Developing a Comprehensive Approach to Minerals Industry Education

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Abstract: *This work follows on from previous papers on minerals industry education, (Tolhurst, 2005 and Baafi, Kell and Tolhurst, 2008. It outlines how key stakeholders influence the requirements for education in the minerals industries. The results of surveys from two key groups, site employers and students are also presented.*

The employer's survey demonstrated that even though the overall workforce demands have decreased since the recent reduction of the minerals boom, the educational needs remain above the current levels of supply, particularly at the paraprofessional, supervisor and graduate levels. This situation closely parallels the previous local experience, where the downturn in employment numbers in the steel industry in the 1980's resulted in increased demand for supervisors, technicians and graduates.

The undergraduate students' survey illustrated how activities that can be regarded as "extra curricula", are highly valued by student participants, making a significant contribution to achieving University and Professional Institutions stated graduate attributes.

Introduction

Whilst the revenue received from the minerals and metal industries has declined in the last year and a half, it is still the largest source of Australia's export earnings, has the largest impact on our balance of trade figures, (Australian Mining Club, 2006) and hence is a major contributor to our nation's economic well-being.

As the world has moved into a situation of surplus for raw materials, decisions on continuing mineral operations tend to be made on the basis of costs and quality of operations. For both of these factors, the skill levels of staff have an important impact. Hence, to retain the greatest possible number and volume of viable mineral and metal producing operations, it is critical that education for these industries is as effective as possible.

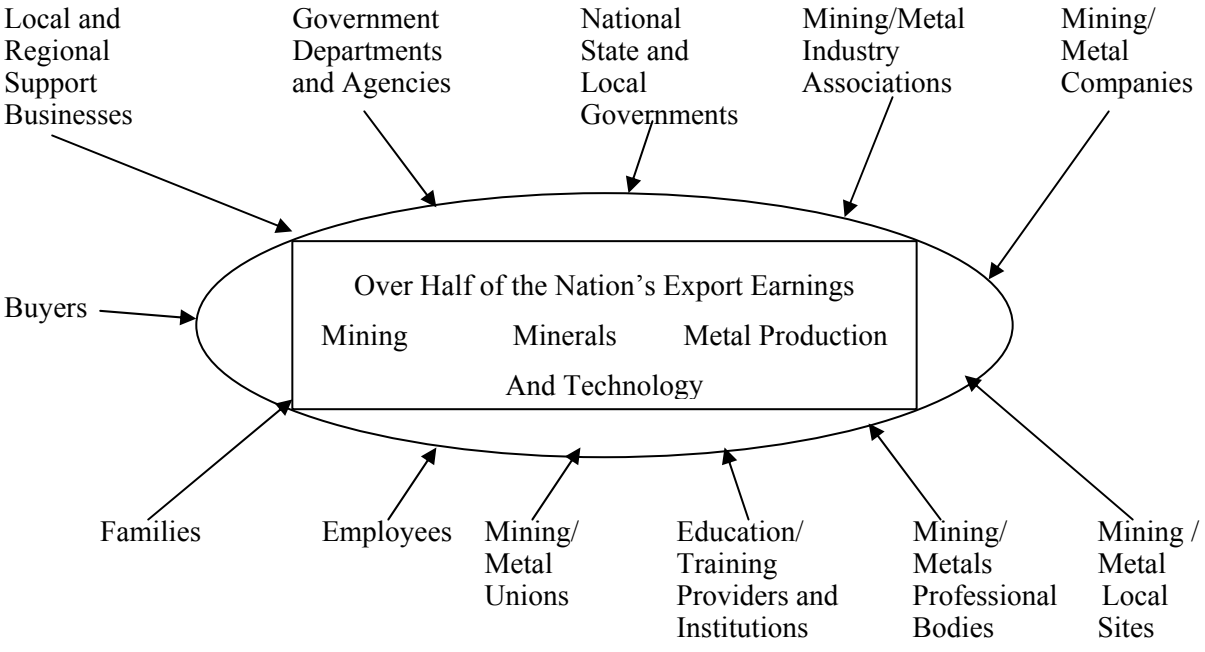

Figure 1 – The range of Stakeholders influencing Education in the Mineral Industries.

