ undergraduate engineering education programmes provide a broad preparation for engineering practice. This reflects the overall nature and scale of engineering practice in NZ, which tends to generate a demand for generalist rather than specialised practice.

Weaknesses

In some fields of engineering and some parts of the world, the existing international standards of graduate attributes at WA level are seen as inadequate for entry into the engineering profession.

Opportunities

There is increasing interest among education providers, students and employers in post-graduate engineering qualifications that provide additional technical skills that would allow graduates to practice more effectively in some fields of engineering than they could with a BE(Hons) degree.

Threats

The perception that Washington Accord graduate attributes are inadequate for entry into (at least some parts of) the profession has led to calls in some jurisdictions for the WA attributes to be revised upwards over time to meet those greater expectations. Disagreements between jurisdictions on this point could damage the broad international acceptance of engineering qualifications.

Engineering New Zealand Responses

The primary purpose of undergraduate engineering education should be to prepare students for entry to professional practice, and this should be reflected in programme-level graduate outcomes aligned with Accord outcomes.

For fields of engineering where additional technical skills are required to allow graduates to practice effectively, accreditation of postgraduate programmes against recognised bodies of knowledge would provide assurance that those engineers have the required skills. As was the case in accrediting engineering education at lower levels, New Zealand can be a leader by doing this at a national level and provide a model for other international jurisdictions to follow.

SUPPLY AND DEMAND

Strengths

The supply of, and demand for, engineering graduates in New Zealand are primarily driven by market considerations, which provide flexibility and diversity of response. The small scale of the NZ engineering and education sector, however, leads to the potential for perverse outcomes from unconstrained markets, so the TEC and NZQA, as major purchasers, and Engineering New Zealand, as the organisation representing the industry, have a role in influencing that market.

Following a period when there were many diverse 2-year engineering qualifications, Engineering New Zealand supported the development of the NZ Diploma of Engineering and there is a strong level of industry support for a single national qualification at that level, with consistent standards and outcomes.

Weaknesses

A shortage of engineering graduates, particularly from 2-year Diploma of Engineering and 3-year Bachelor of Engineering Technology programmes, was initially highlighted by the NEEP project.

Opportunities

The shortage of engineering graduates has been acknowledged by Government, which tagged $42m of additional EFTS funding to additional student places in engineering programmes and is currently funding the Engineering E2E initiative to promote engineering technician and technologist study and career pathways. This was in addition to a longer standing commitment to the targeted promotion of Engineering, Science and IT careers through the Futureintech initiative.

Although the NEEP report did not suggest a need for higher numbers of 4-year degree graduates, there have been expanded 4-year graduate numbers in recent years and demand has nevertheless remained high – possibly due to the Christchurch rebuild.

Threats

High demand for engineering graduates has led many providers to establish engineering programmes. A wish to differentiate those programmes from their competitors has led to programmes with names and contents that purported to respond to regional needs or provide niche programmes but have not corresponded to the principle of a broad preparation for engineering practice, noted above. As a consequence, the diversity of programmes across many providers, especially at BEngTech level, has led to:

- Small numbers of students in each cohort.
- Few staff and high staff workloads.
- Critical dependencies of the programme on unrealistically few staff.
- Difficulty for staff to conduct research.

- Lack of elective courses.
- Potential for programme delivery and the overall learning experience to be distorted by high proportions of international students.
- Instability of the programme structure as the TEO changes it in an attempt to obtain better financial viability.

In these situations, it can become a challenge for the TEO to meet accreditation standards in a robust way and there is a disproportionate effort for Engineering New Zealand and the profession in accrediting small programmes.

These programmes can fail for several reasons, including:

- Being poorly differentiated from other programmes at a curriculum level leading to, for example, too much overlap. Programmes have often attempted to create multiple named qualifications from one base set of courses with a few electives.
- Confusion for students.
- Confusion for employers.
- Limited students' employment prospects.

Engineering New Zealand Responses

A central planning approach for engineering education is unlikely to be successful because the quantity and type of information required to operate such an approach would be impractical to collect, so Engineering New Zealand should continue to support an institution-led approach to address issues within the market. Universities New Zealand (through CUAP), TEC and Engineering New Zealand should continue to have roles in influencing the market.

To maximise the chance that new programmes build a critical mass of students with accompanying technical support and facilities, when Engineering New Zealand is asked to comment on proposed new engineering programmes:

- Demand for engineering education programmes should be substantiated by strong evidence of employer demand for graduates, both in the short and long terms.
- Fine distinctions between different engineering programmes and specialised programme names that go against the NZ approach of favouring relatively general engineering qualifications will be discouraged.

