Managing student diversity in the Master of Engineering Practice program

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Abstract: *The Master of Engineering Practice is a distance education program that is accredited by Engineers Australia and is specifically designed to enable experienced Engineering Technologists to become Professional Engineers. This innovative program enables students to use their workplace learning to demonstrate their achievement of the objectives in up to half of the courses in the program. More than 120 students have been admitted to the program since it was first offered in Semester 2, 2004, and six have graduated.*

There is great diversity in the educational and work experiences that students bring to the program. For example, the educational experiences vary from a 1976 Certificate in Civil Engineering through to a PhD, and the length of work experience varies from 5 years to more than 30 years. For this reason, the first course in the program requires students to reflect on and assess their prior learning and then prepare and negotiate a Pathway to Graduation Plan that is tailored to meet their specific learning needs.

The paper begins with a discussion about the reasons the program was introduced and the learning and teaching contexts at USQ. This is followed by a description of the characteristics of the students in the program, which highlights the diversity within the cohort. The next section outlines the structure of the program and the flexible teaching and assessment approaches used to manage student diversity and to facilitate student learning. Finally, it draws on the results of a 2007 student survey to demonstrate the effectiveness of the program in enabling students to achieve their career goals.

Background

The Faculty of Engineering and Surveying at the University of Southern Queensland (USQ) has more than 2300 students enrolled in its three undergraduate engineering programs: the four-year Bachelor of Engineering, the three-year Bachelor of Engineering Technology and the two-year Associate Degree in Engineering. More than 80% of the students in these programs study off-campus through the distance education mode.

As shown in Figure 1, these highly articulated programs offer existing members of the engineering workforce, and those who are new to engineering, a range of educational options to achieve their career goals, with many students beginning with a two year program and then articulating into higher level programs.

The Faculty also offers a similar suite of undergraduate spatial science programs, with majors in surveying and geographic information systems (GIS). These programs are also offered on-campus and by distance education.

