



Derleme / Review

NEW DEVELOPMENTS IN THE AUSTRALIAN MINING EDUCATION¹

AVUSTRALYA MADENCİLİK EĞİTİMİNDEKİ YENİ GELİŞMELER

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Geliş Tarihi / Received : 14 Şubat / February 2017

Kabul Tarihi / Accepted : 28 Şubat / February 2017

Anahtar Sözcükler:

Madencilik eğitimi,
MEA,
Avustralya.

ABSTRACT

The Australian mining industry is responsible for more than 50% of the export revenues and is the largest exporter of black coal and the second largest exporter of iron ore in the world. As a major export player on the world minerals markets, the Australian mining industry delivers significant benefits to the Australian economy. Graduating good quality engineers for such an important industry requires world-class education. Mining Education Australia (MEA) was developed to deliver a common undergraduate curriculum in mining engineering across Australia. This unique initiative was developed in response to increased demand for mining industry professionals in an environment of limited funding within the traditional university environment and a critical shortage of suitably qualified academic staff. MEA is an unincorporated joint venture between The University of Queensland, The University of New South Wales and Curtin University in Western Australia. In 2009, The University of Adelaide became a member of the MEA Program. This paper discusses the history and governance of MEA as well as the structure of the common curriculum and teaching innovations adopted.

ÖZ

Avustralya madencilik sektörü, ihracat gelirinin %50'den fazlasını karşılayan ve dünyanın en büyük beş üreticisinden biri olan önemli bir sektördür. Böyle önemli bir sektöre maden mühendisi yetiştirmek için, dünya kalitesinde bir eğitim gerekmektedir. 1996 yılında, Avustralya çapında standart bir maden mühendisliği eğitimi imkanı sunacak, orijinal adı Mining Education Australia (MEA) olan Avustralya Madencilik Eğitimi adı altında ulusal bir maden okulu kuruldu. MEA'nın kuruluş amacı, maden bölümlerine verilen maddi desteğin azalması, öğretim üyelerinin sayısındaki azalmaya karşın maden endüstrisinin artan mühendis ihtiyacını karşılamak ve daha kaliteli mühendis yetiştirmektir. Kurucu üyeler Queensland, New South Wales ve Curtin Üniversiteleriydi. 2009 yılında Avustralyanın dördüncü büyük maden okulu olan Adelaide Üniversitesi de MEA'ye katıldı. Bu makale, MEA'nin kuruluş tarihçesini, oluşturulan ortak ders programını ve eğitim ve öğretimde getirilen yeni standartları ve metotları kapsamaktadır.

Keywords:

Mining education,
MEA,
Australia.

¹ This article has been published in the 24th International Mining Congress of Turkey (IMCET 2015) Proceedings' Book

Bu makale Türkiye 24. Uluslararası Madencilik Kongresi (IMCET 2015) bildiriler kitabında yayınlanmıştır.

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INTRODUCTION

The global mining education institutions, especially in the developed countries, faced a number of challenges between 1985 and 2003. These included an acute shortage of talented academic staff, small number of student enrolments, high relative costs, making mining programs vulnerable to closures, when universities were under extreme cost pressures, and most importantly under-resourcing of mining departments because of their comparatively small size, making these departments incapable of delivering top class teaching in all aspects of their courses, despite being excellent in some areas. In Australia, this concern was felt more by the industry when it was realised that a number of mining departments across the world had already been closed down as shown in Figure 1 with exception of Chile, South Africa and Australia. The mining industry through its representative body, the Minerals Council of Australia (MCA) set up a task force to review the state of the minerals education in Australia. The findings and recommendations from this review was published in a report called “Back from the brink” in 1998 (MCA, 1998). In response to industry’s concerns the National Tertiary Education Taskforce established the following Mission.

“The Development of World-Class Education for a World-Class Minerals Industry”

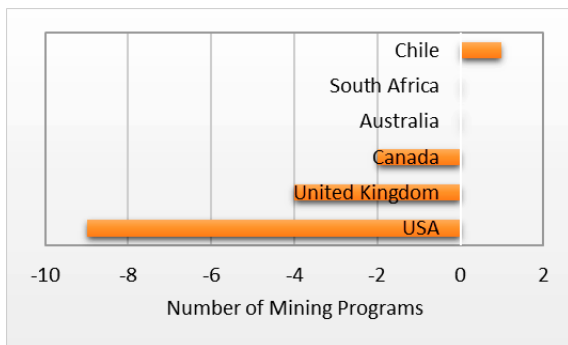


Figure 1. Change in number of mining programs between 1985 and 2003.

