

**STRATEGIC REVIEW OF MINERALS COUNCIL OF
AUSTRALIA TERTIARY EDUCATION INITIATIVES**

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EXECUTIVE SUMMARY

In 1998, a review of minerals tertiary education in Australia was undertaken by the Minerals Council of Australia (MCA). Entitled *Back from the Brink*, it concluded that, in its current form, the system was fragmented, unstable and fragile and could be pushed over the brink of viability by impending change in the university system. These findings caused the MCA to establish and resource the Minerals Tertiary Education Council (MTEC) to manage a five-year program of engagement with nine university consortiums, three each in earth sciences, mining engineering and metallurgy. It was agreed that the program would be reviewed after three years. This report summarises the outcome of that review.

The review has highlighted that the challenges facing minerals tertiary education in Australia are more serious today than they were when MTEC was constituted in 1999. With few exceptions, Australian minerals tertiary education programs are not viable under current circumstances. The changes in university education and their impacts as foreseen in *Back from the Brink* have materialised. These have been compounded by coinciding with major restructuring, consolidation and globalisation of the Australian mining industry and a number of external influences not foreseen in *Back from the Brink*.

MTEC is a “work in progress”. Whilst three years is sufficient time to judge the progress that MTEC is making, it is not long enough to judge if it is having a long-term impact. Further time is required for gains to become embedded. It is essential, therefore, that MTEC continue for at least the remainder of the planned five-year period. There is little doubt that if the MTEC initiative was to cease now, it would have produced few sustainable outcomes and that many more minerals tertiary education programs would be rationalised or closed. MTEC has created momentum in changing the culture of minerals tertiary education providers. The foundations and incentives are in place for MTEC to achieve an accelerated rate of change, albeit perhaps amongst a revised set of partner universities.

The 35 submissions received from a broad range of stakeholders lead to the following conclusions:

- i. MTEC is functioning successfully as a catalyst and driver of the cultural and structural changes required of its university partners.
- ii. This has already delivered gains. MTEC has:
 - a. Influenced public policy related to minerals education.
 - b. Brought the importance of minerals education to the attention of university executive management and, thereby,
 - c. Caused small minerals departments to maintain a presence in large comprehensive universities.
 - d. Leveraged financial support from parent university partners (e.g. MTEC Lecturers, new course development, MTEC workshops, capital grants, education trust and scholarships).
 - e. Caused a step change in collaboration between universities.
 - f. Increased industry’s understanding of tertiary minerals education issues.
 - g. Acted as a conduit to government on tertiary minerals education
- iii. Unforeseen external influences, however, have outweighed these gains.

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- iv. Simultaneously, tertiary mineral programs have also been impacted upon by:
 - a. Restructuring and consolidation of the minerals industry.
 - b. Ongoing funding cuts to universities in real terms.
 - c. University funding models that increasingly favour high volume, low teaching cost programs.
 - d. A decreasing pool of school students studying maths and/or science.
 - e. The emergence of ‘new economy’ disciplines which compete for this shrinking pool of students.
 - f. A declining image of the minerals industry as a “career of choice”.
 - v. The net effect is that the sustainability of the minerals tertiary education system in Australia continues to deteriorate.
 - a. Since *Back from the Brink*, seven Australian minerals programs have closed, three more are under review and are likely to close and four have been rationalised or absorbed into larger schools.
 - b. More departments would have closed but for MTEC support.
 - c. The Australian Minerals Foundation, formerly an active agency in the provision of minerals related short courses, has ceased to trade.
 - d. Most university submissions ‘admit’ to a lack of viability.

MTEC has already achieved significant progress. The current status of each of the five key MTEC initiatives is:

- Collaborative Course Development and Delivery:
 - Some world-class material has been developed and delivered internationally.
 - Some of this material is being utilised to grow new income streams to support university departments.
 - However, some partners have been slow to appreciate benefits and/or to deliver.
- MTEC Lecturers:
 - Some are proving to be effective change agents by innovating, networking, collaborating, developing new programs, relating students, linking to industry and working outside traditional university frameworks.
 - However, some partners are not taking full advantage of the opportunity or utilising it in manners that are not consistent with the MTEC vision.
- Industrial Experience
 - MTEC has raised awareness of the importance of structured industrial experience (IE).
 - MTEC has caused an improvement in the quality of industrial training offered by industry. However,
 - Although use is growing, the IE Website is not as effective as envisaged.
 - Students, universities and industry still rely heavily on direct approaches to each other.
 - Demand for IE places continues to exceed supply.
- Minerals Industry Postgraduate Coursework Program (MIPCP)
 - A sound concept but qualified support for it from universities and industry.
 - Earth sciences program implemented, mining engineering and metallurgy in development phase.
 - However, success is dependent on industry and universities working much closer together to determine market demand prior to course development.

- Centres of Excellence in Mining Engineering
 - Australian National Centre for Mine Ventilation established and operating.
 - National Centre for Rock Mechanics stalled because of Western Australian situation and lack of industry support.

In many instances, university resource constraints are inhibiting opportunities for small departments to be innovative and proactive and to produce MTEC deliverables on schedule. Available resources are being directed towards trying to stay in business.

The following additional concerns arise from the review:

- i. The lack of number and depth of industry submissions to the process and the poor knowledge and understanding of the MTEC process displayed in some industry submissions. There are clearly identifiable needs for:
 - a. MTEC to place more emphasis on communication and networking with middle management of MCA members and others in order to facilitate a greater degree of understanding in the industry as to how exactly MTEC can deliver change.
 - b. Industry to become much more engaged 'at ground level' in MTEC initiatives. Money alone is not sufficient to progress the initiatives and achieve the objectives.
- ii. The dire state of metallurgy programs. It appears that earth sciences and mining engineering have managed to hold ground, albeit that a number of these programs have closed down. However, some discipline areas in metallurgy may have been lost.
- iii. The ongoing boom/bust cycle in graduate recruitment, which is one of the factors that is adversely affecting student enrolments in minerals disciplines. This is not an MTEC problem. Industry must provide more support to universities through consistent recruitment of new graduates if students are to be attracted to careers in the minerals industry and tertiary education programs are to be viable.
- iv. The sustainability of many VET and TAFE minerals programs, especially for supervisors and managers, is also under serious threat. This area was deliberately not targeted by *Back from the Brink* or by MTEC. Some submissions suggest that the MCA should also direct its attention to this situation in the future.
- v. The inability to date of university partners in Western Australia to form a collaborative association. This is damaging industry support for the MTEC objectives. The opportunity for a \$1 million contribution from the WA Government has not been realised. It has also caused the National Centre for Rock Mechanics to stall at a time when industry is experiencing a severe shortage of competent geotechnical personnel in order to fulfil its duty of care obligations and to perform efficiently.
- vi. There are few in industry or university prepared to lead. However, the success of MTEC to date indicates that many are prepared to be led, especially in desperate times.

Nevertheless, the number, breadth and content of the submissions confirm that MTEC is having a positive impact on minerals tertiary education in Australia. The MTEC initiative received almost overwhelming support from all sectors, including institutions from outside the MTEC network.

The submission process has identified that the following are priorities for the future:

- i. MTEC has a critical role to play in the current minerals tertiary education environment, at least whilst minerals departments ride out the wave of university and industry rationalisation.

- ii. MTEC should capitalise on the change that it has already initiated amongst minerals tertiary education providers and the profile that it has established with government.
- iii. More reliable data collection and processing needs to be undertaken in regards to student enrolments, graduate destinations and graduate retainment in industry in order for MTEC to properly manage the process and allocate resources appropriately.
- iv. There is an urgent need to address recruitment into minerals programs. Industry must take some responsibility for this. University departments do not have the skills or resources to 'correct' industry's image.
- v. MTEC needs to improve the marketing of its objectives and achievements to non-MTEC partners, middle management in the minerals industry and to community.
- vi. Future MTEC support to universities should be linked to demonstrated commitment and performance to date.
- vii. The current program initiatives should be reviewed in light of the comments contained in the submissions. Nevertheless,
- viii. MTEC support in the future should give priority to sponsoring MTEC Lecturers and MTEC workshops.
- ix. Further consideration needs to be given to the implications of an aging academic staff profile.

Maintenance of intellectual capital is essential to the future of the minerals industry. Therefore, minerals tertiary education is a critical element in the sustainability equation. The situation with respect to minerals education in Australia is more serious than anticipated in *Back from the Brink*. Unforeseen external influences make it difficult to gauge the magnitude and sustainability of MTEC achievements to date. However, there is no doubt that it has assisted many MTEC partner universities to ride out difficult times.

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Part 1

The Submission Process

1 INTRODUCTION

In 1996, the Western Australian Chamber of Mines produced a discussion paper on minerals tertiary education arising out of concerns it had about the quantity and quality of minerals related graduates available to the Western Australian mining industry. This initiative prompted the Minerals Council of Australia (MCA) to undertake a national review of minerals tertiary education from 1996 to 1998. The MCA conducted national seminars and received written submissions with a view to developing a strategy for how the minerals industry could engage with the tertiary education sector to ensure a sufficient supply of quality graduates in the disciplines of earth science, mining engineering and metallurgy.

These activities resulted in the publication in 1998 of the discussion paper *Back from the Brink, Reshaping Minerals Tertiary Education*. The review concluded that *Australia's minerals education system, in its current form, is fragmented, unstable and fragile and could be pushed over the brink of viability if it does not seize the opportunity offered by change in the university system for a true partnership between industry, government and academia*¹. It identified a series of initiatives and made recommendations as to what was necessary to ensure a more vibrant and sustainable tertiary education environment in Australia.

Back from the Brink recommended that the MCA:

1. Establish and fund the Minerals Tertiary Education Council (MTEC), and
2. Call for collaborative submissions from interested institutions to form a network of centres to work with industry in order to progress the initiatives outlined in the discussion paper.

