IPENZ
ENGINEERS NEW ZEALAND

MINORITY GROUPS IN ENGINEERING EDUCATION

Prepared for the

National Engineering Education Plan Project

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EXECUTIVE SUMMARY

The changing demographics of the New Zealand population may impact on the composition of the engineering workforce in the next 10-15 years. It is likely that more engineers will come from the minority groups Maori, Pasifika and women.

The Department of Labour (2008) profile showed the engineering workforce is dominated by the European male. Statistics New Zealand (2010) projects that by 2026 the percentage of Europeans will decrease and the percentages of the Maori, Pasifika and Asian ethnic groups across the total population will increase. Due to the youthful age structure and higher fertility of the Maori and Pasifika populations, 45.5% of the population between 0 and 14 years old will be Maori and Pasifika in 2026. The percentage of Asian children in this age group will also increase. As a result, greater representation in engineering from these three ethnic groups is likely to occur in the future.

This report details the levels of attainment by gender and ethnicity at Levels 2 and 3 of the National Certificate of Educational Achievement (NCEA) in the subjects (Mathematics with Statistics, Mathematics with Calculus, Physics and Chemistry) that enable prospective students to gain entry to engineering diplomas and degrees at Levels 6, 7, and 8. Maori have low numbers studying these subjects, low levels of attainment and low retention rates in senior secondary school. Pasifika also have low numbers studying these subjects and low levels of attainment but high retention rates in senior secondary school, suggesting that they require more support to select these subjects and achieve credits in them. Women limit their options by their choice of Level 2 and 3 subjects; they are less likely to choose Mathematics with Calculus and Physics that prepare them for entry to engineering qualifications.

The next section provides examples of support programmes that industry training organisations (ITOs), Institutes of Technology and Polytechnics (ITPs), wananga and universities have in place for minority groups in the engineering trades and studying engineering qualifications at Levels 6, 7 and 8. The key success factors of these programmes are:

- they provide positive education and training environments that the minority groups relate well to
- they monitor progress and focus on key areas of need by providing targeted learning experiences; they are not support programmes for only the struggling students
- mentoring programmes provide strong role-models at undergraduate, postgraduate levels, and from the engineering workplace
- they focus on the engineering career i.e. from preparing to enter engineering study to working in engineering
- they are sustainable. The range of support programmes for minority groups in engineering at the universities is well-established due to the commitment from staff and funding from their central university systems.

However, there are shortcomings in the support programmes.

In trades, the main shortcoming for women is the fact that workplaces are only now starting to recognise the potential and value of women workers, and that few workplaces have made arrangements for female-centred trades-training and development. ITOs, ITPs and a wananga have set up short-term programmes or pilot programmes to target specific learning needs (such as marae-based training) for Maori and Pasifika. However some of these programmes are unsustainable because they depend on short-term funding from a central government agency.

There are no specific support programmes for minority groups studying engineering diplomas and degrees at Levels 6 and 7 at the ITPs, although institution-wide programmes provide generic support for Maori and Pasifika. In 2008, the qualification completions in engineering at Levels 6 and 7 were low nationally, suggesting a lack of critical mass in engineering programmes in ITPs. This, in turn, affects the economic viability of specific support programmes in engineering for minority groups.

Support programmes in engineering for minority groups in universities are variable, ranging from very comprehensive focusing on the whole engineering career to minimal where one support person has responsibility to coordinate support in engineering and related disciplines.

As a result of these findings, the recommendations are for:

- engineering educators to note in their future planning the projected change in population demographics in the next 10-15 years, which may create greater ethnic diversity in engineering programmes
- schools to continue working on addressing the barriers affecting Maori and Pasifika students meeting the entry requirements for engineering qualifications
- more research on the reasons why women choose Level 2 and 3 subjects in senior secondary school that limit their career options
- engineering educators to consider the barriers to entering engineering qualifications for each minority group and address them through their recruitment strategies
- recognition of the need for specific programmes that encourage and support women to enter the trades
- ITOs, ITPs and wananga to work with central funding agencies to determine how to make successful support programmes and pilot programmes economically sustainable
- ITPs collaborating on engineering diplomas and degrees to consider how they might coordinate their support for minority groups
- universities to evaluate their support programmes for minority groups where appropriate; address any shortcomings identified and consider how they might coordinate their support programmes.

1. BACKGROUND

In November 2008, a consortium of representatives from NZCED[1], CETTENZ[2], industry training organisations (ITOs), the Institution of Professional Engineers New Zealand (IPENZ) and industry was successful in gaining funding from the Tertiary Education Commission (TEC) to develop a National Engineering Education Plan (NEEP Project). The goal of the Project is to recommend to the TEC in 2010 an engineering education plan and a network of provision for New Zealand.

The overarching issues behind the project are the long-term shortage of engineering skills in New Zealand and the need to ensure that New Zealand's engineering education meets international best practice and can be delivered effectively by a nationally coordinated network of provision. OECD comparisons[3] show New Zealand to have significantly fewer engineering graduates than comparable countries, especially since the difficult geography and dispersed population might indicate the need for more rather than fewer engineers.

Five work-streams in the project are addressing these issues through:

1. developing career progression models to provide quality careers advice and qualification promotion to students, tertiary providers and industry
2. estimating the future demand for and supply of engineers. In 2008, there were 1500 graduates with Level 6, 7 or 8 engineering qualifications. The NEEP Project consortium recommends the required total number of new engineers per year should be 2000-2750. The lower figure is based on historic patterns and allows for "business as usual" whilst the higher figure is based on increased participation by engineers in developing innovation-led businesses
3. reviewing the structures of Level 6, 7 and 8 engineering qualifications. Greater collaboration is occurring between the ITPs and ITOs offering engineering qualifications at Levels 6 and 7 to ensure a suitably coordinated national network of provision across all provider institutions, and to maximize the use of resources. Changes have occurred to the international graduate profile agreed by the member countries that are signatories to the Washington Accord (WA)[4]. Over the next two to three years, the profile of the Bachelor of Engineering (BE) degree in New Zealand is being benchmarked against the WA profile to identify if there are any gaps
4. developing pathways from the Technology learning area in senior secondary school to careers in engineering and related industry sectors
5. identifying barriers to entering the engineering profession and evaluating support programmes for minority groups (Maori, Pasifika, and women) in engineering.

