Assessing final year engineering projects (FYEPs): ensuring learning and teaching standards and AQF8 outcomes

Final report 2015

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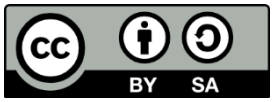

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Executive summary

Issues and context

This research project is a partnership between seven universities – Central Queensland University (lead), University of Technology Sydney, The University of Adelaide, Curtin University, Deakin University, University of Tasmania and RMIT University. The purpose of the project was to develop good practice guidelines to assist engineering educators to improve Final Year Engineering Project (FYEP) practice and assessment and to ensure they meet Australian Qualifications Framework Level 8 (AQF8) outcomes. The project addressed the need that although Final Year Projects are a longstanding feature of undergraduate engineering programs, there is little consistency in how these projects are taught, assessed and supervised (Rasul, Nouwens, Martin & Greensill, 2009).

The recent introduction of the AQF has presented new challenges to undergraduate engineering degrees and in particular, how Honours degrees are awarded. Previously awarded on merit, compliance at AQF8 now means that all students enrolled in four-year embedded Honours degrees will graduate with Honours. Final year projects, as capstone subjects "should enable students to demonstrate program exit outcomes, although opportunities to demonstrate these outcomes will exist throughout a program" (Lawson, Hadgraft & Rasul, 2014). These two factors, inconsistent practice and new levels of compliance, create a gap that this project addresses.

Methodology

Adopting a case study methodology, the data collection comprised two phases: a mapping and review of existing assessment and supervision practices followed by the development and promotion of guidelines to assist engineering disciplines to improve FYEP assessment. Data were collected from 16 universities from all states and territories of Australia in Phase 1. Documentation included course profiles, student guidelines, marking rubrics, schedules, and teaching resources, and exceeded 100 documents. In addition, semi-structured interviews were conducted with 16 final year project subject coordinators. The interview data supplemented and explicated the extensive documentary data. This data was coded thematically, initially from the themes pre-set by the research proposal but then inductively, for a more fine grained approach to analysis. Using the data from Phase 1, the team developed draft guidelines in each of the areas curriculum, supervision and assessment. Accompanying exemplar practice was also developed. These guidelines and practices were then presented at seven workshops throughout Australia and feedback sought from participants. Using this feedback a revised set of guidelines was presented and evaluated at a final workshop, as well as being distributed for comment to all previous participants. The final set of guidelines responded to this last feedback set. This second phase drew on feedback from over 100 participants from 26 universities.

Key findings

- University coordinators are reflective and committed to improved practice with many subject coordinators commenting on changes and improvements made to FYEP over time.
- FYEP or capstone subjects are often organised as two subjects taken over two semesters forming a year-long project. Some universities run single, cross-disciplinary subjects with others having discipline or school specific subjects.
- There are some consistent processes for the ways in which students select projects, are assigned supervisors and enrol in project subjects.
- Project types generally include industry sponsored, university generated and student generated and range from research-focused, investigative, experimental, design and build.

- Most projects in our sample required students to work individually on projects. Some allowed pairs or groups. Some allowed individuals within groups – that is smaller individual projects that can contribute to a larger one. In larger universities, group projects are more practical.
- The data themes clustered broadly into areas of outcomes, curriculum, assessment and supervision.

Outcomes

Data showed that outcomes in subject or unit profiles, ranged from subject specific with some making explicit reference to Engineers Australia (EA) Stage 1 Competencies to more encompassing generic skills and/or graduate attributes. There was considerable language variation with some documents having simple description such as, 'design', 'implement', 'perform', 'prepare.' Others offered qualification: 'produce *high quality*' 'apply *original* thinking.' Our interview data revealed that familiarity with AQF8 varied, with some coordinators not being aware of it and having no consideration, to deep consideration and embedding AQF8 language into project subject outcomes. Most coordinators saw AQF8 as a compliance and documentation issue rather than one that required a fundamental shift in practice, however this was contested during the workshops. For many, the challenges were: What is Honours? Who is eligible and when? How is post-graduate study impacted by AQF8?

Curriculum

The documentation and interview transcripts revealed an overwhelming emphasis on self-directed learning within final year project subjects. Final year projects are recognised as culminating opportunities for students to independently practice and extend what they have learnt in their degree so far. Some universities offered workshop support where students were assisted in research skills such as preparing for and writing a literature review and these ranged from one-off to regular (weekly or fortnightly) seminars or classes. A couple of universities had introduced a stand-alone research methods subject as a prerequisite to the FYEP subject and one had provided a parallel project management course to assist their students with aspects of project work. There was not a clear sense in any of the participating universities of the ways in which students are suitably prepared for project work. It was as if the final year project was a natural culmination to work previously undertaken, but with no clear articulation of where students might have, for example, learnt about research. As will be seen in the guidelines, it is important for curriculum designers to identify where they expect AQF8 to be taught and demonstrated in their courses/programs, as well as within the final year project.

Assessment

Tasks set for assessment purposes varied across universities but most included progress reports and a final report or thesis. One had recently introduced a journal style paper together with supporting documentation as the final submission. Some assessments that students were expected to undertake included presentations, conference style seminars or exhibitions. Weighting for the thesis varied from 40 percent to 100 percent of total available marks, and the number of assessment tasks set varied from three to seven. Close attention was paid to formative assessment in many project courses and some included peer-assessment and self-assessment. The interview data revealed considerable variation in marking and moderation practices and some coordinators expressed deep concern about supervisor bias and variation. There was also some contention about how to and whether to assess the process as well as, or in place of, product. In some instances this extended to consideration of whether the project itself, the project outcomes or the thesis was the product for assessment.

Supervision

There was limited preparation or support given to those academics undertaking supervision of final year projects. No university provided systematic support for supervisors beyond documentation. In most instances, supervisors were given the same materials (outlines, handbooks, etc.) as the students. In some cases, a separate supervisor's handbook was given and in others, those academics new to supervision would be given fewer projects to supervise, or be placed in co-supervision arrangements. There was no consensus on matters of how to best supervise (with groups of students or individuals) or how regularly. At one university, the social moderation practices (where staff met to discuss and compare marking both at planning and implementation stages of the project) presented an opportunity for supervision guidance and support. Issues around quality supervision were related to assessment (knowledge of the student, bias, general inflationary marking) and there was some concern about variation in supervision style. However, some of this is related to systemic and widespread problems rather than an issue specific to the final year project subject. Finally, whilst most supervisors worked within their area of technical expertise, there was recognition of the value of supervising multidisciplinary projects outside of one's own area of technical expertise.

Outputs

Drawing on the substantial data set and working collaboratively as a team (and smaller teams within) this project has made significant contributions to the field of engineering education and the teaching and learning of final year projects. Specifically, it has:

1. Produced a set of guidelines for curriculum, supervision and assessment of FYEPs. Grounded in current theory and practice, the guidelines specifically address the ways in which curriculum designers and subject coordinators can work to address AQF8 requirements within FYEP subjects. Accompanying the guidelines is a set of illustrative practices which enable academics to view and share practice identified as exemplary.
2. Facilitated high quality workshops across Australia and New Zealand. These workshops had immediate benefit to the project itself by providing quality feedback on the guidelines, but participants also commented on the immense value of the opportunity to bring meaning and critique to their own practices in FYEP teaching and learning. Understanding AQF8 and the research requirements of undergraduate engineering degrees were the deep discussion topic around existing FYEP practices in these workshops. Of particular value was the opportunity for participants to share practice.
3. Made scholarly contributions to the field of engineering education. Several conference papers were written by the team, peer reviewed and included in national and international conferences. Two papers were invited for review for inclusion in a Special Edition of the International Journal of Engineering Education. These papers were submitted, and have been reviewed and accepted.

Recommendations

Recommendations pertinent to the guidelines and teaching, supervision and assessment of FYEPs are included in the guidelines document, but are restated here. There are additional recommendations about research directions and practices.

1. Universities and faculties should recognise the increased workload for supervisors and coordinators of FYEPs. Recognition of workload is seen as adequate resourcing and support of staff.

2. Marking and moderation practices in FYEPs must ensure quality and mitigate inequity. Calibration of markers should precede marking to ensure markers are assessing to a shared understanding.
3. Further research into student perspectives and achievements in FYEPs and AQF should be considered.

Contents

Narrative

This narrative section is divided into two main parts. The first expands on the study itself – the background, methodology, findings and recommendations. The second considers the process the project team undertook in carrying out their work, the strengths and challenges.

Part 1

Final Year Engineering Projects (FYEPs) – background

FYEPs or capstone projects have long been a feature of undergraduate engineering degrees and this is due, in part, to the accreditation process that requires students to conduct and manage engineering projects as demonstrable skills, on entry to the engineering profession (Lawson, Hadgraft & Rasul, 2014). Elsewhere, it has been established that there is considerable variation in the projects students undertake, how they are prepared for the experience and how they are supervised and assessed (Rasul, *et al*., 2009). As a culminating experience, the FYEP is typically the last checkpoint before students graduate into the engineering profession and it would be expected that students demonstrate the highest of outcomes expected of their degree (Lawson, Rasul, Howard & Martin, 2014).

FYEPs are documented in the literature as fulfilling many purposes. There is recognition that FYEPs enable achievement of a range of technical, professional and personal skills. Sohel, Thorne, Jegathesan, Sergeev & Bennamoun (2011) point to the achievement of generic attributes such as communication. Similarly, Schmid, Meaker and Thomas (2012) point to teamwork and other professional attributes enabled by projects, particularly when showcased. They add that the networking opportunity with industry presentations enhances employability. The authenticity of project work as enabling and consolidating real life professional engineering skills, is also seen as a means for preparing students for the world of work (Hogan, 2012; McKenzie, Trevisan, Davis & Beyerlein, 2004; Schmid, Meaker & Thomas, 2012).

The recent introduction of the Australian Qualifications Framework (AQF) has presented new challenges to undergraduate engineering degrees and in particular, how honours degrees are awarded. Previously awarded on merit, compliance at AQF level 8 now means that all students enrolled in four-year 'embedded Honours' degrees will graduate with Honours. Final Year Projects, as capstone subjects "should enable students to demonstrate program exit outcomes, although opportunities to demonstrate these outcomes will exist throughout a program" (Lawson, Hadgraft, & Rasul, 2014). These two factors, inconsistent practice and new levels of compliance, create a gap in which our project is located.

The findings of this project recognised that there are both nationally common and locally unique pressures facing universities as they develop curriculum, assessment and supervision practices related to FYEPs. Figure 1 illustrates this. All universities offering engineering degrees are subject to both internal and external accreditation requirements. "Internal and external accreditations are not always competing demands but might manifest as variations in the development and delivery of project subjects across institutions" (Lawson, Hadgraft & Rasul, 2014). Resourcing and governance for example, are locally determined issues and will influence FYEPs.

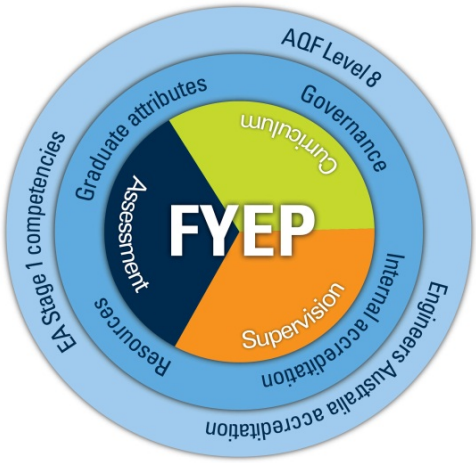

Figure 1: Locating FYEP in local and national contexts

The research project was a partnership between seven universities – Central Queensland University (lead), University of Technology Sydney, The University of Adelaide, Curtin University, University of Tasmania, Deakin University and RMIT University. The purpose of the project was to develop good practice guidelines to assist engineering educators to improve FYEP practice and assessment and to ensure they meet AQF8 outcomes. The project targeted the three areas at the centre of Figure 1; curriculum, assessment and supervision.

Methodology

Adopting a case study methodology, the data collection comprised two phases: a mapping and review of existing assessment and supervision practices, followed by the development and promotion of guidelines to assist engineering disciplines to improve FYEP assessment. Data were collected from 16 universities from all states and territories of Australia in Phase 1 (Table 1). Documentation included course profiles, student guidelines, marking rubrics, schedules, and teaching resources and exceeded 100 documents. In addition, semi-structured interviews were conducted with 16 individual coordinators of capstone project courses across a range of ten Australian universities. The wider project team members approached coordinators from their own institutions as well as those with whom they were connected. The research officer conducted all interviews which ranged in length from 30 to 50 minutes. The interviews allowed participants to explain their documentation and their practices, and in particular to articulate the strengths and challenges of assessment and supervision. Interviewees were prompted with questions such as:

- Tell me about some of the challenges you face with your final year project course.
- What do you see as some of the strengths of the way you do things?
- How are supervisors involved in the assessment and why do you do things this way?

The interview data supplemented and explicated the extensive documentary data. This data was coded thematically initially from the themes pre-set by the research proposal but then inductively for a more fine-grained approach to analysis (Table 2).

Using the data from Phase 1, the team developed draft guidelines in each of the areas curriculum, supervision and assessment. Accompanying exemplar practice was developed drawing on both the literature describing best practice and identified strengths from the coordinator interview data.

These guidelines and practices were then presented at seven workshops throughout Australia and feedback sought, recorded and analysed from participants. Using this feedback a revised set of guidelines was presented and evaluated at a final workshop. The revised guidelines were also distributed for comment to all previous participants. This second phase drew on feedback from over 100 people from 26 universities. The final set of guidelines responded to the final feedback set.

Table 1: Data collection

Data	
Documents (profiles, rubrics, guides, teaching resources)	n>100 Universities providing this data n=16
Semi-structured interviews with coordinators	n=16 Universities providing this data n=10
Feedback from national workshops	Workshops n=8 Total participants n=102 Universities participating n=26

Table 2: Thematic codes in data analysis

Deductive codes	**Inductive codes**
Students	Application of knowledge
Supervising academics	Purpose
Industry partners	Authenticity
Project assessment	Research skills
Curriculum	Challenges
Project selection	Definitions
Standards	Strengths
Staff development needs	Preparation for enrolment
	Professional skills
	Technical knowledge
	Project skills
	Reflective practice
	Project type

Findings

The data broadly clustered into four main areas: outcomes, curriculum, assessment and supervision.

Outcomes

Data showed that outcomes in subject or unit profiles, ranged from subject specific with some making explicit reference to Engineers Australia (EA) Stage 1 Competencies to more encompassing generic skills and/or graduate attributes.

There was considerable language variation with some documents having simple description such as, 'design', 'implement', 'perform', 'prepare'. Others offered qualification: 'produce *high quality*' 'apply *original* thinking'. In addition to that which was documented in outlines and the like, coordinators were able to articulate the types of outcomes and benefits students were expected to achieve as a result of undertaking a final year project. These outcomes included independent thinking about methods of problem solving, synthesising different areas of knowledge and integration of professional and technical engineering skills. There was also recognition of the authenticity of project work. This is consistent with the literature that identifies the variety of outcomes enabled by FYEPs (Hogan, 2012; McKenzie *et al*., 2004; Schmid, Meaker & Thomas, 2012; Sohel *et al*., 2011).

Our interview data also revealed that familiarity with AQF8 requirements varied from some coordinators not being aware of it and having no consideration, to deep consideration and embedding AQF8 language into project subject outcomes. Most coordinators saw AQF8 as a compliance and documentation issue rather than one that required a fundamental shift in practice; however this was contested during the workshops. For many the challenges were: What is Honours? Who is eligible and when? How is post-graduate study impacted by AQF8? There was also discussion about what comprises AQF8 'research' in an engineering context. Emerging from project team meetings and subsequently explored with workshop participants, was the idea that 'research' can be contextualised for engineering.

Note that the following apply regardless of the discipline and/or the project type. Research in engineering at AQF8 is:

- Understanding the local context;
- Defining and identifying the open ended problem, its limitations/constraints, relevant to the practice of engineering;
- Mapping the state of the art globally or broadly: asking the right questions, reviewing literature and current practices using quantitative and qualitative sources;
- Identifying and articulating gaps;
- Determining appropriate methodology and what constitutes evidence;
- Conducting systematic investigation, distillation and application to the engineering problem;
- Undertaking experimentation, design, modelling, problem solving and data collection;
- Analysing and synthesising with critical judgement offering unique interpretation;
- Creating, innovating, publishing – communicating a contribution of knowledge or good practice or delivering novel outcomes in the local context; and
- Autonomous learning and reflecting.

At the AQF8 level, all projects (design, research, experimental, etc.) should build upon and develop similar skills of definition (what is the problem?), literature and practice review (how this problem has been solved or addressed in the past), identification of feasible solutions, testing and investigating (in the laboratory or through model simulations) and the production of recommendations and local knowledge contributions. Students are learning to 'boldly go' beyond the packaged solutions they have learned at AQF7 level (Lawson, Hadgraft & Jarman, 2014).

Curriculum

The documentation and interview transcripts revealed an overwhelming emphasis on self-directed learning within FYEP subjects. FYEPs are recognised as culminating opportunities for students to practice to the extent of what they have learnt in their degree so far. Some universities offered workshop support, where students were assisted in research skills such as preparing for and writing a literature review and these ranged from one-off to regular (weekly or fortnightly) seminars or classes. Such interventions are supported in the literature, particularly for communication skills for international students where English was not their first language (Blicblau & Dini, 2012). A couple of universities had introduced a 'stand-alone' research methods subject as a prerequisite to the final year project subject and one had provided a parallel project management course to assist students with aspects of project work.

There was not a clear sense in all universities of the ways students were suitably prepared for project work, although the literature points to the need for preparedness for project work in the years preceding the FYEP (Hogan, 2012; Nepal & Jenkins, 2011). In the collected data, it was as if the final year project was a natural culmination of work previously undertaken, but there was no clear articulation of where students might have, for example, learnt about research. As will be seen in the attached guidelines, it is important for curriculum designers to see where they expect AQF8 to be taught and demonstrated in their courses/programs, as well as where within the final year project.

Associated areas here were preparation for enrolment and project selection and type. There were also concerns expressed about logistical aspects of sourcing, allocating and administrating projects. Data showed that there were a variety of ways in which these tasks were undertaken. For example, in some instances there was an extensive pre-enrolment process where students were carefully matched with advisors and topics. In other cases the process of topic allocation was administrative only, with students who signed up first securing the topic. However, all universities invested significant time in preparation for final year project subjects, where subject coordinators assumed the primary responsibility for the organisation of projects, organisation of supervisors and oversight of how projects were allocated to students. Whilst academics will assume a primary role in the organisation of projects, Nepal & Jenkins (2011) suggest that student involvement in project scoping and direction is important. At least one of the universities in our data set had moved towards reducing prescriptive topics in favour of negotiated ones.

The interview data showed (and workshop participants confirmed) that there was a lot of concern at the institutional level about what constitutes an appropriate project type. Project types across our sample included industry-based, design, experimental, multidisciplinary, student-initiated, interdisciplinary and supervisor-initiated research projects. The value of an industry project as an authentic engineering experience was noted and this is supported in the literature that highlights the value of both industry and multidisciplinary projects (Hogan, 2012; Bramhall, Short, Hoque, Blohm, Campbell & Young, 2011). Projects could be individual or group. Workshop participants were in agreement that the type of project and whether it is individual or team-based is less important than the degree to which the professional judgement of academics (curriculum designers, advisors, or assessors) focused on overarching AQF8 considerations. This means that with appropriate curriculum design, quality assessment and supervision, it is potentially possible for any project to enable students to achieve and demonstrate AQF8 outcomes.

Assessment

Tasks set for assessment purposes varied across universities, but typical product submissions included project plans and proposals, literature reviews and final reports or thesis documents. One school within one university had recently introduced a journal-style paper, together with supporting documentation, as the final submission. Some other assessments students were expected to undertake included presentations and conference-style seminars or exhibitions, some of which were large public events. In addition to the valuable industry links forged at such events, there is some evidence to suggest that exhibition enhances the quality of student projects (Kar, Mukahar, Enzai, Rais & Sabri, 2013).

Weighting for the thesis varied from 40 percent to 100 percent of total available marks, and the number of assessment tasks set varied from three to seven. Given that the final-year project subject is usually extended (or comprises two linked but separate subjects) and culminates in a final submission, there is often close attention paid to formative assessment. Indeed, improved student engagement and enhanced student interest and learning are possible with strong formative assessment (Gardner & Willey, 2012; Jiao & Brown, 2012). Some project subjects also included peer-assessment and self-assessment.

The marking criteria against which students were assessed were broadly technical (engineering knowledge and skills) and professional (application, communication and teamwork). Some coordinators articulated the challenges posed by the conflation of these criteria, suggesting that seeing the product in isolation to the work conducted, or the process undertaken, is problematic. Some final-year subjects include criteria such as diligence, which is arguably effort, whereas others are more tightly focused on product only. Whilst criteria sheets or marking rubrics were widely supported and a sample of one provided in our exemplar practices document, it should be noted that the use of pre-set criteria is problematic and can result in anomalies (Sadler, 2008).

The interview data revealed considerable variation in marking and moderation practices and some coordinators expressed deep concern about supervisor bias and variation. There was also some contention about how to and whether to assess process as well as product. These sub-themes were seen as important but beyond the scope of the guidelines, because they fell within the local context. However, the data in this area was extensive and is more fully explored by Lawson *et al.* (2014).

Supervision

There was limited preparation or support given to those academics undertaking supervision of final-year projects. None of the participating universities provided systematic support for supervisors beyond documentation. In most instances, supervisors were given the same materials (outlines, handbooks, etc.) as the students. In some cases, a separate supervisor's handbook was provided and in others, those academics new to supervision would be given fewer projects to supervise or be placed in co-supervision arrangements. There was no consensus on matters of how to best supervise (with groups of students or individuals) or how regularly. At one university, the social moderation practices (where staff met to discuss and compare marking both at planning and implementation stages of the project) presented an opportunity for supervision guidance and support.

Issues around quality supervision were related to assessment (knowledge of the student, bias, general inflationary marking) and there was some concern about variation in supervision style. Some

of this however is related to systemic and widespread problems rather than an issue specific to the final year project.

Finally, whilst most supervisors worked within their area of technical expertise, there was recognition of the value of supervising multidisciplinary projects outside of one's own area of technical expertise.

Outputs

Drawing on the substantial data set and working collaboratively as a team (and smaller teams within) this project has made significant contributions to the field of engineering education and the teaching and learning of FYEPs. Specifically, it has:

1. Produced a set of guidelines for curriculum, supervision and assessment of FYEPs. Grounded in current theory and practice, the guidelines specifically address the ways in which curriculum designers and subject coordinators can work to address AQF8 requirements within FYEP subjects. Accompanying the guidelines is a set of illustrative practices which enable academics to view and share practice identified as exemplary. The guidelines are a substantial document and include a description of the theoretical and data base that informed them. Whilst best read as a whole, there are different guidelines for supervisors (advisors), curriculum writers and those academics involved in assessment. The guidelines and accompanying exemplar practice documents will be housed initially with Engineers Australia (EA), but other forums have been suggested such as distributing through the Associate Dean Learning and Teaching network. The guidelines target the points of difference between AQF7 and AQF8 and in this sense are specialised rather than general good practice guidelines.
2. Facilitated high-quality workshops across Australia and New Zealand. These workshops had immediate benefit to the project itself by providing quality feedback on the guidelines, but participants also commented on the immense value of the opportunity to bring meaning and critique to their own practices in FYEP teaching and learning. The workshops provided a forum for deep discussion around existing FYEP practices, as well as understanding AQF8 and the research requirements of undergraduate engineering degrees. Of particular value was the opportunity for participants to share practice.
3. Made scholarly contributions to the field of engineering education. Several conference papers were written by the team, peer-reviewed and included in national and international conferences (Hassan, Rasul, Lawson, Howard, Martin & Nouwens, 2013; Howard, Kestell & Rasul, 2014; Jarman, Henderson, Kootsooks, Anwar & Lawson, 2014; Lawson, Hadgraft & Jarman, 2014; Lawson, Hadgraft & Rasul, 2014; Lawson *et al.,* 2014; Martin, Hadgraft, Stojcevski & Lawson, 2014; Nouwens, Rasul, Lawson, Howard, Martin & Jarman, 2013; Rasul, Lawson, Howard & Martin, 2014). Two papers were invited for review for inclusion in a special issue of International Journal of Engineering Education. These papers received review reports with minor corrections and finally those have been accepted (Lawson, Jarman, Rasul, Howard, Martin & Hadgraft, 2015; Rasul, Lawson, Howard, Martin & Hadgraft, 2015).

Recommendations

Recommendations pertinent to the guidelines and teaching, supervision and assessment of FYEPs are included in the guidelines document, but are restated here. There are additional recommendations about research directions and practices in the guidelines.

1. Universities and faculties should recognise the increased workload for supervisors and coordinators of project subjects. Recognition of workload is seen as adequate resourcing and support of staff.
2. Marking and moderation practices in FYEPs must ensure quality and mitigate inequity. Calibration of markers should precede marking to ensure markers are assessing to a shared understanding.
3. Research into student perspectives and achievements in FYEPs and AQF should be considered.