The Australian minerals industry’s main concern was that, new industry professionals needed to be better educated to deal with emerging challenges of the industry such as globalisation, competition, and rapidly changing technologies. The industry was seeking to ensure that there were sufficient technically capable graduates available to meet its needs, that these graduates valued continuing professional development

and that they had sufficient exposure to industry workplaces to ensure they were aware of broader issues such as safety, environmental care and commercial aspects of their work (MCA, 1998). This resulted in establishment of the Minerals Tertiary Education Council (MTEC) which is a division of the Minerals Council of Australia (MCA) in October 1999. Since this time MTEC has been a major driver in establishing three national higher education programs in Mining Engineering, Minerals Geoscience and Metallurgy across 15 Australian universities, which now produce the bulk of new, highly skilled technical professionals from those disciplines (MTEC, 2015). One of the MTEC initiatives was to support the establishment of Mining Education Australia (MEA).

1. MINING EDUCATION AUSTRALIA

Soon after establishing MTEC, the industry started supporting the mining schools by sponsoring two academic positions at each institution and financially supporting the key course development. While this support helped to sustain the minerals education institutions, it did not provide the kind of improvement in the education system the industry was hoping for. Therefore, the discussions for establishing a national mining school started in 2004 which resulted in the establishment of the Mining Education Australia (MEA). MEA was developed to meet the increasing demand for mining industry professionals in an environment where limited funding exists within the conventional university system and to maintain a critical mass of suitably qualified academic staff. The initiative was stimulated by support and funding from the MCA representing the Australian mining industry. The MCA remains committed to the on-going financial support of MEA to deliver a world class program of undergraduate education in mining engineering.

MEA was set up as a joint venture between three major mining education providers in Australia, namely; the University of Queensland, the University of New South Wales and Curtin University. In 2008, the University of Adelaide became a member of the MEA Program. MEA provides a common curriculum for 3rd and 4th year mining engineering, as shown in Figure 2.

The development of MEA was supported by a \$1.3 million grant from the Federal Government through the Collaboration and Structural Reform funding scheme. Funds from a government

SEM	MINING ENGINEERING UNDERGRADUATE PROGRAM 2015				
1	ENGG1100 Engineering Design	MATH1051 Calculus & Linear Algebra I OR Elective	ERTH1501 Earth Processes & Geological Materials for Engineers	ENGG1400 Engineering Mechanics: Statics and Dynamics OR Elective	
2	ENGG1200 Introduction to Engineering Problem Solving	MATH1051 Calculus & Linear Algebra I OR Elective	MATH1052 Multivariate Calculus & ODEs	ENGG1400 Engineering Mechanics: Statics and Dynamics OR Elective	
3	MINE2105 Introduction to Mining	MECH2410 Fundamentals of Fluid Mechanics	STAT2201 Analysis of Eng & Sci. Data	MINE2123 Structural Mechanics in Mining	MATH2000 Calculus & Linear Algebra II
4	CIVL2210 Soil Mechanics	MINE2201 Physical & Chemical Processing of Minerals	MINE2106 Resource Geology & Surveying	ELECTIVE	
5	MINE3120 Resource Estimation	MINE3121 Mining Geomechanics	MINE3122 Mining Systems	ELECTIVE	
6	MINE3123 Mine Planning	MINE3124 Mine Ventilation	MINE3125 Rock Breakage	ELECTIVE	
7	MINE4120 Mine Geotechnical Engineering	MINE4122 Mining Research Project I	MINE4124 Hard Rock Mine Design & Feasibility	ELECTIVE	
8	MINE4121 Mine Management	MINE4123 Mining Research Project II	MINE4125 Coal Mine Design & Feasibility	ELECTIVE	

Figure 2. The University of Queensland's Mining Program showing common 3rd and 4th year MEA courses (*MEA electives includes: Surface Mining Systems, Underground Mining Systems, Mining Asset Management and Services, Socio-Environmental Aspects of Mining, Advanced Mine Geotech Eng, Mining in a Global Environment and Advanced Ventilation*).

grant have permitted new mining courses and resource materials to be developed to a world class standard. Advanced tools and systems are being applied to the management and delivery of the Joint Venture's teaching resources and innovative delivery and assessment techniques have been developed and are being adopted in all courses. The experience gained from these activities is being shared with others through an active dissemination program including publications. These achievements have been undertaken in a strong interactive environment that forms a model for future cross-university collaboration.

