DIVERSITY, TRANSITION AND GLOBAL EDUCATION THROUGH COMBINED DEGREES

David Wood[1], David Shallcross[2], Kim Stevenson-McBride[3]

Abstract *¾ Combined degrees are a strong feature of Engineering Degree programs at Australian Universities. They have existed at the University of Melbourne since 1987, however, non Engineering Combined degrees were introduced at the University in the mid 1960s. 75% of all Engineering students at the University of Melbourne are enrolled in Combined degrees and this paper provides an analysis of the virtues of combined degrees and the impact on Diversity, Transition and Globalisation with respect to Engineering students. Outside of Australia Combined degree programs for Engineering students are virtually unknown and, where Double degree or Conjoint programs exist, they are relatively minor in terms of student enrolment. Whilst combined degree programs exist at almost all of the 33 Australian University Engineering Schools, not all have direct entry for commencing students, which with flexibility of choice is a strong feature of the University of Melbourne degrees*

.

Index Terms ¾ Combined degrees, diversity, double degrees, transition

INTRODUCTION

Whilst there is a widespread familiarity with Combined degrees, Double degrees and Conjoint degrees in Australia, such study programs are almost unheard of elsewhere in the World. Combined degrees have existed in some Australian universities for 40 years and programs involving Engineering have been available for 20 years. It is only in recent years that the advantages of combined degree programs have been recognised for marketing Engineering degrees amongst the school student population. There are also impacts on Diversity, Transition and Globalisation of Education issues, which are now emerging.

This paper discusses the concept of combined degrees in Engineering Education and, in a World where enrolments in Engineering Education appear to be in decline, the paper suggests that the provision of combined degrees can reverse this trend. The impacts on Diversity, Transition and Globalisation are also discussed.

There can be much confusion in the terminology which is used in Higher Education, e.g. what is referred to as a Subject in Australia is called a Course in the USA. In this paper the following terms are used:

- **Program:** The period of study for obtaining a degree at University, frequently called a Course.
- **Course:** An individual subject.
- **School:** Faculty as used in Australia and not the USA – a group of cognate departments.

COMBINED DEGREES

Combined degree programs are programs of study at University that are offered for undergraduate students, which lead to the award of two degrees. The program of study for each of the two degrees is interwoven yielding a truly combined study arrangement.. Furthermore, some of the courses normally taken in each of the two degrees are deleted from the study program, which enables the duration of the combined degree study period to be reduced to less than the sum of the program durations of the individual degrees. The deleted material is normally elective and this recognises that the student is electing to take the combined degree program. A course which might be duplicated if the individual degrees were simply combined is also deleted, e.g. Maths is usually required for a BE and a BSc.

Combined degrees should not be confused with “double degrees” or “conjoint degrees”, which are programs where students study for two degrees consecutively or in some cases as a special form of parallel arrangement. Double degree and conjoint degree programs require all credits for the individual degrees to be obtained before each of the degrees is awarded. The student receives two degrees from the combined degree program but may not graduate until the prescribed credits for the full program have been obtained.

Combined degree programs form part of the regular offerings at Australian universities, however, of the overseas universities with which the University of Melbourne is associated, only the University of British Columbia, Faculty of Applied Science, offers a truly combined degree program, but the second degree is restricted to Arts. A search of the internet suggests that some overseas universities offer double degree programs or conjoint degree programs. A number of universities offer “minors” as part of the degree program, but this does not involve a second degree. It may be concluded that broadly based combined degree programs are unique to Australia.

[1] David Wood, University of Melbourne, Melbourne, Victoria 3010, Australia dgwood@unimelb.edu.au
[2] David Shallcross, University of Melbourne, Melbourne, Victoria 3010, Australia dcshal@unimelb.edu.au
[3] Kim Stevenson-McBride, University of Melbourne, Melbourne, Victoria 3010, Australia kimsm@unimelb.edu.au

THE AUSTRALIAN EXPERIENCE

Prior to 1972 University Education (Higher Education) in Australia required all students to pay full fees, however, a very generous Commonwealth Scholarship Scheme existed to support the majority of students. From 1972 the Commonwealth Federal Government accepted full responsibility for Higher Education and fees were abolished. Students were accepted into universities according to a profile determined by agreement with the Federal Government through a form of Higher Education Council.