Part 2

Team process

The team comprised ten academics from seven partner universities, a project officer and an evaluator. The team changed membership over time as people either resigned positions or took up new ones elsewhere, but this did not affect team performance. Essentially, the team had highly effective communication channels and all communication was managed through the project officer. The work of the team was progressed through the following major activities:

1. Meeting face-to-face at the inception of the project and several times throughout. These meetings enabled team-building opportunities not otherwise possible through other means of communication, such as video-conferencing or email. Significant intellectual ground was covered at these meetings;
2. The use of sub-teams of three or four to develop draft guidelines within a particular area (curriculum, assessment, or supervision). This enabled the team to have more focused conversations in smaller peer groups. Tasks also became more manageable;
3. The decision for two team members to collaboratively design and each lead one of the dissemination workshops. This enabled each workshop to have the same format and focus. These two members then jointly analysed the feedback to develop the revised and final guidelines; and
4. Writing papers and designing and implementing workshops at conferences helped progress and keep in focus the deliverables of the project.

As noted in progress reports, the original brief of the project was narrowed to the engineering discipline and to academics (rather than students, industry and academics). It should be noted however, that the relevance of the guidelines to information technology (IT) has been welcomed in at least one of the partner universities. There is certainly scope to extend the project to investigate the relevance of the guidelines to disciplines other than engineering and IT and to those with capstone project courses. Similarly, looking at students' perspectives on the curriculum, supervision and assessment of FYEPs, as key stakeholders, would be valuable.

Strengths

The project has produced significant outputs. The guidelines have been well received by workshop attendees in all states of Australia, and two workshops in New Zealand. This is due in part to the timing of AQF compliance and the focus of the project. However, in addition to the production of the guidelines themselves, the reach the team has achieved is noteworthy. The dissemination phase occurred on a national level, with workshops held in all states and 26 universities took part. In addition, two workshops were facilitated in New Zealand, where the relevance of the guidelines was noted and welcomed.

Strong outcomes were possible for several reasons. Firstly, the timeliness of the research project meant team members were interested and motivated in the area of research and in developing useful deliverables. Secondly, each of the team members brought considerable experience and expertise to the project and all had various levels of experience with FYEP coordination and

supervision. Having members with substantial national networks greatly assisted in the data collection phase. Similarly, the team was aided by the capabilities of members who were Associate Deans (Learning and Teaching), as well as a project officer with significant relevant educational design experience in curriculum design and assessment. Diverse team skills, knowledge and experience were clear advantages. Additionally, tight team communication and management took place, enabling all team members to contribute meaningfully and to remain connected to the project throughout. As mentioned above, meeting face-to-face on more than one occasion greatly facilitated this. Finally, the project evaluator, Dr Lesley Jolly, was firmly engaged throughout - attending meetings, participating in email discussion and attending workshops and presentations. She contributed valuable guidance to the team as they grappled with dissemination strategies. Her evaluation report has been attached to this report.

Challenges

The only significant challenge was maintaining momentum when the team was widely dispersed. As noted earlier, the most significant progress was made when the team was able to work together in a face-to-face environment over a sustained period of days. Having people contribute outside of these times was a challenge resulting in greater responsibility for deliverables falling to fewer team members.

Dissemination

Although referred to throughout this report, the dissemination activities of this project are summarised in Table 3. Dissemination workshop materials at AAEE 2013 were also advertised through the Engineers Australia membership network/email. Dr Peter Hoffman (Associate Director, Accreditation, Engineers Australia), Professor Doug Hargraves (QUT) and Dr Lesley Jolly (Strategic Partnerships), who were in the reference group of the project, made the comments that the guidelines represent the culmination of rigorous research and consultation and will greatly assist those interested in enhancing the quality of teaching and assessing FYEPs. They also mentioned that while their primary purpose is to offer instructive and practical ways to ensure projects meet AQF8 requirements, they can also be taken as a guide to good practice in managing final year projects in engineering programs. Although every university differs in the way such projects are situated within their program and curriculum, including supervision and assessment, they encourage all universities to use these guidelines in local discussions and workshops when considering AQF requirements. They are consistent with Engineers Australia's accreditation criteria and are supported by Engineers Australia. These guidelines will be made available to all engineering programs/departments in Australian universities.

Table 3: Dissemination activities

Strategy	Date	Location
Professional Development Workshops		
• Learning and Teaching Standards for Final Year Engineering Projects (FYEPs): ensuring AQF8 outcomes	10 December, 2013	AAEE Annual conference, Gold Coast
• Good practice guidelines for curriculum, supervision and assessment of final year engineering projects and AQF8 learning outcomes	9 December, 2014	AAEE Annual conference, Wellington, NZ
• Good practice guidelines for curriculum, supervision and assessment of final year engineering projects and NZQF8 learning outcomes	16 December, 2014	The University of Auckland, NZ
Conference papers		
• Assessment on Final Year Projects • Development and Assessment of the Final Year Engineering Projects – A Review • Educational purposes of FYEPs and their Assessment • FYEPs: Improving assessment, curriculum and supervision to meet AQF8 outcomes.	2-3 July, 2013	The 4th International Research Symposium on Project Based Learning, Kuala Lumpur, Malaysia
• Assessment of FYEPs – an AQF8 perspective. • Guidelines for Curriculum development of FYEPs to support AQF8 Outcomes. • Supporting students through the FYEPs experience to achieve AQF8 outcomes. • Contextualising Research in AQF8 for Engineering Education. • Getting it right: Assessment tasks and marking for capstone project courses. • Learning and Teaching of Capstone FYEPs: An Australian Study.	8 – 11 December, 2013 8 – 10 December, 2014 2-4 June, 2014	AAEE Annual conference, Gold Coast AAEE Annual conference, Wellington, NZ Capstone Design Conference, Columbus, Ohio, USA
Workshops to evaluate guidelines and resources • Good practice guidelines for curriculum, supervision and assessment of final year engineering projects and AQF8 learning outcomes	13 June, 2014 30 June, 2014 1 July, 2014 17 July, 2014 21 July, 2014 22 July, 2014 1 September, 2014 28 October, 2014	CQUniversity, Rockhampton UTS, Sydney CQUniversity, Brisbane RMIT, Melbourne University of Tasmania, Hobart Australian Maritime College, Launceston Curtin University, Perth The University of Adelaide, Adelaide
Plenary Speech • Ensuring Learning and Teaching Standards and Quality Outcomes in Assessing Final Year Engineering Projects	2-4 April, 2013	International Conference on Engineering and Technology Education, Kuala Lumpur, Malaysia
Seminars/Presentations • Australian Council of Engineering Deans (ACED) • Office for Learning & Teaching Conference	24 April, 2014 10-11 June 2014	

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Appendix A

Certification by Deputy Vice-Chancellor (or equivalent)

I certify that all parts of the final report for this OLT grant provide an accurate representation of the implementation, impact and findings of the project, and that the report is of publishable quality.

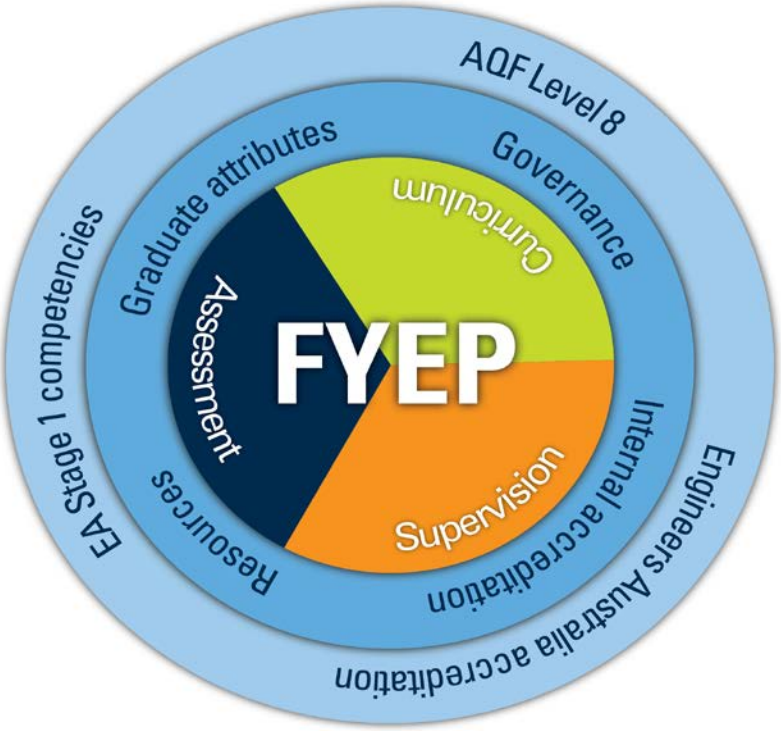
Professor Hilary Winchester, Provost Date: 23 March 2015

Further Appendices

Appendices include:

- Developed guidelines
- Exemplary practices
- Project promotional workshop materials
- Workshop evaluation questionnaires
- External evaluator's report by Dr Lesley Jolly, Strategic Partnerships

Good practice guidelines for curriculum, supervision and assessment of Final Year Engineering Projects and AQF8 learning outcomes



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Foreword

The following guidelines represent the culmination of rigorous research and consultation and will greatly assist those interested in enhancing the quality of teaching and assessing Final Year Engineering Projects. The guidelines were developed as part of collaboration between seven universities and represent input from a total of 26 universities across Australia. While their primary purpose is to offer instructive and practical ways to ensure projects meet Australian Qualification Framework Level 8 requirements, they can also be taken as a guide to good practice in managing final year projects in engineering programs. Of course, every university differs in the way such projects are situated within the curriculum, the nature of projects pursued and the ways in which they are supervised and assessed. We therefore encourage all universities to use these guidelines in local discussions and workshops when considering AQF requirements. They are consistent with Engineers Australia's accreditation criteria and are supported by Engineers Australia. The project team is to be congratulated on work that is significant and timely as universities seek to both improve practice as part of continuous improvement and to comply with new regulatory requirements.

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Table of Contents

Preamble

The following guidelines have been developed as part of phase 2 of the project 'Assessing Final Year Engineering Projects (FYEPs): Ensuring Learning and Teaching Standards and AQF8 Outcomes' funded by the Australian Office for Learning and Teaching. The project team has 7 partner universities – Central Queensland University (the lead), the University of Technology Sydney, Deakin, RMIT University, University of Tasmania, University of Adelaide and Curtin University.

The guidelines typically apply to four year undergraduate engineering degrees with embedded Honours and support achievement of the level 8 learning outcomes of the Australian Qualification Framework (AQF, 2013). The skills and applications outcomes most relevant to Final Year Engineering Projects are as follows and indicate the points of difference (in **bold**) between AQF7 and AQF8:

> Purpose: The Bachelor Honours Degree qualifies individuals who apply a body of knowledge **in a specific context** to undertake professional work and as a pathway **for research** and further learning
>
> Knowledge: Graduates of a Bachelor Honours Degree will have coherent and **advanced** knowledge of the underlying principles and concepts in one or more disciplines **and knowledge of research principles and methods**
>
> Skills:
>
> 1. Graduates will have cognitive skills to review, analyse, consolidate and synthesise knowledge **to identify and provide solutions to complex problems with intellectual independence**
> 2. Graduates will have cognitive and technical skills to demonstrate a broad understanding of a body of knowledge **and theoretical concepts with advanced understanding** in some areas
> 3. Graduates will have cognitive skills to exercise critical thinking and judgement in **developing new understanding**
> 4. Graduates will have **technical skills to design and use research in a project**
> 5. Graduates will have communication skills to present a clear and coherent exposition of knowledge and ideas **to a variety of audiences**
>
> Application of knowledge and skills:
>
> 6. Graduates will demonstrate the application of knowledge and skills **to plan and execute project work and/or a piece of research and scholarship with some independence**

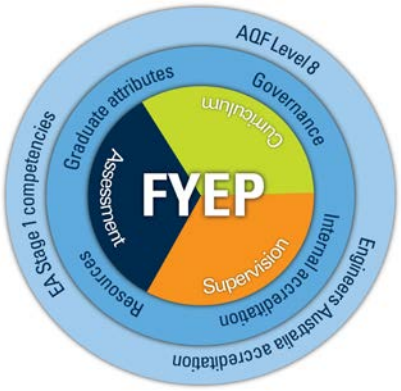
The guidelines are informed by literature and data gathered from 16 Australian universities from all states and territories. Data included documentary material such as subject outlines, student handbooks, supervisor guides, rubrics and teaching materials as well as 16 interviews with course coordinators and a workshop conducted with a range of supervisors and coordinators. This final iteration was derived after dissemination workshop evaluations and testing across Australia which involved over 100 participants from a total of 26 universities.

Introduction

The guidelines are structured around principles of constructive alignment in curriculum design which is recognised as current best practice in Australia (Biggs, 1996). Similarly, the guidelines are underpinned by current best assessment practices including formative, authentic, peer and self-assessment (Boud, 2003; Gardner & Willey, 2012; Hattie, 2008). Further, to reflect current thinking in the practice of supervision, the term 'advisor' is adopted. Whilst it is accepted the term 'supervisor' might be more commonly used, the activity of an effective supervisor who adopts more of a mentor and facilitator role (learner centred) than an authoritative and directive one (teacher centred) is better captured through the use of the term 'advisor'. This reinforces the AQF requirement for students to complete projects 'with some independence'. Such curriculum, assessment and advisor principles are assumed to be already embedded within local institutional practices. Therefore, these guidelines will not address basic educational principles, but rather address how these practices can facilitate students in meeting AQF8 learning outcomes.

The term 'scaffold' is used in a number of places in the guidelines and is best described as the guided support of students. Consistent with the seminal theory of learning espoused by Vygotsky (1978), to scaffold learning is to assist a learner as part of an interaction. It presumes that the more experienced peer (in this case an advisor) can model and demonstrate a concept or task then work together with a student so that he/she become increasingly capable of doing the task for him/herself. In a classroom setting, scaffolding can be described simply as the process 'I do', 'we do', 'you do'.

Scaffolding both within a final year subject and throughout the curriculum is important for all students across all aspects of learning. It is particularly important for the development of academic language skills. Many workshop participants expressed concern regarding the ability of both international and domestic students to meet the high standard of academic writing required at AQF level 8. This suggests a need for the explicit teaching and support of students in this area throughout their program of study.



Whilst there are three discrete sets of guidelines (curriculum, advisor and assessment), they are interconnected and best viewed as a whole. The outer circle of the diagram shown represents the common broader university contexts of external accreditation and regulation that impact on curriculum, advisor and assessment decision making. The middle circle captures those local contextual influences which acknowledge the uniqueness of each university's FYEP subjects.

FYEPs are an ideal place for final demonstration of AQF8 outcomes because they are typically located at the end of the study program and act as an indicator of readiness for graduation into the profession. Depending on curriculum design within the program, the final project might or might not be the first time students encounter independent project work. It might be possible that students have built up to work at this level, or, alternatively, it might have been featured throughout their program. For this reason, the FYEP subject is not necessarily the only place where the AQF8 learning outcomes can be demonstrated. Individual institutions will need to

determine which AQF8 learning outcomes are evidenced in the FYEP and which are demonstrated elsewhere in the program.

Defining a FYEP at AQF8

In order for a FYEP to provide the opportunity for students to demonstrate AQF level 8 outcomes, there must be some attention to *research* activity. Given that research is a significant, though not the only point of difference between AQF levels 7 and 8, the project team sought to unpack the AQF definition of research and began to contemplate what it might mean for engineering education. The AQF (2013, p. 100) defines research as "(comprising) systematic experimental and theoretical work, application and/or development that results in an increase in the dimensions of knowledge". The authors believed that this definition reflected more of a scientific paradigm and that whilst experimental work might indeed feature in engineering education, it didn't fully capture the work of research practised by graduate engineers. The team, together with feedback from workshop participants across Australia, generated a contextualised understanding of what is involved in FYEP work. The following definition and features were developed elsewhere (Lawson, Hadgraft & Jarman, 2014) and are duplicated here. Note that the following apply regardless of the discipline and/or the project type.

- Understanding the local context
- Defining and identifying the open ended problem, its limitations/constraints, relevant to the practice of engineering
- Mapping the state of the art globally or broadly: asking the right questions, reviewing literature and current practices using quantitative and qualitative sources
- Identifying and articulating gaps
- Determining appropriate methodology and what constitutes evidence
- Conducting systematic investigation, distillation and application to the engineering problem
- Undertaking experimentation, design, modelling, problem solving, data collection
- Analysing and synthesising with critical judgement offering unique interpretation
- Creating, innovating, publishing – communicating a contribution of knowledge or good practice or delivering novel outcomes in the local context
- Autonomous learning and reflecting

At the AQF8 level, all projects (design, research, experimental etc.) should build upon and develop similar skills of definition (what is the problem?), literature and practice review (how this problem has been solved or addressed in the past), identification of feasible solutions, testing and investigating (in the laboratory or through model simulations) and the production of recommendations and local knowledge contributions. Students are learning to 'boldly go' beyond the packaged solutions they've learned at AQF7 level.

Project type

The data showed and workshop participants confirmed that there are lots of concerns at the institutional level about what constitutes an appropriate project type. Project types across our sample included industry based, design, experimental, multidisciplinary, student initiated, interdisciplinary and supervisor initiated research projects. Projects could be individual or group.

Workshop participants were in agreement that the type of project and whether it is individual or team based is less important than the degree to which the professional judgement of academics (curriculum designers, advisors, assessors) focuses on overarching AQF8 considerations.

There were also concerns expressed about logistical aspects of sourcing, allocating and administrating projects. Data showed that there was a variety of ways that these tasks were undertaken. For example, in some instances there was an extensive pre-enrolment process where students were carefully matched with advisors and topics. In other cases the process of topic allocation was administrative only with students who signed up first securing the topic. It is clear that these processes are beyond the scope of the guidelines because they are influenced by local institutional factors.

Assessment of individuals within groups

Whilst many institutions have students engaged in individual projects, there are also many where group projects are the norm. The challenge facing academics with group projects is how to assess individual contribution and achievement within the wider group and to ensure that even where project outcomes might be poor, individual learning can be discerned (Howard & Eliot, 2014). All students are expected to (individually) demonstrate those AQF8 outcomes required by their institutions' FYEPs, so it is important for assessment processes to ensure that all aspects of outcomes are assessed and met by all students. Part of good assessment is dialogue – where students engage in learning focused conversations with their advisors and peers – because it enables them to become more reflective and develop capacity for autonomous learning (Sambell, McDowell & Montgomery, 2013). This means the first part of assessing individuals within groups is developing a culture of dialogue, self-reflection and peer assessment. Tools such as SPARK (University of Technology, Sydney, 2011) can provide a means of identifying individual contributions through self and peer assessment. When used regularly it facilitates formative feedback and develops student judgement throughout the project. It is important for students and academics to be able to identify specific intellectual contribution to the project and deliverables. Rather than a hard copy document submission for example, a wiki might be used as a platform because it makes visible to assessors who made what contribution along with a host of other metrics (Lambert, Carter & Lightbody, 2013). Assessors must be alert to potential inequities that develop as a result of group work, and ensure individuals are required to demonstrate how they have met all specified outcomes.

Further recommendations

There were two key areas –resourcing and marking – that consistently appeared in the data and were raised in workshops that, like determining project type, remain outside the scope of the guidelines because they are constrained or at least influenced by institutional practices, procedures and financial capacity. They are however, worthy of attention and resolution.

Resourcing

Issues of resourcing were consistently raised in the data and group into three main areas each impacting on workload. Firstly, there is considerable preparation that takes place in the lead up to the subject offering and this involves organising projects through wide liaison with academics and industry partners, allocating projects to students, appropriately supporting industry stakeholders

and monitoring submissions over an extended period. It should be noted that sourcing projects from industry partners is subject to economic influences and can be particularly challenging at times. Secondly, in many cases engagement with industry is required for both the sourcing of project topics and project supervision and requires substantial ongoing commitment from institutions for external industry supervisors to ensure high quality outcomes. Sustainable industry engagement requires resourcing. Thirdly, events coordination such as seminars and conference style exhibitions requires high levels of planning and organisation not typically factored into workload of those involved.

Additionally, regularly meeting with individual students or teams of students is time consuming, particularly if a student or team is struggling, and supervising these honours projects does not attract the status or workload of higher degree supervision. Failure to recognise the associated workload of the FYEP subject for advisors and coordinators has also led to the expectation that such roles will be learned 'on the job' and no university in our study had formal training or induction for supervisors or coordinators.

As such, the following recommendation is made for institutions at the local level:

1. Universities and faculties must recognise the increased workload for supervisors and coordinators of project subjects. Recognition of workload is seen as adequate resourcing and support of staff. This might involve:
    a. Purchase and/or development of software to set up a database to monitor projects and administrative assistance.
    b. Supporting staff seen by providing handbooks, co-supervision arrangements or simply opportunities for staff to meet to discuss students and projects, which may include meetings with external stakeholders and industry supervisors.
    c. Provision of appropriate training or induction and systems for monitoring quality.

Marking and moderation

Our data suggests that marking, whilst possibly the most critical aspect of the FYEP, is often undertaken with great variability and inconsistency. This sometimes occurs despite very good examples of assessment tools and guidelines. Similarly there was unease about some moderation practices which varied considerably within and across institutions. For example, in one university there were two processes where social (collegial) moderation took place enabling marking to be scrutinised, shared and aligned. In contrast there were some universities where there was no moderation undertaken and acknowledgement that there were inequitable marking practices.

As such, the following recommendation is made for institutions at the local level:

2. Marking and moderation practices must ensure quality and mitigate inequity. Calibration of markers should precede marking to ensure markers are assessing to a shared understanding. Moderation might also follow wide scale marking and can take a number of forms.
    a. Expert moderation has one person to offer qualitative judgement on the marking of the team and/or ensure common means and standard deviations across cohorts.
    b. Social moderation allows markers to meet and compare and adjust marking collaboratively.
    c. Calibration accepts that experienced markers might not need to have all work moderated all the time and instead be subject to random quality control.

Some universities have engaged in cross-institutional benchmarking which is seen as a useful undertaking. As a regular form of moderation however, it is impractical and might best be conducted periodically.

Intended audience

These guidelines are intended for use by final year engineering project subject coordinators whose primary responsibilities may include both operational and governance matters. Subject coordinators may pass these guidelines directly onto others with vested interest such as advisors, or may use these guidelines in the preparation of local materials including subject outlines, assessment activities and criteria. These guidelines will act to assist the coordination of FYEP subjects as it is acknowledged that the role can be more demanding because of the potentially large groups of advisors that may need to be managed.

The guidelines begin with some general principles followed by more specific and instructional guidelines which are aligned with each of the AQF8 learning outcome descriptors.

Guidelines

General notes	Curriculum	Advisor	Assessment
	Learning outcomes must be clearly articulated, explicitly assessed, demonstrable and reflect AQF level 8 (and EA Stage 1 Competencies). • Consider where the target (bold) skills in AQF8 are being taught in your course/program • Identify which AQF8 descriptors you expect your course/program to have demonstrated in FYEP • Ensure both professional and technical outcomes are included (though technical outcomes will vary for individual students) • Support the skills, knowledge and application of skills and knowledge expected in the FYEP subject - including teamwork and intercultural skills - prior to as well as within the subject. This might include project management and research methodologies • Provide exemplar annotated projects for student use • Require students to write regularly and frequently in preparation for final report/thesis/journal paper writing The guidelines below specify what might be included in a unit overview/subject outline as well as the activity to be implemented by whoever might be teaching the subject.	Primarily good mentoring of student projects is about strong interpersonal skills. Strong interpersonal skills will also enable you to facilitate projects that are outside your area of expertise. • If you want to improve your advisory skills then further develop your interpersonal skills, not technical skills • Familiarise yourself with whole of course curriculum to gauge student prior knowledge and skill • Ensure that you monitor and document student progress throughout all phases of the project • Read, review and comment on clarity of communication (e.g. reflective writing, draft submissions) • Scaffold student learning rather than provide answers • Organise group project meetings and consider enabling meetings between groups/individuals In those institutions where you are both advisor and assessor, you will also need to look at assessment guidelines.	Assessment practices must reflect general principles of validity, equity and rigour. There should be a tight focus on the features of the project that separate it from previously demonstrated coursework. • Develop and apply criteria (tools/methodology/moderation) in rubrics or standards statements (and this might be in conjunction with students) that address each of the AQF outcomes • Provide formative assessment that is focused on enhancing student learning and reflection • Look for clear and coherent written exposition of knowledge • Look for evidence of learning in both process and product or artefact • Provide regular and timely opportunities to assess project progression and milestones – consider outcomes and process with appropriate weightings • Actively involve students in self and peer assessment throughout all phases of the project and encourage students to write and reflect regularly In those institutions where you are both assessor and advisor, you will also need to look at advisor guidelines.