However, the relationships between the stakeholders, as shown in Figure 1, in achieving high quality education for the mineral industries is complex and due to the differing perspectives, the current implementation of education policies may not produce the desired outcomes.

The following example can be used to show the influence of stakeholders. Figure 2, outlines how the Metal Price Index, (London Metal Exchange, 2009), has moved in the last seven years, since 2002.

Figure 2 – London Metal Exchange Metal Index Prices, 2002 to 2009

Apart from iron ore and coal, Australian mineral and metal producers are "price takers", with revenues being closely tied to the London Metal Exchange prices. This means that for the three year period to mid 2003, overall prices received remained relatively stable at approximately $US1,100/tonne, but after a sharp upturn, prices stabilized in the next three years, at just under $US2,000/tonne, an almost 80% increase. This resulted in a large number of marginal, or previously not-profitable projects, being commenced. There followed a two year period to mid 2008 when it seemed that metal prices had reached an even higher level of $US3,500, leading to even greater investment decisions. However, in less than a year, the metal price index plunged by more than 60%, down to $US1,600/tonne, resulting in the delaying of planned projects, the closure of some operations and the reduction of outputs at others. One management response to this position has been to reduce costs by minimizing expenditure on items such as education. However, it is exactly this, expenditure on education that is most likely to increase skills and understanding, improving quality and lowering overall costs, providing a greater probability that an operation will remain economically viable.

The data shown below, in Table 1, (Australian Bureau of Statistics, 2009) demonstrates that most professionals working as geologists, mining engineers and chemical/materials/metallurgical engineers in the minerals and metal production industries are graduates, with some young non-graduates working as chemical/materials/metallurgical engineers, but considerably higher numbers of older non-graduates working as professionals across all three major disciplines. This is to be expected as employees with considerable experience build up skills and perform professional roles.

At the para-professional/technician level, the data indicates that about one fifth of the positions are filled by graduates, less than a fifth by personnel trained and qualified at this level, but alarmingly over three-fifths of positions filled by staff without qualifications at this level The impact of employees without sufficient skills or qualifications in these supervisory and often process control positions may lead to operations that have lower recoveries and increased costs. This situation is likely to have resulted from employment practices during the mineral boom and the low levels of

qualification completion rates in recent years in these programs. (National Centre for Vocational Educational Research, 2006)

Table 1 - Qualification Levels of Mineral Industry Employees

Positions	Post-Graduate %	Graduate %	Technician/ Para-professional %	Skilled %	No Qualification %
Professional					
Age 20/34					
Geology	20	80	-	-	-
Mining	17	83	-	-	-
Chemical/ Materials/ Metallurgy	30	62	-	6	2
Age 35/60					
Geology	26	63	11	-	-
Mining	17	61	22	-	-
Chemical/ Materials/ Metallurgy	26	56	5	8	5
Para-professional/Technician					
Age 20/34	4	18	15	11	52
Age 35/60	5	15	19	31	30

Table 2, below, based on data from the Australian Bureau of Statistics, (2009), outlines the percentage of recruitment vacancies in the mineral industries that have been filled as a result of new positions being created, filled as a result of employees leaving the industry and filled as a result of employees changing positions within the industry.

Table 2 - Recruitment of Mineral Industry Professional Vacancies (JobSearch, ABS Statistics, 2009)

Position	New Positions %	Leaving the Industry %	Changing Positions within the Industry %
Geology	3	23	74
Mining	19	79	2
Chemical/ Materials/ Metallurgy	3	52	45

This indicates that a higher volume of education may be needed for the minerals industries than other sectors, due to the number of vacancies created by staff leaving the industry, particularly for the core discipline of mining professionals. The high level of personnel leaving the industry indicates that there is a need to consider retention strategies, or aligning minerals education more closely to industry situations. With a major part of mining professional education being located in capital city universities, the outcome may well be that these graduates are not as likely to remain in regional mining and mineral processing plant locations as regionally educated mining and mineral graduates.