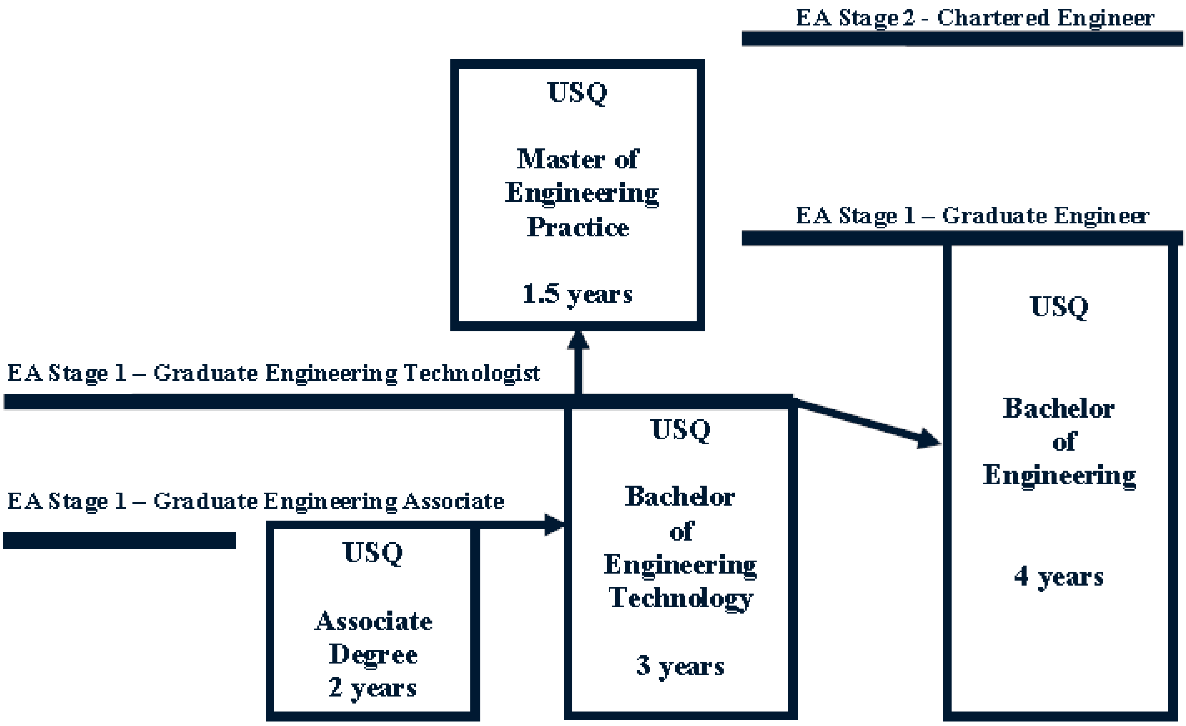

Figure 1: Articulation pathways for members of the Engineering Team

In 2002, following a call for expressions of interest, the Articulation Committee of Engineers Australia (EA) requested the Faculty to consider the development of a distance education program that would enable experienced Engineering Technologists to become Professional Engineers. The key criterion was that students should be able to use their workplace learning to demonstrate achievement of the objectives in up to half of the courses in the program. Such a program would provide an alternative to the only existing option, a Bachelor of Engineering program, a pathway that often required experienced Engineering Technologists to study basic engineering that they had previously studied or that was not relevant to their current employment or future career paths.

Importantly, the members of the Articulation Committee recognised that the graduates of the proposed program would have different knowledge and skills than those of graduates from traditional Bachelor of Engineering programs. They also recognised that whilst these graduates would be different, their knowledge and skills would be at the level required for them work as Professional Engineers in their chosen field. The acceptance of this principle enabled EA to, firstly, encourage the development of this ground breaking program and then, secondly, to accredit the program prior to its implementation.

During 2003, a conceptual model for the Master of Engineering Practice (MEP) program was developed and endorsed by the Faculty's Program Development Team, which included members of Engineers Australia's Articulation Committee. It was agreed the entry requirements for the program would be:

- A Bachelor of Engineering Technology (or an equivalent award) or membership of Engineers Australia at the Engineering Technologist level; and
- At least five years of relevant experience in the engineering industry.

The MEP program was accredited by both the University and Engineers Australia in 2004, and was offered for the first time in Semester 2, 2004. The program addresses a niche market that may not be sustainable in the longer term, particularly with the decline in the number of engineering technology programs in Australia.

Internationally, the only other similar programs appear to be those offered under the 'Gateways' project in the United Kingdom, which began in 2008 under the auspices of the UK Engineering Council. Five universities are currently involved, each offering a masters level program. One significant difference between those programs and the USQ program is that the UK programs include the student's employer in the learning contract which is a three way partnership between the student, the university and the employer.

The students

Six students were admitted to the first offer of the program in July 2004, and more than 110 students have been admitted since then, with 42 being admitted during 2008. Table 1 shows the enrolment and retention data for the program since it was first offered. Although enrolments have grown over the years, the high attrition rate has meant that only a small number of students have graduated.

Table 1: MEP commencing students for the period 2004 – 2009.

Status	2004*	2005	2006	2007	2008	2009*	Totals
Commencing	6	19	7	18	42	30	122
Active	1	6	2	13	40	29	91
Cancelled	4	11	3	4	2	1	25
Graduated	1	2	2	1			6

*The commencing data for 2004 is based on one term and, for 2009, on two of the three teaching terms.

Two factors contributed to the high attrition rate up to 2007:

- Increased student workloads due to skill shortages in their workplaces; and
- Transfers to alternative programs: After completing the first course in the program, ENG8300 Self-assessment Portfolio, some students recognised that they did not have the workplace experience, or requisite skills, to be able to undertake the MEP program. The majority of these students transferred to the Bachelor of Engineering or another USQ program.

