A Fast Track Double Major in Engineering and Innovation with Integrated Industry Participation

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ABSTRACT

The paper describes a proposed innovative fast track double major in Engineering and Innovation being developed at the Swinburne University of Technology. The double degree program is in response to an increasing number of constraints and opportunities facing university teaching programs. The program which has a strong core based in industry may be completed in under three years. In this time the students will have completed the equivalent of the current four and a half year engineering degree and a three year innovation (business) degree. The industry component of the program incorporates industry and university secondment in the form of joint appointments to ensure integration of course material.

INTRODUCTION

Swinburne University of Technology, then Institute, was founded late last century under a bequest from the philanthropist George Swinburne. The engineering programs were from the outset an integral part of Swinburne's offerings. The programs then and now have an unashamed vocational orientation. This orientation led Swinburne to be one of the first in Australia to offer tertiary courses in co-operation with industry and it is now the longest standing provider of such courses.

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University engineering programs are facing a number of challenges which are common in the authors' experience to other countries. These have their origin largely in political and budgetary constraints. On one hand universities are required to support ever growing levels of participation from eligible students and on the other hand they are asked to support this with only marginal increases of funding per additional student. As the number of participating students increase the competition between universities for the best students grows. The students are increasingly being asked to fund their own education under various contribution schemes.

Swinburne is currently offering a range of course combinations and is further developing this with a number of new programs. These include those under the new Pathways Project [1] which offers a variety of paths to degree and certificate qualifications in a number of disciplines including engineering. The courses offered under pathways while offering accelerated programs to some students, are directed principally at those entering from unusual backgrounds which may include substantial industry or trade experience.

The paper describes an innovative fast track double major in Engineering and Innovation aimed at the top quartile of the students entering engineering programs. The program, which has a strong core based in industry, may be completed in under three years of intensive study. In this time the students will have completed the equivalent of the current four year engineering degree and a three year innovation (business) degree. The industry component of the program incorporates industry and university secondment in the form of joint appointments to ensure integration of course material.

ISSUES

Government Funding

A number of the interrelated issues facing university courses and in particular engineering courses are:

- falling university income per student;
- rising salaries for academic staff which are not fully indexed;
- ageing staff profiles;
- erosion of equipment budgets;
- ageing university infrastructure.

In the face of this there is the political imperative to

- improve retention rates;
- have students contribute financially to their education;
- provide alternative pathways for students.

The political imperatives and in particular the drive for improved retention lead in turn to:

- strong competition between universities for the best students;
- lowest common denominator programs stifling brighter students;
- variability in entering student's motivation/ability/knowledge

Professional Bodies

Professional accrediting bodies clearly wish to preserve professional standards [2]. They are conscious that students emerging from the universities do not have a set of skills seen to be relevant to industry. There is particular concern for the level of management and other broadening material in the degree programs which would restore engineers to their historic positions as project managers. As a consequence of this universities are being asked to increase the amount of such material within shrinking contact hours. There is also a belief by some that four years is no longer adequate to train a professional engineer. This arises in part from lowest denominator courses and erosion of contact hours. It has been pointed out that Science degrees are generally three years in duration and within universities there is a suspicion that engineering is over resourced.

Co-operative Education

There is a concern by some that the increasing workloads on academic staff may lead to a weakening of links with industry rather than a strengthening. There is evidence that co-operative education is being abandoned in some universities. This is driven by a desire to include more academic material in the course, the difficulty of placing students during times of recession and in some cases the inability or lack of confidence of academic staff to liaise with their industry counterparts.

OBJECTIVES

The objectives of the program are to:

- attract the best available students;
- cater for potential team leaders and innovators;
- enhance the maturation rate of students;
- maximise industry relevance and participation;
- reduce staff contact loads freeing them for greater industry interaction;
- maximise resource utilisation;
- minimise the net financial outlay of students.

COURSE STRUCTURE

The program is to be conducted over ten quarters with two quarters in industry. The quarters are each of thirteen weeks duration including eleven teaching weeks, one assessment week and a one week break. Quarters run continuously through the year with no extended breaks. There are twenty-eight contact hours per teaching week. The program may be completed in under three years.

The first response by traditionalists is that the work load is too great and that insufficient time is available for absorbing the material. In response to this it may be observed that practising engineers, particularly those in the area of the Engineering Major, have significantly greater demands on their time and ability to absorb and apply new information. It may also be observed that students after their industry periods have a noticeably improved level of maturity, and a more demanding approach to the teaching material in the current four year engineering program. What is also apparent is their desire to cover the balance of the course quickly so that they can get back to industry and the income it brings. Although

some income is earned by some students in holiday breaks in traditional programs the proposed program would see the student entering industry two years earlier than they would for a single honours program and three years earlier than they would for a double major.

Co-operative Education Component

The Faculty of Engineering at Swinburne currently places some 400 students each year in co-operative industry programs. These places are offered competitively to the students who are interviewed in the same manner as graduate engineers would be. Students receive a salary at approximately two thirds of a graduate engineer. There are some hundreds of companies participating in the Co-operative Education [3]. Staff visit the students place of employment twice during each of the six month employment periods to discuss the students role in the company with their supervisor. Some consulting work may occur between the company and Swinburne but currently this is at a low level considering the number of students in industry. It is unusual for the design projects undertaken by the students in their academic program to be related to the work undertaken in their co-operative periods.