1.1 OBJECTIVES

This report addresses the fifth work-stream. Its objectives are to:

- review the current situation of minority groups in engineering
- identify the issues and barriers for each group entering engineering

1 NZCED is the NZ Council of Engineering Deans, for tertiary providers offering four-year professional engineering qualifications.

2 CETTENZ is the Council for Engineering Technician and Technologist Education New Zealand, a bipartite council of the Engineering Deans or Heads of Department from the ITP and university sector responsible for three-year degrees (Sydney Accord criteria) and two-year Diplomas (Dublin Accord criteria).

3 www.oecd.org/edu

4 An international agreement for mutual recognition of four-year engineering qualifications by accrediting bodies in the member countries which are Australia, Canada, Chinese-Taipei, Hong Kong-China, Ireland, Japan, Korea, Malaysia, New Zealand, Singapore, South Africa, United Kingdom and USA.

- evaluate the support programmes available for minority groups in tertiary education
- identify the success factors of these programmes
- identify shortcomings in the support programmes available.

2. THE GENDER AND ETHNIC PROFILE OF THE ENGINEERING WORKFORCE

The Department of Labour (2008) profiled the engineering workforce employed in two NZSCO[5] 3-digit engineering related occupations (214, 311) by gender and ethnicity. In 2006, 86.8% of architects, engineers and related professionals and 83.9% of physical science and engineering technicians were male. In comparison, the percentage of males across all occupations was 53%.

Further profiling shows the percentages of Maori professionals and technicians and Pasifika professionals and technicians in engineering and related occupations were lower than the percentages of Maori and Pasifika across all occupations (Table 1). The percentage of Asian professionals and technicians in engineering and related occupations was similar to or above the percentage across all occupations. Many engineers identified with "other" ethnic groups. These statistics show that engineering and the related professions are dominated by the European male.

Table 1: Ethnic profile of engineering occupations, 2006

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

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

It is important to note that each ethnic group consists of all people who identify with that ethnic group. Some people identify with more than one ethnic group and have been included in each group they identify with. Therefore totals across the four ethnic groups may exceed 100%.

3. POPULATION TRENDS TO 2026

Statistics New Zealand (2010) has updated 2006-base population projections to 2026 for the four broad ethnic categories of European and Other, Maori, Pasifika and Asian. These projections do not give predictions or forecasts but indicate possible changes in the future size and configuration of the ethnic categories by evaluating long-term and short-term demographic trends.

The projections indicate the New Zealand population will become more ethnically diverse. There is growth in the Maori and Pasifika ethnic categories due to higher fertility rates and the current youthful age structure. Growth in the Asian ethnic category is due

[5] New Zealand Standard Classification of Occupations

to gains from net migration. However the European and Other ethnic category will decline due to an aging population and lower fertility rates. It is not certain that these projections will be achieved.

Statistics New Zealand has produced eleven projection series (Table 2) to show a range of scenarios that combine different rates of fertility, mortality, migration and inter-ethnic mobility for each of the four ethnic groups. To assess population changes, Statistics New Zealand uses series 6 (Appendix One).

Table 2

Alternative projection series

Projection series	Fertility	Mortality	Migration	Inter-ethnic mobility
1	Low	High	Low	High
2	Low	Medium	Medium	Medium
3	Medium	High	Medium	Medium
4	Medium	Medium	Low	Medium
5	Medium	Medium	Medium	High
6	Medium	Medium	Medium	Medium
7	Medium	Medium	Medium	Low
8	Medium	Medium	High	Medium
9	Medium	Low	Medium	Medium
10	High	Medium	Medium	Medium
11	High	Low	High	Low

Statistics New Zealand 2010

The 'European or Other (including New Zealander)' population is projected to increase from 3.21 million at 30 June 2006 to 3.47 million in 2026 (series 6). Under the lowest growth scenario (series 1), the European or Other population will be less in 2026 (3.10 million) than in 2006. All other series project higher European or Other populations in 2026 than in 2006, with the highest growth scenario (series 11) projecting a population in 2026 of 3.88 million.

The Māori, Asian, and Pacific populations are projected to increase during the projection period under all series:

- *The Māori population is projected to increase from 620,000 at 30 June 2006 to 810,000 (series 6) in 2026, and range between 700,000 (series 1) and 940,000 (series 11) in 2026.*
- *The Asian population is projected to increase from 400,000 in 2006 to 790,000 (series 6) in 2026, and range between 610,000 (series 1) and 990,000 (series 11).*
- *The Pacific population is projected to increase from 300,000 in 2006 to 480,000 (series 6) in 2026, and range between 430,000 (series 1) and 540,000 (series 11).*

The total New Zealand population is projected to grow from 4.18 million in 2006 to 4.99 million in 2026 (assuming medium fertility, medium mortality, and long-run annual net migration of 10,000 a year). Alternative projections give a range of 4.78 to 5.20 million in 2026 (Statistics New Zealand, 2010).

One could argue that an additional series is required to project changes in the Maori population. Over the next 15 years, fertility rates will remain high and are unlikely to

change; mortality rates will continue to decline; migration is unlikely to be high because of cultural ties to New Zealand; and inter-ethnic mobility will be low. In this scenario, the Maori population could be over one million or about 20% of the population by 2026 (University of Auckland, personal communication 6 May 2010).

Table 3 shows the distribution of the total population of New Zealand for each ethnic group between 2006 and 2026, using the projection series 6 scenario.

Table 3: Total population distribution by ethnic group

Ethnic Group	2006	2026
European/Pakeha	76.8%	69.5%
Maori	14.9%	16.2%
Pasifika	7.2%	9.6%
Asian	9.7%	15.8%

Table 4 is important for the purposes of this report because it shows the projections under series 6 for children aged 0-14 years by ethnic group. The percentages for Maori and Pasifika confirm the youthful age structure of these ethnic groups. By 2026 45.5% of children aged 0-14 years will be Maori or Pasifika.

Table 4: Distribution of population aged 0-14 years by ethnic group

Ethnic Group	2006	2026
European/Pakeha	72.6%	65.8%
Maori	24.2%	27.8%
Pasifika	12.4%	17.7%
Asian	9.4%	17.7%

These children are going to be entering the tertiary education system and possibly choosing careers in engineering. This implies greater representation of the Maori, Pasifika and Asian populations in engineering.

4. MINORITY GROUPS IN NEW ZEALAND SCHOOLS

Each year the Ministry of Education publishes a snapshot of students enrolled in New Zealand schools as at 1 July.