Diversity

The following examples highlight the diversity of the students who have been admitted to the program:

- The youngest applicant was 28 and the oldest 63, with the current median age at the time of admission being 42.
- Whilst many of the students live in Queensland others come from all Australian States and Territories.
- Prior qualifications have been gained in Australia, Fiji, Great Britain, Hong Kong, India, Ireland, New Zealand, Philippines, and South Africa.
- While the majority of the students enter the program after graduating from a Bachelor of Engineering Technology program (or equivalent), the educational experiences vary from a 1976 Certificate in Civil Engineering through to a PhD.
- All of the students have more than 5 years experience in the engineering workforce, with many having between 20 years and 30 years experience, and some have more than 30 years experience.
- The breadth and depth of the work experience the students bring to the program varies greatly. Some students have great depth in a narrow field, others have broad but relatively shallow experience, and a small group have a depth of experience across a broad range of topics.
- Some students work for professional engineers while others employ and/or supervise professional engineers.
- Some students manage, or are responsible for large components of, multi-million dollar projects.
- Two of the students admitted to the program are Chartered Engineering Technologists, and three others are in the process of becoming Chartered Engineering Technologists.
- To date all of the students have been male, although two females are currently applying for admission to the program.

The diversity of the student cohort illustrated in these examples proved to be much greater than the Program Development Team anticipated when the program was being developed.

The curriculum design challenges

The Program Development Team was faced with the following challenges when the initial program structure was developed in 2003-2004:

1. The program design should ensure that graduates are able to demonstrate EA Stage 1 Competency Standard (Engineers Australia 2009), particularly Competency PE1.2 which states that a graduate must demonstrate 'In-depth technical competence in at least one engineering discipline' (e.g. civil engineering).
2. The students should be able to use their workplace learning to demonstrate achievement of the objectives in up to half of the courses in the program.
3. The program should be flexible so that it accommodates the anticipated diversity of the students who would undertake the program.

The initial program structure proved inadequate as it would not effectively accommodate some of the students it was designed for. This was because the Program Development Team had not anticipated the diversity of the prior qualifications, and the amount, breadth and depth of their work experience. The structure was modified following a review undertaken in 2007, with the changes being introduced in 2008. A further change was introduced in 2009 to accommodate students who have already achieved Chartered Engineering Technologist status.

The program structure

At USQ a **program** consists of a number of **courses** and leads to an award such as a degree. Full-time students normally study eight courses in a year and part-time students four courses. Students normally do an average of approximately 165 hours of work to satisfactorily complete a course.

The Master of Engineering Practice (MEP) program is a twelve-Unit program that requires students to complete 10 courses, including two 2-Unit courses. The detailed design of the outcomes focussed curricula was based on the theories and practices associated with distance education, adult learning, reflective practice, negotiated curriculum, and the self-assessment of workplace learning (Dowling 2006).

Two different types of courses were included in the program:

- **Technical courses**: These enable students to learn, practice, and to be assessed on new knowledge and skills. These courses are drawn from the existing suite of Bachelor of Engineering courses. All students must complete two core Technical courses and then demonstrate competence in all of the Technical courses listed for their major by: using their workplace learning; by completing the course; or by being granted an exemption based on prior studies.
- **Portfolio courses**: These enable students to be assessed on the learning, knowledge and skills that they have acquired during their experience in the engineering workforce. The three Portfolio courses were specifically designed for the Master of Engineering Practice program and all students complete the Self-assessment Portfolio and the two, 2-unit Workplace Portfolio courses.

The components of the program are represented in Figure 2. The main components are described in the following sections.

The Self-assessment Portfolio

The **first** course in the program is a core course, *ENG8300 Self-assessment Portfolio*. This innovative course requires students to undertake a self-assessment of their existing knowledge and skills against the graduate outcomes defined for the program. To complete this activity they must reflect on their prior studies and workplace experiences, identify their learning, and then link their learning to the relevant Elements of Competency.

