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Potential Impacts of the New School Qualifications Environment in New Zealand on Tertiary Engineering Education*

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Recently, there have been changes to the New Zealand secondary school qualifications with the introduction of new standards-based qualifications from 2002 onwards to incrementally replace the examinations-based qualifications. The history and structure of the New Zealand qualifications system is outlined in the article with particular reference to industry and tertiary education providers. An area of special interest discussed is the move by the Electrotechnology Industry Training Organisation (ETITO) to introduce a new National Certificate for use within the secondary schools in an attempt to increase the numbers of students taking electronics as a subject. A second area of discussion is the perceived likelihood for increased pressure on students as they move from the new standards-based secondary environment into the more traditional examination-based tertiary sector. Some strategies that could be employed to alleviate these new engineering education challenges for the tertiary sector within New Zealand are outlined in the article.

INTRODUCTION

The New Zealand School System

The New Zealand school system is based, generally, on three levels: primary for Years 1 to 6, intermediate for Years 7 and 8, and secondary for Years 9 to 13. The intermediate school level is common but may, in some cases, be combined with either primary or secondary. Entry to primary school is at age 5 and attendance at school is legally required to age 16. The school curriculum from primary through secondary is based around seven identified learning areas (Language and Languages; Mathematics; Science; Technology; Social Sciences; Health and Physical Well-being; and the Arts) and eight groups of essential skills (Communication; Numeracy; Information; Problem Solving; Self-management and Competitive; Social and Cooperative; Physical; and Work and Study) [1].

Prior to 2002, the school qualification system, administered by the New Zealand Qualifications Authority (NZQA), provided for three levels of predominantly examination-based exit qualifications taken at the end of years 11, 12 and 13, respectively. Students may take up to six subjects in these qualifications, which are:

- School Certificate: Results reported on the certificate as alphabetic grades from A to E. A separate student's result slip will show the actual percentage mark achieved.
- Sixth Form Certificate: Results reported on the certificate as numeric grades from 1 (highest) to 9.
- Bursary: Results reported on the student result slip as final adjusted marks and alphabetic grades where a C grade (the minimum pass) lower level is set at 45%.

Some areas within the United Kingdom were the only others apart from New Zealand to offer external examinations at the end of each of the three levels of senior secondary years.

The School Certificate allowed for some subjects to have a school mark, that is an internal assessment mark rather than an examination, or external assessment mark in some curriculum areas such as art. Some Sixth Form Certificate and Bursary subjects also allow

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for a school submitted mark for areas where a school-based internal assessment component is appropriate; this will be combined with the student's written examination mark to generate a final adjusted mark for that subject. It is also worthwhile noting that routine scaling, to reflect an arbitrary mean for marks in both School Certificate and Bursary results, is common.

A further qualification exists which is not an exit qualification *per se*: a Higher School Certificate is granted to any student who has satisfactorily completed a five year course of secondary study commencing at Year 9 level. At least 60% of the courses undertaken must be in advance of Sixth Form Certificate level.

Some countries have a system of providing students with a single Tertiary Entrance Rank (TER) or equivalent for determining entry to tertiary institutes – this is especially common in most Australian states. In New Zealand entrance to degree level programmes is granted for programmes without restricted entry to students who have gained a Higher School Certificate if they achieve grades of C or better in three Bursary subjects.

In addition, incentives in the form of bursary payments to assist students who wish to enter university are available from the New Zealand Government for students who achieve either an A, for 300 or more marks, or B, for 250 to 299 marks, Bursary result aggregated across the student's marks in their best five subjects. The distribution of marks over the examination system will see approximately 15% of students gain an A-level Bursary and 30% gain a B-level Bursary.

The New Zealand Tertiary System

In effect, the New Zealand tertiary education system is a three-part model also. One part is the traditional university, another part involves the *polytechnics* (although few retain that name) and colleges of education, and the final part covers the private training establishments. Some would use the term tier and rate the three parts from top to bottom respectively. However, with all parts of the tertiary system now able to access government funding, as well as offer courses up to and including postgraduate level, there is some debate as to whether a ranking in this form is productive or counter-productive. In government speak, all tertiary level training institutions are now known as Tertiary Education Organisations (TEOs).