AQF8 learning outcome descriptors	**Curriculum** Teaching/learning activities that support student opportunity to reach AQF8 might include:	**Advisor** Advisor action that supports AQF8 might include:	**Assessment** Assessment activity that support student opportunity to demonstrate AQF8 might include
1. Graduates will have cognitive skills to review, analyse, consolidate and synthesise knowledge to identify and provide solutions **to complex problems with intellectual independence**	• Include scoping statements in unit outline that articulate boundaries of complexity – provide examples of projects that are 'too thick' or 'too thin' • Allow for complexity to apply to process and not just deliverables • Reduce the risk that students complete a simple project done well or a difficult project done poorly • Support students' production of proposals, final reports/journal papers, posters etc. by modelling, jointly constructing, annotating examples of these • Provide extensive formative feedback on individual or group proposals	• Ask open ended questions that challenge the student to consider project complexity, establish stakeholder needs, define context and determine the nature of the problem rather than rush to solutions • Maintain scaffolding of learning but also enable student to take increased control of the project and to do the work themselves • Provide critical feedback so that the student works towards greater complexity and intellectual independence • Where students are engaged in group projects, ensure there is a means for determining individual student contribution. This might be in written submission or oral defence	• Look for complexity as defined by AQF in the project question, scope of works and outcomes • Provide feedback so that the project topic and scope affords the opportunity for the student to demonstrate complexity and intellectual independence in the project itself • Look for independence as evidenced by individual capacity to articulate their contribution to the project and their understanding of the project complexity. This might be in written or oral form

AQF8 learning outcome descriptors	**Curriculum** Teaching/learning activities that support student opportunity to reach AQF8 might include:	**Advisor** Advisor action that supports AQF8 might include:	**Assessment** Assessment activity that support student opportunity to demonstrate AQF8 might include
2. Graduates will have cognitive and technical skills to demonstrate a broad understanding of a body of knowledge and **theoretical concepts with advanced understanding** in some areas	• Facilitate group discussion that explores theoretical concepts • Require library resource activities • Facilitate discussions with external bodies and other experts	• Advise students to locate a range of appropriate sources within the body of knowledge • Advise students to engage in and articulate advanced engineering activity (e.g. calculations, modelling, designs) • Ask open ended questions that probe concepts and advanced understanding	• Look for breadth and diversity of sources (not just a literature review but also industry IP, interviews with stakeholders etc.) • Look for student development and testing of theoretical concepts
3. Graduates will have cognitive skills to exercise critical thinking and judgement in **developing new understanding**	• Include requirement for clearly articulating the local known, probably early in the project (e.g. literature review but not annotated bibliography) • Provide opportunity for students to demonstrate their contribution to the local known (articulating the gap in the local known) • Encourage students to argue the logic of how their contribution addresses the gap	• Direct students to synthesise literature and local known • Enable students to articulate their understanding of the local known compared with their contribution • Scaffold and monitor student work – reduce risk student work is less than AQF8 or well beyond AQF8 • Discourage students simply describing what they have done	• Look for synthesis in the literature review – links between and across sources – not sequential description • Ask if the project shows new understanding – how is it differentiated from previous work in the field and from previous coursework? Look for creative contribution

AQF8 learning outcome descriptors	**Curriculum** Teaching/learning activities that support student opportunity to reach AQF8 might include:	**Advisor** Advisor action that supports AQF8 might include:	**Assessment** Assessment activity that support student opportunity to demonstrate AQF8 might include
4. Graduates will have **technical skills to design and use research in a project**	• Include development of technical skills to the extent that student can demonstrate these in design work in their project • Consolidate and or review student understanding of research methodologies (this might include a parallel subject in research skills, one-off workshops, library skills workshops etc.) • Include requirement for application/demonstration of research skills/methodology (e.g. in project proposal)	• Direct students to relevant technical experts (e.g. lab access, industry experts) • Scaffold the student's understanding and design of their project research methodology/approach (e.g. experimental lab work, modelling, design) • Monitor the outcomes and documentation and provide formative feedback • Resist giving answers	• Look for evidence of engineering discipline technical skills applied in the students' design work – may have focus on outcomes and process/methodology • Look for evidence of use of research outcomes – focus on research process/methodology (selecting appropriate models and theories, drawing logical and justifiable conclusions) • Focus on evidence of student's learning in technical skills demonstrated during project work
5. Graduates will have communication skills to present a clear and coherent exposition of knowledge and ideas **to a variety of audiences**	• Include requirement for formal oral and written presentation/exhibition/ seminar/ where students defend their project to an audience that includes students, academics and where possible, industry and public representatives • Provide opportunity for student rehearsal of presentation in front of peers and others	• Meet regularly with all project students concurrently • Facilitate peer group discussion through modelling asking open-ended questions of each other • Help students arrange an external or independent audience for review of written material and oral presentation • Help student to consider the different needs of diverse audiences	• Look for clear and coherent exposition of knowledge in oral and written presentation • Focus on the dialogue not the monologue • Look for appropriateness of responses to questions from a diverse audience • Ensure students are exposed to a range of higher/lower order questions • Collate feedback and peer and self-assessment of rehearsal and

AQF8 learning outcome descriptors	**Curriculum** Teaching/learning activities that support student opportunity to reach AQF8 might include:	**Advisor** Advisor action that supports AQF8 might include:	**Assessment** Assessment activity that support student opportunity to demonstrate AQF8 might include
			presentation

6. Graduates will demonstrate the application of knowledge and skills **to plan and execute project work and/or a piece of research and scholarship with some independence**	• Include opportunity to teach and develop engineering project management skills (this might be done as a parallel subject, addressed through guest/industry visitor lectures or workshops)
	• Include requirement for project proposal which would include planning documentation
	• Set clear deadlines for expected progress as well as assessment submissions. Given the nature of any project, have clear procedures in place to manage when things that are beyond the control of the student go wrong
		• Scaffold, mentor and monitor student progression through well-organised planning and implementation phases of their project
		• Encourage student to investigate 'state of the art' by asking questions
		• Guide the student to think about similar problems in related domains
		• Provide regular formative feedback and question students to determine where they are in relation to the project's progress.
		• Help students identify barriers and ways to address
		• Where students are engaged in group projects, ensure appropriate guidance and instruction in group work is provided, as well as ensuring there is a means for determining individual student contribution.
		• Be more directive early in a project and gradually encourage students to assume more responsibility
			• Look for application of project management skills such as:
			  • Project planning
			  • Timelines/Gantt charts
			  • Keeping notes of meetings
			  • Action lists
			  • Milestones
			  • Response to disruptions to plan
			  • Communication with stakeholders
			• Focus on the process not the deliverable/outcome
			• Provide regular formative feedback

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Appendix

The following materials are included in the guidelines as they support the continued development of FYEP curriculum, supervision and assessment practices.

Appendix 1

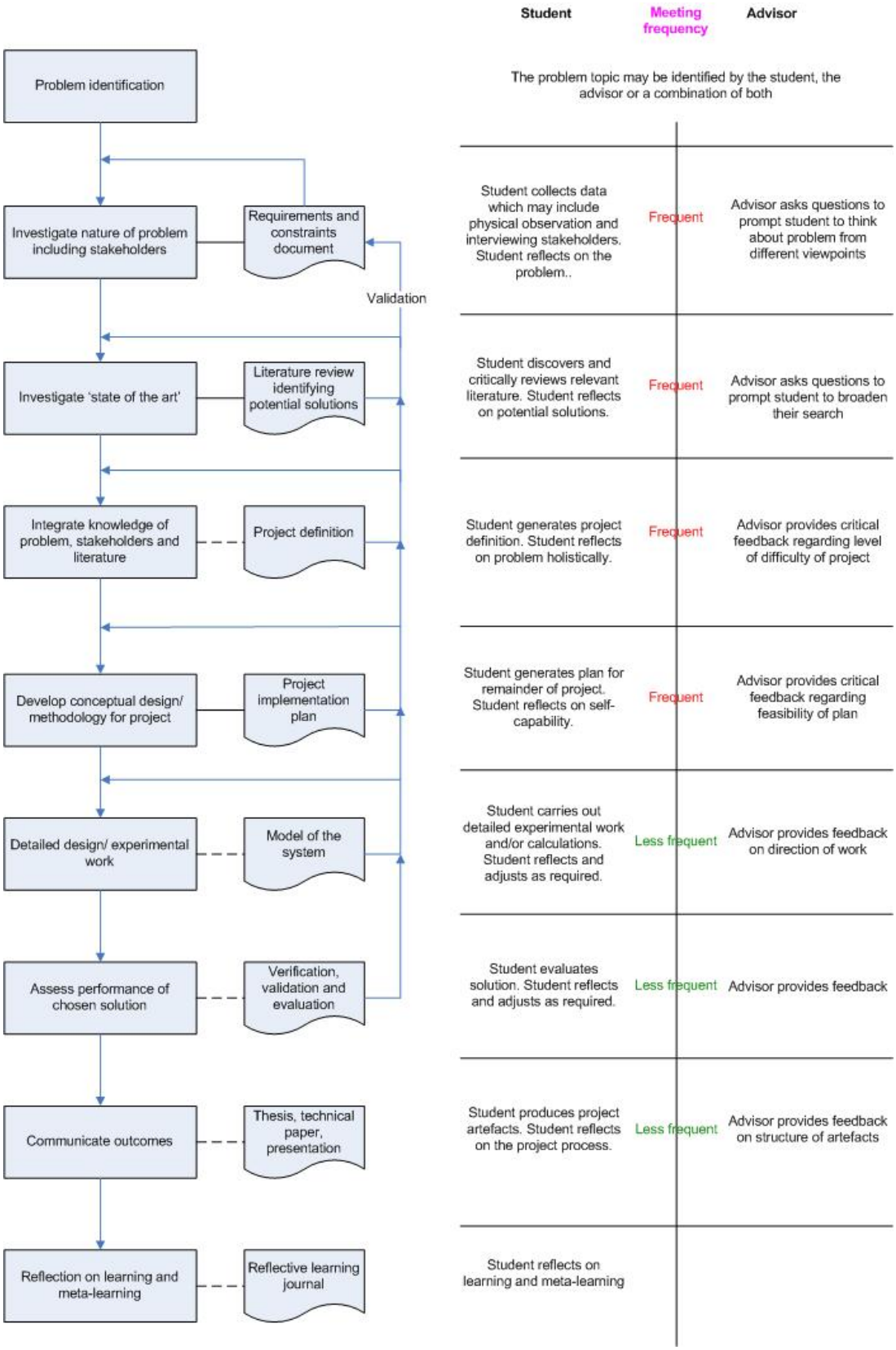
EA Stage 1 Elements of Competency mapped to AQF8

Knowledge and Skill Base: Elements	**AQF8 Outcome***					
1.1 Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline.	1	2		4		6
1.2 Conceptual understanding of the, mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline.	1	2	3	4	5	6
1.3 In depth understanding of specialist bodies of knowledge within the engineering discipline.	1	2		4	5	6
1.4 Discernment of knowledge development and research directions within the engineering discipline.	1	2	3	4	5	6
1.5 Knowledge of contextual factors impacting the engineering discipline.	1		3		5	
1.6 Understanding of the scope, principles, norms, accountabilities and bounds of contemporary engineering practice in the engineering discipline.	1		3	4		
Engineering Application Ability: Elements						
2.1 Application of established engineering methods to complex engineering problem solving.	1	2	3	4		6
2.2 Fluent application of engineering techniques, tools and resources.	1		3	4		6
2.3 Application of systematic engineering synthesis and design processes.	1		3	4		6
2.4 Application of systematic approaches to the conduct and management of engineering projects.	1			4		6
Professional and Personal Attributes: Elements						
3.1 Ethical conduct and professional accountability						
3.2 Effective oral and written communication in professional and lay domains.	1				5	6
3.3 Creative, innovative and pro-active demeanour.		2	3		5	6
3.4 Professional use and management of information.	1		3	4	5	6
3.5 Orderly management of self, and professional conduct.	1					6
3.6 Effective team membership and team leadership.						6

*Numbers refer to AQF descriptors identified in these Guidelines' Preamble.

Appendix 2

Process of mentoring FYEP



Appendix 3

Assessment deliverables

Assessment deliverables	Features
Project proposal	• clearly articulated problem statement/definition or research question • review of capabilities of student(s) • identification of appropriate methodology/approach • broad scoping review of literature or relevant scholarly material and the local known • expected deliverables that address a need or requirement of identified stakeholder or client • Projects scoped to contain an element of difference from existing solutions • Detailed timeline/project planning identifying tasks, activities and milestones and contingency planning • Data and resources required, risk assessment, evidence of support from industry or other external stakeholders, IP and CA resolved • Assessment criteria con-constructed by student and supervisor
Literature Review	Mapping the local known which may include: • review of reference material • previous FYEP reports/theses • academic papers • industry journals, industry IP • interviews, photographs
Progress Reporting	• Reports, blogs, recordings, discussions, • Periodic meetings with advisor • Periodic peer review/evaluation • Applying project management tools and methodologies regularly to report progress and direct/guide project work and decisions • Evidence of progress- meeting milestones • Routine review of work completed, barriers overcome, planned works • Review of project direction and variation in title/topic as needed
Reflective journal or logbook or portfolio	Items listed in 'Progress reporting', as well as (date referenced): • evidence of assumptions made, decision making • notes from meetings, interviews, • experiment records, preliminary analysis, findings • details of theoretical approaches, skills and knowledge beyond those included in previous coursework • synthesis of local knowledge base and data/observations collected in project work • appropriate reflective methodology (e.g. Kolb's learning cycle)
Model/artefact, simulation, design, proof of concept	• engineering design • application of appropriate technical engineering tools appropriate text, calculations, drawings, images • development of experimental design or design prototyping • evidence of methodology (e.g. CDIO)

Final Report/Thesis/ Journal article	Scholarship including: • Evaluate and extract relevant information from key sources and relevant authorities (e.g., print, electronic resources, photograph or via interview) • academic rigor in analysis of relevant literature and body of knowledge forming the foundation of work undertaken • research which has accuracy, validity , certainty, is replicable and has identified weaknesses • publication of outcomes in appropriate format • advance knowledge with fully explained methods and understanding • peer reviewed
Poster sessions, exhibitions, oral defence, interview	• contribution and value adding to local known • clear articulation of critical space of project • fully explained methods and understanding, outcomes and benefits • provides opportunity for communication with a variety of audiences
Peer review	• acts to verify intellectual independence • acts to provide formative feedback and develop evaluation and judgement skills
Publishable material	• Conference or journal paper • Poster for exhibition • Article in industry journal

Exemplar Practices - Curriculum

Final projects as true capstone experiences

There is widespread agreement that the FYEP allows students to build on and extend knowledge developed throughout their program.

It is genuinely capstone as seen in the following comment:

The basic idea is to bring together what they have been able to learn throughout the program and apply it to a substantial engineering project with a research component in order to demonstrate what they are able to achieve as an engineer. (Coordinator)

Previously in their program, students might have been introduced to research and have researched aspects of engineering practice. The final project, however, puts this into practice.

Most of our students are involved in projects that are active areas of research so they get access to academics who are working in a field that is cutting edge. Quite often there'll be a post graduate student or even a post-doc who will be advising the student as well as the academic. I think that's pretty good. So compared to where I was previously, I'd say not everyone does it well, but that's certainly a good aspect of our thesis program - that students are involved in real research. (Coordinator)

Higher order outcomes

When writing outcomes for FYEP subjects, it is important to keep the higher order nature of AQF8 outcomes firmly in mind. University 27Q for example, has higher order outcomes for their Final Year Project course.

- Ability to formulate and plan a personal research project
- Originality, ingenuity and initiative in dealing with critical research issues
- In-depth knowledge of a specialised area within the discipline
- Ability to formulate an appropriate method for investigating a specific research question.
- Ability to analyse raw data, draw appropriate conclusions and present those conclusions in context, with due consideration of methods and assumptions involved.
- Ability to document and report research work undertaken in a format appropriate for academic literature.
- Ability to deliver a research presentation that is clear, confident and engaging to an academic audience.

Student guides

It is common for universities to provide support material for students that explains the project in detail. RMIT has a comprehensive handbook that covers all aspects of the project requirements as well as resources to support students in their project management.

Project handbook - http://project-handbook.pbworks.com/w/page/18981700/FrontPage

Strong pedagogical underpinnings

A specific pedagogical approach suited to final year project work is that of Project Based Learning (PBL).

CQUniversity Australia includes PBL as an essential and substantial part of its Engineering programs. From first year, 50% of the curriculum is dedicated to PBL. This ensures students are well-equipped for the project challenges of the FYEP.

I think because we have a PBL program overall we are developing those skills in our students and I think that what we are doing in the final year projects really is showing that capstone experience - students are getting to that level that they're supposed to. (Coordinator)

This is similar to a hands-on approach adopted throughout a 4 year program at Curtin University (WA)

They do many projects. You know, our courses have this reputation - at least in the state - of being very hands on. Curtin wants to create and foster this reputation of being very hands on.
(Cesar Ortega-Sanchez, Coordinator)

Parallel project management subject

Learning outcomes must be supported within the FYEP subject. Universities do this in a variety of ways via preparatory subjects or workshops within the semesters the FYEP is run. A standout approach however, is seen at the University of Adelaide where a subject in project management is run concurrently with the FYEP subject.

In this subject students learn about risk management, project management, law, HR, fundamentals of business, accounting and a range of professional issues, including presenting with impact. It is contextualised in the project course and students are constantly making links between the two subjects. It is tightly coupled to the project subject and this coupling is seen to lead to much better outcomes, including ones that assist students to reflect.

Probably the direct benefits come from having the project management material tied into the project itself. I think having an application of the theory and being able to use the project as a way to learn this material greatly helps their learning ... We're not so much assessing how they are progressing but more their ability to recognise their own progression and reflect on that ... and trying to get their supervisors to try and discuss it with them.
(Zebb Prime, Coordinator of project management subject)

Provision of research methods subject

In order for students to engage successfully with research methodologies, they must have been explicitly introduced to the concepts and skills associated with research work. At RMIT, research methods subjects are run simultaneously or prior to students undertaking their final year project. They seek to introduce (or consolidate) students' knowledge and skills in research methods.

RMIT Course Overview – Research Methods for Engineers w a L¢ /2dzNJăŜ tNJ2ŦλfŜ π ǑfλǑ1 KŜNJŜ

Former student support

In addition to preparatory coursework, a number of universities draw on the experience and expertise of former students to support those undertaking the final year project. Such support can occur prior to project selection or development or alongside.

At CQUniversity, the Engineering Undergraduate Society runs a session with final year students to share with them the process of undertaking a project of significance.

Similarly at the University of Adelaide's MechExpo, a large exhibition of students' projects, students about to undertake their FYEP will attend and get a sense of the range and quality of projects possible.

Explicit constructive alignment

When planning curriculum and individual subjects, there must be alignment between planned outcomes, teaching and learning activity and assessment. In one institution, the alignment of outcome with assessment is explicit in unit overviews. Alignment of these with teaching and learning practices would be a necessary next step.

- Ability to formulate and plan a personal research project (Assessed in *Progress Report* and *Thesis/Final Report*)
- Originality, ingenuity and initiative in dealing with critical research issues. (Assessed in *Thesis/Final Report*)
- In-depth knowledge of a specialised area within the discipline (Assessed in *Progress Report*, *Seminar* and *Thesis/Final Report*)
- Ability to formulate an appropriate method for investigating a specific research question. (Assessed in *Progress Report* and *Thesis/Final Report*)
- Ability to analyse raw data, draw appropriate conclusions and present those conclusions in context, with due consideration of methods and assumptions involved. (Assessed in *Thesis/Final Report*)
- Ability to document and report research work undertaken in a format appropriate for academic literature. (Assessed in *Progress Report* and *Thesis/Final Report*)
- Ability to deliver a research presentation that is clear, confident and engaging to an academic audience. (Assessed in *Seminar* and *Thesis/Final Report*)

Trans-disciplinary projects

Where universities are large enough, students can be encouraged to undertake multidisciplinary projects. This might be across fields of engineering, but also across other disciplines such as science and IT.

There's a project some years back which wasn't one of mine that I supervised but I always remember it because it was a really excellent example. Three students were looking at the design of a human powered vehicle and they sort of carved it up so one student would do the structural analysis of the frame one did the mechanics of the drive train and the powering requirements and one looked at the aerodynamics and the drag and that sort of thing. So again, it's all part of the same project but the students are actually doing quite distinct elements of that project.
(Damien Holloway, Coordinator – University of Tasmania)

Industry projects

Industry projects are widely acclaimed as the most engaging and authentic of projects students undertake. However, there are ethical dilemmas faced when students undertake projects in their workplace or whilst on internship. Conflicts about academic process, timelines and intellectual property need to be resolved. At the University of Technology, Sydney, students' attention to such dilemmas is made in their guide. 52ƛyƎ l· ǇǊ2ʔŜŎű l·ű ǿ2Ǌʅ π ŎťƛŎʅ KŜǊŜɸ

Project selection

There are a number of ways in which students are assigned or develop projects. At Deakin University ʎƴ ǁKŜ ŘʎăŎʎǈŧʎƴŜ ƻŦ ŜŧŜŎǘʎʎŎŀ·ŧ ŀ·ƴŘ ŜŧŜŎǘʎƻƴʎŎă ŜƴƎʎƴŜŜʎʎƴƎΣ they have shifted project selection from highly specific topics from which students would choose to providing general areas of research from which a project can be developed in Ŏollaboration between student and advisor. This creates a stronger sense of project ownership in both the student and the academic advisor.

Previously before I joined, before I was given (the job) to look after the final year project, the person who was responsible …listed the projects in advance and when the student comes in they have to select the project and communicate with the respective supervisors. In some cases we get a few projects from industry (but the) majority of the projects were from the academics within their school. But now we were are doing, instead of giving, developing a specific title of the project we are in the process of identifying the areas of research and then we ask the student to communicate with the respective academics and then they'll have a discussion with the academic, technical staff as well as the student and then they agree on the project so that way I think there is ownership you know, from the academic, the student and the technical staff. (Aman Maung Than Oo, Coordinator - Deakin)

Exemplar Practices – Advisor

Support development of higher order projects

Both CQUniversity Australia and Curtin University point to the importance of projects being higher order – innovative, scholarly and well-considered.

If there is a design we try to make sure that it's not just a simple design - if you know what I mean - it needs to be a design where they really need to look at bigger contextual issues, so we try to encourage them to think about the sustainability aspects or the cycle aspects or something like that because it shouldn't just be a straight design. I also say to students it should not be something where you can just walk up and pull the manual off the shelf, you really need to be doing some research, looking at what other people have done in that space before.
(Fae Martin, Coordinator – CQUniversity)

Therefore we give them the opportunity to propose their own idea, their own project, their own problems to solve. I must say some of them come up with very good ideas, very good projects, very good challenging problems you know? Some of them go to the conservative side and we have to sort of adjust.
(Cesar Ortega-Sanchez Coordinator – Curtin University)

Focus on process

The learning that takes place during the project should be emphasised over final product.

I make a huge emphasis to students what we assess is the process. We don't care what you are doing really…I tell them, tell it like this to make an impact: "We don't care what you are doing. What we care is how you do it…how you make your decisions, how you make your assumptions, how you select components, what do you see as constraints, how do you plan, how do you follow your plan, how do you reflect on your plan, how you can say 'oh, I underestimated this activity' or 'I thought I had to do this.'…The emphasis is on the process. It is not about getting a dancing robot at the end of one year. It is about what you did and what you thought and what you learned…and if the robot doesn't dance at the end, it doesn't matter…I think that is a great thing that students are getting into the idea that engineering is about the how. It's not about the what.
(Cesar Ortega-Sanchez, Coordinator – Curtin University)

Multi-teamed supervision

Students Ř2ĺyƎ ŜfŜŎúЫĺŎl·f l·yŘ ŜfŜŎúЫ2yĺŎă ŜyƎĺySŜЫĺyƎ at Deakin University meet weekly or fortnightly with their academic supervisor – a common practice amongst universities. However, to address a previously identified challenge, technical staff now attend these regular meetings.

We had a lot of challenges previously; the technical staff they don't know what the students need. (It) might take some significant time to order parts and so on and sometimes some of the parts the student needs might be just in the lab and the student orders them. So to overcome these challenges, we have decided that right at the beginning the technical staff will be right on board. (Aman Maung, Coordinator - Deakin)

Social moderation as a means to support supervisors

Moderation typically assists with ensuring quality marking. At CQUniversity, however, moderation serves a dual purpose of supporting supervisors as well as ensuring equitable marking standards.

Moderation takes place at CQUniversity at the end of the planning phase of the project subject and involves groups of supervisors meeting together to discuss students' process and submissions. During these meetings more experienced supervisors can advise less experienced supervisors about how best to support students – particularly those who are struggling.

Supervision as interpersonal

Students and coordinators recognise that what makes a supervisor 'good' is not technical expertise. He/she has strong interpersonal skills. Supervisors who are good teachers in third year courses are often sought after as supervisors in fourth/final years. Technical expertise can be sought from anyone in the School. Strong interpersonal skills are widely recognised as distinguishing quality supervisors. These factors mean that supervisors can work outside their area of expertise.

I mean I am supervising that one and it's not my area of expertise. It's a bit outside my comfort zone but I still have things to offer but it is a challenge to supervise. If it was within my area of expertise, then I can say to the student 'try this, do that' you know, whereas this is very much more of a two way discussion and he's having as many ideas, if not more, than I am but using me as a sounding board to bounce off. I've supervised a couple of projects like that and every time I do I learn something more about doing something a bit different so there are other things I can offer him.....I supervised another student doing a humanitarian project a couple of years ago. He was doing the combined engineering and business so there's a lot of business element to it and I said to him, you know 'I'm not an expert but you should really speak to people you know in the business school' and he spoke to someone in psychology about designing a survey, working out and going through all the ethics process and so on. I see myself, part of my role was to point him to other people who might be able to help him rather than feeling that I had to do everything myself.
(Damien Holloway, Coordinator – University of Tasmania)

Supervisor guidelines

At Curtin University, in the School of Electrical and Computing Engineering, supervisors are given comprehensive guidelines about how to supervise and support students. Notice that it includes what not to do as well as what to do.

Guide for Supervisors – ŏťťŏļ KŜŴŜ.

Exemplar Practices – Assessment

Clear and high order marking criteria

CQUniversity has a history of using marking rubrics. This one includes detailed criteria for technical and professional knowledge and skills and accompanying standards of performance.

Rubric for final year project – ŏfłŏ] KŜWŜ.

Shared marking

In an oral presentation task at University 27Q, a variety of markers are used including post graduate researchers and industry representatives. This has the effect of ensuring that students can articulate their project to a variety of audiences as well as ensuring more than the supervisor has a say in assessment marking.