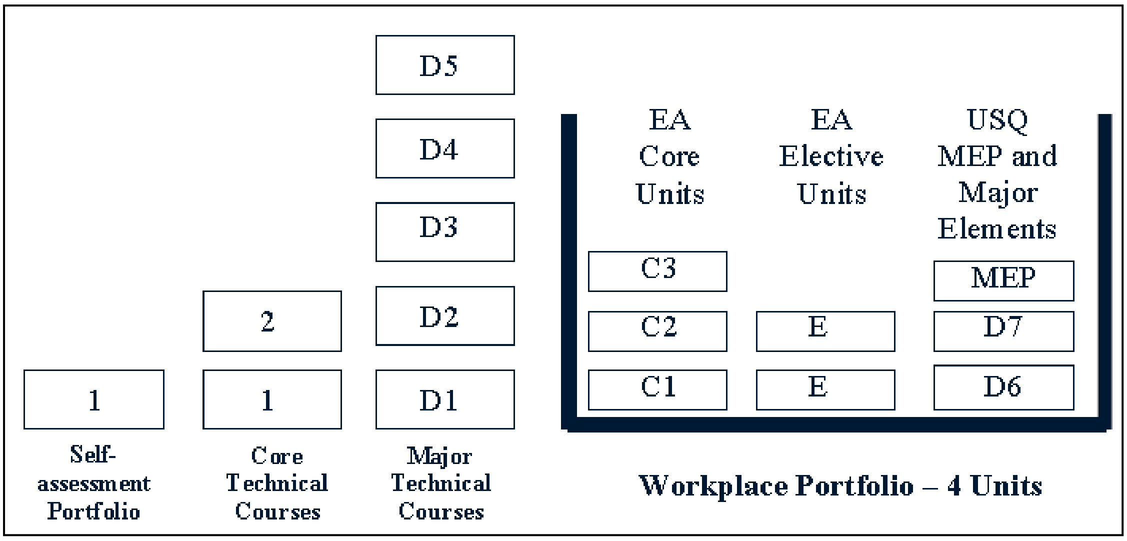

Figure 2: The structure and components of the Master of Engineering Practice program

The graduate outcomes

A detailed set of graduate outcome statements was developed for the program. These not only define the generic outcomes, but also the discipline specific outcomes for each of the majors in the program. These graduate outcome statements enable students to assess their prior learning and plan their individual learning pathway through to graduation.

The **generic** outcomes were developed from the USQ Bachelor of Engineering program and the National Generic Competency Standards for Chartered Professional Engineers, Stage 2 (Engineers Australia 2007), and written in the same format as those Standards. A set of Defining Activities is listed for each Element of Competency and these enable graduate engineers to self-assess their workplace learning and demonstrate their achievement of that competency.

The Stage 2 Competency Standards were adopted as the generic outcomes because the Engineering Technologists who enrol in the program are normally working at the graduate engineer level in these competency domains. Therefore, the adoption of the EA Competency Standards and processes enable students in the program to prepare the documentation they will use if they apply for Chartered Status once they have graduated. This provides these graduates with a considerable advantage when compared to Bachelor of Engineering graduates, who normally require 3-5 years of work experience before they have sufficient experience to be able to apply for Chartered Status.

The **discipline** outcomes were developed by the relevant Heads of Discipline in consultation with their colleagues. This was the first time that discipline specific graduate outcome statements had been defined in such detail at USQ. The discipline statements were written in the same style and format as the generic outcome statements for the program.

Developing a Pathway to Graduation Plan

The students use a number of tables and templates to help them to decide which courses they will study, which workplace experiences they can use to demonstrate achievement of one or more Elements of Competency, and the courses for which they will seek an exemption. For example, a table has been prepared for each major showing the Elements of Competency (graduate outcomes) and the Defining Activities defined for the major. The tables also list, for each Element, the Technical course students would study if they are not able to use their workplace learning to demonstrate competence in that Element.