The ground has also become increasingly muddied with the recent and ongoing merger of institutions. Universities have merged with both polytechnics and colleges of education, polytechnics have become universities (although the Government has now placed a hold on any further movements of this kind) and polytechnics have merged with other polytechnics.

There are also ongoing funding reforms under the Tertiary Education Commission (TEC) auspices, which are likely to see further changes. Recent Government policies in this area have signalled possible moves to further rationalise both the size and shape of the tertiary sector through funding mechanisms.

Most New Zealand university engineering programmes have restricted entry and require a minimum of a B-level Bursary for entry into the first year. Students wishing to enter tertiary level programmes at other tertiary education providers, such as polytechnics or Private Tertiary Establishments (PTEs) at Diploma or Certificate level, will have to demonstrate commensurate levels of secondary school qualifications. Typically, this requires passes in set subjects at Sixth Form Certificate level (typically maths and physics for two year engineering diploma level programmes) down to a minimum of two years secondary schooling including basic literacy and numeracy skills for entry to foundation or trades programmes.

STANDARDS-BASED QUALIFICATIONS

Standards specify learning outcomes rather than other qualifications, which may be more focused on either outputs such as courses completed through examinations or inputs such as number of learning hours or some other measure. Standards based outcome models have been endorsed by international bodies involved with funding education systems such as the World Bank, the Asian Development Bank and the Organization for Economic Cooperation and Development (OECD) [2].

A significant number of countries have, or are in the process of, moving to standards-based assessment including Australian states, Denmark, Scotland, Sweden and various areas of the USA [3]. The main advantage of standards-based assessment is that both teachers and students are clear about what they should know and be able to do when designing summative assessments and reporting results.

The NZQA has as a key function in the overview of qualifications in compulsory (secondary school) and post-compulsory (tertiary) education and training. The original concept of the National Qualifications Framework (NQF) was comprised of national certificates, diplomas and their constituent unit standards. This concept has now been expanded via the development of the New Zealand Register of Quality Assured Qualifications – referred to as the *Register*.

The Register has the support of the New Zealand Vice Chancellors Committee (NZVCC), the Association of Polytechnics in New Zealand (APNZ) and the

Association of Colleges of Education in New Zealand (ACENZ). This Register has four key purposes, namely:

- To clearly identify all quality assured qualifications in New Zealand.
- To ensure that all qualifications have a purpose and relation to each other that the students and public can understand.
- To maintain and enhance a learner's ability to transfer credit by the establishment of a common system of credit.
- To enhance and build on the international recognition of New Zealand qualifications.

The NQF continues to be a subset of the Register and is comprised of unit and achievement standards.

The Register has 10 levels; these are outlined in Table 1.

Table 1: NQF levels.

NQF Level	Equivalence	Current/Typical User Groups
10	Doctoral Studies	Tertiary
9	Masters Programmes	Tertiary
8	Honours Programmes	Tertiary
7	Bachelors Degree	Tertiary
6	Two Year Diplomas	Industry & Tertiary
5	One Year Diplomas	Industry & Tertiary
4	Tradesman Certificates	Industry & Tertiary
3	Bursary & Industry Certificates	School & Industry
2	Sixth Form Certificate	School
1	School Certificate	School

Unit Standards Background

The Industry Training Act of 1992 established Industry Training Organisations (ITOs). These ITOs have four responsibilities as follows:

- To set national skills standards for industry.
- To provide information and advice to trainees.
- To arrange for *on-* and *off-job* training.
- To establish moderation processes for training.

At the beginning of 2002, there were 49 ITOs accredited with the NZQA that were able to write and register both qualifications and associated unit standards on the NQF. Other Standards Setting Bodies (SSBs) include the National Qualifications Committee of the NZQA Board for school curriculum areas. There are in excess of over 1,200 NZQA accredited training providers, from government funded tertiary institutes to full profit private training providers, which are able to deliver training to students using framework units and qualifications.