In 1988 the number of universities in Australia almost doubled as a result of a Federal Government decision to convert all of the Colleges of Higher Education into universities and to amalgamate Teachers' Colleges with univeristies. The cost of the "free" education became a very serious political consideration, and in 1989 all Australian students were required to pay a fee known as the Higher Education Contribution Scheme (HECS). This fee could be deferred and paid as a tax loading following employment after graduation. The HECS fee arrangement is still used and it represents approximately one-third of the cost of educating a student. Indeed, the cost of university education has become a major issue in Australia and universities receive money from the HECS scheme and income from the Government, the total of which is approximately two-thirds of the cost of the education. The difference is obtained by charging overseas students full fees and from other entrepreneurial activities and research.

It is, therefore, surprising that the Federal Government continues to financially support students taking combined degree programs which take one or two years longer than single degree programs. Currently a major review of Higher Education is underway in Australia and it is quite likely that the system will be less regulated with universities charging fees to suit the university with all students receiving a form of Government loan. This may have a significant negative impact on combined degree enrolments.

COMBINED DEGREES IN AUSTRALIA – UNIVERSITY OF MELBOURNE EXPERIENCE

Combined degree programs in Australia were introduced in the 1960s in order to provide a more structured program admission scheme for students who were supported by various forms of scholarship or financial aid. They did not include Engineering degrees until the late 1980s and Monash University and the University of Melbourne in Victoria were pioneers with combined Engineering degree programs.

The first combined Engineering degree at the University of Melbourne was the BSc/BE program (Electrical Engineering). A number of high achieving Electrical Engineering students were overloading with additional courses in Physics and Maths. In addition, a major review into the Department of Electrical Engineering revealed some very difficult problems and the whole Department was revamped. Furthermore, the Department of Computer Science was transferred from the Faculty of Science to the Faculty of Engineering and, together with Electrical Engineering, it formed a new "School" of Electrical Engineering and Computer Science within the School of Engineering.

The new combined degree BSc/BE enabled very bright students to complete two degrees in five years and the then Vice-Chancellor (Professor David Penington) was delighted that the entry score for this program was the highest of any program offered by the University including Medicine and Law. He made it a requirement that the particular program involving Electrical Engineering and Science should be henceforth known as the BSc/BE program to distinguish it from the general BE/BSc programs, which were being developed. This enabled the very high entry standards to remain.

More programs were introduced by the end of the 1980s, all of them involving direct entry from school. This involved each program having a single program code for direct entry from secondary school. The University recognised that a major marketing advantage could be achieved by having direct entry to University from school for combined degree programs and by providing a significant degree of flexibility – "designer courses were born"!

In Australia there is intense competition between universities in attracting the very best school leavers. Without doubt the combined degree program at Melbourne, with its flexible options, has been very attractive to school students who might otherwise have studied other disciplines at university.

Combined Engineering programs were introduced at Melbourne as follows:

- **1989:** Bsurv/BSc
- **1989:** BE/Bcom – Civil Engineers only and second year entry
- **1991:** BE/BSc – Chemical, Civil, Mechanical, Agricultural
- **1992:** BSc/BE – Addition of Computer Engineering and Software Engineering
- **1993:** BE/BA, Bsurv/BA
- **1994:** Surveying became Geomatics
- **1995:** Agricultural Engineering became Environmental Engineering and remained as part of a renamed Civil and Environmental Engineering Department
- **1996:** BE/LLB, BE/BCS – Mechatronics, BE/Bcom – first year entry, all Engineering
- **1997:** Bgeom/BIS – Information Systems
- **2000:** BCS/LLB
- **2003:** BE/BSc – reverted from BSc/BE

All are of five years' duration except for Law, which is six years. The BE title at the University of Melbourne is a generic title and students can major in Civil Engineering,

Environmental Engineering, Electrical Engineering, Chemical Engineering, Mechanical Engineering and Manufacturing Engineering. Within Electrical Engineering, students are streamed at second year into Electrical Engineering, Software Engineering and Computer Engineering. The BCS is the three year Bachelor of Computer Science.