The student then prepares a Pathway to Graduation Plan, which lists the courses they believe they should study to complete the program. The plan also includes the Workplace Portfolio Summary sheet which lists all of the Elements that the student will address in the Workplace Portfolio courses. After a period of negotiation with the Program Coordinator, and the relevant Head of Discipline, the Pathway to Graduation Plan is finalised and approved by the Faculty. The student then follows along that Pathway through to graduation.

The self-assessment process demonstrates the flexibility of the program structure as it allows each student to plan, and then negotiate, an individual learning pathway that will enable them to demonstrate achievement of all of the graduate outcomes defined for the program. It also caters for the diversity of knowledge, skills, prior learning, and workplace experiences that the students bring to the program.

The Core Technical Courses

All students must complete, or be exempted from, the two core Technical courses: MAT1502 Engineering Mathematics 2 and ENG3103 Engineering Problem Solving 3. These courses provide students with the mathematical and computing skills required to complete the technical courses in their major.

The Major Technical courses

The Technical courses in each major are drawn from the higher level courses in the equivalent major in the Bachelor of Engineering program, and include the capstone courses in each of the key subject areas in the major. This ensures that the students have both the breadth and depth an employer would expect when employing a graduate in that discipline.

The Workplace Portfolio courses

The Workplace Portfolio is a key component of the program as it enables students to use their workplace learning to demonstrate both generic and discipline specific Elements of Competency. The four-Unit Workplace Portfolio is equivalent to one semester of full-time study, although part-time students take two semesters to develop their portfolio. For this, and other administrative reasons, the Portfolio is split into two Workplace Portfolio courses.

As shown in Figure 2, the students demonstrate achievement of the following Elements in the Workplace Portfolio:

- the three compulsory EA Elements of Competency (C1 – C3);
- two of the EA elective Elements of Competency (E1, E2 etc);
- six Master of Engineering Practice Elements of Competency (MEP); and
- the Elements of Competency associated with at least two of their Major Technical courses (D).

Students use EA's Career Episode Report format to write narratives to demonstrate their achievement of one or more Elements of Competency. They submit drafts of each CER to USQ staff for comment before submitting the final version, which must be signed by the engineer who supervised their work.

Students who have already achieved Chartered Engineering Technologist status are granted an exemption from one of the Workplace Portfolio courses as they have already demonstrated their ability to prepare CERs, and will have prepared many of the required CERs. When they undertake the remaining Workplace Portfolio course they must still address all of the Elements of Competency listed for their Workplace Portfolio, either by using their existing CERs or by writing new CERs.

The student experience

Two anonymous surveys have been used to seek student feedback about the program and their experiences in the program.

The 2005 survey

An anonymous three page questionnaire was sent to the students in the first cohort in 2005 to gain feedback on the structure of the first course, the study materials, and the assessment processes; and also to gain feedback on the structure and content of Master of Engineering Practice program. The following is a summary of the results from the seven responses received:

- Most of the students enrolled in the program in order to gain Chartered Professional Engineer status or Registration in Queensland as a Professional Engineer (RPEQ);
- Six of the seven students would not have enrolled in the Bachelor of Engineering program; and
- Six of the seven students either agreed or strongly agreed that the program was highly innovative.

The students also provided the following written comments:

"After carrying out my Bachelor of Engineering Technology studies over 10 years (of part-time study) *and probably not getting credit for the subjects I completed, I was not prepared to start the complete Bachelor of Engineering program."*

"*An excellent concept to recognise true experience."*

"*Congratulations on this new concept."*

The MEP …"*gives me an avenue to continue my academic studies, and a realisation of my strengths and weaknesses as an engineer."*

This positive feedback about the program, and the learning and teaching strategies being used in the individual courses, encouraged the staff teaching into the program at that time.

The 2007 student survey

Another survey was undertaken in late 2007 to seek student feedback about the proposed changes to the program structure and on their experience in the overall program and in the course ENG8300. Sixteen students responded, a 50% response rate, although not all students responded to all of the questions. The results for the questions relevant to this paper are shown in Table 2, which also indicates the number responses for each question. The percentage of the students who **agreed** or **strongly agreed** with a statement is shown in the right hand column. In all cases, the remaining students had **no opinion**.