Since 1992, these various SSBs have registered almost 18,000 unit standards and more than 70 qualifications on the NQF/Register respectively. These unit standards cover almost every area of sub-degree education and training. Almost all of the unit standards previously registered on the NQF are *competency-based*. Many of these unit standards have been developed and registered by the various ITOs for use in school, tertiary and industry training environments. The national qualifications are used throughout tertiary education and industry training. It is useful to note that New Zealand universities are not obliged to, and none have yet, registered their qualifications on the Register.

Each of the unit standards equates to a particular block of learning, either skills- or knowledge-based, which is measured by NQF level and *credit value*. A credit is deemed equivalent to 10 *notional learning hours*. In terms of programme development, these notional learning hours are further broken down into contact hours (including contact and other directed hours measurements) and non-contact hours (including self directed).

Unit Standards Defined

Unit standards consist of statements that describe what the learner knows or can do; put another way, they specify learning outcomes. The unit standard will consist of two parts, namely:

1. Elements: learning outcome statements that collectively constitute the unit standard. Elements may also specify a range over which the performance criteria are to be assessed.
2. Performance criteria: statements against which the standard of performance of an element/outcome is assessed, although assessment is conducted at the element level.

An example of unit standard elements and associated performance criteria for a 6 credit level 2 unit standard in the secondary school technology curriculum is shown in Table 2. Note that only one of three elements in the full unit standard is shown.

Unlike an examination-based system, there is no formal grading system associated with unit standards. Assessment activities based on the performance criteria aim to provide *sufficiency* of evidence that a

Table 2: Unit standard example.

Unit Standard 13395: Design and incorporate a control system into a prototype of a technological solution.
Element 1
Demonstrate knowledge of control systems developed for specified performance requirements.
Range: control systems suitable for meeting specified performance requirements and integrated forms of control.
Performance Criteria
1.1: Control systems are described in terms of the advantages and disadvantages of their forms of control.
1.2: Integration of forms of control is discussed in terms of component interfacing and operational requirements.
1.3: Control systems are justified in terms of their identified specific performance requirements.

student is competent to the required standard. If students are unable to demonstrate *competency* at their first assessment attempt, they may undertake subsequent assessment attempts to meet the required competency standard. In a tertiary environment they will typically be allowed two resit attempts before they are required to repeat the coursework.

Unit Standards in Schools

Students normally attempt standard curriculum area subjects, and associated examinations if any, for all of the current exit qualifications. However, many schools also provide students with the option of taking unit standards, at the appropriate level from the framework, in place of examination-based subjects on the basis that 14 credits worth of level 2 unit standards in a single subject area, say mathematics, is deemed to be equivalent to a grade 5 pass for a Sixth Form Certificate. A number of schools have previously offered interested students the opportunity to take electrotechnology unit standards at both year 12 and year 13 in place of a single Sixth Form Certificate or Bursary subject as appropriate.

A considerable number of the students taking the electronics subject have an interest in electrotechnology and move into tertiary study on completion of their secondary schooling. However, a small number of schools have used the electronics subject to provide an option for less able students, those who cannot handle the physics, to complete a course that is less academically challenging as it is unit standard-based.

NATIONAL CERTIFICATE IN EDUCATIONAL ACHIEVEMENT

The previously described secondary school qualification system is in the process of substantial change with the implementation of a new standards-based system to replace the current examinations-based system. This new system commenced in 2002 with the introduction of the National Certificate in Educational Achievement (NCEA) Level 1 which replaced the old Year 11 School Certificate.

It was originally planned that, in 2003, NCEA Level 2 would replace the current Year 12 Sixth Form Certificate and, in 2004, NCEA Level 3 would replace the current Year 13 Bursary examinations. Some 76% of the secondary schools have elected to follow this plan; however, the remainder are either offering a mix of old Sixth Form Certificate and NCEA Level 2 or just Sixth Form Certificate only. This possible mix of old and new qualifications from a portion of the school system may cause significant difficulties in assessing students for meeting entry standards for polytechnic Diploma level programmes at the start of 2004. It may also disadvantage students wishing to either change schools or change subjects for their subsequent years schooling.

