Mining Engineering in Australia
establishing and sustaining education and research excellence

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Outline

- The Australian economy and the central role of mining.
- Mining Engineering education
  - Degree programme and employability
- The demand and supply problem
  - Educational problem facing the mining industry and the university sector
- The solution
  - Sustainable delivery of mining engineering education and research
- Mining Education Australia (MEA)
  - Sustaining education excellence
  - Promoting collaborative research
  - Building a national and international MEA research profile
  - Internationalisation
THE AUSTRALIAN CONTEXT:
THE ECONOMY AND THE CENTRAL ROLE OF MINING
The Australian context

The national economy

1992 – 2012 economy grew at average annual rate of 3.2% per annum – significantly higher than the OECD average.
The Australian context

The national economy

Strong emphasis on exporting commodities – especially mineral and energy resources and agricultural produce.

Recent economic growth has led to significant skills shortages particularly in Engineering:
- 60% of engineering sectors report engineering skills shortages
- 54% report loss of capability
- 40% do not have right mix of engineering skills to meet needs.

2007 – 2010  Net immigration 775,500
Natural population increase 425,900.

Over the period 2000-10 population increased by 16% or 3.1 million
The Australian context

Australian mineral product exports

Value of exports
% of total export value
The Australian context – mining industry

The Minerals Council of Australia (MCA)

MCA represents Australia’s exploration, mining and minerals processing industry, nationally and internationally, in its contribution to sustainable development and society.

MCA member companies produce more than 85 per cent of Australia’s annual mineral output.

The MCA strategic objective is to advocate public policy and operational practice for a world-class industry that is safe, profitable, innovative, environmentally and socially responsible, attuned to community needs and expectations.
The Australian context – mining industry

The Minerals Council of Australia (MCA)

MCA Membership

52 member companies (mining and mining services companies) and 44 associate member companies.

Member companies include: Anglo American Metallurgical Coal Ltd, AngloGold Ashanti Ltd, Barrick (Australia Pacific) Ltd, BHP Billiton, Glencore Xstrata, Newcrest Mining Ltd, Newmont Australia Ltd, Rio Tinto.
MINING ENGINEERING EDUCATION

Programmes, graduates and employability
Tertiary engineering education in Australia

All accredited professional Engineering programmes are normally of four years duration.

Five-year Engineering degree programmes

Melbourne model / Bologna model:
   University of Melbourne and University of Western Australia.

Three-year general undergraduate programme plus two-year specialist Masters programme.
### Bachelor of Engineering graduates available for full-time employment 2012

<table>
<thead>
<tr>
<th>Engineering Field</th>
<th>In full-time employment</th>
<th>Seeking full-time employment, not working</th>
<th>Seeking full-time employment, working part-time</th>
<th>Total seeking full-time employment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aeronautical Engineering</td>
<td>81.4</td>
<td>8.1</td>
<td>10.6</td>
<td>18.6</td>
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<tr>
<td>Chemical Engineering</td>
<td>77.5</td>
<td>11.5</td>
<td>11.1</td>
<td>22.5</td>
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<tr>
<td>Civil Engineering</td>
<td>90.5</td>
<td>5.4</td>
<td>4.1</td>
<td>9.5</td>
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<tr>
<td>Electrical Engineering</td>
<td>88.0</td>
<td>7.4</td>
<td>4.6</td>
<td>12.0</td>
</tr>
<tr>
<td>Electronic/Computer Engineering</td>
<td>79.5</td>
<td>10.5</td>
<td>10.0</td>
<td>20.5</td>
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<tr>
<td>Mechanical Engineering</td>
<td>88.4</td>
<td>7.3</td>
<td>4.4</td>
<td>11.6</td>
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<tr>
<td>Mining Engineering</td>
<td>93.9</td>
<td>5.1</td>
<td>1.0</td>
<td>6.1</td>
</tr>
<tr>
<td>Other Engineering</td>
<td>85.4</td>
<td>7.9</td>
<td>6.7</td>
<td>14.6</td>
</tr>
</tbody>
</table>

Source: Graduate Careers
THE DEMAND AND SUPPLY PROBLEM

Graduate demand and supply
Cyclical nature of mining engineering graduate numbers:

- Long-term characteristic since the 1960s.
- International phenomenon.
- Related to cyclical nature of the mining industry.
Australia: Terms of trade and GDP growth

Source: HSBC Economic Report 2012
Mining Engineering graduates 1969 to 2015

- Lagged supply response to industry booms and busts
- Forecast

Beginning of China growth mining boom
Correlation between mining industry capital investment cycles and numbers of mining engineering graduates
Supply of Mining Engineers

Source: NRSET; MTEC
University constraints

- Economic viability of degree programmes and courses:
  - four-year Bachelor of Engineering programme requires approximate minimum of 80 students (20 per year) to be economically viable.
  - cyclical nature of enrolments hinders sustainability.
  - almost all salary costs are met from teaching income.