Site Employer survey

During late 2007 to the end of 2008, 128 sites were contacted by phone and letter, nationally, across commodity groups. After follow-up and discussion, 118 responses were received. Although it was not initially intended, it has been possible to compare responses received in late 2007, when the information gathered was based on being close to the top of the boom, to those responses received

later in the survey period, towards the end of 2008, when the reduced commodity demand has led to lower levels of overall workforce numbers.

The employer surveys were administered to a range of industry sectors: -

- Initial Trial Survey – WA Eastern Goldfields, nickel and gold industries
- Three large national quarry company sites
- Metal mining sites in Western NSW, Western Tasmania
- Coal sites in the Illawarra, Hunter, Western NSW and the Bowen Basin, Queensland

The qualification levels of employees varied between regions and commodities, although the results were generally consistent with previous research conducted by the National Institute of Labour Studies, (Richardson, 2008)

Table 3 - Percentage Distribution of Staff in Minerals Operations

	Mine and Mill Managers plus Other Professionals	Technicians Paraprofessionals and Supervisors	Skilled Mine/Mill Workers	Other Staff
WA Eastern Goldfields, nickel and gold sites	13.1	7.4	45.6	33.9
National Quarry companies	6.3	11.0	42.6	40.1
Metal Mining Western NSW	14.5	8.8	39.7	37.0
Metal Mining Western Tasmania	11.8	10.4	48.5	29.3
Coal Illawarra	16.4	18.3	38.6	26.7
Coal Hunter	14.6	17.2	41.3	26.9
Coal Western NSW	14.1	18.8	40.7	26.4
Coal Bowen Basin QLD	12.6	15.3	52.6	19.5

As shown in Table 3, the need for technically trained graduates and paraprofessionals was demonstrated to be highest in the Coal industry, (27.9 to 34.7%), followed by Metal mining, (20.5 to 23.3%) and then Quarrying 17.3%. Given this outcome, it is somewhat surprising that Mining Education Australia that embraces the larger University of Queensland and University of NSW mining departments has recently deleted the specialist coal mining subject from their undergraduate programs. (Mining Education Australia, 2009)

Within each of the eight regions, the turnover rates were relatively constant for all staff categories, for that locality. However, the variation between regions was significant, with Illawarra Coal the lowest, 5.8%, followed by Western NSW Coal 7.7%, Quarrying Nationally, 10.2% , Western Tasmania Metal, 11.6 %, Western NSW Metal, 13.0%, Hunter Coal, 13.3%, Bowen Basin Coal, 21.8% and WA Eastern Goldfields 39.4%. A limitation in comparing these results is that the data from the WA Eastern Goldfields was collected in late 2007, at close to the height of the boom, whilst the information from the other seven was collected during 2008, when redundancies and mine closures had commenced. Thus, based on the trend for the turnover rate to decrease during the period of the data collection, the comparative figure for the WA Eastern Goldfields is probably lower, but still above the others.

This data generally indicates a reduced turnover within the coal industry and lower turnover rates in regions that are mainly residential. For the designers and delivers of mineral industry education programs, the results demonstrate that the demand for technical professional and paraprofessional skills is greatest in non-residential and remote regions, whilst the facilities and capacity is more likely to be located in regions with lower turnover and hence less demand. As a result, to provide effective programs, it is likely that the education resources and capacity of the more populated residential centres is needed to provide services for the non-residential more regionally remote locations. To

achieve this, it is likely that a greater alignment of the stakeholders will be required than has been demonstrated previously.

Undergraduate Mining Engineering Student Survey

47 students were contacted through the distribution of survey forms in class and additional copies sent by e-mail. After follow up, 43 surveys were returned, a 91% response rate.