Achievement Standards Defined

The NCEA is based on a new type of NQF standard specifically developed by Ministry of Education expert panels for use by schools in the school curriculum areas. Unlike the existing NQF unit standards, which are competency-based and primarily industry driven, the new NCEA units are *achievement-based*. They are similar to unit standards in that they provide clear criteria for assessing student performance. Yet they differ in that they provide both a broad explanation of how students should be assessed and the differing standards required to achieve the *credit*, *merit* or *excellence* grade for that unit.

An example of part of an externally assessed 3 credit level 2 achievement standard in the secondary school technology curriculum is shown in Table 3. This unit is at the same level as, and broadly similar in learning outcomes to, the unit standard shown in Table 2. Note that the achievement standard explanatory notes, which provide the equivalent of the range statements in the unit standards, have been omitted for the sake of brevity.

In some school curriculum subject areas at least half of the marks for a subject will be generated from examinations run by the NZQA. This is very similar to the pre-2002 school qualification system where

Table 3: Achievement standard example.

Technology Achievement Standard Electronics & Control 2.6: Demonstrate knowledge and understanding of control systems in Electronics & Control.
This standard involves demonstrating knowledge and understanding of inputs, processes and outputs in control systems.
Assessment Criteria: The evidence produced shows the student can:
Credit: Describe the essential features in a range of given control systems.
Merit: Evaluate the design features in a range of given control systems.
Excellence: Justify the selection of essential features required in designing control systems to solve given problems.

marks in some subjects come from internal assessment and external examinations. All subjects will have at least some internal assessment; some may be fully internally assessed.

Existing school subjects from the curriculum areas will be equivalent to 24 credits at the appropriate level, which will be covered in 5 to 8 achievement standards. To be awarded the NCEA at the various levels will require a student to gain at least 80 credits at the respective level with minimum levels for literacy and numeracy skills. An average student is likely to attempt up to 120 credits each year: typically five subjects at 24 credits per subject. The NQF standards used to gain credits towards NCEA may be all achievement standards, a mix of unit and achievement standards, or all unit standards.

NCEA Results

The old/existing exit qualification result notices are simple statements of marks achieved in the various subjects. Current unit standard result notices are simply lists of unit standards completed showing the credit value and level of each of the unit standards. The NCEA result notice will be much more useful in terms of identifying particular strengths of individual students.

As previously described, each of the current standard school subjects will consist of from 5 to 8 achievement units. The NCEA result notice shows which of these units the student has attempted and the respective credit value, the principal assessment method (internal or external), a graphical indication of the percentage of students achieving each grade for the unit, and the credit value for the unit. A simple bar at the bottom of each subject result area shows the students' grade average for the achievement units completed in that subject during the year. An example of this result notice is shown in Figure 1. The result will also show all other unit standards achieved during that year of secondary school that count towards the NCEA.

The ability for a much clearer definition of a student's ability in particular areas through the information contained in the NCEA result notice is itself becoming problematic for setting entry criteria to tertiary programmes. A simple statement, such as *minimum grade 5 in 6th Form Certificate Maths and Physics are required*, will no longer be sufficient. Just taking the simple case for mathematics, there is much debate over whether the exact achievement standards required need to be explicitly stated or whether it may be a more generic *14 credits in NCEA Level 2 Achievement or equivalent Unit Standards are required*.

Obviously, this will depend, to some extent, on the programme requirements. However, if the explicit route is followed, it may disadvantage some or many students if the secondary school, they are attending, has decided not to offer one or more of the required achievement standards for some educational reason.

University Entrance Requirements with the NCEA

The exact requirements for university entrance, or degree level programmes at polytechnics, are still being defined as the NCEA Level 3 is not due for delivery until 2004 – or possibly even later for some schools.