- Mining Engineering has high infrastructure costs – laboratories and equipment.

- Shortage of good staff in many sub-disciplines (e.g., ventilation).

- Staff retention difficult when student enrolments decline or when salaries are not competitive with industry.

- Essential for research performance to be ranked at least world average (ERA – the Australian research assessment exercise).
Difficult to maintain research performance with loss of staff:
• Disciplines within universities are assessed on their contributions to research.
• Research performance will become increasingly important, even critical, to the survival of disciplines:
  • Regular national research performance assessment;
  • Increasing amounts of University funding determined by performance;
  • Within universities performance against national research metrics can and will have significant internal and external funding consequences;
  • International university rankings.
Cyclical nature of mining engineering graduate numbers:

- Large numbers of students enter Mining Engineering degree programmes when jobs are plentiful (boom times).
- Mining Engineering degree takes four years to complete → graduations lag the economic cycle by four years.
- Students who graduate during economic downturns (bust times) cannot find employment in the mining industry.
- Lack of jobs adversely affects student recruitment – enrolments decline.
- Decrease in teaching income adversely affects economic viability of academic provision – pressure to reduce staff or close schools.
- Loss of staff and contraction of facilities adversely affects quality.
- Insufficient graduates when mining economic cycle improves.
- Insufficient academic staff when cycle improves.

Not sustainable!
In worst case, when economic cycle improves:

- Insufficient schools; or
- For some disciplines (e.g., Mineral Processing), NO schools

Eight minerals programmes closed between 1998 and 2004 – just as the China growth boom began
THE SOLUTION

Sustainable delivery of Mining Engineering education and research
The Minerals Council of Australia established the National Tertiary Education Taskforce to identify specific steps for improving minerals tertiary education in Australia.

**Objective:** To develop world-class education for a world-class minerals industry.

Publication of report: *Back from the brink - reshaping minerals tertiary education.*

Identified the “opportunity for a true partnership between industry, government and academia to reshape minerals education in Australia and secure the supply of the industry’s future specialist professionals.”
1999
Minerals Council of Australia established Minerals Tertiary Education Council (MTEC) to build a world-class tertiary learning environment for the education of professionals for the Australian minerals industry.

2006
MTEC established Mining Education Australia (MEA) Joint Venture initially of three universities and now four:
- University of Adelaide
- Curtin University
- University of New South Wales
- University of Queensland
Minerals Tertiary Education Council (MTEC)

Through its university partners, MTEC currently supports and runs a range of educational programmes in the Australian minerals tertiary education sector including:

- Mining Education Australia (MEA);
- Minerals Geosciences Masters (MGM);
- Metallurgical Education Partnership (MEP); and
- Minerals Industry National Associate Degree (MINAD) Project.
MINING EDUCATION AUSTRALIA
The Australian tertiary Mining Engineering sector

39 universities of which 32 offer Engineering programmes.

Eight universities offer Mining Engineering programmes:

- University of Adelaide
- Curtin University
- University of New South Wales
- University of Queensland
- University of Ballarat
- University of Wollongong
- University of Western Australia
- Monash University
MEA

MEA is an unincorporated joint venture, fostered and financially supported by the Minerals Council of Australia (MCA) via its educational arm, the Minerals Tertiary Education Council (MTEC).

Funding is at an agreed rate for each graduate. Currently, the agreed rate is $10,000 per graduate.

After covering its operating costs, MEA distributes funds to the Member Universities on the basis of:

- the number of graduates; and
- the amount of collaboration in teaching.

MEA also uses funds to provide incentives for other types of collaboration such as collaborative research.
MEA Objectives

- Establish and conduct a national, collaborative mining education programme for Australia;
- Rationalise and improve the teaching of mining engineering in Australia by co-ordinating the resources of the Members to produce a greater number of high-quality mining engineering graduates;
- Create an economically sustainable environment for the teaching of mining engineering;
- Increase the interest in, and access to, mining engineering programmes at the Member Universities, resulting in increased graduate numbers;
MEA Objectives

- Attract and develop high-quality students and researchers into the field of mining engineering;
- Produce high-quality graduates and researchers in the field of mining engineering to the benefit of the mining industry and the Australian economy and society generally; and
- Offer high-quality programmes in mining engineering within Australia and internationally.
An economically and academically sustainable environment for mining engineering

- High-quality teaching:
  - A national curriculum for years 3 and 4 of the degree programme;
  - Collaborative teaching;
  - Four universities contributing to curriculum significantly improves quality.