So through the oral presentation and also through especially the poster presentation. We invite industry to come to that. We invite all the post graduate researchers. The post graduate researchers and the academics are responsible for marking the posters so any given poster will be marked by 6 different people. And then there are two of us who moderate and go around every single poster so the students have to be able to communicate to non-specialists. (Coordinator)

Authentic and high impact presentation opportunities

The University of Adelaide promotes its MechExpo – a large and professionally organised exhibition for students to present their projects –as a strong feature of their undergraduate program but also as a means for achieving exceptional outcomes for students and the faculty. Although expensive, it attracts media interest, enhances relationships between the university and industry, and is a source of recruitment for new students.

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Formative assessment

Given that projects span extended periods, interactions between students and supervisor are largely formative in nature where students are guided to develop, refine or extend their projects to meet AQF8 outcomes.

There's a lot of formative feedback with the preliminary report. The main purpose is formative so they get support on their draft, and the final preliminary, once it is assessed, it is normally covered in red and the purpose of that is to take the feedback they've got and apply that to the final report…They've had a lot of support in preparing for their seminar and then when they deliver their seminar it is assessed by a panel of supervisor, academics, post-doctoral and post-graduate students. (Coordinator)

Curtin University also have students present at the end of their planning stage so a panel of assessors can provide feedback about the direction of their project.

Journal article as alternative to final report or thesis

At the Australian Maritime College (AMC), staff have noted that a change to the final assessment from a thesis to a journal article has improved the quality of student work.

Students write a 15 page journal article, worth 70% of total available marks and is marked by their supervisor and moderated by a second person. Students also submit separately, all of the documents summarising their research work. The journal article is seen as an ideal way for students to articulate their work succinctly and to a publishable academic standard.

Practices also noteworthy at AMC are the higher order outcomes specified for the final year project subject, and the variety of assessment tasks. ¦ ɏΛΰ ƻdzΰfΛɏŜ π ŏfΛŏ Ɩ KŜ₩Ŝφ
a Ͱ₩ƖΛɏƎ ₩dzō₩Λŏ π ŏfΛŏ Ɩ KŜ₩Ŝφ

(Alex Forrest, Remo Cossu, Shinsuke Matsubara on behalf of the teaching staff from the National Centre of Maritime Engineering and Hydrodynamics, Australian Maritime College, University of Tasmania.)

Self-assessment

Whilst continuous reflection by students is widely acknowledged as valuable, student self-assessment is systematised at the University of Technology, Sydney, where students identify the criteria by which their final report/thesis is assessed and then assess themselves against these criteria. This allows scope for tailoring of assessment criteria for different projects.

So we used the Engineers Australia Stage 1 Competencies which are very closely aligned to the faculty graduate attributes. What we get the students to do is identify at the proposal stage which graduate attributes they intend to address through their project so because the nature of the projects are different, certain students will address certain graduate attributes and others won't. so there's kind of like a fixed list that all students must address and then there's an optional list where they have to choose 'm out of n' possible graduate attributes that their project will address. So overall, all students must address the same number but the composition of the graduate attributes that they address will vary between students.
(Anthony Kadi, Unit Coordinator)

Self-assessment form – ŏfΛŏ Ɩ KŜ₩Ŝ

Appendix

The following documents and document excerpts have been provided with permission from their authors.

The project team acknowledges the contributions from:

Arnan Mitchell, RMIT

Anthony Kadi & Rob Jarman, University of Technology Sydney

Ian Devenish, CQUniversity Australia

Cesar Ortega-Sanchez, Curtin University

Zebb Prime & Ben Cazzalato, University of Adelaide

Alex Forrest, Remo Cossu, Shinsuke Matsubara, Australian Martime College, University of Tasmania

Course Title: Research Methods for Engineers

Part B: Course Detail

The following link provides important information on the following topics that relates to all courses:

Important Information

- Student Feedback at RMIT
- Student Progress
- Special Consideration, appeals, and discipline
- Academic Integrity
- Student Progress Committee (SPC)
- Assessment Grades
- Classification of award

Teaching Period: Sem 2 2014

Course Code: EEET2449

Course Title: Research Methods for Engineers

School: 125H Electrical & Computer Eng

Career: Undergraduate

Campus: City Campus

Learning Mode: Face-to-Face

Primary Learning Mode:

Face-to-Face

Credit Points: 12

Teacher Guided Hours: 24 per semester

Learner Directed Hours: 80 per semester

Course Coordinator: Prof Arnan Mitchell

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Additional Staff Contact Details

Pre-requisite Courses and Assumed Knowledge and Capabilities

None

Course Description

Research methods are critical aspects of engineering professional practice and scholarship. This course will provide an overview with applied exercises of best practice in addressing an engineering challenge in a systematic manner, evaluating background literature, adhering to ethics, documentation strategies, and communication in the form of both concise as well as detailed written reports, and oral and written communication of complex engineering concepts to a general audience.

Objectives/Learning Outcomes/Capability Development:

This course develops the following Program Learning Outcomes:
1.4) Discernment of knowledge development and research directions within the engineering discipline.
1.6) Understanding of the scope, principles, norms, accountabilities and bounds of contemporary engineering practice in the specific discipline.
2.4) Application of systematic approaches to the conduct and management of engineering projects.
3.1) Ethical conduct and professional accountability.
3.2) Effective oral and written communication in professional and lay domains.
3.4) Professional use and management of information.

Upon successful completion of this course you will be able to:
• Understand the concept of research and the circumstances under which formal research is required in the field of engineering
• Approach engineering research problems in a structured and strategic manner
• Undertake an effective literature review to learn the background material required for the research project and also to identify the current state of the art
• Communicate the findings of a literature review following the accepted standards and traditions of engineering disciplines – especially with regard to referencing
• Prepare and communicate a formal research proposal including a plan, a convincing justification for the research and formal placement of this research within the context of the current state of the art
• Understand and describe the ethical obligations associated with conducting research
• Identify many different forms of plagiarism and ethical breaches
• Appreciate the impact and importance of ethics in engineering research
• Understand and be able to implement best practices in data management
• Appreciate the value of data management for the protection of intellectual property
• Appreciate the role of intellectual property in commercialisation of engineering
• Demonstrate communication skills (written and oral) to explain an engineering research exercise to specialist and non-specialist audiences with motivation, approach, justification, and key outcomes.

Overview of Learning Activities

The course will provide an interactive learning experience through lectures with significant tutorial and workshop-style content.

Details of Learning Activities

Your learning activities will include:

- Attendance at lectures introducing you to the various elements of research methods for engineers
- Guest lectures from research leaders with contrasting styles as examples
- Analysis and guided discussion of guest lectures to highlight key points and different approaches
- Completion of written assignments consisting of a formal literature review and a draft research proposal
- Brief oral presentation of research proposal assignment
- Private study, working through the course as presented in classes and reading of the supplementary material provided online

Teaching Schedule

Week 1_____
Lectures: Introduction to Research Methods, What is Research and Review of Course

Week 2_____
Lectures: The Literature Review: What is a Literature Review; strategies and tools for searching the available literature and tools for managing your references.

Week 3 _____
Lectures: Guest Lecture 1 – example research presentation from an experienced research leader with emphasis on reviewing the literature. Analysis of guest lecture and tips on giving a good presentation and the elements of a good literature review.

Week 4_____
Lectures: Tips on how to read and how to write a concise research paper.'Example Presentations from previous research methods students'

Week 5_____
Lectures: Guest Lecture 2 – Problem Solving Approaches: Presentation and analysis of several formal problem solving approaches including some real world examples.

Week 6_____
Lecture: The research proposal. What are the elements of a research proposal, including literature review, research questions, justification, placement of the proposal in the context of the current body of knowledge, expected outcomes and research planning. A specific systematic approach will be introduced and analysed.

Week 7_____
Lecture: Guest Lecture 3 – example research presentation from an experienced research leader emphasis on diverse presentation styles. Analysis of the guest lecture and discussion of approaches to presentations.

Week 8_____
Tutorial: Lectures replaced by tutorial drop in session for guidance on mid-semester take home test.

Week 9_____
Lectures: Intellectual Property: What is it, why is it needed. How do you identify and record new ideas and important data when they first occur, how do you protect IP, what the role of protected IP in engineering and the commercialisation of technology (with a few real world examples).

Week 10_____
Lecture: Guest Lecture 4 – example research presentation from an experienced research leader with emphasis on intellectual property, industry engagements, commercialisation and presenting concepts to a non-technical audience. Analysis of the guest lecture.

Week 11_____
Lecture: Ethics of doing research. What are Human and Animal Ethics and when are they needed. What are the expectations of a researcher and what constitutes an ethical breach.

Week 12 _____
Lecture: Guest Lecture 5 – example research presentation from an experienced research leader featuring human and/or animal ethics. Analysis of the guest lecture and discussion of ethics in research.

Overview of Learning Resources

You will be provided with detailed lecture and tutorial content as learning resources. This will be supported by supplementary (non-assessable) reading material to enhance the learning outcomes. Course content will made available online.

Learning Resources

Prescribed Texts

References

Other Resources

Learning resources include:
• Course notes available on MyRMIT Studies (Blackboard)

• Suggested reading material available on MyRMIT Studies (Blackboard)

Overview of Assessment

The assessment for this course will be based on the following components:
• Written Reports
• Oral Presentation
• Mid-semester test

Assessment Tasks

Assessment (tutorial tasks and class tests) will occur on a regular basis through the semester to provide you feedback on your performance and the quality of your learning outcomes. The main assessment components will comprise of written reports demonstrating understanding of research methods and a related presentation demonstrating the ability to convey a research concept to a general audience.

The assessment will be based on the following components:
1. A formal, but brief report reviewing the literature on a particular topic
2. Mid-Semester Test analysing a research publication
3. A formal, but brief research proposal in the area of the literature review – both written and oral components

Assessment Tasks Week 1 – Week 6
Literature Review – 30%
Assessment Tasks Week 7 – Week 12
Mid Semester Test – 15%
Research Proposal (written and oral) – 55%

Copying from other students or from any other sources in any assessment task without referencing is called plagiarism and has severe penalties (see: RMIT Plagiarism policy).

Final Grades Available
High Distinction 80-100 HD
Exceptionally clear understanding of subject matter and appreciation of issues; well organised, with formulated and sustained presentation and response to critique. Addresses all the specific objectives with many to a high standard. Evidence of creative insight and originality.
Distinction 70-79 DI
Strong grasp of subject matter and appreciation of key issues; addresses all the specific objectives, with several to a high standard; clearly developed presentation and response to critique. Evidence of creative and solid work.
Credit 60-69 CR
Competent understanding of subject matter and appreciation of the main issues; addresses all the specific objectives, some reasonably well. Clearly developed presentation and response to critique; well prepared and presented.
Pass 50-59 PA
Satisfactory. Appreciation of subject matter and issues. Addresses all the specific objectives; work generally lacking in depth and breadth. Often work of this grade demonstrates only basic comprehension or competency. Work of this grade may be poorly prepared and presented. Investment of greater care and thought in organising and structuring work would be required to improve.
Fail 0-49 NN
Unsatisfactory. Evidence of lack of understanding of subject, minimal or inadequate comprehension and does not address all the objectives. Work is often inadequate in depth and breadth and sometimes incomplete or irrelevant; lack of care and thought in organising and structuring work.

Course Overview: Access Course Overview

URL: http://www.rmit.edu.au/courses/eeet24491450

Authorised 22 July 2014 by Roy Ferguson

UTS –Student Guide Excerpt

4.8 Doing a Project at Work

If your Capstone Project is based on a project whose purpose is to primarily serve the interests of another entity (e.g. person or organisation), such as a workplace project, you must carefully distinguish between your Capstone Project and the other entity's project. The purposes, scope, imperatives, timeline, performance, quality and reporting requirements and criteria, etc. of each are quite distinct. Satisfactory performance on one will not necessarily guarantee satisfactory performance on the other.

The expectations of you on your performance on your Capstone Project are stated in the aims, objectives, and graduate attributes on page 1 of this Student Guide. In addition to those differences nominated above there are other obvious differences e.g. the requirement to submit a Capstone Project Report and, if you are a Distinction or High Distinction nomination, present your project orally. Less obvious differences may be:

- The necessity to identify and make visible why the project is worthwhile to society; e.g. who are the stakeholders; who is advantaged; who is disadvantaged; what are the criteria by which benefits and 'costs' (not just financial, but also e.g. social and environmental) and 'success' are to be determined; how are short- and long-term considerations affected?

- The extent of your delegation e.g. the extent to which you are individually responsible for the definition, planning, monitoring, control, design, implementation, verification, validation, and documentation of the project.

- The extent to which you work autonomously or are supervised on the project, and how closely supervised.

- Identification of the knowledge and skills you have applied on the project.

- Identification of the competencies you have developed through the project.

- You are also expected to demonstrate maturity, information literacy, problem-posing and –solving, and academic literacy, in addition to technical expertise and management skills.

If your project is undertaken at a location outside the University, then you should supply details regarding an external co-supervisor who will be overseeing your work. Your project proposal should accompany a letter of support on a company letterhead and signed by your external co- supervisor. A UTS EHS Risk Assessment must also be completed.

There will be initial liaison between your UTS supervisor and external co-supervisor to arrive at an acceptable mode of operation that ensures your work is properly credited and other assistance is well-defined. The external co-supervisor will normally be expected to attend your seminar if there is one, and be involved in the assessment in an advisory role. The UTS supervisor may visit your project site at appropriate time(s) to assess the context of the project and to liaise with your external co-supervisor.

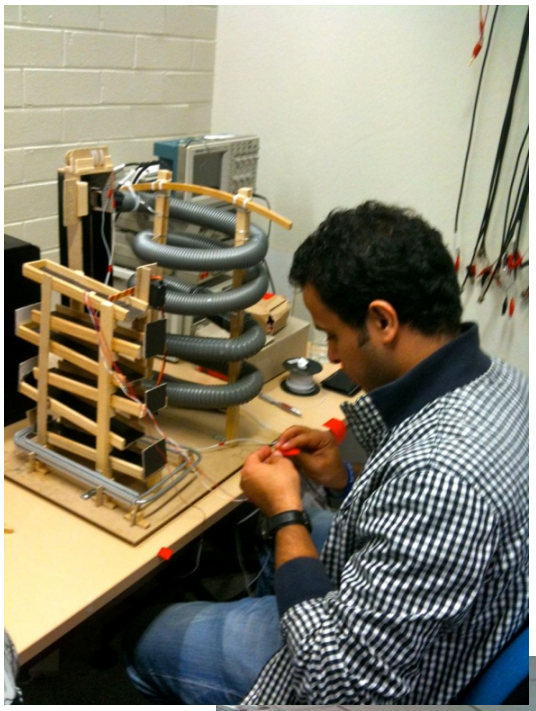
For an on-going work-related project, the Subject Coordinator and UTS supervisor must be satisfied that the proposed project has sufficient elements of definition, contextual analysis and specification to allow opportunity for full and fair assessment of your performance on an Engineering task. This requires mechanisms to be in place which allow your contribution to the project to be visible and traceable and clearly distinguished from the contributions of others in your work place.

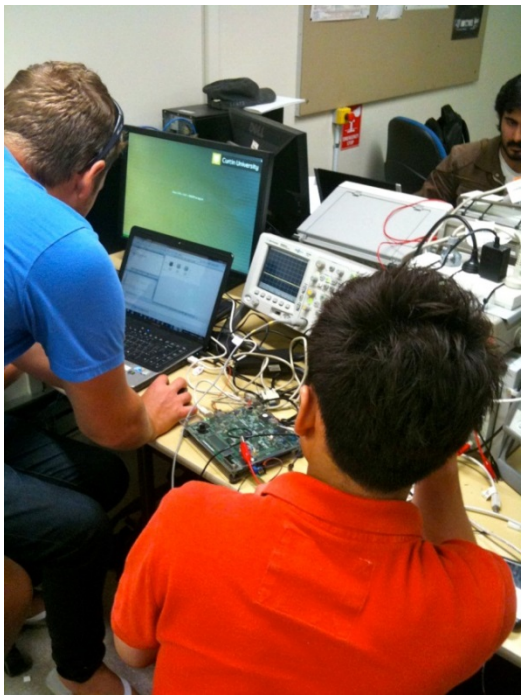
Curtin University

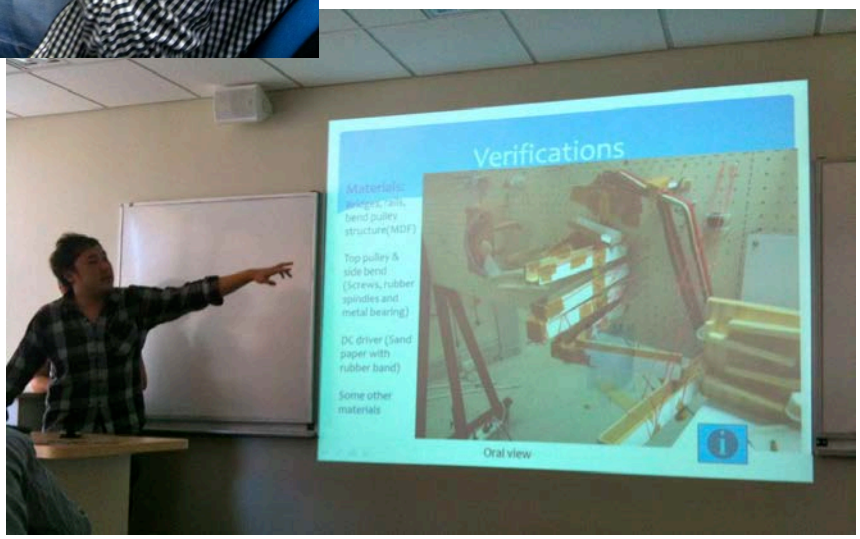
Electrical and Computer Engineering Department

Engineering Project 401 and 402

A Guide for Supervisors







Dr Cesar Ortega-Sanchez

Disclaimer

This document is used in the Department of Electrical and Computer Engineering, Curtin University, to guide the work of Final Year Project supervisors. The intention is to promote the use of a common conceptual framework in which students and supervisors have freedom to apply their own personal style to all project-related activities.
If you have any comments for the author please send them to
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Copyright Information

Table of Contents

Undergraduate Engineering Project

Guide for supervisors

Introduction

Even though the engineering profession has evolved quite substantially in the last hundred years, the ultimate purpose of engineers remains the same: apply knowledge and technology to solve problems.

What has changed over time is the nature of the problems engineers need to solve. Nowadays solving problems in engineering requires not only technical knowledge and skill, but also other set of skills like the ability to work in multidisciplinary teams, effectively communicate in a variety of formats and contexts, and consider the environment and legal framework. Industry is demanding from our graduates all these abilities and more; and correspondingly the final year project should be an opportunity for students to demonstrate they have developed all these abilities during their course.

To ensure a good student experience during their final year project (FYP), it is important that the project unit coordinator and all supervisors agree on what the FYP is, and what it is not. This document presents information that has been communicated to students. Its purpose is to unify the definition and scope of the final year project in the Department.

Why do students do a project?

- To demonstrate they are ready to be “unleashed” to the world as professional engineers.
- Engineers are problem solvers by nature. Hence students cannot graduate if they cannot demonstrate they can solve problems in a systematic way.
- More often than not, problems are vaguely stated, resources (people, time, money and equipment) are limited, and information is incomplete. A good engineer knows how to deal with all this uncertainty to produce a solution that is effective, making the best use of available resources.

What is a project?

In the context of EP401 a project is: **A DESIGN TO SOLVE A PROBLEM**

This simple statement pre-supposes two things:

- Students know what design is
- Students have a problem to solve

What is design?

In engineering **design is a process** comprising:

- Understanding of the problem to solve
- List of requirements
- Planning
- Analysis of previous or similar solutions (research)
- Evaluation of possible new solutions
- Specifications
- Rational selection of tools, methods, components, etc.
- Implementation
- Verification and testing
- Documentation
- Communication of results

More information about the design process can be found in Blackboard.

What is a problem?

In the context of EP401 students need to identify a problem with the following characteristics:

- Challenging. They do not know the answer on day one.
- Requires research: finding, organising and using information.
- Requires creativity
- Requires the use of several tools (HW and/or SW)
- Provides opportunities to demonstrate their ability

Examples of good projects

- Integration of various elements of common technology to create a new system.
- The development of a new design method or a careful examination of one recently proposed.
- A study of a new method of manufacture or a new means of operating existing systems.
- A forensic examination to determine why a given system fails.
- Any task requiring systematic work and so allowing students to demonstrate their ability.

Examples of deficient projects

- Entering numbers on a simulator to obtain some graphs.
- Putting together a commercial kit and test it.
- Use a commercial tool to solve the problem.

Projects like these have the potential of being deemed inadequate by the review panel at the end of semester one, in which case students may fail the unit.

The supervisor

The role of the supervisor is to:

- Meet with students regularly so that they can report progress.
- Verify that students are appropriately following the design process.
- Ask questions on how and why they made their decisions.
- Review with students their plan and how well they are following it.
- Detect problems in time and suggest a course of action.
- Provide feedback on the way students work.

What supervisors are not

The role of supervisors is NOT to:

- Solve students' problems.
- Explain a paper or an equation to their students.
- Tell students what to do every step of the way.
- Give students technical advice, unless the supervisor has information only available to him. If the topic of the thesis is not one of the supervisor's areas of expertise, then advice from a more qualified staff member may be sought after.
- Chase students around to organise meetings.
- Students' solutions should be theirs. Otherwise students just become the supervisor's technicians.

What is expected from students?

- To propose their own projects. They are fourth year student engineers. By now they should be able to identify interesting problems when they see them.
- To keep a logbook. This is the best piece of evidence students can provide to demonstrate HOW they are solving their problem.
- To meet regularly with their supervisor. Once a week is ideal. Once every fortnight as minimum.
- To be able to follow the design process. When in doubt, ask their supervisor.
- They will give their best shot at solving their problem.

What is NOT expected from students?

- To produce a working prototype at the end of the project. They will get more marks from presenting 80% of the plan completed in a systematic way, than from presenting 100% with no logbook.
- To get the plan right on day one. Plans may change during the project, provided students discuss changes with their supervisor.
- To know all the answers on day one. But they should be able to find them by themselves.

The Logbook

- The evidence to demonstrate **WHAT** students are doing and **HOW** they are doing it.
- Should contain everything from the problem statement to final testing. I.e. research, assumptions, decisions, designs, tests, reflections, etc.
- There is a document on logbooks available from Blackboard.

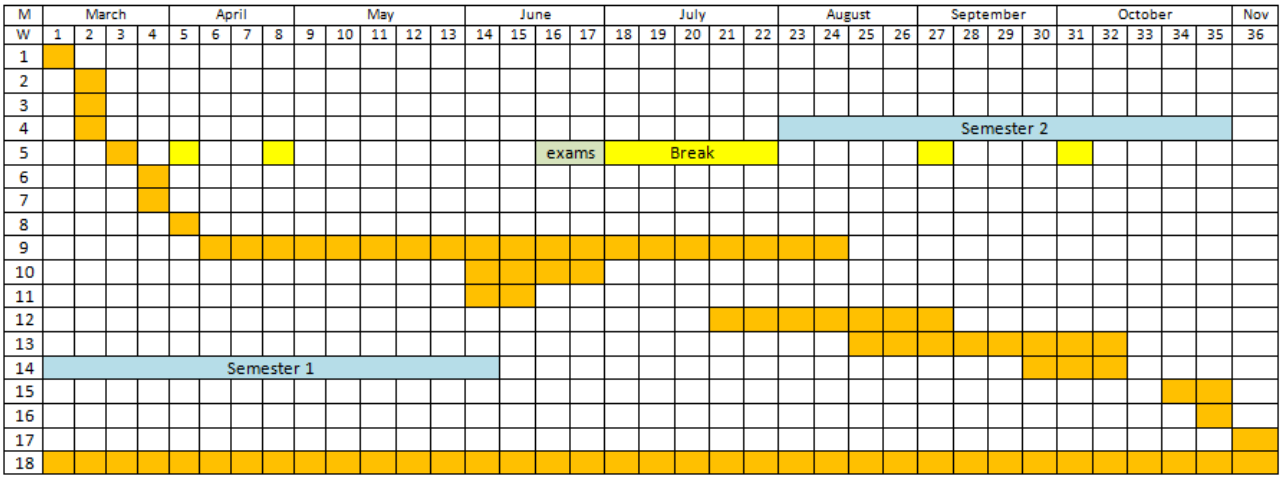
Ideal timeline

The following table presents the ideal timeline for people starting in Semester 1 every year:

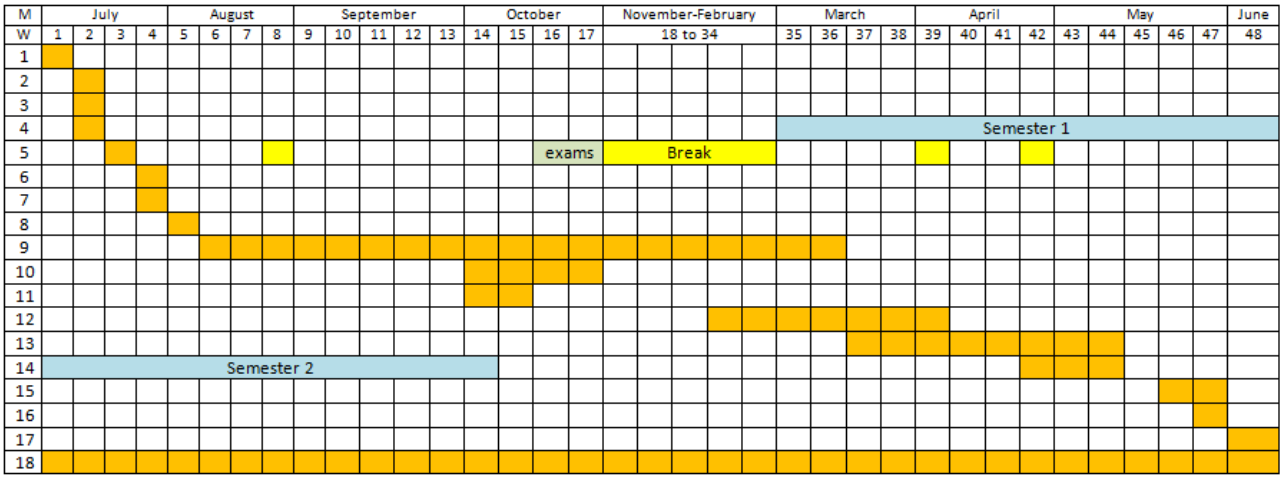
<table>
<tr><th colspan="2">Sept</th><th>Oct</th><th>Nov</th><th>Dec</th><th>January</th><th>February</th><th>March</th><th>April</th><th>May</th><th>June</th><th>July</th><th>Aug</th><th>Sept</th><th>Oct</th></tr>
<tr><td colspan="2">The year before</td><td colspan="4">Summer break</td><td colspan="4">Semester 1</td><td>Winter break</td><td colspan="3">Semester 2</td></tr>
<tr>
<td colspan="2">Start looking for projects.
Talk to potential supervisors.
Talk to current project students.
Attend project poster session.
Have a look at past thesis.</td>
<td>Exams</td>
<td colspan="3">Complete the research stage of your FYP.
If in Perth, meet with your supervisor as frequently as needed. If not, maintain contact via email
Keep a logbook.
Where applicable:
• Order parts
• Start writing software
• Complete design stage</td>
<td colspan="5">Enrol in Engineering Project 401.
Validation, implementation and test of your solution.
Meet with your supervisor at least once every fortnight.
Keep a logbook.
Oral presentation on your progress on Study Week at the end of semester one (June).</td>
<td colspan="3">Enrol in Engineering Project 402.
Complete any pending work from semester one.
Allocate enough time to write your thesis (4 to 6 weeks).
Give your thesis to your supervisor for comments and feedback.
Make corrections and submit at the end of week 12, at the latest.
Submit your thesis and your logbook through the Assignments Office.
Create a poster and submit it electronically through Blackboard.</td>
</tr>
<tr><td colspan="6">Project research and design stages.
(You should propose or select a project in this period. The earlier the better)</td><td colspan="5">Project development stage</td><td colspan="3">Project conclusion stage</td></tr>
</table>

Some students start thinking about project in the first semester of their last year. For these students the following compressed timelines were proposed. Activities are numbered according to the list presented after the tables.