Current indications are that a minimum of 40 (possibly 42) credits at level 3 with two *approved* subjects and any two other learning areas on the NQF will be required. The list of approved subjects is yet to be considered by the Tertiary Entrance Working Party, a sub-group established by the Ministry of Education. There will also be numeracy and literacy prerequisites – these are yet to be defined but will probably be at level 1 and or 2 and cover fundamental skills.

Some form of additional scholarship examination or achievement standard at level 3 may be available for students to demonstrate academic ability. This will supplement the NCEA results to provide scholarship information.

Proponents of the NCEA have previously resisted the inclusion of any form of ranking information on the results slips. Their rationale is that the more

detailed information on a student's NCEA result notice makes an overall performance average in each subject useless. Nonetheless, in June 2001, the Minister of Education announced that grade averages would be shown on result slips (as seen in the sample result notice displayed in Figure 1) in an attempt to increase public confidence in the NCEA. These grade averages will also be of use, although limited, to tertiary institutes in determining requirements for restricted entry programmes such as engineering.

The process used to calculate grade averages will use a simple weighting system where achievement grades of excellence earns 4 points, merit 3 points, and credit 2 points. The credits and points will be used to calculate an average for the achievement units attempted. Grade averages will only be available for

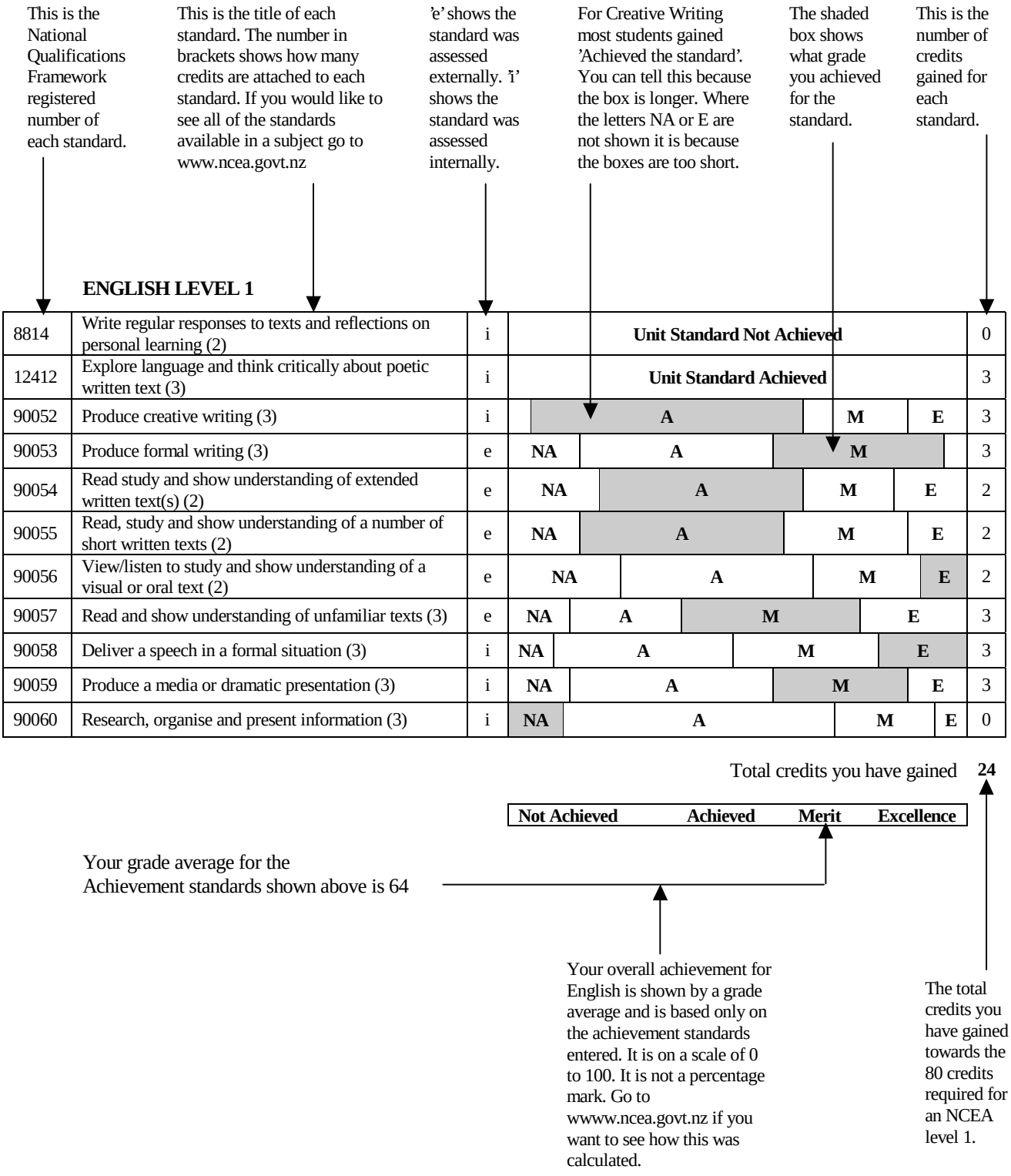

Figure 1: NCEA result notice example.

achievement units. However, where a student takes only achievement units in a single subject they will provide at least as much information as the current Bursary results for the purposes of determining entry to restricted courses.

It is expected to be problematic when determining entry to restricted programmes if students take a mix of different types of units. A student may only take, say, four of the eight available achievement units in a subject such as mathematics. If they get excellence grades for all the units taken, their grade average could conceivably be 100%. This is extremely misleading as, in reality, they have gained 100% for the 50% of the subject they attempted.

INDUSTRY LINKS