4.1 ENROLMENTS BY GENDER

In 2008 and 2009, male enrolments were slightly higher (51%) than female enrolments (49%) at lower secondary level (Years 9-11). From Years 12-15, female enrolments (52%) were higher than male enrolments (48%).

4.2 DOMESTIC ENROLMENTS BY ETHNICITY

The 2009 domestic school roll from Years 1 to 15 excludes international fee-paying students. The largest ethnic group was European/Pakeha (56.6%) followed by Maori (22.2%), Pasifika (9.7%) and Asian (9.2%).

4.3 RETENTION RATES IN SENIOR SECONDARY SCHOOL

It is important to consider the retention rates in secondary school for the four ethnic groups because higher levels of knowledge and skills are required for participation in a knowledge-based society and for improved employment prospects.

The Ministry of Education (2009) reported that in 2007, approximately 75% of students stayed at school to their 17th birthday. However, estimated retention rates of the four ethnic groups differ, reflecting the value each ethnic group places on higher levels of knowledge and skills. More than 90% of Asian students stayed at school to age 17 followed by 80.1% of Pasifika students, 76.6 % of European/Pakeha students and 57.5% of Maori students.

The high retention rate for Pasifika is due to the importance Pasifika families and communities place on education. In 2007, the three career fields of choice by Pasifika students were management and commerce (28%), society and culture (22%) and education (7%). Only 5.3% of Pasifika students were in the field of engineering compared to 7.4% of the total domestic students (Ministry of Education, 2009).

4.4 KEY SUBJECTS FOR ENTRY TO ENGINEERING QUALIFICATIONS

At senior secondary school, the key subjects required for entry to the engineering qualifications of the Level 6 Diploma, Level 7 Bachelor of Engineering Technology (BEngTech) and Level 8 Bachelor of Engineering (BE) are Mathematics (for Level 6 Diploma only), Mathematics with Calculus, Physics and Chemistry (for chemical and process engineering). Tertiary providers have agreed on recommended minimum levels of achievement in these subjects for students to have a "reasonable chance of success" in studying for engineering qualifications (Appendix Two).

Students at senior secondary school work towards attaining National Certificate of Educational Achievement (NCEA) Level 2 and 3 credits in these four subjects. These credits, which have both internal and external assessment, are aggregated to reach the final result.

Analysis of the 2008 NCEA results in these four subjects (NZQA, 2009) show the distribution of the gender and ethnic groups in each subject is similar for both internal and external assessment. Achievement rates are higher for internally assessed credits i.e. more students attain achieve, merit or excellence standards than for credits that are externally assessed. However, more students are externally assessed than internally assessed in each of the four subjects.

For the purposes of this report, the 2008 senior secondary school NCEA external assessment results in these four subjects at Levels 2 and 3 provide a snapshot of the attainment levels and subject choices made by different gender and ethnic groups.

4.4.1 Subject Choices and Levels of Attainment by Gender

An analysis of the Level 2 and 3 subjects that contribute to entry to engineering qualifications (Table 5) shows that Chemistry is the only subject where the percentage of females (54%) is higher than for males (46%). This factor carries through to tertiary study in engineering, where more women students enrol in chemical engineering. The percentage of males studying Mathematics at Level 2 (51%) is slightly higher than

females but the percentages of males studying Physics and Mathematics with Calculus at Levels 2 and 3 is over 60% in both subjects. Although there were more females enrolled in senior secondary school in 2008, they were less likely to choose Physics and Mathematics with Calculus.

In 2008, females consistently outperformed males in these four subjects by gaining higher percentages of achieved, merit and excellence standards.

Table 5: Subject choices and levels of attainment by gender in 2008

Chemistry/Level 2	Entries	Not Achieved	Achieved/Merit/Excellence
Total Male	46%	36.4%	63.6%
Total Female	54%	31.7%	**68.3%**
Chemistry/Level 3	**Entries**	**Not Achieved**	**Achieved/Merit/Excellence**
Total Male	46%	34.3%	65.7%
Total Female	54%	31.5%	**68.5%**
Mathematics/Level 2	**Entries**	**Not Achieved**	**Achieved/Merit/Excellence**
Total Male	51%	31.2%	68.8%
Total Female	49%	26.5%	**73.5%**
Mathematics with Calculus/Level 3	**Entries**	**Not Achieved**	**Achieved/Merit/Excellence**
Total Male	61%	33.1%	66.9%
Total Female	39%	31.2%	**68.8%**
Physics/Level 2	**Entries**	**Not Achieved**	**Achieved/Merit/Excellence**
Total Male	63%	37.9%	62.1%
Total Female	37%	29.5%	**70.5%**
Physics/Level 3	**Entries**	**Not Achieved**	**Achieved/Merit/Excellence**
Total Male	63%	34.3%	65.7%
Total Female	37%	32.9%	**67.1%**

Source New Zealand Qualifications Authority (2009)

4.4.2 Subject Choices and Levels of Attainment by Ethnic Group

The percentages of Maori and Pasifika studying Chemistry, Mathematics, Mathematics with Calculus, and Physics at Levels 2 and 3 are consistently less than 10% of the total number in each subject (Tables 6, 7 and 8). The percentage of Europeans studying each of the four subjects is 60% or more of the total number except for Mathematics with Calculus where it is 55%. The percentages of Asians studying the four subjects range from 19% in Mathematics to 35% in Mathematics with Calculus. This is a high representation considering Asians are the smallest ethnic group on the domestic roll in schools (9.2%) compared with European, Maori and Pasifika groups (Section 5.2).

Over 45% of Maori students did not achieve the minimum standard in each of the four subjects at Levels 2 and 3 in 2008. Pasifika students performed at a lower level with 49% or more Pasifika students not attaining the minimum standard in each subject. The failure rate in Level 3 Physics for Pasifika was the highest at 65%.

In contrast, more than 67% of Asian students attained achieved, merit, or excellence standards in each of the four subjects. Their high performance reflects their strong aptitude for the science and mathematical subjects. Although Europeans had similar levels of achievement, further analysis of the NCEA results show Asian students achieved more merit and excellence standards and did better overall in Mathematics, Mathematics with Calculus and Chemistry.

However, some universities aggregate the Level 3 Mathematics and Physics results of secondary school students when they apply for entry to an engineering degree (Table 9). In 2008 more students were eligible for entry to engineering degrees using the aggregated results at Level 3 except for Maori students who had lower Mathematics results (NZQA 2009).