The rapid adoption of combined degree programs in Engineering at the University of Melbourne has resulted in some pressures on the administrative procedures as well as raising new academic issues in the University. Nevertheless, the major goals of direct entry and preserving flexibility have been retained. As a result the combined degree programs at the University have proved to be a spectacular success in attracting extremely high calibre students into Engineering. In 2002 75% of all commencing Australian students (566) at the University of Melbourne are enrolled in combined degrees.

WHY STUDENTS SELECT COMBINED DEGREE PROGRAMS

There is no doubt that one of the big drivers in selection is the ability to maintain options from University entrance to graduation. Engineering graduates have many choices for an early career options in the variety of Engineering employment opportunities. Arts, Commerce and Law graduates also have a very broad opportunity of career options. The combined degree graduate can defer the decision about career for his or her university life and perhaps be in a far better position to choose upon graduation rather than at the school leaving stage. The authors can recall many cases where undergraduates were convinced about their future life direction only to have a mindchange in the final semester of study.

Statistics indicate that a large percentage of graduates from Engineering schools enter the workplace in occupations far removed from Engineering – perhaps 30%. Whilst this poses some difficulties for Professional Institutions, it is not a major problem. Attributes gained from an Engineering course such as problem solving skills are very attractive in the world of Business.

School leavers tend to be strongly influenced by teachers, parents and promotional material on the internet. There have been many reports of teachers and parents having little knowledge about Engineering. There is evidence of parents and teachers being aware that studying Engineering is challenging and coupled with a high workload. Many influences exist which guide students into business related courses. Nevertheless, many students undertake all of the key Engineering prerequisite subjects at secondary school in order to keep their options open and this, together with the regular promotion of Engineering by universities and the professional institutions, play a role in persuading students to maintain Engineering as a study option.

There is clear evidence [1] that many females select school studies in life sciences and become attracted to Engineering/Science with majors in Genetics, Microbiology, Botany or Geology. In the 1997 Review for the Victorian Government entitled "Demand for Tertiary Studies in Science & Technology" it states "...the Committee observed the rapid growth in popularity of double degrees and the life sciences. School students revealed a positive attitude to Science, a relative ignorance of Engineering and a pragmatic approach to keeping their options open in the face of uncertainty." [1]

DISTRIBUTION OF STUDENTS

Table I shows the pattern of student enrolments in the various Engineering programs at the University of Melbourne for 2002.

TABLE I

Degree(s)	Overseas	Australia	Total
BE	103	109	212
BE/BSc	18	166	184
BE/BCom	38	80	118
BE/BA	2	29	31
BE/LLB	0	14	14
BE/BCS	25	73	98

The table does not include single degrees in Computer Science or any degrees in Geomatic Engineering. 76.7% of enrolling Australian students have chosen combined degrees and this percentage has steadily risen from approximately 50% in the mid 1990s. The figure for overseas students is 44.6%, which is lower than for Australians because overseas students pay full fees and the additional years of study add to the cost.

Approximately 26% of the students enrolling for the first time are female and the figure in combined degrees is higher. Overseas students show a clear preference for the combined degree with Commerce, whilst the majority of Australian students choose Science. The proportion of Australian students selecting Commerce is growing, however, the number of students accepted into this program is constrained by a quota and the demand far exceeds the quota.

Figure I illustrates the enrolment pattern for the Chemical Engineering program from 1988 to 2002 and it is important to note that quotas restrict enrolments into the BE/LLB, BE/Bcom and BE/BA.

One of the very clear outcomes from the existence of the combined degree programs is the rise in the entry standard for all students. In Australia school students are graded by an ENTER score (Equivalent National Tertiary Entrance Rank) and this is on a 100 point scale with the highest achievable score being 99.95. The University of Melbourne has always been the University of first choice for