The Electrotechnology Industry Training Organisation (ETITO) is responsible for registering qualifications in the wider electrotechnology fields. They currently have a number of certificates and diplomas from level 4 to level 6 on the Register with a wide range of corresponding unit standards from levels 2 to 6. Unit standards registered by the ETITO cover both *off-job* theory units for use in tertiary institutes and *on-job* practical units which are for use in industry. The tertiary qualifications range from certificates at level 4 for trades people through to diplomas at level 6 for technicians in fields from electronics to computer engineering, from electrical to telecommunications and industrial automation. Some ITOs are in the process of developing level 7 and 8 qualifications to place on the Register.

As previously detailed, a number of schools have used the lower level off-job unit standards at levels 1 through 3 as a base for implementing electronics courses at year 12 and 13. While these unit standards have filled a gap for the schools, they do not provide the students with a recognised course that has counted towards their exit qualification. In a very forward thinking move, the ETITO has registered a National Certificate in Electronics Technology (NCET) at Level 2 and Level 3 for use by secondary schools within the new qualifications environment. The structures of the NCET qualifications are shown in Table 4 where each Level requires 40 credits for the award of the qualification.

The NCET (Level 2) was trialed by 16 schools in 2001 for Year 12 students. Some 150 secondary schools in New Zealand (out of approximately 440) have been accredited to offer the NCET (Level 2) in 2003. The NCET (Level 3) was trialed by a number of schools in 2002 for Year 13 students and now some 14 schools are accredited to offer the NCET (Level 3) in 2003. Many of these students will carry on to tertiary education programmes.

Reference groups, consisting of the ETITO, industry and tertiary providers, have been established in each of the major cities to assist school teachers in the development of teaching and assessment material for the NCET unit standards. This material is provided by the ETITO to schools for a nominal fee and forms the core of much of the teacher training currently being undertaken. This material is considered *best practice* and would form the core of any programme run within the schools.

The most significant advantage of the NCET over the existing *ad-hoc* use of electrotechnology unit standards is that students can gain a second industry-based qualification while concurrently completing the NCEA. Previous electronics subjects did not count

Table 4: The NCET structure.