Table 6: Levels of attainment in Chemistry Levels 2 and 3 by ethnic group in 2008

Chemistry/Level 2	Entries	Not Achieved	Achieved/Merit/Excellence
Total Entries	38,984	33.8%	66.2%
NZ Maori	6%	51.2%	48.8%
NZ European	66%	32.9%	67.1%
Pasifika	3%	56.1%	43.9%
Asian	21%	27.1%	72.9%
Other	3%	39.1%	60.9%

Chemistry/Level 3	Entries	Not Achieved	Achieved/Merit/Excellence
Total Entries	24,952	32.8%	67.2%
NZ Maori	5%	48.5%	51.5%
NZ European	62%	32.8%	67.2%
Pasifika	3%	54.3%	45.7%
Asian	28%	27.4%	72.6%
Other	3%	37.2%	62.8%

Table 7: Levels of attainment in Mathematics Level 2 and Mathematics with Calculus Level 3 by ethnic group in 2008

Mathematics/Level 2	Entries	Not Achieved	Achieved/Merit/Excellence
Total Entries	123,293	28.9%	71.1%
NZ Maori	8%	45.3%	54.7%
NZ European	65%	27.9%	72.1%
Pasifika	5%	49.0%	51.0%
Asian	19%	20.1%	79.9%
Other	2%	31.5%	68.5%
Mathematics with Calculus/Level 3	Entries	Not Achieved	Achieved/Merit/Excellence
Total Entries	28,781	32.4%	67.6%
NZ Maori	5%	51.4%	48.6%
NZ European	55%	33.5%	66.5%
Pasifika	3%	59.0%	41.0%
Asian	35%	25.1%	74.9%
Other	2%	39.2%	60.8%

Table 8: Levels of attainment in Physics Levels 2 and 3 by ethnic group in 2008

Physics/Level 2	Entries	Not Achieved	Achieved/Merit/Excellence
Total Entries	40,179	34.8%	65.2%
NZ Maori	6%	52.5%	47.5%
NZ European	65%	32.9%	67.1%
Pasifika	4%	55.8%	44.2%
Asian	22%	30.8%	69.2%
Other	3%	44.0%	56.0%
Physics/Level 3	**Entries**	**Not Achieved**	**Achieved/Merit/Excellence**
Total Entries	22,210	33.8%	66.2%
NZ Maori	5%	47.5%	52.5%
NZ European	62%	32.1%	67.9%
Pasifika	2%	65.1%	34.9%
Asian	28%	32.2%	67.8%
Other	2%	39.6%	60.4%

Table 9: Levels of attainment for aggregated Physics and Maths at Level 3 by ethnic group in 2008

Maths and Physics Combined Level 3	Entries	Not Achieved	Achieved/Merit/ Excellence
Total Entries	50,991	33.1%	66.9%
NZ Maori	5%	49.5%	50.6%
NZ European	59%	32.8%	67.2%
Pasifika	3%	62.1%	38.0%
Asian	32%	28.7%	71.4%
Other	2%	39.4%	60.6%

5. BARRIERS FOR MINORITY GROUPS ENTERING ENGINEERING

There are different barriers for Maori, Pasifika and women to enter Levels 6, 7 and 8 engineering qualifications directly from school.

5.1 BARRIERS FOR MAORI IN SENIOR SECONDARY SCHOOL

The barriers for Maori are low retention rates in senior secondary school. Therefore, low numbers study the four subjects that prepare students for entry to engineering qualifications, which is compounded by the low levels of attainment by Maori in these four subjects. School performance has a major impact on the success of Maori school leavers in their first year of degree study (Ministry of Education, 2008).

Ka Hikitia – Managing for Success: The Maori Education Strategy 2008-2012 is the Ministry of Education's approach to addressing the performance of the education system for Maori from early childhood through to tertiary level. The overarching strategic intent is *Maori enjoying education success as Maori*.

The critical years for Maori youth are Years 9 and 10 in secondary school when it is important to keep them present, engaged and achieving. The actions in the *Young People Engaged in Learning* area of the strategy are focused on achieving system change by:

- *increasing the professional and learning capability of teachers.* The *Te Kotahitanga* project is an example of professional development formulated for teachers. Research found that a key barrier to Maori educational achievement is *deficit theorising* by teachers which leads to low expectations of Maori students' abilities to achieve. A professional development programme was developed to improve teacher-student relationships and interaction patterns. When strategies were implemented in the classroom, Maori behaviour changed. Students became more engaged, completed more work and were less likely to be absent, which resulted in an increase in the level of the subject being taught and an increase in students' short-term achievements (Bishop, R., Berryman, M., Tiakiwai, S. & Richardson, C., 2007)
- *focusing on responsive and accountable professional leadership.* Principals and senior staff who concentrate on teaching and learning as a key part of their leadership have improved outcomes for students
- *increasing whanau and iwi authority and involvement in education.* Parents, families and whanau play an essential role in supporting their children from their early years in education. When their involvement is valued, their children's learning is more effective.

The Ministry is monitoring the achievement of the goals and strategies in *Ka Hikitia – Managing for Success* annually in *Nga Haeata Mataranga – The Annual Report on Maori Education 2008-09.*

5.2 BARRIERS FOR PASIFIKA IN SENIOR SECONDARY SCHOOL

The barriers for Pasifika are the low numbers studying the four subjects that prepare them for entry to engineering qualifications and their low levels of attainment which suggests they require more support to select these subjects and achieve credits in them. A strategy to address subject selection could be profiling engineering as a career through role-models Pasifika students relate to, before they reach senior secondary school. Engineering is not well-known as a career by Pasifika students.

The retention rate of Pasifika students is high in senior secondary school, however their rate of achieving credits towards an NCEA qualification may be slower in a calendar year. Pasifika students eventually do achieve, but may take longer. A strategy to address this issue could be schools offering a Year 14 where support is provided for students to

achieve the required NCEA Level 2 and 3 credits in Mathematics and Physics. In the current environment where tertiary providers are restricting entry to some courses, it is important for Pasifika students to continue achieving NCEA qualifications at school to gain entry to tertiary qualifications (Ministry of Pacific Island Affairs, personal communication, 21 July 2010).

5.3 Barriers for Women in Senior Secondary School

The barrier for women is limiting options by choice. Women are less likely to choose Mathematics with Calculus and Physics, which prepare them for entry to engineering. The subjects they choose are more likely to lead them into the service sectors. However, if they do study these subjects at senior secondary school, they outperform males.