In late 1999, the MCA Executive Committee agreed to resource an initial five-year program of engagement with the tertiary education sector. This program was to be managed by MTEC and involved working with nine consortia, three each in earth sciences, mining engineering and metallurgy. These consortia represented a total of 15 universities. It was agreed at the time that the program would be reviewed after three years.

This report summarises the outcome of that review. However, it has taken on added strategic importance due to the realisation in 2002 that, whilst MTEC was making progress, some fundamental changes in the minerals industry and the tertiary education sector may be causing the brink to advance at a faster rate.

¹ *Italics* used in this paper signify 'abridged' quotes from other sources, that is, they are not necessarily verbatim.

2 REVIEW PROCESS

The process that led to the publication of *Back from the Brink* involved contributions from mining companies, universities and technical colleges, consultants, proprietor associations, professional associations and government. Subsequently, the process has focussed on the MTEC partner universities. This has resulted in there being two agendas in the stakeholder forum; a broad program articulated in *Back from the Brink* and a staged and more detailed subset of this program agreed to between MTEC and its partner universities.

Against this background, it was decided to base the current review on the *Back from the Brink* program since:

- Most stakeholders would be more familiar with this program.
- Responses from MTEC partner universities could be slotted into this program.
- The review would be consistent with the process born out of *Back from the Brink*.
- It would provide a benchmark against which to critique changes affecting the viability of minerals tertiary education and the impact that MTEC is having in addressing these changes.

It was also decided that the review may canvas a broader range of ideas and provide a better measure of the commitment of stakeholders and the effectiveness of the MTEC/MCA process if the Terms of Reference were general. Hence, they simply stated:

Comments are sought on some or all of the “Initiatives” and “Nature of Change” in Back from the Brink, especially:

- *the degree to which you believe these have been met, and*
- *the relevance of these now given the substantial changes that have taken place in the minerals industry and the university system since 'Back from the Brink' was published, and*
- *what might be necessary to advance the program to the next stage.*

If possible please quantify your responses.

The “Initiatives” and “Nature of Change” documents that accompanied the Terms of Reference are contained in Appendix I.

The review committee comprised:

Mr RJ Carter	Previously, Chairman National Tertiary Education Taskforce
Mr B Cusack	President Minerals Council of Australia
Professor JM Galvin	Professor of Mining Engineering University of New South Wales

The call for submissions and the Terms of Reference were published in the AusIMM Bulletin and in addition, particular effort was made to bring the review to the attention of the following stakeholders:

- All persons and organisations that had made contributions to the *Back from the Brink* process and who may still have an interest in the process.
- The Project Director nominated in each MTEC partner university contract.
- The executive management of each university contracted to MTEC.
- Respective Minerals Councils in each Australian state
- Professional associations
- State and Federal Government.

3 SUBMISSIONS RECEIVED

A total of 35 responses were received, 34 of which were actual submissions, Appendix II. The breakdown of these is shown in the following table.

Stakeholder Group	Number	Comment
MTEC Partner Universities and Research Institutions	14	Two submissions each from two universities Two submissions each represent two minerals disciplines
Non-MTEC Universities, Technical Colleges	5	Four from two universities
Minerals Companies	7	Two from one mining company
Industry/Professional Associations	3	
Government	3	Two Federal and one State
Consultants/Individuals	3	

4 PROCESSING THE SUBMISSIONS

The initiatives articulated in *Back from the Brink* cover a broad range of issues. It was considered too ambitious by MTEC to address all of these issues in the first instance. Therefore, MTEC decided to focus on the following subset of initiatives:

1. Collaborative coursework development and delivery: Participating universities have agreed to develop appropriate course modules in a distant flexible delivery format in areas of their expertise and to deliver these into other MTEC universities.
2. MTEC lecturers: MTEC is funding each participating university to employ and develop a new member of academic staff to assist in innovative course development and delivery and to address the looming shortage of academics.
3. Industrial experience for undergraduates (IEU). MTEC is working with industry and universities to provide adequate, structured work experience for undergraduates.
4. Minerals Industry Postgraduate Coursework Program (MIPCP). This initiative is concerned with developing a nationally networked postgraduate program in order to remove course duplication, improve course quality and provide students with a larger and more appropriate selection of courses.
5. Centres of Excellence in Mining Engineering. MTEC is overseeing the establishment of two new centres of excellence in mining engineering: The National Centre for Mine Ventilation established by the University of New South Wales and the National Centre for Rock Mechanics planned to be based in Western Australia.

These initiatives correlate to varying degrees with those articulated in *Back from the Brink*. For example, the IEU initiative correlates directly, whilst the MIPCP initiative effectively replaces the concept of an Australian School of Mineral Resources (ASMR). On the other hand, MTEC has not focused to date on Initiative 2 of *Back from the Brink*, namely, *create a system of alternative educational pathways which ensures that the industry benefits from the great strength and depth of graduates in the wider tertiary education system*.

Understandably, some of the non MTEC partners who made submissions are not aware of these developments. Hence, care should be taken not to misjudge MTEC's performance when benchmarking against *Back from the Brink*.

It is apparent from the submissions that some stakeholders still attach a high or even higher importance to some of the *Back from the Brink* initiatives not addressed by MTEC to date. This feedback is summarised in this report, consistent with the terms of reference of the strategic review.

Part 2

The Current Situation

5 SUSTAINABILITY OF AUSTRALIAN MINERALS PROGRAMS

5.1 Generally

- i. In Australia, since 2000:
 - a. 7 minerals departments have closed – 4 of these were MTEC partners
 - b. 3 more are marked for closure
 - c. 4 have been rationalised
 - d. At least 1 other is under review
 - e. The Australian Mineral Foundation, formerly an active agency in the provision of short courses for the minerals industry has also ceased trading.
- ii. Minerals programs in Australia, South Africa and North America are reported to be closing down at a rate of about 2 per year.
- iii. There is no evidence that closure of a minerals department leads to an increase in enrolments at another minerals department.

5.2 Specifically

The following extracts from submissions from both MTEC and non MTEC partner universities summarise the situation as perceived by the universities:

- *Government has introduced student fees and budget cuts (in real terms) to contain costs. Universities have responded with funding models that reward faculties who generate large class sizes and deliver low cost, non-technological, courses. (SA)*
- *Government funding model results in “big is beautiful”. (Vic)*
- *In the last five years there has been a steady reduction in real funding to tertiary education and a steady increase in costs. Both combine to put high cost, low student number courses, such as those in mining and metallurgy, under greater strain and threat. (Qld)*
- *In the current economic climate it is becoming increasingly difficult for universities to justify extraordinary financial support to marginal programs, notwithstanding the ultimate economic importance to the nation of graduates (in these programs). (WA)*
- *Enrolments in tertiary minerals education programs in the Australian university system represent a very small percentage of overall tertiary enrolments (estimated to be <0.5%). This makes these programs vulnerable to closure irrespective of their economic viability. (NSW)*
- *Universities increasingly take the view that industry based programs, such as mining, should be subsidised by the industries that they serve. (SA)*

A number of MTEC partners in earth sciences admit that they are only being sustained by MTEC support. Some MTEC partners are being subsidised at a faculty level. Concern was expressed at the consequences of the inevitable withdrawal of faculty subsidisation at these universities as departments are progressively required to be self-funding. A number of MTEC partners are also being subsidised by research grant and postgraduate fee income. In some cases, this research income is being generated in areas not associated with the minerals industry. There are a range of factors that could affect this funding arrangement in the future.

The budget squeeze has caused some minerals departments to progressively shed staff. This is impacting on their capacity to resource and actively engage in innovation and MTEC initiatives and to retain MTEC Lecturers at the end of their three year MTEC subsidised contracts.

Industry submissions identified with aspects of the above situation:

- *Logistics and staff shortages threaten full realisation of collaboration opportunities.*
- *The long term nature of the need to reform the system of minerals tertiary education in Australia requires a similar long term focus from the funding bodies, that is, the Federal Government and the minerals companies. However, minerals tertiary education may become a lower priority over time and before significant changes are implemented.*

A number of submissions identified that a similar state of affairs exists in the technical college sectors that service the minerals industry:

- *It is becoming increasingly apparent that the problems that beset the sustainability of minerals tertiary education are also present in the technical college sector.*
- *There are now few TAFE Institute Directors or senior staff that have a background or direct interest in the mining/minerals industry. If the minerals industry demonstrates reluctance in using the resources available through TAFE, then those resources will be used for other industry disciplines.*

One submission expressed concern at the shortage of appropriately qualified geotechnical engineers amongst mining engineers, civil engineers and geologists: *...are sourcing engineering geologists from the south island of New Zealand because there is no longer any formal training in this area to the requisite level in Australia.* This submission went on to state that *It is considered essential that the universities develop a cooperative approach with the integration of the major faculties and departments.*

Minerals departments are having to diversify their course offerings in order to:

- Attract sufficient students to keep their programs viable.
- Provide employment prospects for those students who enrol in a cyclic upturn and then graduate in a cyclic downturn.

One of these initiatives is double degrees, encouraged by the introduction of student fees which motivate some students to graduate with two degrees for minimal extra outlay. Double degrees are reducing the pool of students prepared to enter the minerals industry upon graduation. They are one of the factors which cause estimates of minerals graduates to be 'rubbery'.

The situation may be summed up by the following submission extract:

If MTEC were to be disbanded in the near future, it would not have produced a sustainable outcome.... The potential of many of the recent initiatives may not be realised.

6 CAREERS IN THE MINERALS INDUSTRY

6.1 School Students

A number of the following points drawn from university submissions were also referenced in industry submissions:

- i. The number of school students studying maths and science at 'pre-requisite' university entry level to Science and Engineering programs continues to decline. NSW – 40% decline between 1995 and 2002. SA – 11% between 1999 and 2002.
- ii. The pool for minerals disciplines to recruit from is shrinking.
- iii. Those with a strong mathematics and science background are being attracted to IT.
- iv. Quality of those attracted to minerals disciplines is variable.
- v. Quantity remains cyclic. There are indications of improvement in enrolments in mining engineering, minerals engineering and earth sciences at some institutions, although total numbers will remain well below those of 1999 for some time to come.