Table 2: Positive student responses to survey statements

Questions	Number of Responses	% of Positive Responses
Student experiences in the course ENG8300		
The study materials clearly explained what knowledge and skills would be assessed in the course.	14	79%
Together, the course examiner and study materials motivated me to learn how to demonstrate my workplace achievements.	14	93%
The course examiner helped me to understand the course materials.	13	92%
The course examiner was always willing to help me and offer advice.	14	100%
The course examiner answered my queries promptly.	14	93%
The course examiner showed respect and concern for me as an individual.	14	86%
The assessments allowed me to fully demonstrate my knowledge and skills.	14	93%
The course examiner provided appropriate and timely feedback on my assignments and my progress in the course.	14	93%
Student experiences in the MEP program		
Although I have not graduated I am more than happy with the program to date.	14	79%
Student comments on the proposed new program structure		
The new structure of the Portfolio courses will give students more choice when they are selecting EA elective Units	13	62%
The new Portfolio course structure will be much more efficient for students	13	62%
Using the Engineers Australia Element codes (rather than MEP codes) in Career Episode Reports will make the self-assessment process easier.	14	71%

Students were also given the opportunity to write comments about their experiences in the program. The following statements are indicative:

"Developing the CERs as part of the course is a fantastic way to reflect on your achievements."

"I think that the program is well structured and achieves the required outcomes."

"I am enjoying studying again (so far!), and enjoyed defining my graduation pathway!"

"My peers and my Director are very happy with the program and they have asked me to speak with one of the other Technologists about the benefits of studying the program."

"I think the overall program is good and with the proposed changes it will be even better."

Unsolicited student comments

The academic staff who facilitate student learning in the program were encouraged by an unsolicited student letter in May 2006:

"I find that the materials are concise and practical. The section on reflective practice has been extremely useful both inside and outside the realms of the course. It is especially useful when attempting to recollect my thoughts as to why, where and how I went about my tasks and how I reached pertinent goals. It has led me to reflect on what has enabled me to successfully complete my work, and the learning and pattern of thinking that has moulded my professional career."

The first students graduated from the program at the end of 2007 and one of them wrote the following comments about his experience in the program:

"I cannot speak highly enough of the program. It was ideally suited to me in that I had completed a Bachelor of Engineering Technology and had been working in the industry for many years. I knew I had the ability (and practical skills) of the qualified engineers I worked with and craved equal recognition for my work. The Master of Engineering Practice gave me an opportunity to use my knowledge and experience base to demonstrate my ability and gain formal recognition. The Self Assessment Portfolio was an excellent tool to identify deficiencies in my knowledge and to implement a strategy in the workplace to acquire the competencies to successfully complete the course. I completed the program in Semester 2, 2007, and I was promoted in February 2008 – this is a direct result of completing the Master of Engineering Practice."

Conclusion

The Master of Engineering Practice program was developed to provide experienced Engineering Technologists with an alternative pathway to become Professional Engineers. The program was designed to enable them to use their workplace learning to demonstrate their competence in many of the courses in the program. Following a consultative process involving staff and students the program was modified in 2008 to increase its flexibility so that it accommodates the significant diversity of the students enrolled in the program. The changes also decreased the complexity of the program structure and the assessment tasks, and lowered the assessment load for staff.

Most mature age students have firm career goals in mind when they enrol in one of the Faculty's distance education programs. They also believe they know what they need to learn and why, and they do not tolerate out-of-date content or, what they perceive to be, non-essential curricula. Therefore, the positive feedback provided by the cohort of mature age students in the MEP program demonstrates that the program is meeting their needs.

The increasing number of students enrolled in the program, and the consistently positive feedback those students provide to the University, demonstrate that the program is achieving its aims. More importantly, the program is enabling students to achieve their career goals.

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