Jones (2010) has outlined eight recent research findings in a report from the American Association of University Women called *Why so Few? Women in Science, Technology, Engineering, and Mathematics* (STEM subjects) that suggests certain social, cultural, educational and self-confidence factors may provide barriers to women in the United States following careers in STEM subjects. These eight research findings are:

- beliefs about intelligence - if students believe intelligence grows through hard work, they can succeed in STEM subjects. If they do not have this belief, they are more likely to lose self-confidence
- stereotypes – if girls believe they can succeed through learning, they are less likely to believe in the stereotype that boys are better at STEM subjects
- self-assessment – boys at secondary school are more likely to believe they are proficient at Mathematics
- implicit bias – people may hold beliefs about the proficiency of boys and girls in the STEM subjects at an unconscious level even if they do not believe in gender stereotyping
- spatial visualisation skills – boys tend to have better spatial visualisation skills due to their childhood play with blocks and LEGO. Michigan Technological University introduced a first-year spatial visualisation course for engineering students with poor spatial skills. Women students' spatial skills improved markedly and their retention rate increased
- the university student experience – when an engineering school provides activities that include women, they are more likely to become confident in the field
- university faculty – academic women in engineering schools are more satisfied when they have a sense of belonging and equity of opportunity
- workplace bias – women in most STEM fields in the workplace are considered either likeable or competent but not both.

The report recommends strategies to encourage more women in STEM such as providing female role-models in STEM careers to both girls and boys; teaching girls they can develop the skills to study STEM subjects; having supportive tertiary environments for women in STEM and increasing public awareness of the barriers for women in STEM careers.

5.4 Entry via Non-School Routes

Not all people in minority groups enter engineering directly from school. They may enter via the trades or apply for entry to the tertiary providers via recognition of prior learning acquired from other qualifications or on the job. If they intend to enter the engineering qualifications at Levels 6, 7 or 8, they still need the required entry level of Mathematics and Physics. This may necessitate attending bridging courses provided by some tertiary institutions.

6. SUPPORT PROGRAMMES FOR MINORITY GROUPS IN ENGINEERING

This section provides an overview of the support programmes available for minority groups in the trades and by tertiary providers offering engineering diplomas and degrees at Levels 6, 7 and 8. The common success factors for the programmes are identified.

6.1 SUPPORT FOR MINORITY GROUPS IN THE TRADES

6.1.1 Women in the Trades

A study undertaken by the New Zealand Council of Educational Research for the Ministry of Women's Affairs (2008) reviewed young people's career decisions and gender segregation in the trades. Some factors that appear to encourage some young women into trades-related options are:

- families interested in the trades and who are not influenced by gender-based norms
- media and careers information depicting role-models in the trades that young women can relate to
- school programmes that support young women in trades-related learning opportunities and do not emphasise the academic/vocational divide
- trades-training and work environments that support women and minimise discrimination and double standards.

The report recommended more work needs to be done:

- to improve the quality, access, distribution and accuracy of information used to market the trades to women
- to create programmes of training and development that specifically aim to encourage and support more women to enter trades
- by the Ministry to support initiatives in other agencies that assist both young men and women to make decisions about their careers (e.g. Gateway, Schools Plus etc)

Since the publication of the report for the Ministry of Women's Affairs, a tertiary provider and an ITO have developed training programmes for women in the trades. At the end of September 2009, Manukau Institute of Technology (MIT) offered a free, introductory five-day building and carpentry course for women to encourage them into the trades. MIT intended to limit the course to 16 but due to high interest, 42 students attended. The evaluations of the five-day course were positive suggesting follow-up courses. Subsequently in 2010, five students who attended, enrolled in building and carpentry programmes at MIT and Unitec New Zealand. MIT has also considered an introductory course in plumbing. However, a lack of funding is a key barrier to providing further courses (MIT, personal communication, 12 July 2010).

The Electricity Supply Industry Training Organisation (ESITO) is working with two companies recruiting nine or more women into a two-year qualification for line mechanics. Evaluation of the training will occur a month after the qualification starts in August/September 2010 and continue throughout the two-year period (ESITO, personal communication, 7 July 2010).

6.1.2 Maori and Pasifika in Engineering-related Trades

This section outlines two support programmes for Maori and Pasifika provided by engineering-related ITOs; a collaborative initiative between Te Wananga o Aotearoa, Tainui and Wintec to increase Maori participation in the building and construction trades; and support for Maori in the New Zealand Defence Force.

Support Programmes provided by Engineering-related ITOs

Twenty percent of Infratrain's trainees are Maori with low levels of tertiary qualifications or no qualifications. Infratrain has a contract with Te Puni Kokiri to advance the training opportunities for Maori in the infrastructure sector. This contract targeted trainees in Northland, Auckland, Bay of Plenty and Hawkes Bay. An outcome of the contract has been to enrol 250 Maori workers in National Certificates from Levels 1-4. Additional learning programmes were designed in areas where Maori are not achieving and offered in a Maori context. These programmes have been well-received.

Infratrain is also contracted to have five Maori commit to undertake diploma level qualifications and is achieving this outcome by offering scholarships of $10,000 each. Three were awarded at the end of 2009 and another three were awarded by 31 March 2010. Although this exceeded the minimum contracted number, InfraTrain views this as a very positive outcome, which encourages Maori workers to achieve at a higher level.

Successful applicants commit to a three-year part-time programme of study towards the National Diploma in Civil Engineering (Applied). The contract between the trainee, Infratrain and employer requires employers to support the training and provide mentoring and access to experienced engineers over this period. These employers receive $8,000 during the training period and the remaining $2,000 is paid when the trainee completes the qualification. Regional Infratrain staff monitor the contract to ensure outcomes are being met.

This project ends in June 2010. However, Infratrain is seeking further funding from Te Puni Kokiri to continue to encourage Maori into higher level qualifications in the infrastructure sector. The goal is to target Maori on a national basis (Infratrain, personal communication, 5 February 2010).

The second support programme, funded by the Tertiary Education Commission (TEC) is offered by ETITO and ESITO in partnership with the Manukau Institute of Technology, Unitec New Zealand, the Electrical Training Company (ETCO) and Te Puni Kokiri. This project targets Maori and Pasifika young people in Auckland moving from school into traditional trades-training for the electrotechnology and telecommunications industries.