6.2 Career Prospects in the Minerals Industry

6.2.1 University/Association Submissions

- i. *Parents, friends, teachers and career advisors continue to have the biggest impact on student career choices. One survey revealed that parents and friends influenced the career choice of 70% of students. Teachers and careers advisors influenced 40% of career choices.*
- ii. *The image amongst school students, their parents, and career advisors of the minerals industry and a career in it is one of low social status, a dying industry, crude, dirty and exploitive.*
- iii. *The increased prominence of environmental awareness and sustainability in school curricula and project work is displacing inquiry and interest in things technical and making the minerals industry an easy target for negative case studies.*
- iv. *Career choices are adversely affected by press reports of poor mining industry performance eg mine disasters, mine closures, environmental damage. The North Parkes disaster is associated with a 30% withdrawal rate of school leavers from one mining engineering program. There is concern that the environmental damage caused by mining activity tends to receive prominent media coverage, but the good environmental practices widely employed in the industry receive little media coverage.*
- v. *Minerals education providers lack the resources and skills to change public attitudes towards the minerals industry and careers in it.*
- vi. *There appears to be a considerable degree of duplication of effort and resources in marketing the minerals industry to society by various stakeholders.*

6.2.2 Industry/Association Submissions

- i. Submissions recognise the impact on recruitment of:
 - a. *Lack of public trust and old economy image of the minerals industry.*
 - b. *Cultural/media bias against the industry.*
 - c. *Increased competition for maths/science students.*
- ii. *Industry must take responsibility for recognising that both the quality and quantity of graduates will be influenced significantly by the perceived attractiveness of careers in the minerals industry and the marketing thereof.*
- iii. *Increasingly, students are making lifestyle choices. The demands of remote lifestyles, the isolation from one's network of friends and family and the dislocation of fly-in-fly-out are affecting the number of students electing mining careers.*
- iv. *Attracting high calibre undergraduates into the minerals industry will continue to be one of our greatest challenges – particularly as we compete against the business and finance sectors with the perception that they offer higher salaries and more “glamorous” careers.*
- v. *Positioning careers in the minerals industry as “careers of choice” is the sole accountability of industry but this cannot be achieved with any real success by entities within the minerals industry acting in isolation.*
- vi. *A steady stream of quality graduates can only be assured if the minerals industry has the discipline and commitment to provide stable recruitment patterns for graduates.*
- vii. *An integrated approach to managing both the supply and demand of appropriately qualified graduates is required.*
- viii. *There is a need for the development of clear career pathways to attract and retain graduates.*
- ix. *MCA to consider funding media adverts to attract students to industry.*

6.2.3 Other Contributions

- i. *The mineral industry does not fit the lifestyle aspirations of most of the young.*
- ii. *Careers in the minerals industry do not hold the social status and glamour of medicine, finance, information technology and biotechnology.*
- iii. *Geoscience and engineering education are seen as closed and narrow career paths, with all of the negative images of an old-fashioned, technologically backward, non-sustainable industry.*
- iv. *The fact is that, at the age and stage that most students make their tertiary education choices, they are not likely to be empathetic with the minerals industry. There is a need to be more inclusive as to educational background, skill sets and career stage in terms of attracting entrants to the industry.*
- v. *Increasing graduate salaries would assist in attracting quality and quantity.*
- vi. *The Australian Student Mineral Venture (ASMV) is very successful in attracting students into mineral-related tertiary courses, despite the relatively small number of school students who participate. Although it is relatively costly, there is a case for increasing the number of students offered the opportunity to participate.*

6.3 The MTEC Brand Name

The submissions attest to the following:

- i. The MTEC brand name:
 - a. is enhancing the credibility of minerals programs and is assisting in the marketing of them.
 - b. has caused some students to enrol in minerals programs when they otherwise would not have.
 - c. has caused some students who intended to study a minerals program to change their preference to an MTEC badged university.
- ii. Due the masking effects of external influences, other marketing initiatives and the short time that MTEC has been in operation, it is difficult to quantify the overall effect that MTEC has had on recruitment.

6.4 Graduate Placements

The situation with regards to graduate placements is best summarised by the following extracts sourced from a range of stakeholders:

- *The issues that determine the number of mining engineers that enter and are retained in mining operations in the Australian minerals sector fall mostly outside the control of the universities but within the control of the mining companies. Hence,*
- *Concepts that reward universities on the basis of the number of students employed in operational divisions of mining companies are unlikely to assist in sustaining quality mining engineering programs. (University)*
- *Need to recognise that mining engineering placements within some of these alternative employment sectors (e.g. skilled specialist consulting services, investment groups etc) may also be fulfilling a major, but largely unrecognised need for the industry. (University)*
- *Mining companies are forced to rely increasingly on use of external consultants but with the great reduction in professional employment by mining companies, the population of experienced consulting staff is ageing, and supply of experienced staff is also diminishing. (Professional Association)*
- *Graduates feedback suggests that the industry is fouling its own nest, image-wise, with FIFO operations and hours worked at remote locations. (Industry Association)*
- *Overall, only 18% of geoscience graduates take a job in the minerals industry. The percentage of graduates from some MTEC earth science programs is much higher than this, whilst some are lower. MTEC funds should be directed to those universities that have a track record for producing the highest percentage of graduates for the minerals industry. (University)*
- *There is a need for the development of clear career pathways to attract and retain graduates, such as those seen in the oil and gas industry. (Mining Company)*

- *Mining Companies should have structured graduate orientation programs to provide graduates with a variety of experience and exposure to a range of operational areas. These programs should be supported by continuing professional development for graduates through structured CPD programs. (Mining Company)*
- *The industry needs to flatten cycles of hiring and retrenching. These lead to lags and poor reputation with potential professional employees. (Industry Association)*
- *The situation for industry is becoming grave. One large Australian company offers vacation work to mining students, and seeks to contract them into employment a year before graduation. Many smaller mining companies (and some services companies) simply cannot get key technical staff. (Professional Association)*

7 COLLABORATIVE COURSE DEVELOPMENT AND DELIVERY

7.1 Influence of MTEC

The submissions from MTEC partner universities acknowledge that MTEC has:

- i. *Been the catalyst and driver of a step change in networking and collaboration (in lieu of competition) between partner universities.*
- ii. *Educated partners in modern learning principles and delivery modes.*
- iii. *Provided resources, otherwise not available, to develop course material in web-based, distant delivery format.*
- iv. *Demonstrated that web-based, distant delivery formats can facilitate tapping into teaching excellence in other parts of the globe*
- v. *Accelerated entry into modern education delivery modes.*
- vi. *Significantly enhanced quality of teaching material.*
- vii. *Facilitated overlap/gap analysis of postgraduate programs*
- viii. *Enabled access to and sharing of resource material.*
- ix. *Provided opportunity to undertake overlap/gap analysis of undergraduate programs.*
- x. *Demonstrated that there are economic, quality and consistency benefits for both students and industry by developing a national framework and standard for minerals tertiary education.*

There is very strong support for the periodic workshops conducted by MTEC for partner universities. These are credited with:

- i. *Enabling academic staff (in all MTEC programs) to get to know each other, a feat not achieved in the past.*
- ii. *Creating an understanding of what resources and programs exist at partner universities.*
- iii. *Facilitating the sharing of course delivery.*
- iv. *Acting as a catalyst for initiating course rationalization.*
- v. *Enhancing teaching methodology and learning techniques.*
- vi. *Extending these techniques to non MTEC minerals courses.*
- vii. *Being a most effective means of forwarding cooperation.*

One submission encapsulates these outcomes by acknowledging that *MTEC has the potential to change the manner in which academic institutions are structured and staffed.*

7.2 Degree of Collaboration and Networking

- i. *Considered to be 'high' at postgraduate level in Earth Sciences for those MTEC partners in South East of country.*
- ii. *Earth science partners are sharing considerable undergraduate and postgraduate course material.*

- iii. Considered by partners to be ‘reasonable’ in metallurgy and mining engineering. Stronger between some partners than others. One MTEC partner considers that *a true network, involving the effective sharing of academic resources and course materials in metallurgy and mining engineering, does not yet exist*. However, this same submission does acknowledge that *in a wider sense, MTEC has certainly caused the Universities to start to come together*.
- iv. One undergraduate MTEC program is already being shared between two mining engineering partners.
- v. Collaboration is ramping up in terms of undertaking gap/overlap analysis of programs offered by various partners.
- vi. Lack of collaboration between partners in Western Australia is noted in a number of submissions from a range of stakeholders (universities, industry, associations).
- vii. A number of MTEC partners recognise the need for further rationalisation of programs and better utilisation of resources across partner institutions.
- viii. Distance is a factor that is inhibiting collaboration – costs of travel and accommodation in particular.
- ix. There is a view that Cooperative Research Centres (CRCs) have caused a significant improvement in cooperation at post graduate level, however, this has not flowed to the undergraduate teaching level.

7.3 Non MTEC Partners

Comments from non MTEC partners include:

- a) *The idea of MTEC supporting the development of teaching modules across a range of mining disciplines was a fundamentally sound strategy.*
- b) *Some good teaching material has been produced.*
- c) *The MTEC collaborative course modules should be made available to all Australian tertiary minerals education institutions.*

7.4 Challenges

The submissions identify a number of issues affecting the development and delivery of distant, flexible delivery course material. These include:

- i. The development of world-class course materials and their innovative delivery involves significant human resources and up-front and on-going costs. Increases in the national average staff/student ratio for engineering courses over the last decade from around 12/1 to 18/1 and preoccupation with deteriorating economic circumstances have restricted the opportunity for some MTEC partners to allocate resources and to become immersed in this initiative.
- ii. There is a growing appreciation of some of the difficulties and limitations associated with “flexible format” learning. In particular, those courses of a practical nature will still require face-to-face teaching components if they are to be effective.
- iii. If the sustainability of tertiary minerals education programs in Australia is not addressed effectively in the near future, there will be no staff to deliver the material and no students to deliver it to.