Compressed timeline for students starting in semester 1:



Compressed timeline for students starting in semester 2:



List of activities

1. Select project
2. Understanding of the problem to solve
3. List of requirements
4. Planning
5. Analysis of previous or similar solutions
6. Evaluation of possible new solutions
7. Specifications
8. Rational selection of tools, methods, components, etc.
9. Implementation
10. Write Chapter 2 of your thesis
11. Prepare and present 15-minute seminar
12. Testing
13. Write thesis
14. Submit thesis to supervisor for feedback
15. Make corrections
16. Submit thesis
17. Prepare and submit poster
18. Use logbook

The second semester

At the beginning of their second semester, students should be asking themselves the following questions:

- Am I solving an interesting problem that involved research, design and creativity?
- Have I met with my supervisor at least once every two weeks?
- Have I documented everything in a logbook?
- Am I in the last stages of my implementation/test phase?

Answering NO to any of these questions may mean trouble

Where should students be at the beginning of the second semester?

- They should have completed the development part of their project.
- They should be in the final stages: testing, analysis of results.
- They should have a very good logbook documenting all they have done and how they have done it.
- They should have a list of the bibliographic references they used: papers, websites, books, etc.

Anything missing from this list will make thesis writing difficult.

Writing the thesis

What is NOT a thesis?

- An elaborate laboratory report
- A superficial technical report
- A written tutorial
- An essay or similar literary creation

What the thesis is

- A written document used for two main purposes: **Assessment and provide evidence**.
- As an instrument of assessment it is the means by which students demonstrate how well they have met their project unit learning outcomes.
- Reports work done.
- It is also a communication that focuses on intellectual issues. That is, the reasoning behind various decisions made. It can be viewed as a justification of the decisions made.
- As evidence it demonstrates the quality of work graduates of our courses are capable of achieving.

Thesis structure

- Title
- Synopsis or abstract
- Table of contents
- Title page
- Introductory letter
- Acknowledgements
- Nomenclature
- Chapter 1. Introduction (written last)
    - Problem statement (what students wanted to solve)
    - Outline of design solution (what students achieved)
    - Structure of the thesis (the contents of each chapter)
- Chapter 2. Background
    - Everything the reader needs to know to understand the thesis.
    - Everything students did not do.
    - Most references must be used here.
- One or more chapters to outline the solution
    - Emphasise problems solved
    - Justify decisions and assumptions
- One or more chapters on integration and verification
    - How did students verify their solution?
- Conclusions and future work
    - Re-statement of problem and the proposed solution
    - How does the solution compare to other solutions?
    - Reflection: What did I learn? What will I do again? What will I not do again?
    - What work remains pending? What else can be done? How could the solution be improved?
- References
    - A complete list of the references used
    - Must be in an accepted format; i.e. Chicago or IEEE
    - Make sure all work done by others is acknowledged
    - CHECK FOR PLAGIARISM
- Appendices
    - Updated plan
    - Directory structure of attached CD
    - Information that may be relevant to the thesis but does not fit in any of the chapters; e.g. datasheets, demonstration of formulas, engineering tables, etc.
    - DO NOT PRINT OUT SOURCE CODE!

Attached CD

Information that could be used to reproduce, understand and continue the project

- Electronic copy of thesis in Word format
- Copies of relevant articles, datasheets, user manuals
- All source code (VHDL, C, Java, etc.)
- Schematic diagrams of mechanical parts
- List of parts with suppliers
- Etc.

Assessment of thesis

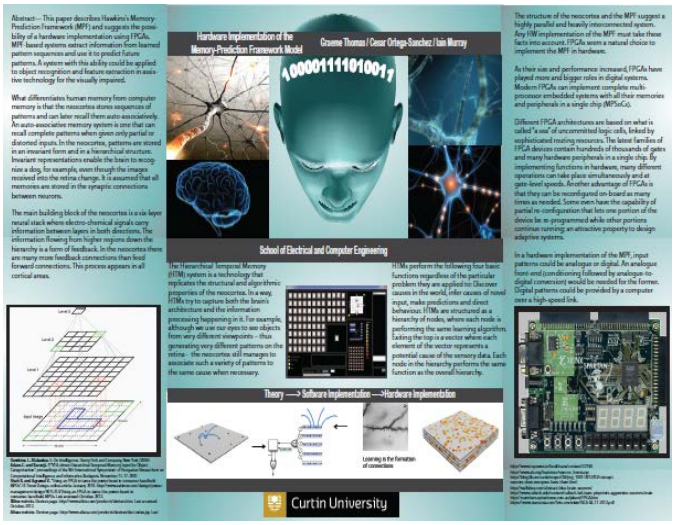
- Students MUST submit an electronic copy in Word of the first draft of their thesis to the supervisor **three weeks before final submission date**.
- Supervisors will give their comments/feedback in **two weeks maximum**.
- Supervisor's comments must be addressed and then two copies of the final version; one hard- and one soft-bound should be printed.
- Supervisor and co-supervisor will give marks to the thesis using a rubric.

Deliverables

- On the last Friday of semester at the latest students must submit to the Assignments Office:
    - Two copies of the thesis' final version. One hard-bound and one soft-bound.
    - Logbook
    - Attached CD
- On Friday of study week at the latest students must **submit via Blackboard** an electronic version of an A1 poster summarising their work.
- Rubrics will be used to mark thesis, logbook and poster.

The poster

- Objective: Communicate work done in one page.
- Free format. Be creative.
- Examples:



The Logbook

- The evidence to demonstrate WHAT students did and HOW they did it.
- Should contain everything from the problem statement to final testing. I.e. research, assumptions, decisions, designs, tests, reflections, etc.
- There is a document on logbooks available from Blackboard.
- Every student must have a logbook and submit it at the end of semester.

Final mark

Task	Value
Poster	15
Logbook	15
Thesis	70

More information

- Doug Myers' guide to projects in ECE's website. Everything students and supervisors need to know is there. Marks and dates may be out-of-date, but the rest of the content is good.
- Check list and other useful documents in Blackboard.
- Rubrics for assessment will be available in Blackboard.

Author: Dr Cesar Ortega-Sanchez
April 2013
Reviewed: September 2014

Curtin University

Engineering Project 401

Date:_____

Rubric to assess oral progress report at the end of semester

Project: _____ Student: _____ Marker:_____

Criteria	Level of achievement 0% Unsatisfactory 35% Satisfactory 70% Exemplary 100%		
Problem statement	No indication of the problem to solve	Brief description of a problem with no clear links to the project	Explicit declaration of the problem tackled in this project
Requirements and specifications	No list of requirements was provided	An incomplete and/or disorganised list of requirements and specifications was presented	A complete and well-justified list of requirements and specifications was presented
Plan	No plan was presented	Only the main activities were mentioned with no indication of time spent on them	A timeline including detailed past, present and future activities was presented
Outline of solution	No block diagram or high level description of the solution was presented	Only high level block/flow diagrams were presented	All parts of the solution (SW, HW, models, etc.) were clearly explained
Assumptions and decisions	No reference at all during the presentation	Some indication that a decision process took place	Explicit list of all assumptions and decisions taken during the project
Learning	No explicit mention of anything of value learned during the project	Learning was implicitly stated during the presentation but no explicit mention of it	Explicit mention of things that will and will not be done in future projects
Progress to date	No indication of activities being completed or carried out	Some activities mentioned but it was not clear how much of the project was left to do	Progress was explicitly addressed and it was clear the project could be completed on time
Quality of presentation	The presentation was disorganised. It did not “flow”. Most of the slides were text-only	Some structure attempted but still some parts seemed disconnected. Some pictures and graphs were used	The presentation had clear beginning, middle and end points. Good use of multimedia.
Length	The presentation was too short (less than 10 minutes) or too long (more than 20 minutes	Some of the content had to be rushed or slowed down to finish on time	All the content was delivered at the same pace and the presentation was close to 15 minutes
Knowledge	The presenter seems to know very little about the project’s subject	The presenter seems to understand the subject but was hesitant during the presentation	The presenter has a very good understanding of the subject and confidently presented it
Answer to questions	The presenter struggled to understand questions and could not articulate answers	The presenter seemed to understand questions but the answers provided were not convincing	The presenter confidently answered all questions

Instructions for markers

- Indicate with a cross (X) how well the student covered every criterion.
- If any of the criteria does not apply to a particular project, ignore it.

Assessment (Tick as appropriate) See overleaf

- ☐ Unconditional pass
- ☐ Conditional pass (state concerns and conditions overleaf)
- ☐ Fail

Comments and recommendations (Feedback to student)

If you ticked Conditional Pass, state below your concerns and what conditions you would impose on the student in order to continue his/her work.

Concerns	Conditions (if applicable)

Curtin University

Engineering Project 402

Rubric to assess logbooks

Although logbooks are personal affairs, there are certain elements that have to be present in any logbook. This marking sheet covers those elements as well as a subjective component of "usefulness"; i.e. how useful will the logbook be in a couple of years if you had to revisit the project.

Student: _____ ID: _____

Criteria	Performance 0%	35%	70%	100%	Total
Suitable notebook **(5)**	No notebook was used, only loose pages	A combination of loose pages and a notebook	Everything kept in a single notebook		/5
List of requirements and specifications **(10)**	Not included in logbook	Dispersed throughout the logbook	Explicit lists of requirements and specifications		/10
Plan **(10)**	No plan was included in the logbook	Only list of personal activities included in plan	A detailed plan for the whole team was included		/10
Log entries properly dated **(10)**	Entries were not dated	Only some entries have dates	Every entry has a date		/10
Assumptions and decisions **(10)**	No reference at all to any decision-making process	Some indication that a decision process took place	Explicit list of all assumptions and decisions taken during the project		/10
Personal contributions **(15)**	It is not clear from the logbook what were the personal contributions to the project	Evidence that some thinking process took place during the project, but contributions lack detail	Every contribution is profusely documented. It is obvious that a lot of thinking was put into the project		/15
Personal record of verification and testing **(10)**	No explicit mention to any verification or testing	Design verification was mentioned, with no evidence that it actually took place	Clear account of all verification that took place		/10
Personal comments and reflections **(15)**	No personal comments or reflections are present	Some superficial personal comments or reflections can be found	Comments and reflections reflect the learning process during the project		/15
Usefulness **(15)**	This logbook cannot be used in the future	Some elements in the logbook are worth revisiting in the future	An effort was made to record entries in a way that could be used in the future		/15
				Total	/100

Curtin University

Engineering Project 402

Rubric to assess posters (The poster conveys 15% of the final mark in this unit)

Project: _____ Student: _____ Marker:_____

Criteria (Marks)	Level of achievement 0% Unsatisfactory 35%	Satisfactory 70%	Exemplary 100%	Total
Overall appearance **(10)**	Scattered and disconnected pieces. Poor colour choices and layout.	Pleasant to look at, but could use some work in layout, colour scheme or fonts	Very pleasing to look at. Attractive colour palette. An “illustrated abstract”	/10
Author Identification **(5)**	None or missing most of the details	Not enough information to contact author without further research	Name, course and complete contact details included	/5
Problem statement **(10)**	Absent or vaguely stated	Present, but not explicit. Buried at end of “Introduction” or “Background.”	Explicit. Prominently visible	/10
Description of solution **(15)**	Absent or very difficult to follow	Some parts of the solution are present but key elements are missing	Complete and accurate description of the proposed solution	/15
Outcomes **(15)**	Absent or not related to the problem	Not enough information to comprehend what was achieved	Clear explanation of how the solution meets the requirements to solve the problem	/15
Conclusions **(10)**	Absent or does not follow logically from outcomes presented	Present but not explicit. Scattered comments in different sections.	Explicit statement providing a thorough reflection on the achieved outcomes	/10
References **(5)**	No list of references	A list of reference was presented, but in-text referencing is inconsistent	References were used where appropriate and listed in a correct format	/5
Organisation and flow **(10)**	Logically organized and easy to follow. Graphically clear	Implicit flow by making headings stand out but improvements still needed	Logically organized and easy to follow. Does not need further explanation. Graphically clear.	/10
Text/Graphics balance **(10)**	Too much text with no figures or not enough text to explain figures	Mostly balanced, but still too much text or graphics	Balanced. Text and graphics are evenly dispersed in the poster	/10
Text Size and Accuracy **(10)**	Some fonts are too small or too little. Misspelling mistakes abound	Easy to read main text from 1.5 meters, but text in figures too small. One or two misspellings.	Very easy to read. Fonts large enough to read from 2 meters. All words and terms spelled correctly and defined	/10
			Total	/100

Adapted from http://www.honors.hawaii.edu/documents/programs/spring_symposium/poster_rubric.pdf

Curtin University

Engineering Project 402

Rubric to assess final reports (The thesis conveys 70% of the final mark in this unit)

Project: _____ Student: _____ Student ID:_____

Criteria (Marks)	Level of achievement 0% Unsatisfactory 35%	Satisfactory 70%	Exemplary 100%	Total
Structure **(5)**	The thesis does not have the recommended structure	An attempt was made to follow the structure, but there still are omissions	The thesis has the recommended structure	/5
Format **(5)**	The thesis does not follow the recommended format	An attempt was made to follow the format, but there still are mistakes	The thesis consistently followed the recommended format	/5
Introduction **(10)**	No indication of the problem, solution and thesis structure	Some elements are missing in the introduction	Includes problem statement, outline of solution and thesis structure.	/10
Background information **(10)**	Most of the information is incomplete or irrelevant.	Some information is either disorganised, incomplete or irrelevant	All information is relevant and was presented in a logical sequence	/10
Implementation/ Development **(10)**	Only the very basics of the solution were mentioned in the thesis	Parts of the solution were presented in detail, but others were not mentioned	The solution was explained in detail and it is technically sound	/10
Diagrams, graphs and equations **(10)**	No diagrams or figures were included in the thesis	Only high level block/flow diagrams were included	All solutions were explained using diagrams, graphs or equations	/10
Problem-solving **(15)**	No evidence that any problem-solving took place	Some problems were mentioned with no discussion on how they were solved	Problems faced and the process followed to solve them are well documented in the thesis	/15
Verification **(10)**	No evidence that any verification took place	Verification was mentioned, with no evidence that it actually took place	The evidence provided demonstrates the solution was thoroughly verified	/10
Conclusions and future work **(10)**	No attempt to provide a final reflection on the work done	Conclusions and future work presented are superficial. No reflection is evident	It is evident conclusions and future work are the result of deep reflection	/10
Referencing **(5)**	Apparently, no references were used to complete the project	A list of reference was presented, but in-text referencing is inconsistent	References were used where appropriate and listed in a correct format	/5
Plan **(5)**	No plan was included in the thesis	Only the main activities included in the plan with no mention of deadlines	A detailed plan was included with a reflection on how it changed over time	/5
Style **(5)**	The thesis looked improvised. No attention to detail was evident	Some attempt at presenting a professional-looking document with some points of improvement	The thesis looks very professional and was pleasant to read	/5
			Total	/100

(Please turn the page over)

Comments from supervisor and co-supervisor

Your role: **Supervisor / Co-supervisor**

In your opinion…	Answer
… is the work presented in this thesis good enough to be published?	**Yes / No / May be** If yes: **Conference / Journal**
… should this thesis be considered for ECE's best thesis prize?	**Yes / No / May be**
… should the student be encouraged to participate in the IET/IEEE student project competition? (This competition is more about presentation skills than technical content)	**Yes / No / May be**

For supervisor only:	
Did the student meet with you regularly?	**Yes / No**
Did the student present a draft of the thesis to you?	**Yes / No**
Did the student work to their project plan?	**Yes / No**
Did that plan change much over the year?	**Yes / No**

General comments on the thesis (feedback to student):

Your Name: _____ Signature _____

Date: _____

ENEG14005 – Engineering Project Implementation – Grading Criteria

Student Name: ..... **Student No:** ..... **Date:** ...../...../.... **Project Title:** .....

Note in the criteria below, it is intended that for each higher grade, students would be able to demonstrate the competencies defined for the lower grades. That is, to be graded at the credit level on one of the objectives, students would also be expected to demonstrate the knowledge, skills and attitudes listed under the pass level.

Learning Outcome	Fail	Pass	Credit	Distinction	High Distinction
1. Demonstrate a capability to apply to a substantial degree the Engineers Australia generic attributes for professional engineers to an engineering project	Unable to demonstrate a sufficient number of the Engineers Australia Stage 1 Competency Elements to an acceptable level. ☐	Demonstrates a substantial number of the Engineers Australia Stage 1 Competency Elements to an acceptable level. ☐	Demonstrates a substantial number of the Engineers Australia Stage 1 Competency Elements to a sound level. ☐	Demonstrates a substantial number of the Engineers Australia Stage 1 Competency Elements to a high level. ☐	Demonstrates a substantial number of the Engineers Australia Stage 1 Competency Elements to an exemplary level. ☐
2. Implement the plan prepared for the project, monitor and review project progress, and take initiative to resolve problems, adjust project strategies and maintain work and reporting schedules.	Insufficient evidence of monitoring and review of progress; failure to manage project to meet deadlines. ☐	Acceptable evidence monitoring and review of progress; managed project to deal resolve problems and meet deadlines. ☐	Evidence of systematic monitoring and regular review of progress; managed and adjusted project plans to resolve problems and meet deadlines. ☐	Evidence of systematic monitoring and regular review of progress using a range of project management tools; managed and adjusted project plans to resolve problems and meet deadlines. ☐	Evidence of systematic monitoring and regular review of progress using a range of project management tools; managed and adjusted project plans to resolve problems and/or enhance the project and meet deadlines. ☐
3. Work and learn autonomously and in a professional manner and communicate effectively using formal and informal progress reports, professional presentations and project documentation	Insufficient evidence of reporting to supervisor; incomplete or poor quality of project documentation, reports and/or presentations. Excessive reliance on supervisor. ☐	Acceptable evidence of reporting to supervisor; acceptable quality of project documentation; required some supervisor support to complete technical tasks and manage project. ☐	Evidence of regular reporting to supervisor; clear and organised project documentation; minimal supervisor support required to complete tasks and manage project. ☐	Evidence of regular, relevant reporting to supervisor, clear and organised project documentation; student drives project and seeks guidance to confirm critical aspects of the project. ☐	Evidence of regular, relevant reporting to supervisor; comprehensive, clear and organised project documentation; student drives the project and innovates, and seeks guidance to confirm critical aspects of the project. ☐
4. Gather, evaluate and extract relevant information from key sources and relevant authorities and use information effectively to justify analysis, project choices and decisions	Insufficient evidence of ability to gather, evaluate or present information required to justify project decisions. Unreliable sources used. ☐	Acceptable evidence of ability to gather, evaluate and present authoritative information required to justify key project decisions. Range of sources is limited. ☐	Sound evidence of ability to gather, evaluate and present authoritative information required to justify key project decisions. A variety of sources is used. ☐	Extensive evidence of ability to gather, critically evaluate and present authoritative information required to justify most project decisions. A wide variety of sources is used. ☐	Exemplary evidence of ability to gather, critically evaluate and present authoritative information required to justify most project decisions. An extensive variety of sources is used. ☐
5. Think critically, demonstrate sound analysis, make sound judgements in all stages of the project and articulate decisions and supporting thinking in project working documents for the project supervisor and in final reports & presentations.	Insufficient evidence of thinking, analysis, justification and/or explanation of technical and project management decisions or poor judgements. ☐	Limited but acceptable evidence of thinking, explanation, basic analysis and justification of key technical and project management decisions and acceptable judgement. ☐	Sound evidence of thinking, explanation, analysis and justification of key technical and project management decisions. Some reflection on decisions made. ☐	Extensive evidence of thinking, explanation, critical analysis and justification of most technical and project management decisions. Detailed reflection on decisions made. ☐	Exemplary evidence of thinking, explanation, critical analysis and justification of technical and project management decisions. Sustained reflection on decisions made. ☐

ENEG14005 – Engineering Project Implementation – Grading Criteria

6. Solve technical problems and issues that arise, explain judgements made based on technical knowledge and standard practice, and comply with safety, risk, sustainability and other professional requirements.	Insufficient evidence of application of technical knowledge or standard practices to the project; insufficient evidence of addressing professional requirements. Significant technical errors. ☐	Technical problems and decisions explained in terms of fundamental technical knowledge and practices. No significant technical errors. No significant oversights in safety / risk assessment. ☐	Technical problems and decisions clearly explained in terms of fundamental technical knowledge and practices. No significant technical errors. No significant oversights in safety / risk assessment. ☐	Technical problems and decisions explained in detail and clearly, in terms of fundamental technical knowledge and practices. Advanced technical knowledge applied to project. No significant technical errors. No significant oversights of professional requirements. ☐	Technical problems and decisions explained in detail and clearly, in terms of fundamental technical knowledge and practices. Advanced technical knowledge applied innovatively to project. No significant technical errors. No significant oversights of professional requirements. ☐
7. Evaluate project processes, technical outcomes of the project and the lessons learned from the project experiences	Insufficient evidence of evaluation of technical outcomes or evaluation of management of the project. Insufficient evidence of reflection and lessons learned. ☐	Acceptable evidence of evaluation of aspects of technical outcomes and evaluation of management of the project. Some evidence of reflection and lessons learned. ☐	Sound evidence of evaluation of aspects of technical outcomes and evaluation of management of the project. Evidence of reflection with clear outline of lessons learned. ☐	Extensive evidence of evaluation of technical outcomes and evaluation of management of the project. Evidence of reflection with clear and detailed outline of lessons learned and suggestions for improvement. ☐	Extensive evidence of evaluation of technical outcomes and holistic evaluation of management of the project. Evidence of reflection with clear, detailed outline of lessons learned and suggestions for improvement and development. ☐
8. Write a formal technical report and dissertation describing the project, the issues faced and the choices made in managing or implementing the project, the reasons for making choices, project evaluation and what was learned from the project experiences	Insufficient evidence in report and dissertation of issues, choices faced, approaches or methods used or justification for making choices. Insufficient evidence of reflection on what was learned. ☐	Acceptable evidence in report and dissertation of basic issues, choices faced, approaches and methods used and justification for making choices. Some evidence of reflection on what was learned. ☐	Sound evidence in report and dissertation of issues, choices faced, approaches and methods used and justification for making choices. Evidence of reflection on what was learned. ☐	Extensive evidence in report and dissertation of issues, choices faced, approaches and methods used and justification for making choices. Detailed evidence of reflection on what was learned about some aspects of the project. ☐	Extensive evidence in report and dissertation of issues, choices faced, approaches and methods used and justification for making choices that shows a holistic understanding of the project.. Holistic evidence of reflection on what was learned about moat aspects of the project ☐

	Supervisor Assessment
Reporting to supervisor and engagement with project	Comments:

ENEG14005 – Engineering Project Implementation – Grading Criteria

	Portfolio Components
Thesis	Comments:
Technical Paper	**Please circle: Pass / Fail** Comments:
Oral Presentation	**Please circle: Pass / Fail** Comments:
Poster	**Please circle: Pass / Fail** Comments:
Stage 1 Competencies assessment	**Please circle: Pass / Fail** Comments:

ENEG14005 – Engineering Project Implementation – Grading Criteria

Reflective paper	**Please circle: Pass / Fail** Comments:
Supervisor's Name: **……**	Comments:
Supervisor's Grade:	
Moderation	**Comments from Moderation**
1st Moderator's Name: **……..**	Comments:
1st Moderator's Grade:	
2nd Moderator's Name: **……..**	Comments:

ENEG14005 – Engineering Project Implementation – Grading Criteria

2nd Moderator's Grade:	
Further Comments from Moderation Meeting:	Comments:
Final Grade:	

Rethinking Final Year Projects and Dissertations: Creative Honours and Capstone Projects.

