Australian Council of Engineering Deans Inc.

Summary of Best Practice Guidelines for Engineering Faculties on Effective Industry Engagement in Australian Engineering Degrees

An outcome of the project 'Enhancing Industry Engagement in Engineering Degrees'
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This is a summary of guidelines that apply to 'formative' degree programs that prepare graduates to enter engineering practice as professional engineers or engineering technologists. Such programs are accredited by Engineers Australia if they deliver graduates with the Stage 1 Competencies for the corresponding occupation and are compliant with other accreditation criteria. One of these is that within their program, graduates have exposure to professional practice. Most students, both domestic and international, enrol into four-year Bachelor of Engineering degrees that are accredited by Engineers Australia as qualifications for entry to practice as professional engineers.

The guidelines have been developed after wide consultation with representatives of universities, industry and relevant professional bodies. They are intended to strengthen the culture of industry engagement in engineering education in Australia. They have been designed with an acute awareness of diversity of all aspects of engagement. The engineering faculties and schools in the 34 Australian universities that provide formative engineering degrees are diverse. Additionally, the 'industries' that engage with engineering education can include: government, private, research and charity organisations; large, small and medium organisations; professional societies and organisations; and individuals. Amongst the universities are examples of effective models of industry engagement, including teaching by staff with considerable industry experience and through well-established internship schemes.

Aims and Scope

These guidelines are aimed at supporting engineering schools to provide improved industry engagement for ALL student engineers in a formative degree program. Thus, the guidelines are intended to promote existing good practice across the system as a whole and are consistent with – and effectively expand upon – the current expectations of Engineers Australia (EA) in program accreditation (EA, 2013). Recognising that the environments in which universities operate can limit capacity to achieve a wide range of desirable goals, the guidelines present opportunities for universities to differentiate themselves by focussing on the adoption of particular areas of the recommendations. The guidelines also adopt the underlying principles that students can learn much about practice whilst at university and that successful graduates will continue to learn throughout their careers.

The Vision

Engineering education provides students with the best possible learning and experiential opportunities to develop competencies (knowledge, skills, attitudes) that can underpin their successful lives as engineers contributing to a well-functioning society (Rychen & Salganik, 2003, adapted by Male, 2010). Engineering graduates will contribute to the economy and to improving workplaces, industry, the environment and the general well-being of society, locally and globally.

This project contributes to this vision by establishing industry engagement in formative engineering degrees as a key element of the culture of all engineering faculties and their partnerships with employers. Such a culture will support students to progress through their programs and prepare them for their transition to engineering practice.

By engaging in authentic engineering problems, solutions, practices and roles, students will be more highly motivated to their studies, and will:

1. Improve their understanding of the concepts, tools and applications of engineering science and fundamental mathematics and sciences.
2. Comprehend the relevance of socio-technical competencies.
3. Develop the desired attitudes for engineering practice.
4. Develop their identities as student engineers, and develop self-efficacy to achieve their goals.
5. Develop accurate perceptions of engineering practice, in preparation for the transition to practice.

Benefits to Industry

Industry participants in the project reported that by engaging with engineering education they have experienced:

- visibility and loyalty among students and graduates who become future employees, clients, contractors, alliance partners, etc., and
  - enhancement of their organisation brand among these future engineers
  - improved accuracy of perceptions about working for the organisation held by prospective graduate recruits, thereby improving their retention
- opportunities to work with future graduates and to identify potential graduate recruits
- opportunities to influence the capabilities of future graduates
- opportunities for professional development for staff through the experience of engaging with students
- personal satisfaction for those engaged in working with students
- appeal to the organisation's employees
- social licence for the organisation
- development of relationships with university researchers leading to future collaborations
- access to university resources such as laboratories, libraries, and experts.

Curriculum Themes for Improved Exposure to Engineering Practice

Theme 1 Engineering curriculum design and delivery should incorporate the spectrum of local and global engineering practice

a. Curriculum design is informed by present and prospective engineering practice, including research in engineering practice, engineering applications and engineering science.

b. Curriculum delivery includes a range of experiences of engineering practice, by positioning theory in its application contexts, by using industry-based examples and projects; and by site visits and guest lectures.

c. Authentic and substantive challenges requiring contextual understanding ensure students develop judgement, significant technical expertise, teamwork, initiative, and sound practice under mentoring and monitoring arrangements involving professional engineers.

d. Socio-technical dimensions of the curriculum demonstrate the integrated nature of engineering practice where technology and people interact and engineering knowledge and skills are combined with others' professional and generic skills. For example, student teams should work on technical problems in social contexts, and at least one unit should involve students from a non-engineering discipline that intersects with engineering practice.

e. Work-based learning is integrated and assessed.

f. E-portfolios and/or reflective journals are used by students to track the development of their capabilities towards the EA Stage 1 and Stage 2 competencies.

g. Curriculum design and delivery are undertaken by academics recruited and rewarded by processes that acknowledge industry experience and engagement.