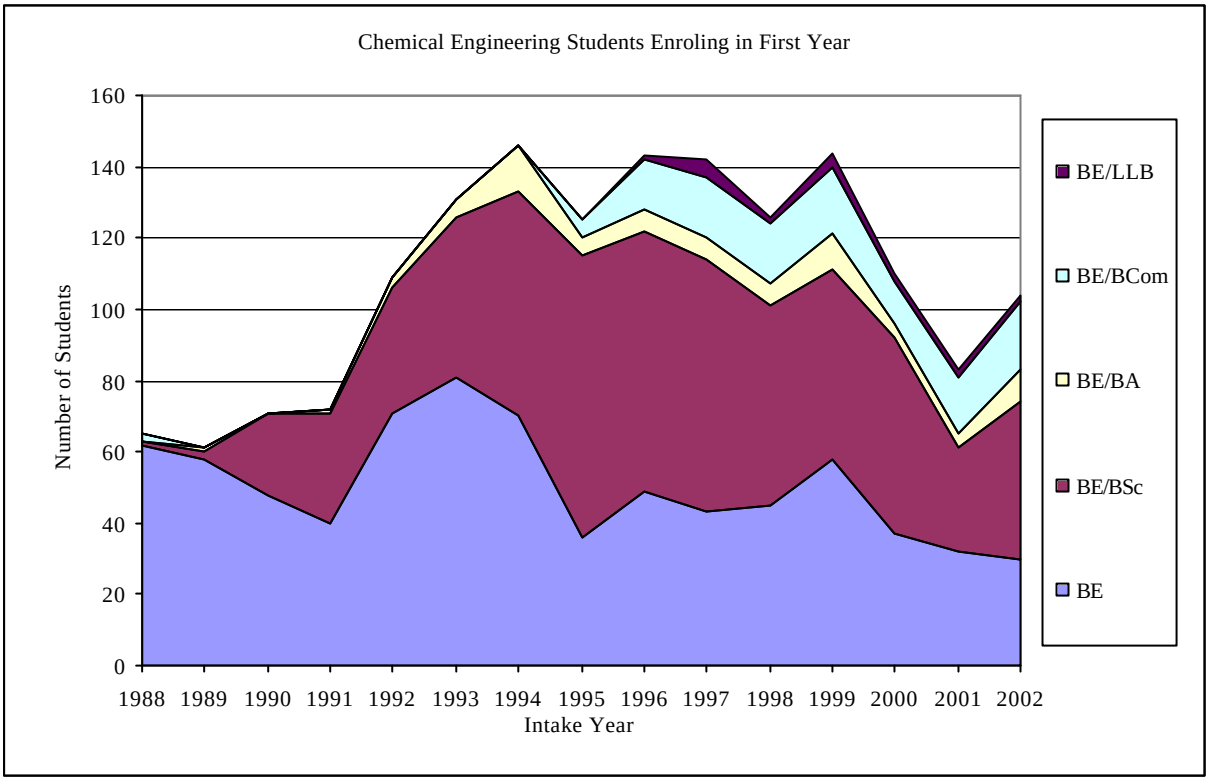

FIGURE 1
ENROLMENT PATTERN FOR THE CHEMICAL ENGINEERING PROGRAM FROM 1988 TO 2002

Engineering students in Victoria, however, since the introduction of combined degree programs all entrance score requirements have risen. Hence a large number of capable students do not get selected into the combined degree streams and many enrol in other universities. Table II illustrates the ENTER scores over the past five years for some of the programs.

TABLE I

Degree	1998	1999	2000	2001	2002
BE	87.30	91.45	90.85	91.75	91.90
BE/BSc	89.85	93.15	91.65	92.00	93.30
BE/BCom	97.00	97.95	97.35	97.45	98.05
BE/BA	93.60	95.70	93.05	94.95	96.70
BE/LLB	99.00	99.30	99.40	99.30	99.30

ENTER Scores for entry to the University of Melbourne

These ENTER scores are typical for Engineering in the Australian Group of Eight and Associate Engineering Schools (Melbourne, Monash, Adelaide, ANU, NSW, Sydney, Queensland, Newcastle, Western Australia and Wollongong). All have combined degrees and have ENTER scores significantly higher than other Engineering Schools in Australia.

DIVERSITY

The greatest change in the enrolment pattern in Engineering over the past 20 years is the growth in Diversity within the student population. In the early part of the past decade, "Diversity" meant "Women in Engineering". Today it includes many different cultures representing the wide range of nationalities of the student population.

Having a wide selection of combined degree programs has enabled the University of Melbourne Engineering School to attract female students who might otherwise have selected Commerce, Science (Life Sciences) or Arts programs. Across the whole Faculty the percentage of female students is now 28%, which is the highest in Australia and one of the highest worldwide. The figures for Chemical Engineering are 50%.