The following is a chronology of the development of MEA.

2004

- Initial discussions for MEA started.
- MEA was established.
- Identified common courses.
- Established a common program structure.
- Identified course convener and local coordinators.

2005

- Established a common program.
- Established new courses at local universities.
- Detailed course content.
- Developed course profiles.
- Identified course delivery mechanisms.
- Test run of some common courses.

2006

- Inclusion of details in Universities' Handbooks.
- Transition run.

2007

- Australian undergraduate school of mining was fully operational.

2008

- MEA produced first graduates.
- Adelaide University joined MEA.

2. BENEFITS OF MEA

Mining Education Australia is a first and unique educational initiative in the world which standardised the mining education across the country through industry, government and university collaboration. It has provided many benefits to the universities, students and the industry, which includes (Tuckwell, 2004):

- improved quality of graduates;
- increased quantity of graduates;
- allowed sharing academic expertise;
- provided a common education standards (across universities);
- sustained viability of programs – opportunity for growth;
- increased the quality of teaching courses and materials;
- access to marketing strategies – broad and focused;
- international market; and
- new generation academics.

The major benefits MEA program provides for mining engineering students includes:

- a nationally recognized, comprehensive educational program covering all aspects of mining engineering, technical, operational and social/community issues;
- access to national group of mining academic staff with skills in all major areas;
- exciting new and innovative teaching and learning programs, including collaborative student activity across four member university nodes;
- opportunities to undertake exchange semesters among member universities; and
- a world-class degree and industry-supported national program.

Since the setup of MEA, the number of mining graduates produced by the member universities for the mining industry has more than tripled from 72 in 2007 to 250 in 2014 as shown in Figure 3. Today, MEA provides 90% of Australia's mining engineering graduates.

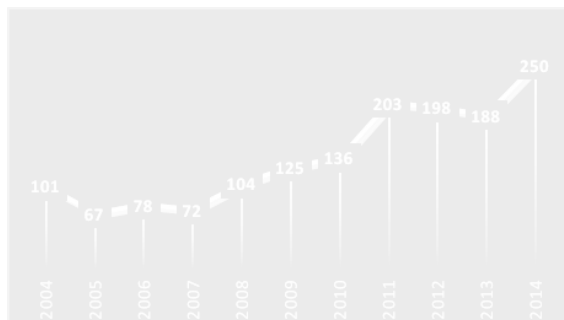


Figure 3. Total number of mining engineering graduates from the MEA members' universities.

3. MAJOR CHALLENGES IN SETTING UP MEA

Mining academic staff at all four member universities played a major role in preparing for and establishing the MEA joint venture, aligning curricula among the MEA universities and developing courses to be taught at all four institutions. Major challenges and obstacles were identified and addressed during the establishment of MEA included different program structures at each university, variations in teaching styles, the need for specialised courses, the number of courses offered, course weightings, pre-requisites, time table incompatibilities, lack of commonality in delivery and assessment mechanisms, electives, and laboratory facilities. In order to overcome these challenges and develop a climate of collaboration, MEA developed and implemented a range of collaborative strategies.

These include:

- a joint venture agreement between the four universities;
- collaborative course teams;
- implementation of tools to support cross university teaching and assessment;
- implementation of tools and processes for cross university student collaborative assessment, moderation and evaluation processes;
- program leaders committee, and
- twice yearly academic workshops.

4. MEA MANAGEMENT STRUCTURE

The management structure of MEA is shown in Figure 4. It has a governing board, executive committee, program leaders committee and course leaders and course coordinators.