Theme 2 Engineering education should incorporate the student's whole experience

a. Students engage in a participatory experience through which they develop into competent, motivated, professional graduates. Their development is influenced by experiences both within and outside the classroom, encouraged by faculty members and industry practitioners. The student's engineering education experience is framed by being and being treated as a 'student engineer' (e.g., Lindsay, Munt, Rogers, Scott, & Sullivan, 2008).

b. Students engage in extra-curricular activities that have professional dimensions, e.g. networking events, mentor schemes, careers expos and professional meetings.

c. Student engineers develop their identities and self-efficacy through gaining confidence in the development of their knowledge and skills, which in turn requires understanding of and confidence in achieving possible future roles.

Recommendations for Engineering Faculties

F1. All engineering faculties should establish and maintain effective industry engagement as part of faculty culture in which:

- **F1a.** All engineering faculties should establish people, processes, and resources to ensure strong relationships with industry
- **F1b.** All engineering faculties should provide structural and developmental support for academics to engage with industry
- **F1c.** All engineering faculties should engage engineers with industry experience, in facilitating learning
- **F1d.** Industry consultation should be structured and transparent

F2. All engineering programs should use industry-based assignments

F3. All student engineers should have substantial opportunities to work and learn in industry

F4. High percentages of students should have opportunities to undertake industry-based final year (capstone) projects

F5. Emulated work integrated learning is recommended as an example of effective industry engagement

F6. Students should be encouraged to take responsibility for seeking opportunities to learn about engineering practice

F7. Engineering faculties should support and recognise industry engagement undertaken by student groups

Recommendations for Industry

I1. Organisations should provide regular and structured student engineer employment

I2. Engineering employers should provide support for their engineers to engage with engineering education

I3. Engineering employers should provide support for academics to experience industry

Recommendations for Professional and Industry Bodies, and Governments

B1. Industry bodies, universities, student societies, and the Australasian Association for Engineering Education, should consider establishing a resource centre to support industry engagement with universities

B2. Government, professional bodies, and engineering faculties should consider establishing a joint internship scheme

B3. Engineers Australia should consider developing an e-portfolio resource for student engineers

B4. Industry bodies should establish and support industry engagement with education

B5. Government incentives should be considered

B6. Engineers Australia's Accreditation Board should review the accreditation guidelines with respect to exposure to engineering practice

Definitions

Engineering practice The activities undertaken by professional engineers in the course of their work.

> *While the outcomes of engineering generally have physical forms, the work of experienced professional engineers recognises the interaction between people and technology. Professional engineers may conduct research concerned with advancing the science of engineering and with developing new principles and technologies within a broad engineering discipline. Alternatively, they may contribute to the education of engineers, continual improvement in the practice of engineering and to devising and updating the codes and standards that govern it.* (EA, 2012, p1)

Industry Companies, government, engineers, industry bodies/associations, and charities

Internship Student employment paid or unpaid in an engineering environment, for an extended period longer than three months and often six months, commonly undertaken by students during one or more semesters of the engineering program

Program A course of study from first year to degree completion

Student employment Internships and/or vacation employment as defined above and below

Unit A module of study usually taken over one semester. Others might call these 'papers', 'subjects' or 'courses'

Vacation employment Engineering student employment paid or unpaid outside class-time in an engineering environment, commonly at least 12 weeks accumulated before graduation - This could be during vacations or increasingly is undertaken by students on a part-time basis during semester, but is not allocated a semester during the engineering program.

References

EA (2013). Accreditation Management System for Professional Engineers Retrieved 17 November, 2013, from http://www.engineersaustralia.org.au/about-us/accreditation-management-system-professional-engineers

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The project has 12 partner universities:

- Australian Maritime College
- Curtin University
- Deakin University
- James Cook University
- The University of Melbourne
- RMIT University
- Queensland University of Technology
- Swinburne University of Technology
- University of South Australia
- University of Southern Queensland
- University of Technology Sydney
- The University of Western Australia.

Industry partners are

- Australian Constructors Association
- Engineers Australia
- Minerals Council of Australia
- Australian Mines and Metals Association
- Consult Australia;
- Australian Petroleum, Production and Exploration Association.

Other Resources

Resources from the project are available at http://arneia.edu.au/resource/43 and include

- a reflection questionnaire to help program leaders in identifying the strengths and weaknesses
- complete best practice guidelines
- exemplars for engineering faculties
- exemplars for employers.

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