- Internationally competitive research:
  - MEA grants to foster collaborative research;
  - Industry collaboration encouraged.

- Internationalisation.

- Marketing and promotion – students, governments, industry, community.
MEA Governance

- Governing Board
  - Executive Director and MEA Executive
    - Programme Leaders Committee
      - Academic staff from Member Universities
MEA Governing Board

The Governing Board oversees the direction and operation of MEA. In particular, it:

- sets the strategic direction of MEA;
- is responsible for the financial management of MEA;
- sets goals and key performance indicators for MEA;
- approves the annual operating plan and budget;
- appoints the Executive Director;
- approves the Curriculum and the programme content and structure; and
- develops and oversees student recruitment.

The Governing Board meets at least twice each year.
MEA Governing Board - membership

The Governing Board is constituted as:

- a person appointed by the University of Adelaide;
- a person appointed by Curtin University;
- a person appointed by the University of New South Wales;
- a person appointed by the University of Queensland;
- the Executive Director;
- a person nominated by the Board of Directors of MCA who shall be the Chair of MTEC or a member of the Board of Directors of MCA; and
- three persons, nominated by the MCA, who have knowledge of, and are experienced in the mining industry.
MEA Executive

Under the direction of the Governing Board, the MEA Executive:

- develops and is responsible for the implementation of a business plan for MEA, which is approved by the Governing Board;
- implements the marketing plan approved by the Governing Board;
- implements the strategic directions set by the Governing Board;
- monitors and reports to the Board on the performance of MEA against the key performance indicators and goals set by the Governing Board; and
- considers recommendations on academic matters brought forward by the Programme Leaders Committee for approval and implementation as considered appropriate.
The MEA Executive is constituted as:

- a senior academic appointed by each University Member who has authority at his or her University over the resources within that University with respect to undergraduate mining engineering;
- the Executive Director;
- a person nominated by the MCA; and
- the Chair of the Programme Leaders Committee.

The MEA Executive meets at least four times each year and is chaired by the Executive Director.
The objective of the MEA Workshops is to bring MEA academic staff together twice yearly in July and November to assess the Semester’s work and to plan for the new semester.

Each workshop runs for two days and has a number of sessions devoted to standard topics such as curriculum. It also usually includes sessions on strategies, e.g., research.
The research context – the MEA strategy

- Build a national MEA research profile for mining engineering.
- Identify MEA research synergies and build on them.
- Establish a collaborative, supportive MEA research community.
- Build research grant applications around the best expertise in each university.
- As far as possible, concentrate publications in journals that have high quality and impact.
- Ensure members’ profiles are kept up-to-date in research council databases and in MEA records and promotional activities.
The research context – the MEA strategy

**Project:** Research funding for competitive applications

**Purpose:** To build a MEA research profile and increase the quantity and quality of mining research in MEA universities.
The research context – the MEA strategy

Criteria for funding

- Proposal must involve MEA staff from at least two member universities.
- Proposal must be a real collaboration and must bring more than would be delivered by any individual partner.
- Expected that project would leverage additional funding from non-MEA sources or be a pilot for a subsequent larger grant application or both.
- Subject to satisfying previous criteria, quality of the proposal is the overriding criterion. Quality includes potential for the project to generate further research and potential for generating papers in archived journals.
- A short report summarising outcomes against original objectives is required at the conclusion of the project.
The research context – the MEA strategy

General:

• Publish an annual summary of all significant research conducted by MEA academics (papers, grants, awards, summaries of successfully completed projects).
• Provide copies of the annual research report to industry and research funding agencies.
• Develop capability statements in collaborative research strengths; circulate to industry.
• Promote the MEA research profile on the MEA website.
• Consider holding MEA research forums for industry.
Number of Mining Engineering graduates by year for MEA universities, non-MEA universities and total.
Number of commencing MEA Mining Engineering students
Total number of MEA Mining Engineering students by year

- **Total MEA students**
Internationalisation

Memorandum of Understanding with Pontificia Universidad Católica del Perú

Australia Latin America Foundation (ALAF) grant for seven Australian Leadership Award Fellowships:

**Title:** Collaborative leadership for teaching sustainable mining practices

**Participants:**
- Universidad Nacional de Colombia
- Universidad de Azuay, Ecuador
- Pontificia Universidad Católica del Perú

Five-week visit to MEA universities (July-August 2013) and Australian mining industry: workshops, mine visits, collaboration.