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EDUCATING AUSTRALIAN MINING ENGINEERING STUDENTS FOR THE FUTURE

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Some developments in Australian University mining engineering education over the last ten years are described. The paper examines the structure of Australian mining engineering centres of learning, curriculum and teaching, staffing and industry involvement and concludes that with rationalisation a better graduate will result from exposing the student to a comprehensive Departmental structure which is adequately staffed and appropriately resourced.

INTRODUCTION

The system of University education of Australian mining engineering students has gone through rapid change over the last decade. Some aspects such as a reduction in the number of University Departments offering courses from ten to six have been well documented. The so called "Dawkins" inspired changes upgrading Institutes of Technology and Colleges of Advanced Education to University status with consequent enhancement in prestige and redistribution in research funding have also been widely reported. Other changes have occurred in a more evolutionary fashion, but with significant impact. The creation of viable postgraduate schools within Mining Departments, increases in advanced technical input in teaching curriculum and a greater demand for financial accountability are examples of these progressive changes.

CENTRES OF LEARNING

A Mining Engineering Department can look to the following goals as the minimum support structure to maintain academic excellence and economic viability.

a) A professional mining academic full-time staff complement of eight.

b) A Bachelor degree graduation number of 30 per year, or with expected loss from failures, a departmental undergraduate complement over four years of about 150.

c) A postgraduate school with 40 students undertaking research higher degrees (Masters and PhDs) of whom at least half are Australian nationals.

d) Links with associated geology, metallurgy and engineering disciplines within the same University structure.

e) An annual budget of $4.0 million to service academic and support staff salaries, postgraduate and some undergraduate scholarships, research support, maintenance and general operating costs.

The last point emphasises the fact that operation of a Mining Engineering Department must be approached in a business-like fashion. Expenditure of $4.0 million per year must be supported by accountability. Approaches to Commonwealth Government funding of University places cannot be expected to support this sum alone. Taxpayers support based largely on per capita enrolment could be expected to cover of the order of $1.0 million of this sum. The remainder must come from the private sector, probably largely from:

a) Research contracts (with the mining industry),

b) Consulting and testing services (with the mining industry and government),

c) Short courses (to industry and government personnel), and

d) Fee paying students.

It is clear that most of this additional sum will have to be generated from support from Australian operating mines. It is unlikely that the Australian industry can support six comprehensive Mining Engineering Departments as described above. Just (1990) considered that there is considerable economic justification for concentrating mining engineering higher level tertiary education at a small number of large centres. The Australasian Institute of Mining and Metallurgy Education Committee proposed a decade ago that a rationalisation to four Departments was needed. The mining industry as a "free market" force in employing graduates and supporting research and other activities will in time determine the number of viable Departments which can be supported. A number of two to four would provide a geographic spread, maintain competition, be able to supply good numbers of industry entrants (and re-entrants following postgraduate courses) and with good management be able to attract and sustain adequate industry support.

CURRICULUM AND TEACHING

Teaching curriculum must continue to be closely associated with technical innovation and research advances. Association of Departmental academic staff with mines, support industries and research activities provides the impetus, state of the art instrumentation and other aids that keep teaching up to date. The best mining courses will emerge with curriculum which is

a) Strongly technically based (with a small management/economics support component),

b) Soundly based on mathematical/scientific principles so that critical thought processes are developed,

c) Supported by practical laboratory instruction that introduce the latest equipment, instrumentation and approaches,

d) Reliant on appropriate mining industry or support industry input to ensure that engineering design teaching is highly relevant, and

e) Broadly based so that graduates are prepared for employment in the underground, surface, coal or metalliferous mining industries or associated industries and support functions within Australia or overseas.

Technically advanced courses teach the graduate "why" and so develop ability to question and solve problems throughout a career. They do not allow time to fully teach "how" to do the job although significant application orientation can be included by way of examples in courses. Industry must supply "on the job" training to develop focussed capability of the new graduate for the specific situation.