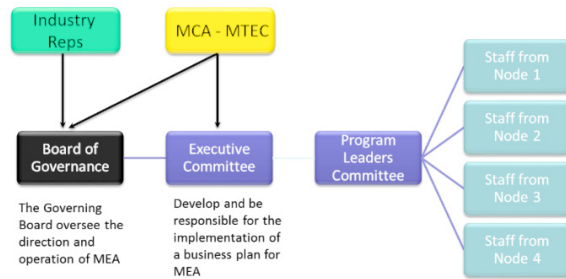


Figure 4. MEA Management Structure

5. GOVERNING BOARD

The MEA Governing Board has a member from each member universities, three members from the industry, the MEA Director and the director of MTEC, meets once a year and 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 Director;
- approves the curriculum and the program content and structure; and
- develops and oversees student recruitment.

The Governing Board appoints a Director who is a senior academic of one of the Members. As a general rule, the appointment will rotate between academics of the Member Universities. The appointment may be on a part-time basis and is for a three year term, which may be renewed.

5.1. MEA Executive Committee

The Executive Committee is chaired by the Executive Director of MEA and comprises senior teaching nominees from each participating university and the Chairman of the Program Leaders' Committee. The committee meets at least four times a year and is responsible for implementing the business plan approved by the Board and pursuing the strategic objectives defined by the Board.

The MEA executive committee:

- develops and is responsible for the imple-

mentation of a business plan;

- implements the strategic directions and marketing plan;
- 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 brought forward by the Program Leaders Committee regarding academic matters.

5.2. MEA Program Leaders Committee

Each university appoints a senior teaching academic as its Program Leader responsible for coordinating the undergraduate teaching program at that university. The Program Leaders are represented on the MEA Executive by their chairman and responsible for:

- designing and reviewing the program structure, content, delivery and resource requirements and allocation;
- approving course outlines, learning guides and assessment schedule;
- implementing and monitoring an assessment moderation process;
- approving the exchange of students between MEA partners;
- monitoring the level of collaboration within each of the course teams;
- reviewing and researching potential innovative teaching and learning technologies and encouraging their adoption in the MEA Program.

5.3. Course Leaders and Coordinators

The Program Leaders appoint Course Leaders at each university to be responsible for the development and delivery of each MEA course. For each course the Course Coordinators from each university work as a team under the leadership of the Course Leader.

5.4. MEA Academic Staff Workshops

Twice yearly all academic staff of MEA come together for three day workshops. This workshop is held in Sydney, Brisbane and Perth (or Kalgoorlie) in a rotating fashion. This workshop enables all participants to discuss different aspects

cts of the project, participate in staff development workshops, assess the progress of the project, deal with any issues that might be impeding the project and build an understanding of the common goals and values of MEA. This workshop is a major change management strategy (Andrews and Lind, 2007).

5.5. Course Development and Improvement

MEA currently supports 12 compulsory common courses during the final two years of mining engineering program at each member university complemented by a number of more specialised elective courses. Member universities continue to be responsible for the more general engineering education during the first two years of the degree.

MEA takes a collaborative approach to course development, delivery and assessment. Each course is developed by a team of academics consisting of a representative from each partner institution and includes a nominated course convenor and three node co-ordinators. Under the guidance of an educational consultant, a rigorous course development process ensuring alignment between course objectives, teaching and learning activities, graduate attributes and assessment was introduced and is an integral part of the development of all courses. This approach to course development was new to most of the academics in MEA and required them to build capacity to undertake the collaborative development essential for MEA's common curriculum and to design course that met industry requirements that specifically requested the development of workplace skills such as team work and communication.

In order to address regional differences and specialities, 80% of the content is core and 20% complimentary. Regular meetings occur between the course teams and the twice yearly workshops enable the course team members to work together to maintain high academic standards and implement any minor changes required. This rigorous approach to course design is now an integral part of MEA course development activities, with existing academics demonstrating high levels of expertise in the MEA curriculum design process and providing support in this regard to new academics coming into the program. This ensures the high standard of curriculum design implemented for the MEA course development process continues.

Course materials (learning guides, readers, slides, etc.) are professionally developed, reviewed by the industry and UQ's Teaching and Educational Development Institute (TEDI) and published for students. The materials are provided to students in the first week of each semester.

5.6. Course Evaluation and Improvement

MEA has implemented a comprehensive course evaluation and improvement process. Feedback is received from the students for every course through end of semester evaluations. Course leaders collect the survey results from all MEA universities and analyse the results to identify any issues, develop an action plan to resolve these issues and report back to the Program Leaders Committee for implementation.