The outcome is to produce trade-qualified Maori and Pasifika young people to National Qualification Level 4 in either electrical engineering-related trades or telecommunications. This will be achieved through a combination of structured specialised ITP study and local community/employer work experience providing a pathway into paid employment as a Modern Apprentice.

An evaluation of an earlier project launched in Wellington in 2007 through WelTec in partnership with Te Puni Kokiri identified the need for students to understand the importance of the work ethic in the working environment. Therefore, the new programme will include strong community-based work ethics. A Training Manager Maori and Pasifika was recruited early in 2010 to work with Maori and Pasifika young people, their families and the communities across the two ITPs to provide a pastoral and educational support mechanism (ETITO, personal communication, 11 February 2010).

Iwi Participation in the Tertiary Sector

Iwi are becoming major players in the tertiary education sector. For example, Ngai Tahu formed Te Tapuae o Rehua in 1998 to work in partnership with tertiary institutions in the South Island to increase the participation and achievement levels of Ngai Tahu students. Other iwi have analysed the knowledge and skills they require and are using their settlement funds to support tertiary programmes.

In 2009, Te Wananga o Aotearoa (TWoA), Wintec and the Waikato Raupatu Lands Trust Development Unit entered into a pilot joint venture to provide pre-trade or pre-apprentice carpentry training programme for Maori. TWoA delivered a 0.5 EFT Certificate in Tikanga Maori (Level 3), Wintec delivered a 1.0 EFT Certificate in Trade Technology (Carpentry Level 3) and the Trust provided some financial support for students and venues such as marae for work experience. The joint venture scoping document stated that *both these programmes will be integrated to include theory, practice and work experience (on marae and with industry) and to incorporate te reo, tikanga and Maori pedagogy.*

This aim was further defined in the Statement of Intent signed by the Chief Executives of all three partners as:

- *successful delivery of the Māori Trade Training, Certificate in Trade Technology (Carpentry Level 3) and Certificate in Tikanga Māori (He Papa Tikanga Level 3) programmes which will progress from a pilot programme into a long term sustainable and beneficial education product valuable to all involved;*
- *increased Māori participation in the building and construction trades;*
- *furnish people with the knowledge of Māori heritage, language and culture.*

Interviewees from all partners agreed that the aims in the joint venture scoping document and Statement of Intent were met in broad terms and there was evidence through the student surveys and interviews conducted by Wintec that students were satisfied with the course.

Another success factor of this pilot programme was the collaboration between TWoA, Wintec and iwi as each partner contributed in their area of strength. TWoA has the expertise in Tikanga Maori and is unlikely to develop their own engineering or trades school; Wintec provided the trades-training and the iwi provided access to work experience on the marae. TWoA has investigated other opportunities for collaboration with iwi and tertiary providers as it recognises there is unrealised potential in this area but the restrictions of the capped funding environment in trades-training have an impact on what can be achieved (TWoA, personal communication 10 May 2010).

Support for Maori in the New Zealand Defence Force

The New Zealand Defence Force (NZDF) has an over-representation of Maori in the non-commissioned ranks (18.19%), where trades-training occurs, compared with the proportion of Maori in the New Zealand population. The over-representation is due partly to the strong history of the Maori Battalion, which continues to provide role models for Maori seeking a career with the NZDF. Most Maori enter the army or navy, but very few are in the airforce. Generally Maori and Pasifika prefer to stay in the non-commissioned ranks (93.4% in the Regular Force) because they enjoy the family/whanau or fono/team environment. The few who move into the commissioned ranks (6.6% in the Regular Force) and become officers often require mentoring to adapt to an environment where they can feel isolated.

Structures and policies have been developed in the NZDF to build the mana of Maori. A centralised Runanga chaired by the Chief of the Defence Force has recently been set up to deal with *all things Maori* from policies to practice; a bi-cultural policy is now in place; there are kapa haka groups at the national and local levels; and full-time Maori Cultural Advisers are employed on all bases with Liaison Officers reporting to them (NZDF, personal communication 7 May 2010).

6.1.3 Features of the Support Required for Minority Groups in the Trades

The findings from the Ministry of Women's Affairs report and the support for Maori and Pasifika provided by Infratrain, ETITO, the TWoA, Wintec, Tainui collaboration and NZDF have highlighted that it is essential:

- to create training environments and learning experiences in the trades that Maori, Pasifika, and women relate to and that assist them in the work environment
- to identify the areas where support is most needed and have commitment from trainees, ITOs and employers to ensure outcomes are achieved
- for tertiary providers to collaborate in their areas of strength to create joint programmes that address the culture of the minority group and provide the technical knowledge and skills
- to create an environment that builds the mana of Maori.

6.2 SUPPORT FOR MINORITY GROUPS STUDYING ENGINEERING DIPLOMAS AND DEGREES

ITPs offering engineering diplomas at Level 6 and engineering degrees at Level 7 have institution-wide programmes that support Maori and Pasifika in all disciplines rather than specific support programmes in their engineering faculties. The Ministry of Education has provided information on actual qualification completions in 2008 for diplomas (270) and engineering technology degrees (180). These figures suggest that it is not economically viable for ITPs to offer support programmes specifically for minority groups in engineering due to insufficient critical mass.

The University of Auckland and the University of Canterbury have the largest cohorts of students studying engineering at Level 8 in New Zealand. These institutions have the critical mass to provide comprehensive support programmes for minority groups in engineering. AUT offers engineering diplomas and degrees at Levels 6, 7, and 8 and has a comprehensive support programme for Maori and Pasifika. Victoria University has broadened its support programme to Maori and Pasifika students studying engineering, science, architecture and design.

The University of Canterbury, the University of Waikato and Massey University have university-wide support programmes for Maori and Pasifika and key support people in science and engineering to coordinate peer support, mentoring and academic assistance in these faculties. These support people may or may not have an engineering background.

6.2.1 Support Programmes for Women Studying for a Bachelor of Engineering

The Universities of Auckland and Canterbury have programmes to support women through engineering; however the lack of critical mass at the other universities is a barrier to their development of support programmes. The Auckland and Canterbury programmes are similar because they both have student-led committees to provide social and educational networks for women students and opportunities to attend evenings with industry. Both committees encourage their members to assist in recruitment in schools by attending open days or giving presentations.