8 ACADEMIC STAFF

8.1 Staff Profile

Back from the Brink identified an element of the problem to be *an acute shortage of talented staff, as a result of University remuneration packages having become hopelessly uncompetitive with those in the minerals industry*. Apart from the introduction of MTEC Lecturers, the submissions indicate that the situation has deteriorated due to:

- i. The academic profile continuing to age, with many eligible to retire in the next few years.
- ii. The remuneration gap continuing to increase.
- iii. The lack of students undertaking postgraduate studies.
- iv. The lack of industry experience amongst potential academics.
- v. The lack of resources to employ new staff (many departments are shedding staff).

8.2 MTEC Lecturers

Of the five initiatives currently being supported by MTEC, the establishment of MTEC Lectureships is the one with the most immediacy and presence. All partner universities were allocated a position and this position is funded in advance by MTEC. The incumbents are expected to be actively engaged in assisting to achieve the objectives of the other MTEC initiatives. MTEC has devoted considerable additional resources into developing these staff members for this purpose.

With two exceptions (discussed later), it is clear from the submissions of MTEC partner universities that the MTEC Lecturers are highly valued and are contributing in a range of ways, some of which were not envisaged at the start of the initiative. Contributions include:

- i. Functioning as effective cultural change agents by innovating, networking, collaborating, developing new programs, relating to students, linking to industry and working outside traditional university frameworks.
- ii. Providing a flow-on effect of enthusiasm and commitment towards innovative teaching.
- iii. Growing new research bases.
- iv. Providing critical staff mass.

Nevertheless, one university submission considers that *it is doubtful as to whether the individuals concerned (with one exception) have contributed to the wider notion of an MTEC network*. This contrasts with the bulk of the university submissions which clearly indicate that MTEC Lecturers, facilitated by MTEC workshops, have made a major contribution to breaking down barriers between universities and to networking. A number of reasons such as interpretation, expectations and level of engagement in MTEC workshops may account for this disparity.

There is a general concern as to the future of the MTEC Lecturers when current MTEC funding expires. It appears that many partners cannot afford to renew their contract unless further financial support is forthcoming.

Two MTEC partner universities (being the exceptions referred to earlier) failed to make any reference to the presence and role of their MTEC Lecturers. This omission was not inconsistent with the overall quality of their respective submissions. Effectively, these two submissions displayed little affinity with the MTEC vision and a poor understanding of the drivers, directions and achievements of MTEC.

8.3 Quality of Teaching

Back from the Brink and the subsequent MTEC initiatives were born out of concerns regarding the quantity and quality of minerals graduates. Given that the quantity of students determines the viability of minerals tertiary education programs, it is not surprising that most submissions made some reference to this issue. However, quality was only raised in two university submissions and one industry submission. All three focused on the quality of teaching, rather than the quality of the graduate. They encapsulated the following points:

- i. *The MTEC collaborative course development and delivery initiative is exposing students to a group of world class lecturers, including industry specialists and international lecturers.*
- ii. *At this stage, teaching quality is being affected primarily through improved teaching resources and the development of alternative delivery modes funded by MTEC, rather than through raising the quality of existing teaching staff.*
- iii. *Whilst it is important for academics to undertake research, this should not be at the expense of teaching quality.*

9 INDUSTRIAL EXPERIENCE

A range of responses was received which are open to a number of interpretations. Some respondents reported that the Industrial Experience Undergraduate (IEU) website had been very successful in gaining industrial training placements for undergraduates whilst others reported that, at best, it was marginally effective. It is possible that the website has been responsible for redirecting some industrial placements from one institution to another, with no net gain. The principal conclusions that can be drawn are:

- i. MTEC has created an awareness of the importance of structured undergraduate industrial experience.
- ii. MTEC has caused an improvement in the quality of industrial experience provided by industry.
- iii. The IEU Website is growing but is not as effective as envisaged.
- iv. Students, universities and industry still make direct approaches to each other.
- v. Some industry partners have a misconception as to the function of the IEU website.
- vi. The number of placements is still well short of demand.
- vii. Industry rationalisation and workplace restructuring are limiting the opportunities for industrial training.
- viii. Some organisations consider that they do more than others.
- ix. There is recognition by some industry partners that industrial training needs to be more actively supported.

10 POSTGRADUATE AND CPD

10.1 Masters by Coursework

Submissions from MTEC partners in the earth science discipline dominated this category. This is not surprising given that these partners have focussed on the collaborative development and sharing of postgraduate programs.

There was a reasonable degree of consistency in submission content, which may be summarised as:

- i. Collaboration between MTEC partners has resulted in a world class program taught by world class presenters.
- ii. Despite some material being world-class, enrolments in most traditional coursework programs are below sustainable levels in all three MTEC disciplines (earth sciences, metallurgy, mining engineering).
- iii. Typically, each program requires 15 students to be viable. However, most currently run with 4 to 10.
- iv. The introduction of full fees by the Federal Government for Masters by Coursework has seriously affected enrolments and, hence, the viability of Masters by Coursework programs.
- v. Some MTEC lecturers are successfully causing enrolments to increase.
- vi. Some programs would cease but for MTEC support.
- vii. A number of universities involved in earth science suggest that the solution lies in:
 - Industry committing to send students to these courses for CPD purposes.
 - Recruitment of international fee-paying students.
 - MTEC assisting in recruiting fee-paying international students, both by making approaches to Australian international aid programs and by marketing programs overseas.

10.2 MIPCP

Direct or indirect reference to the Minerals Industry Postgraduate Coursework Program (MIPCP) was made in most of the MTEC partner submissions. Effectively, the earth science partners viewed it as an extension to the Masters by Coursework activities they had already been undertaking for MTEC, whilst the MTEC mining engineering and metallurgy partners recognised it as an initiative distinct from their other MTEC commitments. This is understandable given the nature of the MTEC contracts.

Extracts from two submissions, one representing mining engineering and the other mining engineering and metallurgy, are useful for encapsulating the views of the mining engineering and metallurgy partners.

- *The concept of the MIPCP provides for far greater flexibility and opportunity for students, without compromising course quality, or flexible entry objectives than the original objective of establishing the AGSMR. However,*

- i. *It will require ongoing MTEC support to realise the potential.*
 - ii. *The need to clearly identify future industry requirements is an urgent priority.*
 - iii. *Each university must then be prepared to recognise other providers in areas of agreed excellence and rationalise courses accordingly.*
 - iv. *The apparent lack of commitment by some sections of the industry to support postgraduate students engaging in CPD is an obstacle to the viability of any postgraduate coursework initiatives at any university.*
 - v. *These issues are considered a priority area for future MTEC activity.*
- *The approach being developed is eminently sensible, provided*
 - i. *there is a genuine market, and*
 - ii. *it is recognised that individual institutions now have some marketable programs already in place and these will not be surrendered.*
 - iii. *Institutions may still develop specific postgraduate programs in the future that will co-exist with the “MTEC Masters”.*
 - iv. *The worst situation would be for MTEC to advertise/promote courses, only to have to cancel them in the light of uneconomic numbers, thus alienating the few who did enrol.*

(One submission made it clear that the alienation referenced in the last point has already occurred in the field of earth science.)

It appears that there is a clear distinction between the approaches of the earth science partners and the mining engineering and metallurgy partners to the concept of MIPCP:

- The earth science partners have developed top class products and are now seeking a market for them.
- The mining engineers and the metallurgists are hesitant to develop products until they have a committed market for them.

The submissions indicate that the position of MTEC university partners with regards to the concept of a MIPCP is:

- It is a sensible and sound concept.
- It has support at a department level within respective universities.
- There remain a number of bureaucratic and administrative hurdles to overcome at a university executive level related to matters such as fee structures, recognition of prior learning and program duration.
- The transfer of students and/or staff between partner institutions is very expensive and involves a number of logistical issues yet to be adequately addressed.
- The introduction of full fees for Masters by Coursework programs means that any minerals related programs are unlikely to be viable unless industry commit to providing students and assisting with student fees.
- Lack of industry engagement with the process to date may be frustrating the initiative.

Only two industry submissions make a direct or indirect reference to the concept of a MIPCP. These comments suggest that the industry need for such a concept identified in *Back from the Brink* is still relevant and important:

- i. *Important practical initiative that is being embraced by industry.*
- ii. *Little, if any work appears to have been done towards the creation of a world-class centre for postgraduate minerals education.*

Overall, the submissions suggest that industry needs to become more engaged in this initiative in order for it to progress.

10.3 Continuing Professional Development

Significantly, Continuing Professional Development (CPD) was raised in submissions across the full spectrum of stakeholders. Some of the issues have already been noted in earlier sections of this report relating to Masters programs and MIPCP. Further points for consideration that can be gleaned from the submissions include:

- i. Industry restructuring and cost savings have resulted in a reduction in structured professional development programs within companies.
- ii. Many companies have significant internal training programs which may be termed CPD.
- iii. Work rosters are not conducive for employees undertaking CPD.
- iv. Those organisations operating in the coal sector have an awareness of the role of CPD in maintaining competencies and satisfying ‘duty of care’ obligations. One of these mining companies submitted that:
 - a. *Changes in statutory certification processes will catalyse industry action for supporting CPD*
 - b. *There is a need for more integration of courses and programs to provide continuity between undergrad and CPD learning.*
- v. The MIPCP Program can result in “fit for purpose” CPD programs that have national portability.
- vi. The best market for CPD programs appears to be in areas related to managing core risk in mining e.g. risk management, mine ventilation, ground control.
- vii. At least one MTEC funded undergraduate/postgraduate program has already been adapted and is being used for the training of statutory Mine Ventilation Officers. The income from using this program for CPD purposes is being utilised to support undergraduate teaching activities.