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1. Example title *(To convey to others the central aspects):*

The Mechanical Engineering Final Year Project at University of Adelaide, Australia

2. Contact details and context

Name: Associate Professor Benjamin Cazzolato
Institution: University of Adelaide, Australia.
Email: benjamin.cazzolato@adelaide.edu.au
Degree Programme: School of Mechanical Engineering (Mechanical, Mechatronic, Aerospace, Automotive, Sports and Sustainable Engineering)
Course/unit/module title: Final Year Undergraduate Projects

3. Please describe the main features of the project and the learning outcomes

The final year project in the School of Mechanical Engineering aims to provide solutions to engineering problems related to industry or to scientific research, with emphasis on project management and effective communication. It is considered to be an important part of the engineering education process and projects sponsored by local industry are strongly encouraged. Industry sponsored projects enhance student skills through relevant real-world projects in research and development, and profits industry by collaboration in training expertise transfer, innovation and development.

The scope of the projects is often ambitious, such as the design, build and launch of a supersonic combustion RAM jet, racing a Formula SAE (Society of Automotive Engineers) racing car, designing and launching an autonomous unmanned air vehicle, improving the energy efficiency of a winery or the design and build of autonomous robotics to search and identify friends and foes. This is facilitated by the extensive resources put in place by the School to support the students including the provision of a project budget and access to workshop staff time and manufacturing facilities (detailed in Section 8).

Each project has at least one academic supervisor, and in the case of industry sponsored projects, an industry-based supervisor. The role of the supervisor is more mentor than boss for the duration of the course. Supervisors are also required to provide summative assessment on all course deliverables (see Section 4 below). Students work in teams ranging in size from one to a dozen. Although the projects require a minimum of 330 hours of student time, many students spend over 600 hours and some up to 1000.

Unlike traditional engineering honours projects where individual students work on research based questions, this project actively encourages projects involving teams. In addition, recognising the diverse range of careers that our graduates enter, any type of project is allowed so long as it meets minimum criteria (detailed in Section 7 below). Only 20% of projects are of the traditional research type. Students are encouraged to suggest projects themselves as these often lead to outstanding outcomes.

The most common way that companies may be involved in the final year projects involves entering into a sponsorship agreement. An upfront fee to cover incidental expenses is charged. If both the company and the academic supervisor agree that the project has met specified goals, a further payment to the School of Mechanical Engineering is required at the completion of the project. Students are not paid a stipend. Costs of production of substantial items of test equipment must be met by the company. However, equipment already available in the School can generally be used for the project free of charge provided that certain guidelines are met.

Workshops throughout the year assist in the management of the project and associated deliverables.

Course Objectives: On completion of the course, students should have sufficient knowledge to:

- Develop a research or project plan
- Determine appropriate milestones and their associated time frames
- Manage a small group undertaking research or design project
- Orally present their findings to a large group with widely varying degrees of technical knowledge
- Prepare a well written technical report detailing their project.

Graduate Attributes to be developed:

- ability to apply knowledge of basic science and engineering fundamentals;
- ability to communicate effectively, not only with engineers but also with the community at large;
- in-depth technical competence in at least one engineering discipline;
- ability to undertake problem identification, formulation and solution;
- ability to utilise a systems approach to design and operational performance;
- ability to function effectively as an individual and in multi-disciplinary and multi-cultural teams, with the capacity to be a leader or manager as well as an effective team member;
- understanding of the social, cultural, global and environmental responsibilities of the professional engineer, and the need for sustainable development;
- understanding of the principles of sustainable design and development;
- understanding of the professional and ethical responsibilities and commitment to them; and
- expectation of the need to undertake lifelong learning, and the capacity to do so.

4. How do you assess the work and what evidence do you have that standards are comparable with more traditional formats?

Assessment

Assessment is comprised of written, oral and visual forms of communication. This is comprised of a Preliminary Report (10%) in the first semester. In the second semester a Public Seminar (10%), a public exhibition branded as MechExpo (10%), Student Achievements (10%), Project Outcomes (15%), Workbooks (5%) and a Final Report (40%).

All assessment, with the exception of the Preliminary Report (a predominantly formative assessment), Student Achievements and the Workbooks, are assessed by at least two staff members. The Final Report (typical of a traditional honours thesis) and Project Outcomes are assessed by the supervisor and another academic staff member not related to the project. If the two staff cannot agree on a mark, then this goes to a third staff member to moderate. All theses worthy of a high distinction are moderated by a third (very experienced) staff member for quality assurance.

Assessment of the Public Seminar is undertaken by a panel of at least 4 staff members.

The assessment of MechExpo (the project exhibition) is conducted by both academics and external judges. The external judges consist of practicing engineers, patent attorneys, managers and entrepreneurs. Each project would be typically assessed by at least 8 assessors. The assessment of the external judges and academics are typically within 10% of each other. MechExpo is characterised by intense and enthusiastic competition for the few (but lucrative) prizes for excellence that are sponsored by local industry. For more information regarding MechExpo see:
http://www.mecheng.adelaide.edu.au/mechexpo/

Self and Peer Assessment
In groups of two or more students, self and peer assessment is used to redistribute the marks according the effort and outcomes achieved by individuals. By explaining this process early on it lessens, but does not eliminate, the tendency of less capable students from "sitting back" and letting their peers do the work.

External Examiners
The traditional model of an engineering honours project in Australia is for students to work as individuals on a research-based project, and the main assessment is the final thesis. This differs considerably from the model employed in the School of Mechanical Engineering at the University of Adelaide, where the final thesis, although still the largest individual assessment, only accounts for 40% of the final mark awarded for the course. What further differentiates the course from others are that group projects are actively encouraged, and research-based projects typically only account for 20% of projects, with the majority being in the form of design, build, test and evaluate. Despite the significant differences in assessed deliverables, in 2009 the School was involved in a program to benchmark the quality of the assessment of the final theses. This involved exchanging ten theses, representing each decile from the annual cohort, with an engineering school at another Group of Eight (sandstone) university that employed a traditional research based assessment. The theses were then assessed based on supplied marking criteria. Moderated marks were on average within 2% of the mark awarded by the source institution.

5. Hot tips and things to look for

Project Outcomes
The projects consume a great deal of resources, so when planning, it is desirable that the project outcomes go beyond the learning outcomes of the students necessary to meet the course objectives. These broader measures of success should reinforce the School's Strategic Plan, and in particular the Research and Research Training, and the Learning and Teaching objectives. These may include, but not be restricted to, the following:

- Research generation, for example a conference or journal paper
- Research assistance, for example the design and build of a rig to facilitate research
- Generate media interest, for example a newspaper article, magazine article, television news story, science shows, etc.
- Meet the needs of the community or local industry

Project Database
Managing in excess of 250 students, 200 potential projects and 25 supervisors is time consuming and logistically difficult. Consequently a custom web-based database was developed. Staff can enter project information using an online proforma, and manage students who wish to undertake the project. Students can view project information, what special skills might be needed, and who is currently selected for the project. They may also indicate which projects they would like to participate in by voting for up to six projects. The database also serves as a repository for electronic copies of the theses and posters (presented at MechExpo) for the benefit of future students. For more information on the database, please see: https://projectselect.mecheng.adelaide.edu.au/

Sponsored Projects and Risk Mitigation
Typically one third of projects are industrially sponsored. Given the high level of industry engagement it is important to manage expectations of both students and sponsors. Students with low GPAs or a poor track record are discouraged from undertaking industry projects in order to avoid sponsor disappointment or damage the University brand in case the student fails to deliver.

6. How well does it work?

Student Perspective

Formal Student Evaluation of Learning and Teaching (SELT) are conducted biennially. In terms of the outcomes from the survey, 90% of students are moderately to extremely satisfied with the course. This is despite what is seen as a heavy workload, with 90% of students assessing the workload of this course as between moderately heavy to very heavy (somewhat higher than for other courses).

Employer Perspective
There is anecdotal evidence that many students gain employment based on their projects. During MechExpo it is common for judges and visitors to encourage students to apply for positions within their organisations. This trend for employment is equally true for students in both industry sponsored as well as non sponsored projects.

Staff from most large engineering and manufacturing companies across the state attend MechExpo, indicative of the quality and effectiveness of the event and the course in general. In addition, companies sponsor the event, reflecting both the interest in and regard with which the projects are held, and which assists in meeting the substantial costs of hosting the event (see Section 8 below).

Media Perspective
The projects and MechExpo attract significant attention from the electronic and print media. In most years it would be expected that several dozen stories appear in local and national newspapers, television news and web-based news. In addition, in recent years two national science shows have filmed several of the projects. The School's blog captures many of such stories: http://blogs.adelaide.edu.au/mecheng/.

Research Perspective
Students are actively encouraged to publish their results in peer reviewed conferences and journals. On average there is one publication for every 4 projects. Although it is mostly the research based projects that result in papers, approximately 10% of the design, build and evaluate projects also result in papers.

7. What problems / issues have arisen?
To mitigate the risk of negative outcomes the following criteria is considered when defining a project:

- Do the supervisors have the skills needed, or are prepared to invest sufficient time, to provide adequate supervision?
- Is the project feasible within the time constraints of the course and the skills of the students?
- Does the project address the learning objectives of course?
- Are there sufficient resources (including funds, space, equipment, workshop and human) to complete the project objectives with minimal risk?
- Have all risks to the project been identified, and should one occur, then the students will not be disadvantaged?
- Does the project address the broader issues associated with the School's strategic plan?
- Do the students have the necessary skills to successfully complete the project?

8. How resource-intensive is it?*:*

Requisite Resources
The course is very resource intensive compared to other courses and rightly so given the nature of the course. Students meet weekly with their supervisor, and although dependent on the size of the group, each student can expect at least half an hour a week of supervisor support. In some projects this is likely to be close to an hour per week spanning 32 weeks. In addition to supervisor support, the School of Mechanical Engineering provides each student with a budget of up to AUD $200 for capital expenditure. Industry or supervisor sponsored projects may have considerably larger budgets, sometimes as much as $100K. Throughout the year students are offered a dozen academic workshops, of between one and two hours each, principally on areas of academic and professional communication, and project planning and management. The School also provides up to 40 man hours of technical workshop (both mechanical and electrical) support per student. Finally the large number of students (in excess of 220 in 2010 and expected to approach 300 by 2013) requires significant infrastructure including space, equipment, purchasing, logistics, occupational health and safety.

Public Seminars
The public seminars span three days in two parallel sessions. The logistics of planning and preparing for this event are similar to hosting a research conference. There are chairs to organise, presentations need to be allocated to streams, timetables to prepare, venue preparation, tea and coffee provisions, a book of abstracts to collate and circulate to the students and public, advertising of the event, and finally assessment by at least four staff for each presentation.

MechExpo
MechExpo is extremely resource intensive. A 4,000m^2 venue offsite is hired to host the event. Booths for the 60+ (in 2010) projects are provided to each group. Transportation of all the exhibits and other resources such as computers and AV equipment, to and from the venue is necessary. A shuttle bus is operated to take the public to and from the University to the venue. Marketing of the event is extensive via print and electronic media, targeting the public and secondary schools, in particular those students in years 9-11 with an interest in science and technology.

9. Details of support material / course work / assessment methods *(Please attach as* separate *files any details that you think would help others considering adopting this approach; e.g. student instructions or the course handbook):*

10. Relevant references and Web sites *(To articles / web sites that describe this approach):*

http://www.mecheng.adelaide.edu.au/students/projects/

http://www.mecheng.adelaide.edu.au/mechexpo/

http://blogs.adelaide.edu.au/mecheng/category/mechexpo/

http://www.mecheng.adelaide.edu.au/industry/projects/

http://www.mecheng.adelaide.edu.au/industry/projects/MechEngSponsorshipBrochure.pdf

Unit summary

Unit Title: Research Project

Unit Code: JEE418 & JEE419

Semester: 1 & 2 **Year** 2014

Pre-Requisites: Completion of all year 3 units or with permission from course coordinator.

JEE418 is a pre-requisite for JEE419

Prior knowledge &/or skills:

Courses: Bachelor of Engineering (Naval Architecture)
Bachelor of Engineering (Ocean Engineering)
Bachelor of Engineering (Marine and Offshore Engineering)

Credit Points: 25

National Centre: Maritime Engineering and Hydrodynamics

Campus: Launceston

Teaching staff

Title	Name	Office	Email	Phone	Consultation Days & Times
Unit Coordinator	Dr Alex Forrest	G60	Alex.Forrest@amc.edu.au	6324 9744	email preferred
Unit Lecturer	Dr Remo Cossu	G70	remo.cossu@utas.edu.au	6324 9724	email preferred
Supervisor	Each student will be allocated a supervisor, who will be the primary point of contact for this unit				to be agreed between supervisor and student

Unit description

This unit is an individual research project conducted over two semesters in the final year. The student conducts a research project in a relevant topic of their choice, and produces a high quality written journal article and project documents. Their work will then be presented to their peers and independent external assessors.

Learning outcomes

On successful completion of this unit, students should be able to:

1. Apply original thinking and develop a research plan to an open ended problem.
2. Develop and research a solution to the given problem by using an experiment, and/or a computer program/simulation, and/or any another methodology approved by the supervisor.
3. Summarize and document the problem, the applied methodology and the conclusions obtained from the developed research plan to professional written and oral standards.
4. Explain, discuss and defend the investigation process and outcome of the Research Project to a group of peers with an oral presentation.

Graduate attributes

BE Degree Outcomes

A. Demonstrate technical knowledge
B. Design for the maritime environment
C. Solve maritime engineering problems
D. Manage, create, use and disseminate information
E. Communicate effectively
F. Work in teams
G. Manage self and others
H. Negotiate the business environment
I. Behave as a professional
J. Consider wider context of engineering knowledge and work

The relevant *BE Degree Attributes* are in the *BE Course Rules* at:

http://www.amc.edu.au/be.course.content.rules

Content

The student can select a topic for consideration following consultation with AMC staff members. Upon agreement with the respective staff members, the student will be assigned to a project supervisor to whom the student will be responsible for the execution of the project. The format and documentation of the final thesis will be in the form of a Journal Article and Project Documents, which are listed in Table 1.

There are no formal classes scheduled for the Project. However, the student is expected to consult with the project supervisor at times mutually agreed upon and attend workshops as organised by the unit coordinator.

The project plan should include a risk assessment which will be addressed in a workshop.

The student will be required to give an oral presentation of the final journal article to an audience consisting of students, staff, technical and non-technical personnel from AMC, industry and the community. Oral presentations should also be to a high professional standard.

Confidential material used in the Research Project has to be specified by the supervisor.

Learning resources required

Requisite texts

For research:

to be advised by supervisor.

For writing:

Robert, D. and Gastel, B., *How to Write and Publish a Scientific Paper*,7th Ed, Cambridge, 2012.

Additional helpful literature sources will be discussed in the workshops or made available online.

Recommended reading

To be advised by supervisor.

E- (electronic) resources

MyLO: Yes

- Electronic submission
- Supplementary lecture notes
- Additional information

Equipment & materials

Materials to be provided by the student

USB and hard-drive.

Experimental work: lab coats, overalls, safety boots or any other project specific equipment as advised by supervisor.

Materials to be provided by AMC:

As advised by supervisor.

Extra costs:

Photocopying and printing costs.

As advised by supervisor.

Computer hardware & software

As advised by supervisor.

Work Health and Safety (WHS)

The University is committed to providing a safe and secure teaching and learning environment. In addition to specific requirements of this unit you should refer to the University's policy at: http://www.utas.edu.au/work-health-safety/

All laboratory work requires students to follow OH&S requirements stipulated for the areas utilised. Students must wear lab coats or overalls and safety shoes for all laboratory sessions.

Details of teaching arrangements

Learning strategies

Self-directed study.

Class times

Not applicable. Students are to meet weekly with supervisors or at times to be mutually agreed. In addition, there will be a group meeting with the Unit Coordinator at the start of each semester, a library introduction session at the start of semester one, and a session on journal article writing and risk assessment. Other workshops will be held throughout both semesters.

Workshop schedule

Class	Day	Time	Location	Group
Workshops	Monday (Date to be advised.)	16:00 ~ 16:50	NH.Communal Centre 131. Lecture Room Or PC room (or specified through e-mail.)	All

Specific attendance/performance requirements

As agreed by the supervisor, students are expected to attend an introductory session on the use of the library for research, and a session on journal article writing. Details of these sessions will be organised by the Unit Coordinator. Students are also expected to attend the rest of the workshops and they will be responsible for the work presented in these sessions.

Specific facility requirements

If any physical experiments are required to be conducted within the Towing Tank/Model Test Basin/Cavitation Tunnel/Flume Tank/AUV Lab/Build Studio/Workshop and/or if there is to be any use of the High Performance Computing Cluster, then students must have the project plan reviewed and approved by the appropriate facility manager(s) or coordinator(s) prior to any facility time being booked. Bookings are made on a first-come, first-served basis, so students are encouraged to complete their project plan as soon as possible. The points of contact (POC) for 4th year Research Project facilities are as follows:

Build Studio/Workshop:	Michael Underhill
Cavitation Research Laboratory:	Bryce Pearce
Computer Cluster:	Jonathan Binns
Flume Tank:	Rowan Frost
Model Test Basin:	Tim Lilienthal
Towing Tank:	Tim Lilienthal
AUV Lab:	Alex Forrest

Assessment

Assessment

Table 1 Assessment Schedule and Deadlines

Assessment Task	Due Date	% Weighting for JEE418/419
Project Plan[1]	On or before 4pm, 7th April 2014 (S1, Week-7, Monday)	-[1]
Interim Report[2]	On or before 4pm, 16th June 2014 (S1, Week-16, Monday)	-[2]
Poster conference[3]	4pm, 29th Aug 2014 (S2, Week-7, Monday)	-[3]
Journal Article Submission	On or before 4pm, 3rd October 2014 (S2, Week-11, Friday)	70%
Executive Summary Submission[4]	On or before 4pm, 3rd October 2014 (S2, Week-11, Friday)	-[4]
Project documentation % Execution	On or before 4pm, 3rd October 2014 (S2, Week-11, Friday)	15%
Oral Presentation	24th October 2014 (S2, Week-14, Friday)	15%

[1] Assessment of the project plan will be included in the overall grade given for JEE418 and is required to have a risk assessment included.

[2] Assessment of the Interim Report will be included in the overall grade given for JEE418

-[3] A poster conference will be held in the second semester (in week 7). The participation for students is voluntary unless mandated by their supervisor. There is no assessment for this session but students are highly encouraged to take this opportunity to enhance their presentation skills and discuss their project with peers and get feedback on their work.

-[4] Assessment of the Executive Summary is included in the Oral Presentation.

Assessment details

General

Throughout their Project students should be in contact with their supervisors to discuss their research and progress.

JEE418 will be assessed by the submission of both the Project Plan and Interim Report and will be graded in an Ungraded Pass or Fail format. JEE419 will be assessed by an oral presentation and the submission of a written Thesis in the form of a Journal Article and Project Documents in addition to a small component for project planning and execution. The final mark for JEE419 will be used for JEE418 when calculating final grades for the year.

Assessment of JEE418

Project Plan

Task Description:	A Project Plan outlining the research project must be developed through consultation with your supervisor(s) and primarily focuses on the aims, scope of work, preliminary literature survey and other aspects to each individual project. In addition, a risk assessment should be included.
Linked to the Unit's learning outcomes:	1 and 3
Assessment criteria/guidelines:	The Project Plan is individually assessed by the supervisor based on the Marking Rubric for the Project Plan with the assessment grade of an Ungraded Pass or Fail. You must obtain an Ungraded Pass to pass JEE418.

Interim Report

Task Description:	Interim Report summarising the research project undertaken in JEE418 must be developed in consultation with your supervisor(s). The aim of producing the Interim Report is to form a fundamental document which will be developed to the Project Documents linked and

	distilled to a quality Journal Article. The report must contain the project evaluation at the stage of submission.
Linked to the Unit's learning outcomes:	1, 2 and 3
Assessment criteria/guidelines:	The report is individually assessed by the supervisor based on the Marking Rubric for the Interim Report with the assessment grade of an Ungraded Pass or Fail. You must obtain an Ungraded Pass to pass JEE418.

Assessment of JEE419

Journal Article

Task Description:	A quality Journal Article addressing the thesis and key findings of the research project must be developed through consultations with the supervisor(s). Guidelines for the journal format will be available online.
Linked to the Unit's learning outcomes:	1, 2 and 3
Task Length:	Maximum 15 pages
Assessment criteria/guidelines:	70% of the unit's marks. The Journal Article is assessed by the supervisor and moderator based on the Marking Rubric for the Journal Article.

Project Documents

Task Description:	The Project Documents summarising the research project undertaken in JEE418 and JEE419 must be developed from the Interim Report in consultation with your supervisor. The aim of producing the Project Documents is to compile all of the key research work and outcomes, and to complement the Journal Articles with detailed and/or additional explanation. E.g. additional results or methodologies not presented in the journal article.
Linked to the Unit's learning outcomes:	1, 2 and 3
Task Length:	There are no set limits here. However, your supervisor must be able to easily archive all of the information you provide.

Assessment criteria/guidelines:	15% of unit's marks. The Project Documents are individually assessed by your supervisor based on the Marking Rubric for the Project Documents

Oral Presentation

Task Description:	An Oral Presentation of the project to students, staff and invited guests will be given as part of a "Thesis conference" on the date given in Table 1. The executive summary submitted is for the invited guests at the Thesis conference.
Linked to the Unit's learning outcomes:	4
Task Length:	Timetable to be finalised, however it is likely you will be given 10-15 minutes to present followed by 10 minutes of questions.
Assessment criteria/guidelines:	15% of the unit's marks. As part of the assessment component 9 given in Table 2, the Executive Summary will be provided to the invited guests and assessed as a component of the oral presentation.

Project Grading

A student's performance in the Project will be assessed for each of the components as shown in Tables 2 and 3 using marking rubrics for JEE418 and JEE419, respectively. For JEE418, all facets of the criteria must be satisfied for awarding the ungraded pass. For JEE419, each component will be allocated the weighting given in Table 3. The marking rubrics will be handed out separately and will be available online.

Table 2 Measures for JEE418

	Description of component	Grade
1.	Project Plan	Pass/Fail
2.	Interim Reports	Pass/Fail

Table 3 Weighting for JEE419

	Description of assessment component	document	Weighting
1.	Quality of presentation of journal article	Journal Article	70%
2.	Student's discussion of relevant theory		
3.	Quality & methodology		
4.	Originality and creativity of thought		
5.	Discussion of works/results/findings		
6.	Conclusions		
7.	Project Documents and Execution		15%
8.	Oral presentation		15%

Late submissions

Delays in the submission will not be accepted without prior notice in writing to the Unit Coordinator. Students requiring such a delay must apply in writing to the Unit Coordinator, stating clearly the justification for such a delay. The application must be accompanied by a statement from the supervisor(s) either supporting, or otherwise, the delay. Available certificates explaining the cause of the delay should be attached to the application.

In general, delays will not be granted without exceptional circumstances beyond the control of the student.

For Projects which are submitted after the due date without prior approval from the Unit Coordinator as described above, marks will be deducted at a rate of 10% of the final mark for each day (including non-working days) beyond the due date. Any submission later than 5 workdays will not be accepted and result in failing the unit.

How your final result is determined

The grade that you receive for this unit will be determined by a committee of examiners. The raw marks that you receive from each piece of assessable material will be combined in order to determine a letter grade for the unit (see Assessment Schedule for percentage weighting).

Upon the successful submission of the Project Plan and Interim Report and the assessment and recommendation by the supervisor, the examination committee will award an ungraded pass

required for the continuation of the research project into JEE419. Any failure to fulfil the requirements will consequently result in failure of the JEE418 Research Project.

The Journal Article will be marked independently by the supervisor and a moderator appointed by the Unit Coordinator. The external assessors' marks will be aggregated to provide the mark for component 8 (oral presentation). If there is any major disagreement between the assessors, the Unit Coordinator can discuss the marks with them, moderate the thesis himself, and/or appoint a further independent person (either from inside or outside AMC) to assist. The Unit Coordinator will then determine the recommended mark based on all assessments conducted which will then be presented to the examiners' committee.

Any project for which the proposed grade is HD will be moderated by the Director of the Centre, who must either confirm the grade, or recommend to the exam committee that a different grade be awarded.

Problems with your assessment

If you have questions or problems with your assessment, you should discuss this with the following people:

(1) Project Supervisor.

(2) Unit Coordinator.

(3) Deputy Director (Students and Education), NCMEH.

(4) Director, NCMEH.

If this does not resolve the issue, you may a file formal appeal. The procedure is given at: http://www.studentcentre.utas.edu.au/examinations_and_results/results/result_review_results.htm

Course rules

More information with regard to content, assessments, grading, etc. is found in the Course Rules Document at: http://www.amc.edu.au/be.course.content.rules

Academic referencing

In your written work you will need to support your ideas by referring to scholarly literature, works of art and/or inventions. It is important that you understand how to correctly refer to the work of others and maintain academic integrity.