The key difference between the programmes at the two universities is that the Faculty of Engineering at the University of Auckland has a paid position for a Women in Engineering Equity Advisor whose role is to recruit and retain women; support them through university; and advise Faculty on strategies to encourage participation and retention. A comprehensive range of services is offered to undergraduate and postgraduate women students such as:

- information, support and assistance in academic, personal and career issues
- support of a women in engineering student network (WEN)
- assistance for women to choose their specialisation at the end of Year One by providing opportunities to talk with engineers and visit sites

- visits to Year 10, 12 and 13 students in girls' schools in Auckland and Otago. Year 12 is viewed as a critical decision point when students decide whether or not to take Mathematics with Calculus in Year 13
- special tutorials for first year women in Mechanics, which is viewed as a difficult subject
- university students mentoring school students and women engineers mentoring university students.

The outcomes of this support programme are continuing awareness in the schools visited of engineering as a career for women; an increase in 2009 in first year enrolments from 20% to 23%; a retention rate of 99.9% of women at the end of the first year; recognition that the key decision points for women are at the end of Year 12 and on graduation, when women decide if they will enter engineering or pursue a career in another field such as banking or finance; and the importance of trying new strategies to attract and retain women (University of Auckland, personal communication, 16 December 2009).

6.2.2 Support Programmes for Maori and Pasifika Studying for a Bachelor of Engineering

Commitment from the University of Auckland to a structured programme for effective participation of Maori and Pasifika in engineering has led to developing a strategy referred to as a model of best practice (Murray and Morgan, 2009). The strategy is based on:

- Readiness – The preparation of secondary students for entry to engineering is being achieved through a distance mentoring project. Mentoring is provided online by students in SPIES (South Pacific Indigenous Engineering Students), which is a central support group for Maori and Pasifika Engineering students. The mentors advise on subject selection; develop networks with people in tertiary; and assist in the development of general skills
- Recruitment – SPIES students assist with recruiting Maori and Pasifika into engineering by travelling to the regions to visit schools and participating in open days. Successful applicants in the Maori and Pasifika Targeted Entry Scheme (MAPTES) are placed in a mentoring and tutoring programme (Tuakana Engineering Programme). The progress of each cohort is monitored and additional learning opportunities are provided in the form of targeted tutorials and study retreats
- Retention – Examples of retention methods include SPIES students role-modelling, mentoring and tutoring first year students; and monitoring the performance of students enrolled through MAPTES. These methods are working because the numbers of Maori and Pasifika students are increasing each year (Murray and Morgan, 2009)
- Research – The Whakatau Kairangi project aims to unify the postgraduate students; to provide support for them to attend writing retreats for their research; to raise their awareness of relevant indigenous conferences; to keep them involved in SPIES and raise their awareness of SPPEEx (South Pacific Professional Engineering Excellence), which is a network of indigenous professional engineers providing opportunities for career and personal development
- Role-modelling – this underpins the other four components of the strategy because strong role-models provide examples of and access to engineering careers.

Victoria University's Awhina support programme for Maori and Pasifika in engineering, science, architecture and design has existed for the last 10 years. Although Victoria has only offered the BE degree since 2007, it was a natural extension to support Maori and Pasifika studying engineering through the Awhina programme. The Deputy Dean (Equity)

is responsible for the Awhina programme, which provides mentoring and tutoring services for students through to postgraduate level and an outreach programme to raise awareness of and recruit Maori and Pasifika students into engineering, science, architecture and design careers.

An equity practice was initiated at the Auckland University of Technology (AUT) in 2002 to improve the academic outcomes of the Maori students and domestic Pasifika students enrolled in programmes across the university (Elliott, 2010). The Integrated Team Model of Student Success (ITMOSS) policy is partially funded by the Maori and Pacific People's Special Supplementary Grant administered by the Tertiary Education Commission and by faculties implementing the policy. The ITMOSS philosophy is *to facilitate the strengthening of the relationship between the student and the academic staff to enable academic staff accountability for the success of that student*. Responsibility lies with academic staff and students to improve the retention and academic outcomes of Maori and Pasifika students in their immediate academic environments.

The School of Engineering at AUT, which is part of the Faculty of Design and Creative Technologies, implemented this policy in 2002 and has continually changed and developed the content and delivery of its programmes to achieve excellence in engineering education for Maori and Pasifika students. The Dean has overall responsibility for the policy within the Faculty and has appointed an experienced academic staff member as Domain Leader to implement the policy in undergraduate and postgraduate programmes within the School of Engineering. Statistics provided by AUT between 2001 and 2004 show a closing of the gaps in retention and successful completions between Maori and Pasifika and all students where ITMOSS strategies are implemented. These strategies consist of:

- informing students of the aim of ITMOSS
- identifying "at risk" students and providing them with support
- mentoring of students by final year students
- recommending relevant student services
- providing a whanau/fono study room, access to computers and "after hours"
- presenting at staff development programmes and advising staff on cultural matters
- providing advice to programme leaders on the content and delivery of courses where there are barriers to success such as poor attendance, and low academic results.

6.3 SUCCESS FACTORS OF THE SUPPORT PROGRAMMES

The key success factors of the programmes described in this paper are:

- they provide positive education and training environments that the minority groups relate well to
- they monitor progress and focus on key areas of need by providing targeted learning experiences. They are not support programmes for only the struggling students
- the mentoring programmes provide strong role-models at undergraduate, postgraduate levels and from the engineering workplace
- they focus on the engineering career i.e. from preparing to enter engineering study to working in engineering
- they are sustainable. The Awhina programme at Victoria University and range of support programmes for minority groups in engineering at the other universities are

well-established due to commitment from staff and funding from their central university systems.

6.4 SHORTCOMINGS IN THE SUPPORT PROGRAMMES AVAILABLE

The main shortcoming for women is the lack of specific encouragement and support for women to enter early trades-training. ITOs, ITPs and TWoA have set up short-term programmes or pilot programmes to target specific learning needs for Maori and Pasifika. However some of these programmes are not sustainable because they depend on short-term funding from a central government agency.

ITPs have no specific support programmes for minority groups studying engineering diplomas and degrees at Levels 6 and 7 although institution-wide programmes provide generic support for Maori and Pasifika. Based on actual qualification completions at Levels 6 and 7, lack of critical mass in engineering programmes suggests it is not economically viable for ITPs to offer specific support programmes for minority groups.