Level 2	Credits
18239: Demonstrate introductory knowledge of circuit concepts and measurements for electronics	5
18240: Demonstrate knowledge of basic electronic components	5
18241: Demonstrate knowledge of basic electronic systems	5
18242: Construct a simple printed circuit	3
18243: Construct simple electronic products from supplied circuit schematics	6
NCEA Level 2 Maths, Computing or Science elective units	16
Level 3	Credits
19743: Demonstrate knowledge of semiconductor materials and devices	5
19744: Demonstrate knowledge of basic digital and analogue circuits and processes	5
19745: Demonstrate knowledge of signals and the transmission of information	5
19746: Demonstrate knowledge of electronic product quality and reliability	4
19747: Demonstrate knowledge of mircocontrollers	5
NCEA Level 3 Maths, Computing or Science elective units	16

towards either the Sixth Form Certificate or the Bursary qualification, although many institutes recognised the work undertaken. In addition, by requiring mathematics and physical science elective units, the electronics subject is being made more attractive to those higher achieving students who wish to continue onto tertiary programmes. It should also end the unfortunate situation where some schools are using electronics to provide an option for less able students in place of physics or mathematics courses at those higher levels.

CHALLENGES FOR TERTIARY INSTITUTIONS

The post-2002 school qualifications environment in New Zealand will pose particular challenges for tertiary providers in the following areas:

- The setting of entry criteria for programmes to cover both breadth and depth considerations associated with the new NCEA environment will, of necessity, result in more complex entry requirements. The determination of whether or not applicants meet these entry requirements will also require more effort – both in terms of time to complete the review and understanding of the various allowable permutations.
- Ranking of students for restricted entry programmes will be more problematic in that no longer will a simple Bursary, or NCEA equivalent, score be sufficient.
- The possibility for students to take a mix of unit types for a single subject may increase. This will lead to equivalence problems, eg *does an* excellence *in a level 3 mathematics achievement standard for probability carry more or less weight than a* credit *in a level 3 unit standard for calculus with regards to entry to engineering programmes*?
- Some very capable students may not have had the same exposure to the *examination*-based systems currently used in engineering programmes in tertiary providers. It will conceivably be possible for a student to complete a NCEA, and thus gain eligibility for entry to tertiary studies, without attempting any external assessment achievement standards; it is therefore conceivable that students may qualify for entry to university without ever having written any examinations.
- Students coming from a standards-based school system are likely to be less *independent* learners, and possibly *superficial* learner-oriented, than they possibly were under the examination-based exit qualification system. They will be used to having very explicit learning outcomes and performance or assessment criteria to tell them what they need to know or do in order to be successful and are unlikely to be able to cope with increasingly learner-driven tertiary environments.
- Schools are not currently set up to cope with neither the NCET nor many of the other technology curriculum areas. Teachers associated with the technology curriculum lack the core *engineering* approach required to satisfactorily teach many of these new units. Few, if any, qualified engineers are in the secondary school system as technology educators and most teachers associated with *electronics* in schools are physics teachers. In many cases there are insufficient numbers of students in schools to allow the electronics and other engineering-based technology curriculum sub-areas to be offered.

STRATEGIES FOR TERTIARY INSTITUTES

Tertiary institutes must be much more proactive over the forthcoming years with regard to providing more complete information to schools, and prospective students, on subject choices for Year 12 and 13 students with regards to programmes with restricted entry at tertiary institutes. This information must make recommendations on what units should be taken in pursuit of the NCEA. Forward-looking institutes may require a mix of both achievement standards and unit standards.

The qualification evaluation process for some, and potentially most, students applying for engineering programmes at tertiary level is likely to increase in both complexity and requirement. The earlier that training can be given to staff tasked with the selection of students, the more likely that students, with the right potential but the wrong standards selection at school, can be correctly identified and offered places – either in existing programmes or new foundation or pre-entry programmes. This is illustrated by a recent survey completed at RMIT University, Melbourne, Australia, which showed that the TER scores used there provided, at best, only a *moderate predictor of success* over time for law, engineering and physical sciences programmes [4]. The NCEA will allow tertiary institutes to potentially recognise a much wider range of knowledge and skills in students than that provided by the current system of simply using Bursary results. The test will be if the tertiary institutes can achieve this.