11 CENTRES OF EXCELLENCE

The concept of two centres of excellence in mining engineering, one in Mine Ventilation and the other in Rock Mechanics, was referenced in the submissions of each of the three MTEC mining engineering partners. One submission noted that:

The Australian National Centre for Mine Ventilation:

- *Has established a strong presence in undergraduate and postgraduate teaching in mine ventilation.*
- *Provides a starting point for building a research capability in this area. However,*
- *Is faced with global competition for research income, particularly from other priority sectors beyond the immediate mining engineering or mine site related sectors.*

The presence that this centre has established in undergraduate and postgraduate teaching in mine ventilation was acknowledged in a range of other submissions.

Two submissions noted the lack of progress in establishing a National Centre in Rock Mechanics in WA. One of these submissions acknowledged that *there is significantly more scope for research in rock mechanics, as it is a core component of virtually every type of mining.*

The third mining engineering partner submitted that:

- *Centres of excellence develop in particular locations based on the efforts of the local individuals. These are not national centres in the sense that they involve substantial contributions from different institutions across the country. They are national centres in the sense that they operate nationally, and are seen by the industry as national resources.*
- *The mining situation is likely to be very similar. It is likely that excellence in ventilation and geomechanics will develop primarily in individual institutions.*
- *Despite the earlier ideas that MTEC could play a real role in establishing national centres of excellence, the role should no longer be a priority for MTEC, either in terms of effort or funding.*

It is noteworthy that none of the submissions considered how a National Centre in Rock Mechanics might address the critical shortage of geotechnical engineers in the Australian minerals industry

12 RESEARCH

Many of the issues canvassed under other headings in this report are associated with research. This section is concerned with those that impact on the sustainability of minerals tertiary education.

Back from the Brink recognised that academics have a teaching and research role within the university system. This was appreciated in various ways in submissions from across the full range of stakeholders. The main points of concern were:

- i. Research has traditionally provided sources of additional funding to support academic activities and teaching initiatives within university departments.
- ii. The shift away from centralised industry funded centres towards competitive bidding for research grants has opened the market up to new players, including private consultants. This is having the effect of taking money out of the tertiary education system.
- iii. The success rate for minerals-related ARC-funded project proposals is poor, apparently because the applied nature of these projects does not sit well with an ARC focus on basic (pure) research.
- iv. The financial sustainability of minerals tertiary education will suffer if it cannot attract research funds to the same extent as other university disciplines.
- v. Linkage to a CRC provides an opportunity to subsidise teaching initiatives, especially at undergraduate level.
- vi. University, industry and professional associations expressed concerns at over-reliance on research institutions to satisfy future teaching needs, especially in regards to dedication and quality of the teaching effort.
- vii. *It is important not to jeopardise Australia's significant position of strength in minerals research by under-resourcing or taking the situation for granted.*

13 PROFESSIONAL ASSOCIATIONS

The AusIMM was the only professional association to make a submission. This submission was focused on the state of tertiary education in metallurgy.

Only one submission from those MTEC partners engaged in earth sciences made mention of a professional association. This was in regard to the AusIMM course recognition process.

The AusIMM was referenced by two MTEC mining engineering partners and one non-MTEC partner. One of these MTEC partners also made reference to the IEA.

One industry submission recognised that the Mine Managers Association was a stakeholder in minerals tertiary education.

It appears from the submissions that AusIMM and the IEA have a low level of engagement in the MTEC process.

14 ALTERNATIVE PATHWAYS

Given that this topic constitutes Initiative 2 from *Back from the Brink*, it is not surprising that it has elicited comment from across the full range of stakeholders. The comments lend themselves to summary under the following headings:

- Earth science submissions: MTEC partners do not identify with the industry meaning of the concept. Rather, they tend to relate it to the cross-skilling of those who already have a degree in geoscience. This is in stark contrast to that of another earth science submission from a non-MTEC partner which was of the view that *despite the rhetoric of “Back from the Brink”, (the minerals industry) is still trapped in a linear view of education and career development.* This submission went so far as to suggest *why not hire expert HR and finance managers, commercial decision-makers, IT people, etc, and train them in the limited bits of geoscience and the mining process that they require?*
- Mining Engineering and metallurgy submissions. These display industry’s understanding of the concept and relate it to a number of MTEC initiatives already in hand. Comments included:
 - *The need for alternative pathways is as real now as it was in 1998.*
 - *This objective is still clearly very important, and is highly appropriate for MTEC to undertake, but it requires industry commitment to achieve it.*
 - *The difficulty in enunciating and quantifying industry needs has hampered university ability to plan for, and provide for those needs.*
 - *Although MTEC addresses tertiary education, greater focus needs to be given to pathways from the State-funded technical and further education (TAFE) programs and also to pathways back into further education from tertiary education.*
 - *The industry would benefit from a common framework for mining competency and qualifications.*
- Alternative Pathway Provider. This submission noted that:
 - *In recent years there appears to have been a drift away from the mineral industries engagement in VET/TAFE issues.*
 - *Other professional engineering bodies, such as the Institution of Engineers, Australia has taken quite a different approach and continue to be closely involved in technician and para-professional education.*
 - *Whereas, up to a decade ago, it was relatively common for many TAFE students to gain credit transfer and articulate into mining and metallurgy/materials degrees, these pathways appear to have all but disappeared.*
- Mining Companies. Although only one mining company made detailed comments, these captured many of the salient issues, viz:
 - *Conversion courses for non-graduates remains a useful but challenging initiative; very relevant for Minerals Processing and Mining Engineering.*
 - *Differing opinions exist in industry about the preparation required; there is some lack of understanding of the current constraints existing within centres (eg hours, teaching staff etc).*

-
- *Important that centres achieve consistent national standards of learning outcomes.*
 - *Has the potential to resolve significant threats to all stakeholders but requires innovative approaches by all.*
 - *Requires a review to confirm viability and an action plan for this initiative.*

It would appear from the submissions that as far as non-MTEC members are concerned, little has changed in regards to alternative pathways since *Back from the Brink* was published. This may be correct given that MTEC has deliberately chosen not to address this issue up to this point in time. It is known however, that change in this regard has occurred in some institutions as a result of faculty or university policy.

15 CURRENT MTEC MEMBERSHIP

There is a view amongst some non-MTEC universities that failure to gain membership of MTEC in 1999 amounted to a *de facto* withdrawal of accreditation for their programs. One submission also motivates gaining membership of MTEC on the basis that *the widely accepted definition of tertiary education in Australia is that it includes two major sectors, Higher Education, (the university sector) and Vocational Education and Training (VET), predominately TAFE.* These submissions request another opportunity to gain membership of MTEC.

A significant difference stands out between two of these submissions in regards to what they are asking for. One effectively seeks MTEC membership in recognition of the benefits of being associated with the MTEC network and profile. It specifically acknowledges that *new 'funding' need not be financial.* In contrast, the other submission is premised on the view that there should be at least one minerals program in each discipline in each state and that *funding of \$300 000 per annum, supplied jointly by MTEC and Federal/State government* would see their discipline flourish in their home state.

16 INTERNATIONAL COURSES AND STUDENTS

Submission comments can be summarised as follows:

- i. Some earth science programs and mining engineering programs are attracting international students to Australia but the number is small and not sufficient to impact on program viability.
- ii. Some earth science MTEC partners have a desire to attract international students to Australia in order to make their programs viable and, to this end, are seeking MTEC support to market them to organisations such as AusAid.
- iii. The potential to deliver MTEC programs internationally was recognised by a number of university providers.
- iv. The potential was also recognised in two industry submissions. One was qualified by *only in select areas*. The other was concerned with growing *an Asia-Pacific pipeline for talent in the Australian mining industry*.
- v. One minerals processing program and one mining engineering program are already being delivered internationally in a flexible format.

17 THE CONCEPT OF A NATIONAL SCHOOL

Two submissions made references to the formation of some form of National School of Minerals education. These were contrasting:

- *We recommend that reconsideration is given to the original concept of an Australian School of Mineral Resources, provided that it is established as a borderless network to encourage input from a wide range of public and private providers. It should also have a specific charter to utilise modern, high quality, computer-based training technology. It should be established as a corporate entity with a clear charter to build an international business in education and training delivery for the industry, and a sound business plan for achieving commercial sustainability.*
- *Any thought of an Australian Academy type concept is premature and at the present stage of MTEC development, would be a distraction from the priority tasks facing MTEC.*

18 UNIVERSITY/INDUSTRY/GOVERNMENT ENGAGEMENT

18.1 Parent University Support

Some universities have demonstrated strong commitment to the minerals industry, with combined contributions exceeding several million dollars in cash alone. However, with one exception, much of this has been directed towards research and postgraduates initiatives and not towards undergraduate education. Three industry submissions specifically queried the long term support of parent universities to the MTEC education initiatives.

18.2 MTEC in General

Submissions across the full spectrum of stakeholders attest directly and indirectly that, at a national level, MTEC is playing an important role in:

- a) Bringing to the attention of government those issues that affect the future of minerals tertiary education in Australia.
- b) Bringing the importance of minerals education to the attention of university executive, thereby
- c) Causing small minerals departments to maintain a presence in large comprehensive universities.
- d) Increasing industry's understanding of tertiary minerals education issues.
- e) Aligning the visions of tertiary minerals providers and the minerals industry.
- f) Leveraging financial support from university partners (e.g. MTEC Lecturers, new course development, MTEC workshops, capital grants, education trust and scholarships).
- g) Providing *influential input into the development of National Research Priorities and funding of CRCs.*
- h) Generating MCA Executive support for minerals tertiary education.