The support programmes in engineering for minority groups in universities are variable. The University of Auckland has comprehensive programmes for all minority groups which focus on the engineering career i.e. from senior secondary school where career decisions are made to entry into the engineering profession. Their model of best practice for Maori and Pasifika may assist other universities to identify areas of their programmes they can develop further. Only two universities have support programmes for women in engineering. Other universities could consider developing support programmes for women if they have sufficient critical mass.

7. RECOMMENDATIONS

Minority groups may have a more significant presence in the engineering sector due to changing demographics in the next 10-15 years. Effective support programmes to encourage minority groups to take up the trades or study engineering and enter the profession are vitally important if the severe skill shortages in the engineering sector are to be alleviated.

As a result of these findings, the recommendations are for:

- engineering educators to note in their future planning the projected change in population demographics in the next 10-15 years, which may create greater ethnic diversity in engineering programmes
- schools to continue working on addressing the barriers affecting Maori and Pasifika students meeting the entry requirements for engineering qualifications
- more research on the reasons why women choose Level 2 and 3 subjects in senior secondary school that limit their career options
- engineering educators to consider the barriers to entering engineering qualifications for each minority group and address them through their recruitment strategies
- recognition of the need for specific programmes that encourage and support women to enter the trades
- ITOs, ITPs and wananga to work with central funding agencies to determine how to make successful support programmes and pilot programmes economically sustainable
- ITPs collaborating on engineering diplomas and degrees to consider how they might coordinate their support for minority groups
- universities to evaluate their support programmes for minority groups where appropriate; address any shortcomings identified and consider how they might coordinate their support programmes.

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APPENDIX ONE

Projection series 6 assumes:

Fertility: By 2026, the total fertility rate will be 1.85 births per woman for European or Other women, 2.50 for Māori women, 1.50 for Asian women, and 2.65 for Pacific women, while the total paternity rate will be 0.165 births per man for European or Other men (with non-European and non-Other women), 0.95 for Māori men (with non-Māori women), 0.23 for Asian men (with non-Asian women), and 1.00 for Pacific men (with non-Pacific women).

Mortality: Life expectancy at birth will increase for the European or Other population to 82.2 years for males and 85.4 years for females by 2026, for the Māori population to 75.4 years for males and 79.2 years for females, for the Asian population to 86.6 years for males and 89.7 years for females, and for the Pacific population to 77.0 years for males and 80.4 years for females.

Migration: There will be long-run annual net migration levels of -3,000 for the European or Other population (from 2013), -3,000 for the Māori population (from 2012), 12,000 for the Asian population (from 2010), and 500 for the Pacific population (from 2008).

Inter-ethnic mobility: There will be a net change to the population, due to people changing their ethnic identification, of 0 percent a year for the European or Other population, -0.3 percent for the Māori population, -0.2 percent for the Asian population, and -0.2 percent for the Pacific population.

Statistics New Zealand 2010

APPENDIX TWO

August 2010

MINIMUM LEVELS OF ACHIEVEMENT THAT LEAD TO A "REASONABLE CHANCE OF SUCCESS" IN STUDYING FOR ENGINEERING QUALIFICATIONS (DRAFT ONLY)

The following is recommended entry advice for those entering tertiary study in engineering on the basis of qualifications achieved in secondary school. This advice is in the form of the minimum level of achievement that leads to a reasonable chance of succeeding in the particular qualification. Individual tertiary providers may establish different entry requirements (for example different number and level of credits, competitive entry based on aggregate grades and other criteria). They may also have pathways for individual students who have not achieved these standards or have come via a different pathway, if the provider believes the student has a reasonable chance of succeeding in the qualification.

	NCEA	Other qualifications
Diploma in Engineering	Achieve at least 48 Level 2 NCEA credits, in four subjects, including a minimum of: • 12 in Mathematics. Physics is a recommended entry subject. Qualifying credits may be recognised in the relevant subjects within the Technology learning area e.g. Construction and Mechanical Technologies for civil or mechanical engineering and Digital Technologies for electrical engineering. Note: at least 12 credits in Chemistry is required if chemical/process engineering is developed as a discipline. The other qualifying credits should come from across the curriculum for each subject.	At least C Pass in Sixth Form Certificate in both Physics and Maths
BEngTech	Achieve University Entrance, with at least 42 Level 3 NCEA achievement-based credits, from a subject cluster, including a minimum of: • 14 in Physics • 14 in Mathematics with Calculus • 14 in Chemistry (chemical/process engineering only). Other subjects in which qualifying credit may be recognised are Statistics and the relevant subjects within the Technology learning area e.g. Construction and Mechanical Technologies for civil or mechanical engineering and Digital Technologies for electrical engineering.	B Bursary with 45% or more in both Physics and Calculus (and Chemistry if studying chemical/process engineering) or Equivalent Cambridge score or Equivalent International Baccalaureate

	Note: the qualifying credits should come from across the curriculum for each subject.	
BE	Achieve University Entrance, with at least 60 Level 3 NCEA credits from a subject cluster, including a minimum of: • 16 in Physics • 16 in Mathematics with Calculus • 16 in Chemistry (may not be required for all programmes). Other subjects in which qualifying credit may be recognised are Statistics and the relevant subjects within the Technology learning area. The qualifying credits should come from across the curriculum for each subject and some credits should be at merit or excellence level. Note: particular providers may set a higher entry standard either for particular papers or for entry as a whole.	'A' Bursary with 60% or more in both Physics and Calculus (and Chemistry if studying chemical/ process engineering) or Equivalent Cambridge score or Equivalent International Baccalaureate

CREDIT FOR TRANSFER BETWEEN PROGRAMMES

- In general, where a qualification has been awarded, the maximum credit is UP TO 50% of the qualification being sought, ASSESSED ON A CASE-BY-CASE BASIS. However, when a qualification is relinquished, the MAXIMUM credit transferred to another qualification at the same institution may be HIGHER.
- Credit from Level 4 study towards any Level 6 or above qualification would not normally be given.
- From Level 5 Certificates towards a Level 6 Diploma in Engineering
    - Up to 120 credits (1.0 FTE)
- From a Diploma in Engineering towards a BEngTech
    - Up to 180 credit points (1.5 FTE year)
- From Diploma in Engineering towards a BE
    - Up to 120 credits (1.0 FTE)
- A candidate holding a Diploma in Engineering and a Diploma in Engineering (Applied) (e.g. the NDipEng (Applied) in the civil or mechanical fields) can expect to receive separate credit for both Diplomas.
- From a BEngTech towards a BE
    - Up to 240 points (2.0 FTE years)