5.7. Collaboration Process

MEA offers a unique opportunity for students at the partner institutions to access a much larger pool of expertise than is available through single institution programs. Academic staff who are expert in their teaching areas are called upon by other MEA universities to give a set of lectures to share their expertise with all MEA students. Using a range of technologies, including collaborative teaching tools such as Moodle, video conferencing and SparkPlus™, staff are able to teach across the institutions providing access to a rich pool of expertise and addressing shortfalls in expertise at individual institutions. The collaboration also enables cross-institutional student projects and other learning activities.

5.8. Quality Assurance and Moderation Process

In order to ensure standardisation of assessment across the program, MEA developed standard criteria for projects, group work, presentations and assignments, with the ability to adapt for specific circumstances within the individual course. It was also recognised that in some cases course teams would need to develop criteria for specific assessment items not covered by the generic tools. This work was largely carried out by the program leaders committee with feedback from other staff. A moderation process for assignments and courses was also developed. It was decided that a sample of individual and group assessment items in three of the courses would be reviewed against the standardised assessment

criteria developed for each assessment item. An individual assignment, a group assignment and an individual examination made up this process.

5.9. Student Conference

MEA holds a student conference each year which showcases the best of high quality research projects undertaken by students enrolled in MEA mining engineering programs across Australia. The location of this conference is rotated each year between members' universities.

Up to five students selected from each university who are sponsored by MEA and their home university to attend and present their paper at the conference. In addition to each student receiving a certificate of participation and their paper published in the MEA journal, the best three presentations are awarded prizes. The judging panel comprises programme directors from each of the MEA universities for the selection of award winners.

The conference is telecast live and students at each university are encouraged to engage in the Conference. Students in Years 3 and 4 are particularly encouraged to view the telecast and participate during question time.

5.10. Journal of Research Projects Review

All papers presented at the MEA Student Conference are automatically eligible for inclusion in the journal of MEA Research Projects Review, following a peer review process. This journal is circulated to the industry and other stakeholders to highlight the quality of research projects undertaken by MEA undergraduate students by publishing a selection of only the best research papers.

The Course Convenor at each university may nominate up to two further papers for inclusion in the journal. Each submitted paper must be reviewed and co-authored by the student's supervisor.

5.11. MEA Student Exchange Program

As 3rd and 4th year curriculum of every MEA university is the same, any student from an MEA university can study at another MEA university as an exchange student for a semester or two in their 3rd or 4th year of study program. As the offered courses are the same at each institution, students have no problems with course selecti-

ons/ compatibility.

This exchange study program offers many benefits for students, including:

- spending one or two semester(s) at an MEA institution other than their home node;
- opportunity to meet and work with other student groups; and
- living and studying in different location;
- possibility to link in with summer industrial work experience.

CONCLUSIONS

Mining Education Australia was developed to meet the increasing demand for mining industry professionals in an environment where limited funding exists within the conventional university system and to maintain a critical mass of suitably qualified academic staff. The initiative was stimulated by support and funding from the MCA representing the Australian mining industry. The MCA remains committed to the on-going financial support of MEA to deliver a world class program of undergraduate education in mining engineering.

MEA is unique from a world-wide perspective. Approximately 30 academics across four institutions develop and deliver a common curriculum. Commonly, academics develop and deliver their programs either individually or in teams within their own institutions. Developing an environment that encouraged collaboration between the different institutions and enabled the development of an agreed curriculum has been essential to the success of MEA.

MEA has become a successful initiative with superior education outcomes, including:

- a comprehensive educational program covering all aspects of mining engineering, technical, operational and social/community issues.
- improved and enhanced student experience through access to a combined national cohort of mining academics at four institutions and alternative and innovative delivery and learning methods; and
- student access to well prepared, up-to-date and quality assured teaching materials including course profiles, learning guides, reading material, slides, videos, mining industry software packages, and laboratories.

The success of the MEA was commended in the recent Accreditation Report by Engineers Australia to the School of Engineering, citing “Team skills, project management, sustainability and ethics are all well covered throughout the program, and the implementation of MEA has assisted in mapping graduate attributes well to course content”. MEA provides industry with graduates equipped with professional skills, life-long learning capabilities and exposure to a standard curriculum.

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