A limited number of companies will be invited to make submissions and become partners in the venture. This will permit the participating and contributing companies to have access to the above average students undertaking the program. In consideration of this the companies will provide significant material resource for the program in the form of staff time and equipment. This is already the case with the research programs associated with the engineering major under support from major computer manufacturers.

Design and innovation studies, which will be team based, would be drawn only from industry needs. In many cases these would support postgraduate studies currently being undertaken with potential partners. Project leaders from the University and industry would brief students on project requirements prior to their co-operative period. Industry staff, some on joint appointments, will present material applicable to current and projected industry directions within the academic program. Similarly some academic staff will be based in industry on joint appointments for periods presenting material for advanced students and practicing engineers together on industry premises; currently this form of program is offered on university premises.

Engineering Major

The engineering major chosen for this program is Computer Systems Engineering [3]. Engineers in this area are in significant demand in Australia and elsewhere. The material contained in the teaching programs is amenable to computer aided learning; an extremely large body of material being available with a significant part of this material having been developed for industry needs. Unlike other engineering disciplines it does not require heavy engineering equipment to support it. It does have the particular difficulty that within the framework of a normal four year program where equipment sees use for only 50% of the year that equipment is obsolete before it becomes unserviceable. In the Swinburne context the programs are supported by a very strong applied research group in the form of the Cray Research sponsored research laboratory.

Innovation Major

The Faculty of Engineering has achieved significant international recognition for its School of Innovation and Enterprise. While the School draws heavily on the traditional areas of business it has the distinguishing feature of presenting this material in a form specifically designed to be accessible by engineers. It is widely recognised that engineers are losing their traditional place as senior project managers to graduates from other disciplines. Increasing specialisation is principally to blame for this although the erosion of teaching hours devoted to contextual material does play an important part. It is strongly believed that the innovation degree component of the program will be seen as relevant and attractive to the student body. Syllabi for representative subjects in the innovation major are presented in the Appendices. A more complete listing of subjects which will be covered is contained in the University Handbook [3].

CONCLUSIONS

It is believed that the fast track program will be highly attractive to those students wishing to complete a program containing the proposed mix of material and industry experience in minimum time. Staff, and in particular junior staff, believe that the program would provide the opportunity for them to maintain links with industry as professional engineers while returning to the education system something of what they obtained. It is also believed that the program will make more effective use of educational resources and as such be attractive to funding bodies. It is currently planned, subject to accreditation, to introduce the program in 1995. Comment is currently being sought from industry, professional, student and other bodies including those attending this conference.

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REFERENCES

[1] "The Pathways Project", internal implementation document, Swinburne University of Technology, Australia, 1993.

[2] "IEAust Guidelines for the Accreditation of Engineering Degree Courses", Institute of Engineers Australia.

[3] "Swinburne University of Technology Handbook", Swinburne University of Technology, Australia, 1993.

APPENDIX

FT---: THE BUSINESS PLAN
3 hours per week for two quarters

Subject aims and description
This unit aims to provide the entrepreneur with an appreciation of a business plan in: raising ventue capital, defining the potential risk and problems in the venture; testing and building the entrepreneurial team and planning the operation of a business.

Self-selected teams will choose an invention or product as a basis for the business opportunity and will develop an appropriate business plan.

Generall teams will work independently and will be tutored by staff on specialist areas. Some lectures by external consultants in business plan evaluation will be held and time will be scheduled for the developing of presentation skills.

Textbook
Legge, J. and Hindle, K. The Structure of a Business Plan, Melbourne: Swinburne Press, 1992.

References
Golls, C. Enterprise & Venture Capital: An Entrepreneurs' & Investors' Handbook, Sydney: Allen & Unwin, 1989.
Timmons, J. New Venture Creation: Entrepreneurship in the 1990's, 3rd Edition, Homewood, Illinois, 1990.

FT---: MANAGING THE GROWING BUSINESS
2 hours per week for two quarters

Subject aims and description
This subject aims to provide the student with the ability to: identify the stages of business growth and the problems and opportunities to be managed; recognise the increasing complexities of the growing enterprise; describe the functional, planning and control needs of each stage; identify the tools and techniques available to manage and sustain growth; recognise the different leadership styles appropriate to the stage of business growth; identify the practices by which business maintains innovation; and to plan for business harvest.

Textbooks
Anderson, R.L. et al. Managing Growing Firms, Englewood Cliffs, Prentice-Hall, 1987.
Drucker, P. Innovoation & Entrepreneurship: Principles & Practice, London, Heinemann, 1985.
Fritz, P. The Possible Dream - TCG: An Australian Business Success Story, Ringwood, Vic., Ashwood House/Penguin Books of Australia, 1988.

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Davie, R.S. and Stamm, W.J. Australian Cases Studies, 1990