Failure to appropriately acknowledge the ideas of others constitutes academic dishonesty (plagiarism), a matter considered by the University of Tasmania as a serious offence.

For information on presentation of assignments, including referencing styles:

http://www.utas.edu.au/library/assist/gpoa/gpoa.html

Please read the following statement on plagiarism. Should you require clarification please see your Unit Coordinator.

Academic misconduct

Academic misconduct includes cheating, plagiarism, allowing another student to copy work for an assignment or an examination and any other conduct by which a student:

a) seeks to gain, for themselves or for any other person, any academic advantage or advancement to which they or that other person are not entitled; or
b) improperly disadvantages any other student.

Students engaging in any form of academic misconduct may be dealt with under the Ordinance of Student Discipline, and this can include imposition of penalties that range from a deduction/cancellation of marks to exclusion from a unit or the University. Details of penalties that can be imposed are available in the Ordinance of Student Discipline – Part 3 Academic Misconduct, see http://www.utas.edu.au/universitycouncil/legislation/

Plagiarism is a form of cheating. It is taking and using someone else's thoughts, writings or inventions and representing them as your own; for example, using an author's words without putting them in quotation marks and citing the source, using an author's ideas without proper acknowledgment and citation, copying another student's work. If you have any doubts about how to refer to the work of others in your assignments, please consult your lecturer or tutor for relevant referencing guidelines, and the academic integrity resources on the web at: http://www.academicintegrity.utas.edu.au/

The intentional copying of someone else's work as one's own is a serious offence punishable by penalties that may range from a fine or deduction/cancellation of marks and, in the most serious of cases, to exclusion from a unit, a course or the University.

The University and any persons authorised by the University may submit your assessable works to a plagiarism checking service, to obtain a report on possible instances of plagiarism. Assessable works may also be included in a reference database. It is a condition of this arrangement that the original author's permission is required before a work within the database can be viewed.

For further information on this statement and general referencing guidelines, see http://www.utas.edu.au/plagiarism/ or follow the link under 'Policy, Procedures and Feedback' on the **Current Students** homepage.

Further information and assistance

If you are experiencing difficulties with your studies or assignments, have personal or life planning issues, disability or illness which may affect your course of study, you are advised to raise these with your lecturer in the first instance.

There is a range of University-wide support services available to you including Teaching & Learning, Student Services, and International Services. Please refer to the ***Current Students*** homepage at: http://www.utas.edu.au/students/

Should you require assistance in accessing the Library visit their website for more information at: http://www.utas.edu.au/library/

If you encounter problems along the way and can't talk to your supervisor about it you should follow the chain of command and seek advice initially from the Unit Coordinator, then the Department Head of Maritime Engineering or finally the Director of National Centre for Maritime Engineering and Hydrodynamics.

JEE419 Research Project - Marking Rubric for Journal Article, 2014							
			High Distinction	**Distinction**	**Credit**	**Pass**	**Fail**
1	**Quality of presentation of journal article (15%)**	Written communication skills in final journal article (5%)	Excellently structured, concise, coherent and easily readable journal article that adheres to the given format & style (including referencing) with an excellent abstract.	Well structured, concise, coherent and easily readable journal article that adheres to the given format & style (including referencing) with a well written abstract.	Well structured, coherent and easily readable journal article that adheres to the given format and style (including referencing) with a good abstract.	Coherent and easily readable journal article that adheres to the given format and style (including referencing).	Poorly structured, difficult to follow journal article that does not adhere to the given format and style (including referencing).
		Grammar and spelling (5%)	Perfect grammar and perfect spelling.	Very small number of incorrect grammar use or trivial spelling mistakes.	Some use of incorrect grammar and/or spelling mistakes.	Satisfactory use of grammar spelling, but there are a number of errors.	Sub-standard grammar and spelling.
		Data presentation (Figures/Tables/ Equations/ Appendices) (5%)	Presented data in a format that enabled easy and clear interpretation because: * the format adheres to excellent engineering practice (professional level) * it is clearly and accurately sorted and labelled * clear, concise and accurate legends and units are used	Presented data in a format that enabled easy interpretation because: * the format adheres to excellent engineering practice * it is clearly and accurately sorted and labelled * clear, concise and accurate legends and units are used	Presented data in a format that enabled interpretation because: * the format adheres to good engineering practice * it is clearly and accurately sorted and labelled * clear and accurate legends and units are used	Presented data in a format that enabled interpretation because: * it is clearly and accurately sorted and labelled * clear and accurate legends and units are used	Data presentation is sub standard due to insufficient labels and/or units not specified and/or legends not clear.
2	**Student's discussion of relevant theory and methods (10%)**	Evaluation and discussion of theory and the limitations and implications (5%)	Demonstrated a level of conceptual understanding that will allow her/him critically to evaluate research, advanced scholarship and methodologies and argue alternative approaches. Can draw the limitation and implication within research work by reflecting theory or hypothesis.	Can critically evaluate relevant theory and methods, reviewing its reliability, validity and significance. Can investigate contradictory information/identify reasons for contradictions.	Can select appropriate techniques of evaluation and can evaluate the relevance and significance of the information collected.	Can evaluate the reliability of information using defined techniques and/or supervisor guidance.	Failed to evaluate the reliability of information using defined techniques and/or supervisor guidance.
		Literature survey (Depth, Diversity and Adequacy) (5%)	Supported the work with extensive and diverse, relevant and current literature in adequate research discipline, link all of the research and development work to relevant theory, methods, techniques and practices.	Supported the work with relevant and current literature in adequate research discipline, link most of research and development work to relevant theory, methods, techniques and practices.	Supported most of the work with relevant literature, link some of research and development work to relevant theory, methods, techniques and practices.	Supported at least half of the work with literature, link some of research and development work to relevant theory, methods, techniques and practices.	Partially link the work to relevant theory, methods, techniques and practices.

JEE419 Research Project - Marking Rubric for Journal Article, 2014							
			High Distinction	**Distinction**	**Credit**	**Pass**	**Fail**
3	**Quality and Methodology (20%)**	Standard of research and development (5%)	Demonstrated professional standard of research and development with high quality methodology and no mistakes. Excellent justification of the methodology. In the presented form the Journal article could be considered for submission to a Engineering or Scientific Journal. (*1)	Demonstrated professional standard of research and development with high quality methodology and no mistakes. Excellent justification of the methodology.	Demonstrated high standard of research and development with high quality methodology with a single lapse in technique. Very good justification of the methodology.	Demonstrated adequate standard of research and development with adequate quality methodology with occasional mistakes in the work. Adequate justification of the methodology.	Does not Demonstrated acceptable standard of research and development with poor methodology and an unacceptable number of mistakes in the technique. Inadequate justification of the methodology.
		Verification and validation (5%)	Demonstrated excellent verification and validation with excellent understanding and correct application in order to evaluate results and findings extensively. In the presented form the Journal article could be considered for submission to a Engineering or Scientific Journal. (*1)	Demonstrated excellent verification and validation with excellent understanding and correct application in order to evaluate results and findings extensively.	Demonstrated good verification and validation with good understanding and application in order to evaluate results and findings.	Demonstrated sufficient verification or validation with moderate understanding and application to check results and findings.	Does not Demonstrated any verification nor validation to check results and findings.
		Quantity of engagement (5%)	Demonstrated outstanding level of engagement.	Demonstrated high level of engagement.	Demonstrated good level of engagement.	Demonstrated acceptable level of engagement.	Demonstrated poor level of engagement.
		Synthesis of Research Work (5%)	Synthesize all relevant elements of the research work with excellent professional standard. In the presented form the Journal article could be considered for submission to a Engineering or Scientific Journal. (*1)	Synthesize all relevant elements of the research work with excellent professional standard.	Synthesize all relevant elements of the research work with good standard.	Synthesize some relevant elements of the research work.	Demonstrated poor level of synthesis of research work.
		(*1) This does not include the AMC Engineering Thesis Journal.					
4	**Originality and creativity of thought (10%)**	Novelty and innovative ideas in research (5%)	Demonstrated excellent and extensive use of novel and innovative ideas in the research with excellent new perspectives of advancement in a field of research.	Demonstrated a high level of novel and innovative ideas in the research.	Demonstrated a good level of original thought (or ideas) in the research.	Demonstrated perfunctory level of original thought (or ideas) in research.	Demonstrated no original thought (or ideas) nor innovative input into the research.
		Student's contribution to originality and creativity of thought in research (5%)	Demonstrated originality, creativity and novelty by exercising initiative and personal responsibility in research practice with little, or no, need for input from supervisor, within agreed guidelines or guidance.	Demonstrated originality, creativity and novelty by acting autonomously, with minimal supervision or direction, within agreed guidelines or guidance.	Demonstrated originality and creativity by acting with increasing autonomy, with reduced need for supervision and direction, within defined guidelines or guidance.	Demonstrated originality and creativity by acting with limited autonomy, under direction or supervision, within defined guidelines or guidance.	No attempt to contribute to originality and creativity of thought in the research.

JEE419 Research Project - Marking Rubric for Journal Article, 2014							
			High Distinction	**Distinction**	**Credit**	**Pass**	**Fail**
5	**Discussion of works/ results/ findings (30%)**	Thoroughness and quality of discussion of work/results/ findings (10%)	Thorough, clear, logical, coherent and articulate discussion of the work, results and findings with excellent professional standard and significant impact in the research.	Thorough, clear, logical and articulate discussion of the work, results and findings with excellent professional standard.	Thorough, clear, logical and articulate discussion of the work, results and findings with good professional standard.	Adequate logic, clarity and articulation in the discussion of the work, results and findings with good standard.	Jumbled, confused and muddled discussion of the work, results and findings. Lack of articulacy and clarity (clearness)
		Interpretation of work (10%)	Demonstrated excellent professional standard in interpretation of works/results/findings with significant impact in the research field.	Demonstrated excellent professional standard in interpretation of works/results/findings.	Demonstrated good professional standard in interpretation of works/results/findings.	Demonstrated adequate level of interpretation of works/results/findings with occasional vagueness present in the discussion of the works/results/findings.	Poor interpretation and vague discussion of works/results/findings.
		Implication of works in research (assumptions, limitations, outcomes, etc.) (10%)	Demonstrated an in-depth understanding of, and effectively convey, the implications of the work, which reflects on significant impact in the research field.	Demonstrated an in-depth understanding of, and effectively convey, the implications of the work.	Demonstrated a clear understanding of, and effectively convey, the implications of the work.	Adequate understanding of the implication of works of the work with only minor misinterpretation.	Clearly does not understand the implications of the work - assumptions, limitations, outcomes etc.
6	**Conclusions (15%)**	Summary of the research (7.5%)	Excellent professional standard of summarising the work. Clear, concise, insightful, well-constructed summary of the work with thoughtful and incisive comments on project outcome with significant impact in the research filed. No new material introduced in the conclusion.	Professional standard of summarising the work. Concise, insightful, well-constructed summary of the work with thoughtful and incisive comments on project outcome. No new material introduced in the conclusion.	Good standard of summarising the work. Concise, insightful, well-constructed summary of the work with thoughtful comments on project outcome. No new material introduced in the conclusion.	Adequate standard of summarising the work. Perfunctory summary of the work with some lack of logic and insight. Perfunctory comments on project outcome. No new material introduced in the conclusion.	Inadequate conclusions which lack logic, clear thought and insight. Insufficient understanding of the project outcome.
		Summary of implications of research (assumptions, limitations, outcomes, etc.) (7.5%)	Demonstrated exceptional understanding of the implications of the work with excellent suggestions/ideas for future work	Demonstrated a high level of understanding of the implications of the work. Good suggestions/ideas for future work.	Demonstrated a clear understanding of the implications of the work. Good suggestions for further work that are mainly linked to the existing project.	Demonstrated an understanding of the implications of the work with only minor misinterpretations. Some suggestions for future work which are mainly linked to the existing project.	Clearly did not understand the implications of the work. Suggestions for further work are poor and not linked to the existing project or no suggestions for further work are given.

7.2 Appendix B Capstone Assessment Form

Overview

Table 1 below shows 21 indicators adopted from the *Engineers Australia Australian Engineering Stage 1 Competency Standards.*

The Competency Standards are divided into three **Units**: (PE1) Knowledge Base, (PE2) Engineering Ability, and (PE3) Professional Attributes. Each Unit has **Indicators** numbered PE1.1, PE1.2, PE1.3 etc.

In Capstone Project, you are required to identify a subset of Indicators that will assist you to focus the development of your project proposal, as well as be applied in the assessment of your completed project. This includes choosing a number of indicators from each unit.

For example,

1. (PE1) Knowledge Base, choose 3 out of the 5 Indicators
2. (PE2) Engineering Ability, choose 5 out of the 11 Indicators
3. (PE3) Professional Attributes choose 3 out of the 6 Indicators

It is the responsibility of each student to decide which indicators they wish to consider/address, however, you may wish to consult your supervisor. You should identify your chosen indicators by putting an **[X]** in table 1.

In this way, your project focus areas and the assessment of them will most likely be a unique combination of indicators; as unique as your capstone project.

The nature of a project is such that changes occur; perhaps subtle changes in intended outcomes or methodologies. To accommodate these variations, you may change your choice options to better reflect the project pathway you intend to pursue. However, **your final set of assessment indicators must be finalised by week 12 of the semester in which you complete your project**.

Instructions for using Table 1 in preparing your Proposal

Read through all of the indicators listed in Table 1 – determine your choice indicators by considering carefully how you believe you will be able to deliver/demonstrate this competency by the end of your project.

Use the *Appendix B Assessment Template* provided to list each of the indicators in the first column. In developing your proposal, identify the tasks and activities you will undertake as part of your project work which will address each of the indicators. Your supervisor may be able to assist you to align your strengths/skills/attributes and your project aspirations to indicators.

Agree on a final subset of indicators, and include these in your Proposal documentation. You should also complete a self-evaluation of the applicability of each indicator to your project. That is – can you identify/predict before the project begins how/where particular indicators will be applicable. **Use a simple scale – such as '0' for not applicable (obviously there should be <u>none</u> which you choose that are not applicable) up to a '5' for indicators which you consider will be critical in your project work.**

Table 1: Indicators adopted from
Engineers Australia Australian Engineering Stage 1 Competency Standards.

It is recommended that you use this form to assess your capstone project against all 21 indicators. Use the results of this initial assessment to choose 3 indicators from PE1, 5 indicators from PE2 and 3 indicators from PE3.

	PE1	**KNOWLEDGE BASE**	**Chosen Criteria**
Choose 3 indicators from PE1	PE1.1	Demonstrated use of sound knowledge of mathematics, physical, life and /or information sciences to analyse and solve technically challenging engineering problems	[ ]
	PE1.2	Advanced knowledge in a technical area in the student's engineering discipline to a level that engages with current developments in technical and professional practice.	[ ]
	PE1.3	Demonstrated ability to develop mathematical and/or physical models to use for analysis and design	[ ]
	PE1.4	Demonstrated ability to work from first principles in tackling a technically challenging problem	[ ]
	PE1.5	Demonstrated knowledge of materials and resources relevant to a student's discipline and the ability to select the most appropriate materials and techniques to meet a particular objective.	[ ]

	PE2	**ENGINEERING ABILITY**	**Chosen Criteria**
Choose 5 indicators from PE2	PE2.1	Demonstrated ability to identify the nature of a technical problem, make appropriate simplifying assumptions, achieve a solution, and quantify the significance of the assumptions to the reliability of the solution	[ ]
	PE2.2	Demonstrated ability to investigate a situation or the behaviour of a system and ascertain the relevant causes and effects	[ ]
	PE2.3	Demonstrated ability to address issues and problems that have no obvious solution, involving uncertainty, imprecise information, conflicting factors and require originality in analysis	[ ]
	PE2.4	Demonstrated appreciation of the interactions between technical systems, safety sustainability and the social, cultural, environmental, economic and political context in which they operate, and the relationships between these factors.	[ ]
	PE2.5	Demonstrated ability comprehend, analyse and quantify the nature of risk, both of a technical kind and in relation to clients, users, the community and the environment and devise strategies for managing this risk	[ ]
	PE2.6	Demonstrated ability to utilise a systems-engineering or equivalent disciplined, holistic approach to incorporate all considerations	[ ]
	PE2.7	Demonstrated ability to partition a problem, process or system into manageable elements, for purposes of analysis or design; and of re-combining these to form the whole, with the integrity and performance of the overall system as the paramount consideration	[ ]
	PE2.8	Demonstrated ability to conceptualise and define possible alternative engineering approaches and evaluate their advantages and disadvantages in terms of functionality, cost, sustainability and all other factors to deliver an optimal approach and defend the selection.	[ ]
	PE2.9	Understanding of the need to incorporate cost considerations throughout the design and execution of a project and to manage within realistic constraints of time and budget.	[ ]
	PE2.10	Demonstrated ability to consider the commercial, financial, and marketing aspects of an engineering project	[ ]
	PE2.11	Demonstrated proficiency in employing technical knowledge, design methodology, and appropriate tools and resources to design components, systems or processes to meet specified performance criteria	[ ]

	PE3	PROFESSIONAL ATTRIBUTES	Chosen Criteria
Choose 3 indicators from PE3	PE3.1	Demonstrated effectiveness in discussion and negotiation and in presenting arguments clearly and concisely in both oral and written communication (including clear diagrams and engineering sketches or drawings)	[ ]
	PE3.2	Demonstrated ability to locate, catalogue and use relevant information , including proficiency in accessing , systematically searching, analysing and evaluating relevant publications	[ ]
	PE3.3	Demonstrated ability to apply creative approaches to identify and develop alternative concepts and procedures and identify opportunities for improvement.	[ ]
	PE3.4	Demonstrated intellectual rigour and an ability to recognise limits to ones knowledge and seek advice, or undertake research, to supplement it	[ ]
	PE3.5	Demonstrated awareness of legislation, statutory requirements standards and codes of practice relevant to your project	[ ]

Instructions for using Table 2 in preparing your Progress Report and Final Assessment

Once you have finalised your indicators for either your progress report assessment or final project assessment, you will need to use Table 2 '*Descriptors for Assessing Indicators*' listed below to complete a self assessment of your work. The descriptors applied here are identical to the descriptors for (H)igh Distinction, (D)istinction, (C)redit, (P)ass, and (Z) Fail grades awarded in UTS subjects – so they should be well known to you, and your supervisor.

Table 2: Descriptors for assessing indicators – based on descriptions for UTS grades of H, D, C, P, Z

Indicator Score	Descriptors for UTS grades
5	Work of *outstanding quality* as for 4, but superior – at a standard worthy of publication
4	Work is of *superior quality*, including a capacity to demonstrate a competency/indicator at a level well above what is expected from late stage UG coursework; demonstrates learning at a superior level
3	Work is of *good quality* demonstration of a competency / indicator at a level higher than what is expected from late stage UG coursework AND presents a clear rationale / critique / discussion for the appropriateness / validity of the technique or tool or methodology used / applied
2	Work is *satisfactory* demonstration of a competency / indicator at a level equivalent to what is expected from a late stage UG coursework. Note, in capstone projects – we should have expectations that students are delivering at a level greater than 2 out of 5!
1	Work is *less than satisfactory* demonstration not sufficient to demonstrate competency / indicator at level expected from late stage UG coursework material, or perhaps satisfactory demonstration of only early stage foundation level engineering science material
0	This Indicator is not applicable to or not demonstrated in the capstone

Instructions for using Table 3 and Table 4 in preparing the Final Assessment

Table 3 lists evaluation criteria which considers the overall (holistic) aspects of the project rather than specific components assessed by the indicators. Your supervisor/assessor will use this, as well as Table 4 in determining your overall recommended project mark/grade. Again, table 2 '*Descriptors for Assessing Indicators*' listed above are used to score each evaluation question out of 5.

Table 4 provides a guide showing how assessment (out of 5) of your chosen indicators (from Table 1) are combined with the overall evaluation (Table 3) to provide a recommended grade for your project. You supervisor and/or assessor will use Table 4 to confirm a final mark/grade for your project.

Table 3: Overall Project Evaluation Criteria

	Evaluation question	Supervisor/ Assessor evaluation
Content	Does the candidate clearly identify a question to be answered or problem to be solved?	0 1 2 3 4 5
	Does the candidate present the results of the project in a succinct and cogent form, with suitable illustration where appropriate?	0 1 2 3 4 5
	Does the candidate demonstrate significant engineering judgement at a level that would be reasonably expected from a recent engineering graduate?	0 1 2 3 4 5
	Is the content sufficiently substantial and broad ranging to allow coverage of the chosen assessment indicators?	0 1 2 3 4 5
	Does the report contain sufficient material suitable for publication? **H (5):** Peer Reviewed Conference Paper **D (4):** Editor Reviewed Conference Paper (IEEE standard) **C (3):** Engineering Paper / Seminar for graduate audience **P (2):** Engineering application note (provide graduate engineers to help them to learn about / gain an appreciation of subject material.	0 1 2 3 4 5
Knowledge / Ability	Does the candidate exhibit sufficient knowledge of the research topic and familiarity with the discipline it embraces for a final report at this level?	0 1 2 3 4 5
	Does the candidate demonstrate a capacity for clear thinking?	0 1 2 3 4 5
	Does the candidate demonstrate significant techniques of analysis and/or evaluation as outlined in the chosen assessment indicators?	0 1 2 3 4 5
	Has the candidate demonstrated an understanding of project management techniques and applied them effectively in their capstone project.	0 1 2 3 4 5
	Has the candidate demonstrated an ability to manage their own time and processes effectively, prioritising competing demands to achieve the required goals and objectives	0 1 2 3 4 5
Presentation	Does the work represent a well planned approach to the subject matter?	0 1 2 3 4 5
	Is the report structured appropriately?	0 1 2 3 4 5
	Does the candidate appropriately orient the reader to the ground to be covered and the arguments made?	0 1 2 3 4 5
	Is the presentation of the report, in matters of grammar, spelling, punctuation and general appearance, adequate?	0 1 2 3 4 5

Table 4: Combining assessment and evaluation criteria to recommend a mark/grade.

Chosen assessment indicators requirement		**Overall evaluation criteria requirements**	**Final Mark/Grade**
A total of: **3 × 5's in PE1** Knowledge Base, and **5 × 5's in PE2** Engineering Ability, and **3 × 5's in PE3** Professional Attributes	**AND**	Work demonstrating **outstanding quality in ALL** Evaluation Questions (ie: 5's in all questions in Table 3)	High Distinction [85, 90, 100]
At least: **1 × 5's in PE1** Knowledge Base, and **1 × 5's in PE2** Engineering Ability, and **1 × 5's in PE3** Professional Attributes, and the **remaining indicators should be 4's**	**AND**	Work demonstrating **superior quality in ALL** Evaluation Questions (ie: 4's or 5's in all questions in Table 3)	Distinction [75, 80]
4's in at least 7 of the 11 chosen indicators	**AND**	work demonstrating good quality showing **more than satisfactory achievement in ALL** evaluation criteria (ie: 4's in at least 8 of the 14 questions in Table 3)	Credit [65,70]
At least 3's in ALL chosen indicators	**AND**	work demonstrating **satisfactory achievement in ALL** evaluation criteria (ie: at least 3's in all questions in Table 3)	Pass [50, 55, 60]
2's in any of the chosen indicators	**OR**	work **demonstrating unsatisfactory achievement in ONE or more** of the evaluation criteria (ie. 2's in any of the questions in Table 3)	Fail [less than 50]

Attach this completed form to your blue or green or gold form

UTS:Engineering

Appendix B: Capstone Assessment Form

FACULTY COPY

Project Number:		Supervisor:	
Student Name		Project Title	
Student No.		Major (eg. civil eng)	
Subject No.	48006 / 48016 / 48012 / 48026	External supervisor:	

Preparing your Assessment Form

Proposal: Use this template to prepare your indicator assessment form. You should download this template and cut and paste the relevant indicator descriptions into the table. You should use a different font or italics to highlight this text. On a new line, add sufficient detail to as needed; **no more than 50 words per indicator**. In preparing to undertake your project**, identify how or where or when this indicator is applicable to the project work you will undertake, include cross-references to relevant sections and/or page numbers in your proposal.** Use a simple scale – such as '0' for not applicable (obviously there should be none which you choose that are not applicable) up to a '5' for indicators which you consider will be critical in your project work Next, use self-assess the extent to which you believe the indicator is applicable to your project.

You should then **print a copy, complete the details on the cover page and staple it to your Proposal assessment form**. This form will be used to facilitate feedback with your supervisor and assess your project proposal – this will give you confidence that what you intend to undertake is achievable. Your supervisor will also offer their evaluation for the indicators you have chosen.

Progress Report and Final Assessment: Use this template to document your assessment indicators. As above, you should download this template and use a different font to highlight the relevant indicator. On a new line, add sufficient detail to the softcopy as needed; **no more than 50 words per indicator.** In undertaking your project to-date, **identify exactly how or where or when you have delivered/demonstrated this indicator. Be clear and specific; include cross-references to relevant sections and/or page numbers in your report, quote actions/activity that you undertook and when.** Use Table 2 *Descriptors for assessing indicators* in Appendix B to self-assess the extent to which you believe you have been able to deliver/demonstrate each indicator.

You should then **print a copy, complete the details on the cover page and staple it to your Progress assessment form, or your Final Report assessment form**. The form will be used as feedback/review of your progress report or as a component of your final capstone project assessment.

You will have an opportunity to review your supervisor's assessment of your progress report. Typically, you will not have an opportunity to review your supervisor's assessment of your final capstone project report.