The NEEP report recommended that the TEC should only fund tertiary providers offering qualifications developed within the NEEP framework to ensure ongoing national consistency and prevent local qualifications from developing, so Engineering New Zealand will not support or (generally) accredit qualifications at the Dublin Accord level other than the New Zealand Diploma in Engineering.

Industry places value on the development of hands-on applied skills at all levels of engineering. As a result, Engineering New Zealand emphasises the importance of:

- A strong level of industry engagement in aspects of the delivery of programmes, and
- Academic staff with practical industry experience in the NZ context.

Growing a new engineering programme can test the capability of any TEO because, for a new programme to be provisionally accredited from the first graduates onward, it is essential that the first few cohorts of students achieve graduate attributes that meet the required standard for the programme, even when student and staff numbers are small. Forward investment in

academic staffing to lead programme development and the early stages of programme delivery is therefore important.

EDUCATION LEVELS AND ARTICULATION BETWEEN THEM

Strengths

Our existing three educational levels match those of international accords and the proposed accreditation of postgraduate programmes would provide quality assurance and standardisation for postgraduate outcomes in particular fields of engineering.

Weaknesses

There is often an uncomfortably high level of common course content at TEOs that teach both 2-year diploma and 3-year degree, or 3-year degree and 4-year degree. This leads to a risk of not providing underpinning knowledge of engineering sciences, and not helping students develop the different levels of problem-solving ability expected at different levels. Complexity is a key differentiating factor between engineer, technologist and technician levels, and it is difficult to do justice to this in a common course.

The articulation from 3-year degree to 4-year degree is difficult to accomplish for those students who change institutions. The universities that offer 4-year degrees do not accept BEngTech graduates directly into the 4th year. This also has the effect that the long-term postgraduate study options are limited for BEngTech graduates.

Opportunities

Increasing the number of students who enter engineering initially aiming at diploma or BEngTech level could increase the number of graduates at that level, which (based on the NEEP report) would be desirable for New Zealand.

Having more students enter initially aiming at diploma or BEngTech level qualifications could lead to fewer students dropping out of 4-year programmes for which they are not academically prepared.

Threats

On the one hand, a shortage of articulation options (especially between institutions) limits the opportunities for students whose entry into engineering has been slowed by poor secondary school preparation, or a practical rather than a theoretical approach to problems.

On the other hand, articulation that does not acknowledge the fundamental difference in complexity between the graduate outcomes of DA, SA and WA qualifications risks providing students with notional qualifications that do not meet the complexity requirements of the higher-level graduate attributes.

Engineering New Zealand Responses

Engineering New Zealand will encourage initiatives to strengthen articulation / progression pathways within the educational structure but Engineering New Zealand recognises the challenges involved so the progression pathways for individual students would have to be assessed case-by-case. Guidelines developed as part of the NEEP project should be seen to reflect minimum credit requirements rather than minimum expectations for additional study.

Students considering articulating from shorter to longer engineering programmes should consult with the provider of the longer programme as early as possible to understand the prerequisites and thus make the articulation as convenient and require as little additional work as possible.

ACCREDITATION CONSIDERATIONS

In the light of the foregoing discussion, the SAB will provide the following guidelines to accreditation panels:

1. To prepare students for entry to professional practice programme-level graduate outcomes should be aligned with Accord outcomes.
2. Demand for proposed new engineering education programmes should be substantiated by strong evidence of employer demand for graduates, both in the short and long terms.
3. Panels should note in their reports if they observe fine distinctions being made between supposedly different engineering programmes and specialised programme names that go against the NZ approach of favouring relatively general engineering qualifications.
4. TEOs should be able to demonstrate to panels that they have a strong level of industry engagement in aspects of the delivery of programmes and academic staff with practical industry experience in the NZ context.
5. For provisional accreditation, it is essential for panels to see evidence that the first few cohorts of students are likely to achieve graduate attributes that meet the required standard for the programme, even when student and staff numbers are small.
6. Panels should enquire into articulation pathways from shorter qualifications, and the information provided to students who wished to follow those pathways, as part of their examination of entry requirements for engineering programmes that are proposed for accreditation.

The SAB will also take the following actions itself:

1. The SAB will not support or (generally) accredit qualifications at the Dublin Accord level other than the New Zealand Diploma in Engineering.
2. Work with Engineering Deans to encourage initiatives to strengthen articulation / progression pathways within the educational structure.