The surveys received included: -

- 11 from final year students, out of 12, 92% response rate
- 19 from 3rd year out of 20, 95% response rate
- 6 from 2nd year, out of 8, 75% response rate
- 5 from 1st year, out of 5, 100% response rate

Results from 3rd and 4th year, where students have gained some experience and the numbers form the majority of the classes are likely to have higher reliability. Results from 1st and 2nd years provide an indication only, as they had not experienced many mining subjects and the number surveyed is only a smaller fraction of the total student numbers. Students were asked to rank, from 1 to 5, the benefit gained though participation in the 2008 New Leaders Conference and National Mining Games, with 1 being no benefit, 3 moderate benefit and 5 high benefit. The %'s shown below, are the percentage of students who claimed to have obtained moderate to high benefit for this skill or attribute. The skills and attributes as those listed as engineering graduate attributes by the University of Wollongong, (2009) and the professional body, the Australasian Institute of Mining and Metallurgy, (2005)

Table 4 – Student benefits from participation in the 2008 New Leaders Conference and National Mining Games

	New Leaders		Mining Games	
	Mean	%	Mean	%
Teamwork Skills	3.17	67	4.74	100
Decisionmaking	3.08	67	4.21	100
Co-ordination/organising skills	3.67	91	4.16	100
Competency in equipment use			4.00	95
Problem Solving	2.92	67	4.05	100
Verbal Communication	3.08	75	3.79	95
Technical Knowledge	3.75	100	3.74	84
Better Informed about the Profession and Industry	3.75	100	3.63	89
Broad Industry Knowledge	3.67	92	3.53	84
Industry contacts	3.25	75	3.53	68
Leads for employment	3.42	75	3.47	68
Ability to Learn Independently	2.83	67	3.21	74
Academic Subjects	2.92	67	3.00	79
Submission/Report writing	2.42	50	2.11	42

Of the 14 potential areas of benefit through participating in these two events, only one, Submission or Report Writing, (or written communication) failed to be judged by more than half of the students as providing moderate to high benefit. In 9 of the 14 categories students estimated that they had achieved moderate to high level benefits by taking part in either the New Leaders Conference and/or the Mining games.

High level benefit scores, with means of greater than 4 out of 5, were achieved through participation in the mining games in 5 categories, Teamwork, Decisionmaking, Co-ordination/Organising, Equipment Use and Problem Solving, all skills highly valued by the profession and employers.

This feedback demonstrates the value of activities such as conference and mining games participation, that could be regarded as optional, add-on extra curricula activities and not a core part of undergraduate programs.

Mining Games

The value from taking a comprehensive approach to educational programs, that enhance academic studies through closely related employment opportunities, interaction with the professional body and industry-based professionals, as well as involvement with minerals industry communities, is demonstrated by the results from the 2008 National Australasian Institute of Mining and Metallurgy (AusIMM) Mining Games.

At that competition, there were 20 teams, one corporate, 8 from regional mining universities, 7 from capital city mining universities and 4 from non-mining, (geology) universities. The overall results shown below demonstrate the superior performance of students from the regional mining universities, where a more comprehensive approach to minerals industry education programs is more likely to occur.

Corporate	1 team,	4th place overall
Regional Mining Universities	8 teams,	average 8.9th place overall
Non Mining Universities, (Geology)	4 teams,	average 11th place overall
Capital City Mining Universities	7 teams,	average 13.3th place overall

Of the nine events, 8 were won by teams from the regional universities, 1 by the corporate team reinforcing the positive outcomes achieved by conducting minerals education in regional settings where students become immersed in the industry.

Conclusions

The demand for education programs in the Australian minerals industries has been outlined and the limitations of current approaches practices explained. The varying perspectives of different stakeholders have been outlined. The research has also shown the benefits that can be achieved by taking a flexible, blended, comprehensive approach to minerals industry education.

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