Postgraduate teaching will continue to grow in importance with this student group forming a dynamic component of Mining Departments. Growth will occur in three areas.

a) Postgraduate research degrees. Acceptance of the importance of formal University based research study in the mining industry has been slow. Industry, and government funding agencies are now supporting scholarships and other research costs in targeted areas at substantial levels. Both Australian and foreign students are being attracted to this form of study. A balanced mix of nationalities at this level invigorates the programme. Some sections of industry have come to the point of placing a premium on employment of those with a postgraduate degree.

b) Postgraduate course work Masters degree enrolment will be a major area of growth. Mining Departments have the opportunity to base these on advanced technical instruction. (Teaching of management skills at this level should be principally left to Engineering Management or Master of Business Administration courses.) These courses may be structured with intensive block teaching components and field sessions to allow engineers

from operation to enrol with minimum time away from the job.

c) Short Courses for ongoing education should be more actively promoted by Universities. Running short courses with instruction given in conjunction with intensive teaching of advanced subjects in course work Masters degree curriculum allows efficient resource allocation.

STAFFING

The generally accepted profile of an Australian academic in a tenured University establishment position is of a person with a good Honours Bachelor degree, a PhD degree and demonstrated teaching and research ability. For a mining engineering academic, previous industrial or research experience and an awareness of the Australian mining industry is very important.

Attainment of the PhD degree has generally been necessary for promotion within the academic hierarchy. The pool of Australians holding mining engineering PhD degrees is small. This has had two effects

a) Difficulties are presented in attracting qualified applicants for vacant academic positions.

b) There has been limited career movement between those in industry and in academia except at the junior level.

The ideal Departmental staff complement would be made up of people with a mix of backgrounds. A significant proportion would have traditional qualifications. These staff would maintain long term stability and growth of the Department and its reputation. Intellectually active staff in a stable situation will contribute to progressive improvement. There is also a need for frequent injection of qualified engineers with current industrial experience into this staffing mix. These staff will strengthen contacts with industry and provide valuable instruction in for instance design and application subjects. The latter staff member coming from industry should not see the University as an early retirement position, but rather as a career opportunity of at least medium term length before return, perhaps, to industry.

Whatever the staff member's background, a challenging career path must be presented. Work schedules must allow time for in-depth research to be undertaken and industrial relationships nurtured. Good researchers provide vitality and make the best teachers. Researchers who do not teach are failing to utilise one very important path for transmittal of knowledge.

The recent increase in Australian enrolments in post-graduate mining engineering courses augers well for the future supply of academic staff. While there may be some room for improvement in academic working condition, pay scales and the like, it is the career development and challenges that motivate academic staff in the long term.

INDUSTRY INVOLVEMENT

Mining engineering as an academic pursuit exists because of an operating industry. A successful Department will have the closest involvement with a wide number of mining operations and industry support structures such as State Mines Departments, research institutions, professional bodies and technical vendors.

The University - Industry relationship is two way; universities have an essential need for input and assistance while industry recognises direct benefits from the teaching and research role as well as their need to contribute to the process of achieving a successful output.

Industry contribution to teaching subjects at postgraduate and senior undergraduate level has direct benefits. The ability to focus applications, identify current problems and alternative practical solution paths will enhance structured University teachings. Assistance in the teaching of short courses can be especially beneficial.

Industry views are important in the design of curriculum. The structure of individual subjects is best developed through informal contact between academics and industrial colleagues. Industrial Advisory

Committees to a Department, Visiting Committees and the like may contribute to achieving balance in the broad structure of a course but do not have the scope to grapple with detail of individual subjects.

It is important that all sectors of the mining industry are perceived in the best light by undergraduate and post-graduate students. Many mining companies support generous scholarships to maintain a high profile in the eyes of the student body, to provide a formal mechanism for interacting with Universities and of course to provide benefit assistance. Companies can also project a high profile through the following:

a) Encouraging field trip visits and for remote sites, assistance with travel costs.

b) Offering vacation employment and structuring it so that even junior level students are occupied in meaningful tasks relevant to their engineering discipline.

c) Inviting students to work on "small" engineering problems which can form the basis of final year thesis projects.

d) Contributing to teaching through the giving of guest lectures and provision of data for mine design classes.

e) Sponsorship of student social events.

CONCLUSIONS

Change can be expected in the structure of Australian mining engineering education. With limited abilities of governments and industries to support education costs, rationalisation will occur in the number of Australian Mining Engineering University Departments. University education within other professional disciplines has, or is going through similar rationalisation. A better graduate will result from exposing the student to a comprehensive Departmental structure which is adequately staffed and appropriately resourced.

Mining faces many technical challenges. Universities must be aware of these changes and at least in part, help to lead the way. The University-Industry relationship is two way and there are strong benefits to be had if both groups can work together effectively.

ACKNOWLEDGMENT

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REFERENCE

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