This is being achieved in a variety of ways:

- Executive Director, MTEC, membership on the Advisory Council (Industry Visiting Council) of at least one major school.
- Engagement of the Executive Director, MTEC, with Executive Management of MTEC partner universities.
- MTEC workshops structured to provide CPD to academic staff.
- Participation of Executive Director, MTEC, in a range of discussions and forums associated with university reform.

There is a range of opinion as to the effect that MTEC has had on industry support and linkages for universities at a local level.

- a) In general, the earth science partners consider that it has enhanced their linkages with industry.
- b) One mining engineering partner has acknowledged in some detail how MTEC has enhanced the profile of the discipline and the mining industry within the university.
- c) Another mining engineering partner has submitted that *MTEC has made no difference to the exceptionally strong linkages that already existed (with industry) and has not enhanced the linkages. It is probably unlikely that MTEC can contribute much in this regard, as the industry support is regionally based and best left to the individual institutes.*
- d) On the other hand, one major industry stakeholder effectively cautioned that *some centres are relying too much on ongoing "goodwill" and local industry support and that more collaboration is required amongst universities.*

It would appear, both from what is contained in the submissions and what is not, that the sum total of university support to the MTEC initiative is very high (exceeding \$2 million in cash alone) but that this support is not uniformly distributed.

18.3 MTEC Management

Both universities and industry acknowledged the leadership being provided by the MTEC Executive. For example:

- *** is very satisfied with the leadership and administration of the program. The Executive Director and his support staff have worked tirelessly and effectively to advance the program, keep the associated bureaucracy and reporting to a sensible minimum, and keep the communication lines open. The MTEC meetings and workshops have taken place at a sensible frequency and have been effective. (University)*
- *Secretariat is well regarded by stakeholders and is recognised as having made some key achievements in a difficult area. (Industry association.)*

Part 3

Advancing the Initiative

19 ADVANCING THE PROGRAM

The general nature of the Terms of Reference elicited a broad range of proposals for advancing the initiative. Not surprisingly perhaps, given the current state of minerals tertiary education, all submissions were premised on the continuation of MTEC.

It is not practical to summarise all proposals in this report. The following sub-sections attempt to capture the essence of the proposals. Some proposals have been omitted because they are initiatives that MTEC has either already evaluated or is in the process of implementing. Nevertheless, these submissions serve a purpose in that they confirm a need to improve the marketing of MTEC to both the general public and within sponsoring mining companies.

19.1 MTEC Objectives and Relevance

Both university and industry submissions identified that the challenges facing minerals tertiary education are as serious today as they were in 1999.

- *The objectives outlined in Back from the Brink are still very relevant and should be a focus of industry and MTEC to advance the program initiatives to the next stage.*
(Industry)
- *The set of issues associated with change are as relevant now as they were in 1998.*
(University)

All submissions either pre-supposed that MTEC would continue or recommended that it should:

- *MTEC is best placed to lead the reform of the minerals tertiary education system, because it is nationally-based, and therefore covers the whole Australian industry, and Canberra-based, with access to the Federal Government and its funding. Importantly, it has a track record of achievement.* (Industry association.)
- *...the MCA and MTEC (should) exert real leadership in this time of restructuring and rapid change in the industry, by developing an educational blueprint for the industry of 2010 and beyond. This will necessarily mean making people and organisations uncomfortable.*

A number of submissions explicitly or implicitly acknowledged that the industry and university circumstances at the time of formulation of the MTEC agenda have changed. Some of these questioned if there was a need to adopt different or more innovative approaches to minerals tertiary education in some areas. These areas included:

- Recruitment strategies (eg coordinate nationally through MTEC)
- Recruitment markets (eg source graduates in other disciplines and resource bridging programs)
- Industrial training (eg Incorporate “Recognition of Prior Learning (RPL)” for students with existing experience, training outside of normal Christmas break)
- Discipline range covered by MTEC (eg expand to include activities that contribute to sustainability of whole industry)
- Education models eg

- *“Collaborate or close” philosophy should be debated; alternative solutions may be possible to avoid damaging fallout and loss of skills/capacity*
- *Academic mix of teaching and research remains important but alternative models may be appropriate, eg develop research centres with R&D-focused staff as well as research/teaching staff mix.*
- Membership of MTEC eg
 - Collapse all three disciplines into three institutions, that is, only have three MTEC university partners, each of which teaches earth sciences, mining engineering and metallurgy.
 - Develop CRCs around these three institutions.
- University/industry partnership (eg *Ensure industry membership of advisory councils is “high profile” to improve links between industry and universities*).

One university, one industry and one professional association submission each recognised that there is a need to base decision making on a more reliable database. One submission was in regards to student enrolment numbers (‘rubbery’) and the other two related to graduate destinations and retention ratio within the minerals industry. Both are required in order to measure the magnitude of the problem so that it can be more effectively managed.

19.2 Marketing

The submissions identified that, in order to achieve the tertiary minerals education goals of the MCA, there is a need to increase the marketing effort at three levels:

Level 1

A number of submission from non-MTEC universities noted that they do not know what had been achieved by MTEC. These conclude that MTEC needs to market itself and its activities more. This was supported by one submission from an MTEC partner university, three submissions from industry and one submission from an industry association.

MTEC is a valuable resource to the industry, however, there needs to be more emphasis on communication and networking of the group to facilitate a greater degree of understanding in the industry as to how exactly MTEC can deliver change. Our view of MTEC is that it should be the catalyst for collaboration across the industry and therefore, it need to raise its profile with mining companies. (Industry submission)

Level 2

A number of submission from MTEC universities noted advantages in MTEC marketing its programs at a national level. It appears that university partners consider that this will not only reach a larger audience but also enhance the creditability of the programs.

Level 3

It is apparent that considerable scarce educational resources (cash and time) are being redirected by individual minerals departments to marketing the ‘image’ of the minerals industry as a starting point in trying to get students interested in their programs. These initiatives are not co-ordinated nationally at any level (across universities, in association with the MCA, AusIMM

etc). The cost effectiveness of initiatives such as school programs, scholarships, ASMVs, school and media advertisements is unknown.

Both industry and university submissions identified that a nationally coordinated marketing campaign is required to raise the profile of careers in the minerals industry. A number of these submissions specifically identified MCA/MTEC as the body to resource and undertake this task:

- o *MTEC should review the effectiveness of marketing and recruitment initiatives of all stakeholders.*
- o *MTEC should take a more prominent future role in facilitating and co-ordinating the national school student recruitment activities and marketing of the industry profile and prospective career opportunities.*

One industry submission suggested that:

MTEC organise a bi-annual seminar to track changes and needs and ensure communication between stakeholders

This suggestion would appear to address a range of issues raised in this strategic review.

19.3 Recruitment

Student enrolments determine program viability. Since 1999, enrolments have entered a trough. This has coincided with a budget squeeze on universities. It is apparent from the submissions that these factors have distracted some MTEC partners from the MTEC initiatives. Specifically, they have been preoccupied with fighting to stay in business rather than focusing on working with MTEC to improve the business.

All stakeholders recognised the need to urgently address student enrolments. Some proposed solutions were cached in a traditional framework, others were more innovative. Suggestions addressed the following range of needs:

- Increase the number of students studying maths and science at school – MTEC and government.
- Improve industry image – industry.
- Proactively market minerals career paths – industry and universities.
- Proactively market minerals programs – universities and MTEC.
- Adopt more stable recruitment patterns – industry.
- Government funding to be more flexible towards minerals tertiary education – government.
- Fund more scholarships and ASMV type activities – industry.
- Increase salaries – industry.
- Attract more international fee paying students – universities and MTEC.
- Broaden the scope of minerals programs to provide graduates with more alternative career structures in order for them to justify the significant investments of time and money in university education – universities.

19.4 Collaboration and Networking

A number of submissions emphasised that *the network goal was the highest priority in 1998 and continues to be the case, and it is more important in 2003*. Putting aside the Western Australian situation for the moment, when all the submissions are reviewed, there is no doubt that MTEC has been very successful in fostering collaboration and networking across its members – *MTEC has been the catalyst and driver for a step change in collaboration..* Most of the university partners acknowledged this collaboration and many expressed a degree of surprise and excitement as to where it was leading and what could be achieved as a result.

It is apparent from the submissions that MTEC workshops and MTEC Lecturers have contributed significantly to achieving these outcomes. However, most universities made it clear that they could not retain their MTEC Lecturer at the end of their three-year contract unless further financial support was forthcoming (from MTEC).

Whilst some university submissions considered that true collaboration had been achieved, a number of other university and industry submissions recognised that this goal was still some way off. However, it was generally appreciated that it would take time to change university culture in order to achieve such a goal and, therefore, it would be over-ambitious to expect it to be achieved by this stage.

Submissions from industry and professional and proprietor associations identified an urgent need to resolve the “holding pattern” of the Western Australian institutions in order to advance the tertiary minerals education initiative.

The three WA universities need to cooperate and rationalise programs in order to realise efficiencies and attract students. Current competition is to detriment of industry and potential professionals.

Proposals (all from MTEC universities) for advancing collaboration and networking included:

- *MTEC Workshops in 2003 focus dominantly, perhaps solely, on the task of usage of MTEC material.*
- *MTEC Lectures continue to be funded after expiration of their current contracts.*
- *MTEC make the continued funding of the MTEC lecturers conditional on demonstrable progress in the utilisation of existing MTEC material.*
- *Removal of internal university administrative impediments to course sharing.*
- *Address in more detail the practical, logistical and economic issues associated with national delivery of coursework (undergraduate and postgraduate). This includes optimum models for moving students around (local and international); or staff, or both; plus the provision of appropriate facilities at universities for distance delivery and effective student learning by remote access.*

19.5 Course Development

Those MTEC universities who have developed course material for MTEC within their contracted time frames are keen to extend the initiative into other subject areas:

Stepping up of the current MTEC initiative to cover the overall program would be in the interests of the industry in terms of more common and consistent standards of graduates across the country; and also in the interests of the universities in terms of portability of shared resource material and staff, with improvements in both teaching quality and operating efficiencies.