With the introduction of the NCET there is an ideal

opportunity for tertiary institutes to acknowledge the place that unit standards have in the NCEA and in preparing students for entry to tertiary engineering programmes. However, potentially significant levels of support for teachers in schools are required if technology curriculum achievement units, and unit standards for qualifications such as the NCET, are to be used, as they rightfully should, as a further indicator for determining entry to tertiary engineering programmes. This support could be in the form of direct teacher training programmes, either face to face or distance delivery, or indirect and informal assistance to technology teachers on an opportunity basis.

Staff from the Faculty of Design and Engineering at Christchurch Polytechnic Institute of Technology (CPIT), Christchurch, New Zealand, have implemented both online learning modules for direct teacher training and have also provided indirect and informal assistance through the provision of specialist tutors participating in the relevant areas of electronics programme in schools.

There is an increasing recognition of the requirement for tertiary providers to move their engineering students towards becoming *independent deep* learners. This potentially requires the move from the more traditional mode 1 form of tuition to a mode 2 model [5]. With a standards-based secondary education system potentially moving further away from the concept of independent deep learning, there may be more changes required to the current tertiary engineering education programmes in New Zealand. These changes may also include a move to standards-based tertiary engineering education programmes.

The need for tertiary institutes to review curriculum material is also being driven by a changing accreditation and professional registration system for professional engineering. Recent changes to the legislation concerning registration as a Chartered Professional Engineer within New Zealand now sees a new focus on the students applicants being able to demonstrate *competency* against a number of standards [6]. This presents the unique situation of students having competency standards both before and after their tertiary education experience – but some form of old style mode 1 education during that. Is it now also time to review the tertiary education system to present a seamless competency-based engineering education experience from pre-entry through to continuing professional development?

Students entering tertiary education will face increased and significant challenges in adapting to a different, potentially confusing, and definitely more challenging learning environment compared to what they experienced at secondary school. Tertiary institutes will need to be aware of this new type of student with a different learning background and provide opportunities for these students to adjust. Many tertiary institutes are already acknowledging that their programmes are overfull and new students are increasingly finding it difficult to cope with the change from school to tertiary environments. This situation is only likely to be exacerbated once the NCEA graduates start entering tertiary level engineering programmes.

The use of computer-based learning systems for both content and learning to learn material to alleviate some of these concerns may be essential. Many computer-based learning systems currently used in engineering education do not encourage the required independent deep learning style. An increased awareness of this need when developing such systems would increase the student's abilities in this area and help to fill perceived gaps left by the school system.

CONCLUSIONS

The forthcoming years will see students entering tertiary engineering education programmes in New Zealand with potentially significantly different sets of knowledge and skills compared to current students. Student recruitment is likely to face significant increases in both complexity and rigour and will require changes from current practices to ensure that students are provided with every opportunity to succeed within the tertiary engineering environment.

Tertiary institutes offering engineering education programmes must recognise the magnitude of the changes coming and move to implement strategies to meet the challenges arising from those changes. Both curriculum reviews and the application of appropriately designed computer-based learning systems within secondary schools and tertiary education programmes may provide help to meet these challenges.

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BIOGRAPHY

Paul Wilson received his BE(E&E) (Hons) degree from the University of Auckland in 1992 while serving as an electronics engineer with the Royal New Zealand Navy. He entered the world of academia in 1993 when he took on the position of lecturer with the Auckland University of Technology. In 1998, he became the Academic Leader for the BEngTech programme at Christchurch Polytechnic Institute of Technology (CPIT) where he led the development and implementation of this sole engineering degree within CPIT. He was Head of School of Electrotechnology from November 2000 and accepted the Dean of Faculty of Design & Engineering position in October 2002. His research interests are engineering education, computer engineering and robotics. He is also a member of IPENZ and a Registered Engineer.