It is clear that, whilst a smaller proportion of overseas students overall enrol in combined degree programs, having the Commerce option has been very attractive to this group. It was noticeable in 2002 that many overseas students intending to study Engineering changed their mind at the last minute and opted for Commerce. Without the BE/Bcom program more overseas students would have been lost to Engineering.

As a result of having direct entry into a wide range of combined degree programs, not only are the study programs

more diverse, but the student population is more diverse, which adds to the quality of the campus based education.

TRANSITION

A major issue for today's commencing student population is concerned with transition from school to university. Some regard this as a transition from teaching to learning and, whilst this is a key component in transition, it is not the only factor. For a new student the problems of transition are not new; they are not a 21st Century discovery. As Quality Agencies via Governments became more intrusive into university life, universities are called upon to address an ever growing list of issues, most of which are counterproductive. In many universities the "Teaching Police" have discovered that, within the Engineering Discipline, Transition is a significant issue.

Students entering Engineering programs at university discover the joys of studying Engineering, however, there is no analogous course at school and for a number of students this poses a significant challenge. Maths, Physics and Chemistry are often regarded as a continuation of school activities, however, Thermodynamics, Mechanics, Statics, Digital Systems are not given an obvious foundation at school. To meet these subjects for the first time in lectures of 400 students is somewhat daunting.

The first year of a combined degree program frequently minimises the impact of new Engineering studies and hence may students do not meet the new challenges until they have matured within the university environment. The non Engineering degree within the combined degree package provides a strong pathway through transitional issues.

GLOBALISATION

Engineering Education has always been "global" in terms of content and in general Engineering graduates are well suited to work in many different countries. There is clear evidence that shows that combined degree graduates have a greater maturity and a more "rounded" approach when they graduate. This provides a great degree of confidence when seeking an Engineering career in other countries. The education in Languages, Commerce, Life Sciences etc provides the new graduate with additional tools to meet the challenges of commencing a career overseas.

A major factor in global education is the opportunity for students to undertake exchange programs overseas. The University of Melbourne has a very large number of Exchange Agreements and, furthermore, is a founding member of UNIVERSITAS 21, a group of 17 comprehensive Universities in 10 countries (www.universitas.edu.au). Through UNIVERSITAS 21 a strong scholarship program exists, enabling many students to take an Exchange period. Being enrolled in combined degrees enables many students to select their overseas courses with more flexibility than is provided by a single degree enrolment.

Through U21 the University of Melbourne Engineering School is establishing a special global Exchange arrangement involving study in three differnt countries whereby students may complete two years of the four year degree in two different overseas countries, whilst commencing and completing the program in Melbourne. The flexibility offered by the combined degree enrolment enables students to approach the Exchange with confidence.

ACCREDITATION

Over many years accreditation of Engineering courses by professional institutions followed a very thorough process of review of course content, assessment, contact hours etc. The process has been one which is very input driven and of questionable value in the 21st Century. The Institution of Engineers Australia and some of the British Institutions have moved to an output focus. There are key graduate attributes that form the basis of a sound accreditation program. It is now recognised that Engineering graduates may achieve the key graduate attributes in a variety of ways, providing the essential core curricula elements are present. An examination of the attributes associated with the study program for combined degrees demonstrates the extra qualities that graduates from these programs exhibit.

All of the University of Melbourne combined degrees are fully accredited by the Institution of Engineers Australia and programs involving Chemical Engineering are also accredited by the Institution of Chemical Engineers in the UK.

CONCLUDING REMARKS

The impact of combined degree programs at the University of Melbourne has been very significant. Transition into university can be enhanced, a diverse group of very high achieving students are seeking to enrol in the programs and the demand has never been higher.

Anecdotal information from returning Exchange students suggests that the design of the Exchange program is enhanced if courses from the full combined program are considered. Indeed a student recently returned from an Exchange year having studied French in Toulouse and Law and Engineering in the UK. He has now completed his degrees with double first class honours.

Whilst one or two universities outside of Australia offer a type of combined degree, the extent and high quality programs are unique to Australia. Within the Australian 33 faculties of Engineering, the Group of 8 and Associates offer a wide range of excellent combined degrees and these programs are commended to the International Engineering Education fraternity.

REFERENCES

[1] Seale, A.S., "Demand for Tertiary Studies in Science & Technology", *Victorian Government*, July 1997.