However, experience is also indicating that the costs of delivery of this material may be higher than originally envisaged. These costs are associated with:

- i. Provision of appropriate classroom facilities
- ii. A realization that the programs still require a degree of face-to-face teaching to be effective.
- iii. Maintenance of programs in an up-to date form.

One university considers that the *MTEC initiative has the potential to deliver quality, cost effective CPD and, in some instances, competency-based training to the minerals industry*. One industry submission appears to have identified a similar potential:

Ensure that courses are accredited and linked to relevant career development structures – eg training, certificates, job descriptions

Industry identifies four issues relevant to advancing course development:

- i. Ensure that courses are not over-reliant on individual teachers.
- ii. Involve industry professionals in course development and delivery.
- iii. Maintain courses up to date.
- iv. Be more innovative.

19.6 Academic Staff

In order to advance the MTEC initiative, *it is becoming increasingly critical that future academics are identified, secured and trained in all discipline areas. A continuing strategic development of the MTEC lecturer program is needed to address this important future need.*

19.7 Alternative Pathways

Alternative pathways were considered relevant to future directions by a range of stakeholders. Some considered that they had taken on added importance since *Back from the Brink* due to the changes that have impacted on both the university system and the TAFE system. Issues that were identified for attention in order to advance this initiative were:

- i. Articulation of alternative educational pathways into minerals undergraduate and post graduate programs. (One submission charged MTEC with this task.)
- ii. Recognition of prior learning from other institutions, portability of student enrolments, recognition of other courses and assessment processes as satisfying degree requirements, and more flexible entry requirements.
- iii. Alternative pathways and qualifications need to receive recognition from statutory qualifications boards and senior mine management.

19.8 International

One university submission noted that:

MTEC is the logical vehicle to link up with other international initiatives related to minerals tertiary education

Some universities recognised that:

A number of the MTEC initiatives are enabling various providers, both individually and collectively, to have a greater potential to attract international students, and also provide to the international market. This potential should be pursued as a higher priority in future MTEC activity, as a means of providing greater sustainability to the Australian MTEC providers

An industry submission noted a similar opportunity but made it an MTEC objective after 2005.

19.9 Research

A number of submissions suggested that MTEC could advance the position of minerals tertiary education by assisting its partner universities to:

- i. Strengthen their links with CRCs.
- ii. Improve their success rate in ARC grants.

19.10 Leadership

Two industry submissions made reference to a need for industry champions in order to advance the process.

19.11 Performance Auditing

Submissions across the full range of stakeholders considered that the initiative could be advanced by auditing existing MTEC partners as a basis for:

- i. Weeding out non-performing or non-committed MTEC partners.
- ii. Basing funding on performance.
- iii. Assessing parent university commitment to sustaining minerals tertiary education and the MTEC objectives.
- iv. Providing the opportunity for new partners to join the consortium.
- v. Encouraging a greater level of innovation

Part 4

Conclusions

20 CONCLUSIONS

The challenges facing minerals tertiary education in Australia are more serious today than they were when MTEC was constituted in 1999. The changes in university education and their impacts as foreseen in *Back from the Brink* have materialised. These have been compounded by coinciding with major restructuring, consolidation and globalisation of the Australian mining industry and a number of external influences not foreseen in *Back from the Brink*.

With few exceptions, Australian minerals tertiary education programs are not viable under current circumstances. Seven have closed in the last three years, three more are marked for closure and it appears a number of others remain open only because of MTEC support; financial and/or political. The problems do not all relate to whether the programs are viable in their own right. Just as consolidation and the quest for productivity in the minerals industry has caused large mining companies to dispose of small assets, so too is behaviour in the university system resulting in resources being redirected from small to large departments.

Minerals disciplines are further disadvantaged by a range of other external factors that include:

- Ongoing funding cuts to universities in real terms.
- University funding models that increasingly favour high volume, low teaching cost programs.
- A smaller pool of school leavers possessing the required level of maths and science to be admitted into university minerals programs.
- Increased competition for these students, especially from emerging ‘new economy’ disciplines like Information Technology, Telecommunications and Photovoltaics.
- A declining image of the minerals industry as a “career of choice”.

Against this background, it is difficult to quantify the effects that MTEC has had on the viability of minerals tertiary education in Australia. External influences have increased and probably outweigh gains. However there can be no doubting that MTEC is having a significant effect on minerals tertiary education. MTEC has:

- i. Influenced public policy related to minerals tertiary education.
- ii. Brought the importance of minerals education to the attention of university executive and thereby,
- iii. Caused small minerals departments to maintain a presence in large comprehensive universities.
- iv. Leveraged significant financial support from university partners.
 - v. Been the catalyst and driver for a step change in collaboration between universities.
 - vi. Increased industry’s understanding of tertiary minerals education issues.
- vii. Acted as a conduit to government on tertiary minerals education matters.

Some MTEC partners consider that a high level of collaboration has been achieved. Given the culture in which these partners have traditionally operated, the degree of collaboration that has been achieved in such a short time frame is remarkable in many aspects. However, in general it falls well short of the desired target and has yet to be optimally converted into increased quality, efficiency and then economic gain. MTEC has been successful in initiating a significant cultural shift across a range of disciplines and entrenched work environments but considerably more time, effort and rationalisation is required before a genuine and sustainable outcome is produced.

It is apparent that university resource constraints inhibit opportunities for small departments to be innovative and proactive.

By all accounts, the MTEC workshops and the MTEC Lectureships have contributed substantially to achieving MTEC objectives. Some MTEC Lecturers are proving to be effective change agents by innovating, networking, collaborating, developing new programs, relating to students, linking to industry, working outside traditional university frameworks and growing new areas of research. However, it appears that some partners are not taking full advantage of the opportunities intended by this program component and are not utilising their MTEC Lecturers in a manner consistent with the vision and intent of MTEC.

Some world class MTEC teaching modules have been developed and delivered nationally and internationally. Some of this material is also being used to grow new income streams to support university department activities. However, some partners have been slow to deliver. In a number of cases, it appears that their current economic circumstances are sufficiently dire as to cause effort and resources to be redirected to 'staying in business' rather than 'improving business' through innovation.

It is concluded from the submissions that MTEC has been successful in creating an awareness of the importance of structured undergraduate industrial experience. This has caused an improvement in the quality of industrial experience provided by industry. However, demand for industrial training places still exceeds supply. Whilst the IEU Website is growing, it is not as effective as envisaged. Students, universities and industry still make direct approaches to each other. This is likely to always be the case.

Sound but qualified support exists for the Minerals Industry Postgraduate Coursework Program (MIPCP). It is implemented in earth science but still in the process of assessment and development in mining engineering and metallurgy. However, it is apparent that this program, along with other Masters by Coursework programs and Continuing Professional Development Programs, will not be successful unless they are market driven. Currently, the earth sciences have a world class product but lament the lack of a market, whilst mining engineering and metallurgy lament an engagement from industry to determine what market they need to develop programs for. There is a need for industry and universities to work much closer together in identifying what programs are relevant and viable.

One of the Centres of Excellence in Mining Engineering, namely, the Australian National Centre for Mine Ventilation has been established and is operating. Establishment of a National Centre for Rock Mechanics in Western Australia has stalled because of the Western Australian situation and lack of industry support. Failure of the universities to form an effective collaboration in Western Australia came in for the strongest negative comment from industry in the submissions. This is detracting from the successes of MTEC. It has the potential to adversely affect future support for the initiative.

The number, breadth and content of the 35 submissions confirm that MTEC is having a positive impact on minerals tertiary education in Australia. The MTEC initiative received almost overwhelming support from all sectors, including institutions from outside the MTEC network.

Nevertheless, the following additional concerns arise from the review:

- i. The lack of number and depth of industry submissions to the process and the poor knowledge and understanding of the MTEC process displayed in some industry submissions. There are clearly identifiable needs for:
 - a. MTEC to place more emphasis on communication and networking with middle management of MCA members and others in order to facilitate a greater degree of understanding in the industry as to how exactly MTEC can deliver change.
 - b. Industry to become much more engaged 'at ground level' in MTEC initiatives. Money alone is not sufficient to progress the initiatives and achieve the objectives.
- ii. The dire state of metallurgy programs. It appears that earth sciences and mining engineering have managed to hold ground, albeit that a number of these programs have closed down. However, some discipline areas in metallurgy may have been lost.
- iii. The ongoing boom/bust cycle in graduate recruitment, which is one of the factors that is adversely affecting student enrolments in minerals disciplines. This is not an MTEC problem. Industry must provide more support to universities through consistent recruitment of new graduates if students are to be attracted to careers in the minerals industry and tertiary education programs are to be viable.
- iv. The sustainability of many VET and TAFE minerals programs, especially for supervisors and managers, is also under serious threat. This area was deliberately not targeted by *Back from the Brink* or by MTEC. Some submissions suggest that the MCA should also direct its attention to this situation in the future.
- v. The inability to date of university partners in Western Australia to form a collaborative association. This is damaging industry support for the MTEC objectives. The opportunity for a \$1 million contribution from the WA Government has not been realised. It has also caused the National Centre for Rock Mechanics to stall at a time when industry is experiencing a severe shortage of competent geotechnical personnel in order to fulfil its duty of care obligations and to perform efficiently.

The review has provided insight into the nature and impact of change on the MCA minerals tertiary education initiative and the level of commitment for the process. When the submissions of the MTEC partners are reviewed overall, it is apparent that they fall into three categories:

- Those who engaged in the process and are highly committed to it.
- Those who are following but, nevertheless, delivering.
- Those who are not engaged do not share the vision and are not utilising MTEC resources effectively.

It appears that there are few in industry or university prepared to lead. However, the success of MTEC to date indicates that many are prepared to be led, especially in desperate times

The submission process has identified that the following are priorities for the future:

- i. MTEC has a critical role to play in the current minerals tertiary education environment, at least whilst minerals departments ride out the wave of university and industry rationalisation.
- ii. MTEC should capitalise on the change that it has already initiated amongst minerals tertiary education providers and the profile that it has established with government.

- iii. More reliable data collection and processing needs to be undertaken in regards to student enrolments, graduate destinations and graduate retainment in industry in order for MTEC to properly manage the process and allocate resources appropriately.
- iv. There is an urgent need to address recruitment into minerals programs. Industry must take some responsibility for this. University departments do not have the skills or resources to 'correct' industry's image.
- v. MTEC needs to improve the marketing of its objectives and achievements to non-MTEC partners, middle management in the minerals industry and to community.
- vi. Future MTEC support to universities should be linked to demonstrated commitment and performance.
- vii. The current program should be reviewed in light of the comments contained in the submissions. Nevertheless,
- viii. MTEC support in the future should give priority to sponsoring MTEC lecturers and MTEC workshops.
- ix. Consideration needs to be given to the implications of an aging academic staff profile.

Maintenance of intellectual capital is essential to the future of the minerals industry. Therefore, minerals tertiary education is a critical element in the sustainability equation. Because the minerals industry and the university system have simultaneously ventured down parallel paths of rationalisation, the situation is more serious than anticipated when *Back from the Brink* was produced.

MTEC is a "work in progress". Whilst three years is sufficient time to judge the progress that MTEC is making, it is not long enough to judge if it is having a long-term impact. Further time is required for gains to become embedded. It is essential, therefore, that MTEC continue for at least the remainder of the planned five-year period. There is little doubt that if the MTEC initiative were to cease now, it would have produced few sustainable outcomes and that many more minerals tertiary education providers would succumb. MTEC has created momentum in changing the culture of minerals tertiary education providers. The foundations and incentives are in place for MTEC to achieve an accelerated rate of change, albeit perhaps amongst a revised set of partner universities.

REFERENCES

Back from the Brink – Reshaping Minerals Tertiary Education. National Tertiary Education Taskforce Discussion Paper. Minerals Council of Australia. February 1998

ACKNOWLEDGEMENTS

This review was undertaken with assistance from Mr Barry Cusack, President of the Minerals Council of Australia and from the Secretariat of MTEC, Dr Kevin Tuckwell and Ms Alison Way. The contributions of all are gratefully acknowledged.

APPENDIX I

TERMS OF REFERENCE



Terms of Reference

Strategic Review of the Minerals Council of Australia Tertiary Education Initiative (MTEC)

Since “*Back from the Brink – Reshaping Minerals Tertiary Education*” was published in 1998, there have been some significant structural changes within the minerals industry and the Australian tertiary education sector.

The Executive Committee of the Minerals Council of Australia is reviewing the MTEC program against the initiatives in *Back from the Brink* and in light of these changes. The objective is to chart the way forward for 2003-2005, and to consider what may be required post 2005.

MCA is inviting written submissions from interested stakeholders.

Guidelines

Comments are sought on some or all of the “Initiatives” and “Nature of Change” in Back from the Brink, especially:

- *the degree to which you believe these have been met, and*
- *the relevance of these now given the substantial changes that have taken place in the minerals industry and the university system since 'Back from the Brink' was published, and*
- *what might be necessary to advance the program to the next stage.*

If possible please quantify your responses.

The “Initiatives” and “Nature of Change” are reproduced in the attached ‘Background Information’.

Further information can be obtained from http://www.minerals.org.au/tertiary_education or by contacting MTEC (03) 8344 4698.

Submissions will be in confidence unless otherwise requested.

Submissions should be lodged electronically (mtecreview@minerals.org.au) or in hard copy on or before the closing date:

Closing date for submissions - 17 April 2003.

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Background Information - for the MTEC Review

In 1998, following the publication of “Back from the Brink”, the Minerals Council of Australia (MCA) called for collaborative submissions from institutions to form a network of centres to improve minerals education in Australia.

In late 1999 the MCA committed extensive funding over five years and established the Minerals Tertiary Education Council (MTEC) to progress the initiatives recommended in “*Back from the Brink*”.

'Back from the Brink' identified three initiatives and a series of changes that it advocated were necessary to deliver an Australian system of minerals education to serve the industry well into the long term.

'Back from the Brink' can be downloaded from the MCA website at:
http://www.minerals.org.au/downloads/pdf/backfromthebrink_chap.pdf .

The Initiatives

Initiative 1 Create a select network of centres and link this with industry. Each member-centre within the network should:

- a) collaborate where desirable with other members to offer a world class minerals program and be able to deliver truly effective and, where necessary, innovative coursework;
- b) have a structured practical experience program;
- c) have an academic staff mix which is able to provide, as a priority, first class teaching, while also maintaining research skills in at least one significant area of the minerals field;
- d) have the commitment and ability to attract talented students;
- e) be located close to a research facility;
- f) have long-term support from their parent university; and
- g) have the willingness and capability to deliver education to (full-fee paying) international students.

Initiative 2 Create a system of alternative educational pathways which ensure that the industry benefits from the great strength and depth of graduates in the wider tertiary education system. Three steps are required:

- a) describe the broad educational preparation necessary for graduates filling the roles of mining engineers, metallurgists and geoscientists;
- b) define a 'roadmap' of educational pathways into the minerals industry and how they might be followed; and
- c) establish a national network of 'service' courses to support the alternative pathways.

Initiative 3 Establish the Australian School of Mineral Resources (ADSMR) in order to create a world-class centre of postgraduate minerals education. Coursework will cover:

- a) conversion courses for non-minerals graduates to support Initiative 2;
- b) master coursework in advanced technical areas; and
- c) short courses for continuing professional development.

These courses must be readily accessible to industry through the innovative coursework design and delivery.

The Nature of Change

Industry must change by:

- accepting there are limitations to the outcomes that can be delivered in an undergraduate degree course;
- accepting its own need for genuine continuing professional development (CPD) among its employees by establishing structured company CPD programs;
- identifying skills requirements needed
- from new graduates and implementing the necessary graduate orientation programs to deliver them;
- lessening the cycle of demand for newly graduated professionals by adopting more stable recruitment patterns;
- taking a greater role in the provision of undergraduate practical experience;
- increasing the percentage of companies being prepared to employ new graduates; and
- broadening its view of what constitutes a graduate suitable for a minerals industry career and rethinking recruitment efforts to reflect this.

Universities must change by rewarding behaviour aimed at:

- encouraging cooperation between individual departments both within universities and between universities, to share resources and to develop and deliver world class minerals education;
- encouraging innovation and regular examination of the traditional design and delivery of tertiary education; and
- placing a priority on the development of teaching excellence in tertiary education.

Federal government should assist change by changing the funding framework for higher education to place greater emphasis on:

- improving educational quality by encouraging cooperation and sharing between universities to efficiently utilise public and private resources;
- developing teaching excellence in tertiary education;
- encouraging and supporting student mobility to pursue cost effective and superior quality courses; and
- reducing the administrative burden on universities and rewarding the quality of educational outcomes.

Professional associations must continue to :

- work together to adopt a broader view of the tertiary qualifications and professional experience necessary for roles in the minerals industry;
- focus on systems for continuing professional development management which encourage strong continuous learning beliefs and behaviour; and
- consider whether consolidation or amalgamation of organisations might be in the best interests of minerals professionals and the industry.

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APPENDIX II

LIST OF SUBMISSIONS

Institution	Person	Dept/School/Division
ACMER	Clive Bell	
AMIRA	Dick Davies	
AngloCoal	Eric Ford	
ANU	Ian Roach	
AUSIMM	Don Larkin	
BHP Billiton		
Centennial Coal	R G Cameron	
Commonwealth Department of Industry, Tourism and Resources	Tess McDonald	Minerals Development Resources Division
CRCLEME	Pat James	CRCLEME E&T
Curtin University of Technology	Eric Grimsey	Director WASM
DEST	Patricia Looker	
Illawarra TAFE	Ray Tolhurst	
James Cook University	Bob Henderson	School of Earth Sciences
Mike Etheridge Macquarie University	Mike Etheridge	Department of Earth and Planetary Sciences, GEMOC (Geochemical Evolution and Metallogeny of Continents)
MIM	Jodie Hope	Manager - Recruitment & Development
Monash	Jim Cull	
Murdoch University	Yianni Attikiouzel	Division of Science and Engineering
Pells Sullivan Meynink Pty Ltd	Tim Sullivan	Principal
Rio Tinto	Peter Williams	HR Manager Rio Tinto
RioTinto	Peter Glazebrook	Technical Services
University of Adelaide	J Foden	Head Geology and Geophys
University of Ballarat	Stephen Hall	Head of School of Science and Engineering
University of Ballarat	Michael Tuck	
University of Melbourne	John McKenzie, Janet Hergt	Faculty of Science
University of South Australia	Professor Robin King	Applied Geology and Minerals Processing
University of South Australia	Stephen Priest	School of Geoscience, Minerals and Civil Engineering
University Tasmania CODES	Ross Large	
UNSW	Bruce Hebblewhite	School of Mining Engineering
UNSW	Mike Katz	Key Centre for Mines International UNSW Mining Research Centre
UQ	Don McKee	
UWA	Bill Stone	Centre for Global Metallogeny
VIEPS	Reid Keays	
WA Mines Chamber	Lee Jackson	
WMC	Cliff Parker	
QLD Mines	Submission declined	Dept of Natural Resources and Mines