Student Self–Assessment Summary

Write your self-assessment (a score out of 55 as there are 11 indicators worth 5 each)

Student signature Date

Supervisor / Assessor Assessment Summary

Write your self-assessment (a score out of 55 as there are 11 indicators worth 5 each)

Supervisor signature Date

Assessor signature Date

Capstone Project Assessment Template

Which of the following applies (circle as appropriate): Proposal Assessment Progress Assessment Final Assessment			
Indicator	**Proposal Assessment**: In preparing to undertake your project, identify how or where or when this (choice) indicator is applicable to the project work you will undertake. **Progress Report and Final Capstone Project Assessment**: In undertaking your project, identify how or where or when you have delivered/demonstrated this (choice) indicator	self assessment (out of 5) based on descriptors in table 2	supervisor and assessors assessment (out of 5) based on descriptors in table 2
PE1._		0 1 2 3 4 5	0 1 2 3 4 5
PE1. _		0 1 2 3 4 5	0 1 2 3 4 5
PE1. _		0 1 2 3 4 5	0 1 2 3 4 5
PE2. _		0 1 2 3 4 5	0 1 2 3 4 5
PE2. _		0 1 2 3 4 5	0 1 2 3 4 5
PE2. _		0 1 2 3 4 5	0 1 2 3 4 5
PE2. _		0 1 2 3 4 5	0 1 2 3 4 5
PE2. _		0 1 2 3 4 5	0 1 2 3 4 5
PE3. _		0 1 2 3 4 5	0 1 2 3 4 5
PE3. _		0 1 2 3 4 5	0 1 2 3 4 5
PE3. _		0 1 2 3 4 5	0 1 2 3 4 5
	total (out of 55)		

Additional assessment comments:

Example: Extract from Appendix B for a proposal submission.

This has been highlighted to make it clear this appendix B is read in the context of a project proposal.

Capstone Project Assessment Template

Which of the following applies (circle as appropriate):

Proposal Assessment ~~Progress Report Assessment~~ ~~Final Assessment~~

Indicator	**Proposal Assessment**: In preparing to undertake your project, identify how or where or when this (choice) indicator is applicable to the project work you will undertake. **Progress Report and Final Capstone Project Assessment**: In undertaking your project, identify how or where or when you have delivered/demonstrated this (choice) indicator	self assessment (out of 5) based on descriptors in ta	supervisor and assessors assessment (out of 5) based on
PE1.3	*Demonstrated ability to develop mathematical and/or physical models to use for analysis and design* The inverted pendulum control system will be modelled to produce a control system block diagram including values for system parameters. This mathematical model will then be used to develop a digital feedback control system capable of maintaining the 'pendulum' in the vertical position.	4	0 1 2 3 4 5
PE2.6	*Demonstrated ability to utilise a systems-engineering or equivalent disciplined, holistic approach to incorporate all considerations* In preparation for the experimental investigation: a draft specification based on discussions during previous semester with supervisor will be further developed; a design considering cost and component availability constraints will be provided to the workshop for manufacture; electronics systems and sensors implemented; DAQ system and digital controller interface operation verified.	4	0 1 2 3 4 5
PE2.9	*Understanding of the need to incorporate cost considerations throughout the design and execution of a project and to manage within realistic constraints of time and budget.* A preliminary budget has been approved – to be finalised as quotes for major expense items are provided. The majority of small components are available ex-stock. Issue with supplier of PCB motors – may need further discussion and decision regarding long-term supply/availability of replacement parts. Need to schedule workshop activities ASAP – lead-time presently 3-4 weeks.	3	0 1 2 3 4 5

The description of indicator PE1.3 has been included and highlighted in italics

For the proposal, around 50 words outlining how or where or when the student believes/plans to address this indicator.

For the progress report and final report, the student needs to cross-reference sections of the reports to demonstrate clearly where this indicator is addressed.

This is the student's self-evaluation of this indicator. In the proposal stage it is used as a measure of the applicability or the perceived importance or amount of work this indicator may have over the duration of the project.

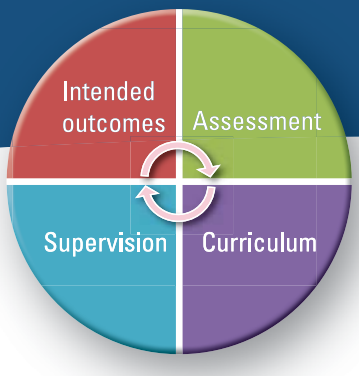
For the progress report and final report, this self assessment should be based on the description in Table 2.

An Office for Learning and Teaching Project

A²E² ANNUAL CONFERENCE
8 – 11 DECEMBER 2013

WORKSHOP SESSION 2E
10 DECEMER 3.30 – 5 PM

DEVELOPMENT OF LEARNING AND TEACHING STANDARDS OF FINAL YEAR ENGINEERING PROJECTS (FYEPs)



UTS UNIVERSITY OF TECHNOLOGY, SYDNEY

Curtin University

RMIT UNIVERSITY

THE UNIVERSITY of ADELAIDE

DEAKIN UNIVERSITY AUSTRALIA Worldly

UTAS

CQUniversity AUSTRALIA

THE PROJECT

The FYEP is the culminating learning experience of engineering programs. It requires students to demonstrate that they can integrate knowledge, skills and professional graduate attributes developed during the program and perform at a standard expected of graduates. National and international engineering accreditation guidelines require engineering programs to show that students are capable of managing projects of substance.

Current requirements – meeting AQF8 (Australian Qualifications Framework) research capabilities and satisfying Threshold Learning Outcomes to be used by TEQSA (Tertiary Education Quality Standards Agency) – places new pressure on final year project courses to have valid and reliable assessment practices.

This project is a partnership between seven Australian universities. It seeks to map assessment and supervision practice in Australian universities and to provide a set of guidelines and tools to ensure AQF8 outcomes and national consistency.

One third of Australian universities have contributed to the project's data set. These contributions have led to deeper understandings about assessment, curriculum, supervision and intended outcomes, including understanding of AQF8.

WHAT WE KNOW SO FAR

The final year project or capstone project course in engineering degrees is valued as a unique, integrating and authentic project experience that enables students to demonstrate and consolidate what they have learnt throughout their degree.

- Projects entail a combination of technical and professional skills, knowledge and application.
- There is great variation across universities in Australia in terms of how Final Year Projects are defined, assessed and linked to intended outcomes.
- There is some consistency in how students prepare for and select projects and some confidence in the rigour of the projects.
- Universities are thinking (and worried) about AQF8 and how it might affect their projects and Honours stream students.

HOW TO GET INVOLVED

Attend our workshop at the A²E² Annual Conference (Session 2E, 10 December, 3.30 – 5 pm)

8 – 11 December 2013
Gold Coast, Queensland.

Look for details in the conference program.

www.engineersaustralia.org.au//australasian-association-engineering-education/2013-annual-conference

CONTACT THE PROJECT LEAD:

Associate Professor Mohammad Rasul
School of Engineering and Technology
CQUniversity Australia

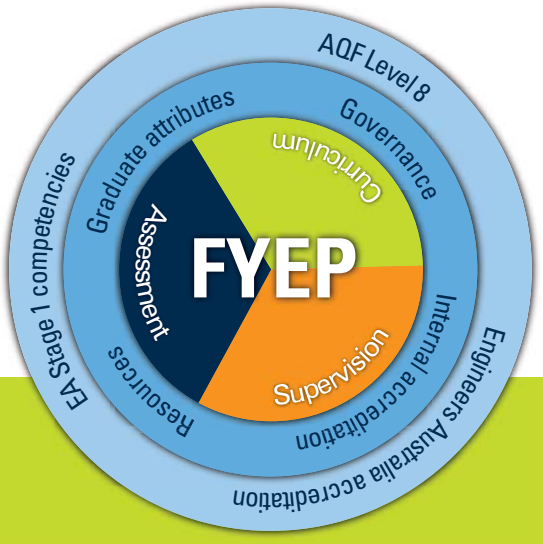
Phone: 07 4930 9676 or 0402 431 669
m.rasul@cqu.edu.au

CRICOS Provider Codes: Qld 00219C, NSW 01315F, Vic 01624D

jn13-696

AN OFFICE FOR LEARNING AND TEACHING PROJECT

GOOD PRACTICE GUIDELINES FOR CURRICULUM, SUPERVISION AND ASSESSMENT OF FINAL YEAR ENGINEERING PROJECTS: ENSURING AQF8 OUTCOMES.



A²E² Annual Conference
8 – 11 December 2014
Workshop Session 6E
Tuesday, 9 December 3.30 – 5 pm

THE PROJECT

This OLT project has mapped assessment, curriculum and supervision practices in Final Year Engineering Projects. It gathered documentary and interview data from 16 institutions from all states and territories in Australia. The team presented draft guidelines at a series of national dissemination workshops where over 100 participants from 26 universities took part. Their feedback informed this final iteration of guidelines. The team has also developed a set of exemplar practices to accompany the guidelines.

THE GUIDELINES

Universities in Australia and New Zealand are moving towards meeting national qualification framework requirements. The guidelines are designed to assist final year project subject coordinators in meeting curriculum, supervision and assessment requirements to AQF level 8.

The guidelines are founded on strong and current educational theory and focus specifically on the points of difference between AQF level 7 and 8. They are instructional, practical and supported by exemplar practices from across Australia.

The guidelines acknowledge that AQF8 can be demonstrated throughout a program of study, but suggest that the FYEP is an ideal place to assess AQF8 because it is a culminating, synthesising experience for students.

GUIDELINES

General notes	Curriculum	Advisor	Assessment
	Learning outcomes must be clearly articulated, explicitly assessed, demonstrable and reflect AQF level 8 (and EA Stage 1 Competencies). • Consider where the target (bold) skills in AQF8 are being taught in your course/program. • Identify which AQF8 descriptors you expect your course/program to have demonstrated in FYEP. • Ensure both professional and technical outcomes are included (though technical outcomes will vary for individual students). • Support the skills, knowledge and application of skills and knowledge expected in the FYEP subject prior to as well as within the subject. This might include project management and research methodologies. • Provide exemplar annotated projects for student use. • Require students to write regularly and frequently in preparation for final report/thesis/ journal paper writing. The guidelines below specify what might be included in a unit overview/subject outline as well as the activity to be implemented by whoever might be teaching the subject.	Primarily good mentoring of student projects is about strong interpersonal skills. Strong interpersonal skills will also enable you to facilitate projects that are outside your area of expertise. • If you want to improve your advisory skills then further develop your interpersonal skills, not technical skills • Familiarise yourself with whole of course curriculum to gauge student prior knowledge and skill • Ensure that you monitor and document student progress throughout all phases of the project • Read, review and comment on clarity of communication (e.g. reflective writing, draft submissions) • Scaffold student learning rather than provide answers • Organise group project meetings and consider enabling meetings between groups/individuals In those institutions where you are both advisor and assessor, you will also need to look at assessment guidelines.	Assessment practices must reflect general principles of validity, equity and rigour. There should be a tight focus on the features of the project that separate it from previously demonstrated coursework. • Develop criteria (tools/methodology/ moderation) in rubrics or standards statements (and this might be in conjunction with students) that address each of the AQF outcomes • Provide formative assessment that is focused on enhancing student learning and reflection • Look for clear and coherent written exposition of knowledge • Look for evidence of learning in both process and product or artefact • Provide regular opportunities to assess project progression and milestones – consider outcomes and process with appropriate weightings • Actively involve students in self and peer assessment throughout all phases of the project and encourage students to write and reflect regularly In those institutions where you are both assessor and advisor, you will also need to look at advisor guidelines.
AQF8 learning outcome descriptors	**Curriculum** Teaching/learning activities that support student opportunity to reach AQF8 might include:	**Advisor** Advisor action that supports AQF8 might include:	**Assessment** Assessment activity that support student opportunity to demonstrate AQF8 might include
1. Graduates will have cognitive skills to review, analyse, consolidate and synthesise knowledge to identify and provide solutions to complex problems with intellectual independence	• Include scoping statements in unit outline that articulate boundaries of complexity – provide examples of projects that are 'too thick' or 'too thin' • Allow for complexity to apply to process and not just deliverables • Reduce the risk that students complete a simple project done well or a difficult project done poorly • Support students' production of proposals, final reports/journal papers, posters etc. by modelling, jointly constructing, annotating examples of these • Provide extensive formative feedback on individual or group proposals	• Ask open ended questions that challenge the student to consider project complexity, establish stakeholder needs, define context and determine the nature of the problem rather than rush to solutions • Maintain scaffolding of learning but also enable student to take increased control of the project and to do the work themselves • Provide critical feedback so that the student works towards greater complexity and intellectual independence • Where students are engaged in group projects, ensure there is a means for determining individual student contribution. This might be in written submission or oral defence.	• Look for complexity as defined by AQF in the project question, scope of works and outcomes. • Provide feedback so that the project topic and scope affords the opportunity for the student to demonstrate complexity and intellectual independence in the project itself • Look for independence as evidenced by individual capacity to articulate their contribution to the project and their understanding of the project complexity. This might be in written or oral form
2. Graduates will have cognitive and technical skills to demonstrate a broad understanding of a body of knowledge and theoretical concepts with advanced understanding in some areas	• Facilitate group discussion that explores theoretical concepts • Require library resource activities • Facilitate discussions with external bodies and other experts	• Direct students to a range of sources within the body of knowledge • Direct students how to engage in and articulate engineering activity (e.g. calculations, modelling, designs) • Ask open ended questions that probe concepts and advanced understanding	• Look for student development and testing of theoretical concepts • Look for breadth and diversity of sources (not just a literature review but also industry IP, interviews with stakeholders etc.)
3. Graduates will have cognitive skills to exercise critical thinking and judgement in developing new understanding	Include requirement for clearly articulating the local known, probably early in the project (e.g. literature review but not annotated bibliography) Provide opportunity for students to demonstrate their contribution to the local known (articulating the gap in the local known) Encourage students to argue the logic of how their contribution addresses the gap	Enable students to articulate their understanding of the local known compared with their contribution Scaffold and monitor student work – reduce risk student work is less than AQF8 or well beyond AQF8 Discourage students' simply describing what they have done	Look for synthesis in the literature review – links between and across sources – not sequential description Ask if the project shows new understanding – how is it differentiated from previous work in the field and from previous coursework? Look for creative contribution.

Curtin University

UTS UNIVERSITY OF TECHNOLOGY, SYDNEY

CQUniversity AUSTRALIA

DEAKIN UNIVERSITY AUSTRALIA Worldly

RMIT UNIVERSITY

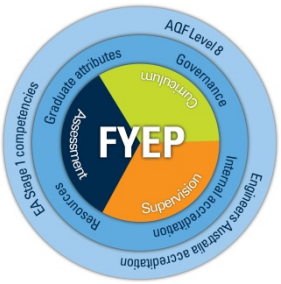
THE UNIVERSITY of ADELAIDE

UTAS

BE WHAT YOU WANT TO BE

CRICOS Provider Code: 00219C FL140609

Workshop Evaluation



Thank you for attending the Final Year Engineering Project workshop in Wellington. We would appreciate it if you take the time to evaluate the workshop by answering the following questions. Your feedback will assist the Project Team to maximise dissemination and feed into the official evaluation of the OLT project.

For the following questions please indicate your preference by selecting one of the following statements: Strongly Disagree; Disagree; Neutral/Undecided; Agree; Strongly Agree.

Question	Strongly Disagree	Disagree	Neutral/ Undecided	Agree	Strongly Agree
1. The workshop helped me think effectively about the way FYEP is delivered in my institution.					
2. The workshop helped me think about the way I personally work with students doing FYEP.					
3. The workshop allowed me to articulate the implications for me of AQF8 requirements.					
4. The workshop gave me the chance to see how other people and places handle FYEP.					
5. I can see how at least some of the guidelines may be used in my institution.					
6. The car analogy worked well for me.					
7. I am interested in reading more of the guidelines.					
8. The project team did a good job of facilitating the workshop.					

Other feedback

What aspects of the workshop did you find most interesting? .....
.....

What aspects of the workshop did you least enjoy? .....
.....

What was the most important issue raised by the workshop, in your opinion? .....
.....

Any other comments? .....
.....

Thank you for providing feedback.

Follow-up interview

It would be helpful for our external evaluator, Dr Lesley Jolly, to chat to you briefly to discuss your experience at this workshop. If you are willing to take part in a 15-minute phone interview, please list your details below. Alternatively you can contact Lesley direct at ljolly@bigpond.net.au

Name	Contact Details

Assessing Final Year Engineering Projects – Final Evaluation Report

January 2015

Dr Lesley Jolly
Strategic Partnerships

Assessing Final Year Engineering Projects – Final Evaluation Report

January 2015

This is the final report of the evaluation of the OLT-funded project *Assessing Final Year Engineering Projects (FYEPs): Ensuring Learning and Teaching Standards and AQF8 Outcomes*. OLT describes the evaluator role as: "*a sounding board for the team, asking questions that will enable greater clarity and precision to be attached to planned processes and outcomes*". In this case the evaluator has been asked by the team to

- Establish an evaluation framework, including internal and external processes
- Establish a dissemination strategy, and
- Agree on an iterative, formative self-evaluation process by the team.

In the event, the evaluator had the opportunity to work closely with the most active project members and provide "critical friend" input throughout. This has made the task of final evaluation much easier. This report deals in detail with the response of the engineering education community to the work of the project, which has been very positive.

Year One Evaluation

Discussion amongst the team in the early part of the project refined the objectives of the project thus:

1. [Develop] a good practice guideline for design and assessment of FYEPs based on the Threshold Learning Outcomes for Engineering;
2. [Develop] a clear definition of how FYEPs address the requirements of AQF8 standards, particularly in the key area of research skills;
3. Benchmark assessment practices with some consideration of the rationales and barriers to implementation encountered in a range of contexts.

Gradually the team realized, on the basis of literature review and the accounts of participants, that there were three key areas affecting the ability of final-year projects to meet AQF8 standards; curriculum, assessment and supervision. The first year of the project was spent largely in collecting evidence of current practice and attitudes from around Australia. Since the project team was large, it was possible to split into working teams focused on each of the key areas with the bulk of the co-ordination carried out over both years by Dr Rob Jarman and Ms Justine Lawson. The first year also saw the articulation of an evaluation plan, as follows.

Evaluation Plan

The original proposal outlined the tasks for the evaluator as:

- Establish an evaluation framework, including an internal and external processes
- Establish a dissemination strategy, and
- Agree on an iterative, formative self-evaluation process by the team.

It was agreed that formative evaluation would be accomplished through the evaluator's ongoing participation in team meetings.

The evaluation plan was based on a program logic approach and a stakeholder analysis was undertaken to consider what measures of success would be relevant to all major stakeholders.

The program logic approach

The following Intended Program Logic was developed in consultation with and observation of the team.

INPUTS	ACTIVITIES	OUTPUTS	OUTCOMES	IMPACTS
Project manager Researcher/s Staff time (workshops & writing) Travel costs Published literature Existing course outlines and associated documentation	Background research Data gathering interviews Analysis of interviews Analysis of documents Team meetings Dissemination workshop (AaeE 2013 and 2014) Dissemination workshop other institutions	Lit review for paper writing Numbers and identities involved in workshops/development Continual refinement of focus and understanding- direction and content Numbers and identities of people interviewed How many, where, what submissions	Development of common vocabulary and understanding of scope Best practice review of Final Year projects and how they serve AQF8 outcomes Development of scaffold of guidelines for use of the best-practice model	Wider discussion of how to attain targeted AQF8 outcomes using final year projects. Discussion on how well assessment practices demonstrate attainment of AQF8 outcomes. Changing practices in final year project courses.

The following monitoring plan was therefore proposed for ongoing assessment of the progress of the project.

Monitoring Matrix

FOCUS	PERFORMANCE INDICATORS	DATA SOURCES	DATA COLLECTION METHODS	RESPONSIBILITY FOR COLLECTION	TIME FRAME
Objective 1 [Develop] a good practice guideline for design and assessment of FYEPs based on the Threshold Learning Outcomes for Engineering);					
Outcomes Development of scaffold of guidelines for use of the best-practice model	Evidence-based guidelines, clear and concise, relevant to academic contexts	Team discussions Participating academics	Observation Interviews	Evaluator informed by comments of project team	By Sem 2 2014
Outputs Analysis of documents	Good selection of documents from different approaches to project courses	Courses around the country	Personal approaches to course organisers	Project team	Sem 2 2013
Objective 2 Clear definition of how FYEPs address the requirements of AQF8 standards, particularly in the key area of research skills;					
Outcomes Development of common vocabulary and understanding of scope Best practice review of Final Year projects and how they serve AQF8 outcomes	Comprehension outside the project team Evidence-based, clear, concise descriptions of practice	Participating academics Participating academics	Interviews Interviews	Evaluator Evaluator	Sem 2 2014
Outputs Review of literature Analysis of interviews	Good coverage of relevant literature, used in publications Grounded analysis by theme and concept	Academic literature and institutional/regulatory documentation	Desk survey Nvivo or similar data	Research Assistant	End of 2013

			management program		
Objective 3: Benchmarking of these outcomes based assessment practices with some consideration of the rationales and barriers to implementation encountered in a range of contexts					
Outcomes Development of common vocabulary and understanding of scope	Satisfaction of project team and participating academics	Team meetings, conference workshops etc.	Survey	Evaluator	Ongoing
Outputs Continual refinement of focus and understanding-direction and content	Content and results of discussions	Newsletters, team meetings, communication outputs	Content analysis	Team and evaluator	Ongoing

Finally, the evaluation matrix suggested what the final evaluation questions were likely to be and identified where extra data collection would be necessary beyond ongoing monitoring. These questions provided a framework for both ongoing (formative) and final (summative) data gathering.

Evaluation Matrix

QUESTIONS	SOURCES OF INFORMATION	TIME FRAME
APPROPRIATENESS How well did informants respond to the AQF focus – was this part of their planning? Were the methods used and questions asked appropriate in all of the institutions?	Interviews conducted with academic participants	Semester 2 2014
OUTCOMES How well did academics within and outside the project team understand the model and guidelines? What kinds of changes did participants foresee could be possible as a result of the guidelines?	Observation in team meetings, interviews with participants, including team members	Semester 2 2014
IMPACT Did academics feel they could use the guidelines? Did professional bodies see benefit in the guidelines?	Interviews with academic participants, members of ACED and members of AE Accreditation committee	Semester 2 2014

What permanent embedding (such as in accreditation measures) has happened or can be expected?		
EFFICIENCY To what extent were resources (time etc) a barrier to implementation? How were resource problems overcome? Do participants feel that the model provides return on their investment of effort?	Observation at team meetings, interviews with team members	Ongoing
SUSTAINABILITY What needs to be done to foster implementation in particular institutions? Are there review processes which will maintain quality control? What resources would be necessary to widen the impact of the guidelines?	Interviews with participants and consultation with project team	Semester 2 2014

Year Two Observations

Evaluation activities of the evaluator throughout 2014 consisted of:

- attendance at three workshops and planning meetings with team members,
- attendance at academic feedback workshop in Brisbane
- interviews with five implementing academics,
- attendance at presentations at AAEE conference in Wellington, NZ.
- attendance at workshop at AAEE and administration of exit survey.

Team activities

While the tactic of splitting the team into three working parties had some risks it seems to have paid off in this case. Participants noted that this arrangement allowed for "more focused conversations and sufficient cross-fertilisation" and made it easier to come to decisions. One senior participant noted that it allowed her "the opportunity to be more involved than in other projects" and several commented on the way they learned a lot from their peers and expanded

their networks. They expected this to bear fruit in future projects. While having just two people pull the findings, presentations and reports together ran the risk of loss of input, all interviewees were happy that their working group's discussions had been captured in the final guidelines. As in all projects, organization wasn't perfect however, with some participants missing out on promised teaching relief, for instance.

Feedback workshops

The evaluator only had the chance to attend one feedback workshop, in Brisbane, although a series were run all around the country. At these workshops, the co-ordinators within the team presented preliminary findings and draft guidelines to gauge what the response might be from teaching academics. Attendance was not restricted to one university so a useful dialogue was generated around the diversity of approaches across institutions.

At the observed workshop, participants showed keen interest in gaining a better understanding of AQF8 requirements and were forthright in their opinions about what they thought academics needed the guidelines to tell them and how. Although only eight people attended, they all expressed satisfaction with the workshop, saying they had learned a lot, had a lot to think about and were looking forward to the appearance of the guidelines. The organisers, too, felt that the workshops were invaluable to them in understanding current practice and the practical needs of the academics.

Interviews with implementing academics

Interview protocols probed the five evaluation domains of Appropriateness, Outcomes, Impact, Efficiency and Sustainability. The participants were all people who had either been involved in the project directly or at least contributed to some of the feedback workshops. They were all people who were in a position to influence adoption and promotion of the guidelines at their institution. The following summarises their responses in the five evaluation domains.

Appropriateness

Respondents found the project to be timely and well-focussed. One commented that rigour is particularly appropriate in capstone subjects since it affects the future employability of student engineers, so the attention paid to issues such as supervision and assessment were very useful. The strategy of bringing together good practice from around the country was also appreciated. There were some reservations about the ease with which the guidelines could be applied in

departments where people were unable or unwilling to review existing programs. For this reason, institutional support from within universities and from organisations such as Engineers Australia was seen as critical by some.

Outcomes

While the guidelines were accepted in themselves all respondents said that they thought they would work best for awareness-raising around a number of pedagogical issues and would ideally be used to start local conversations within institutions.

Impact

One of the major impacts of this project has been the way it has allowed academics to explore a wide variety of approaches to Final Year Projects used in the participating institutions. This diversity encompasses matters of types of projects, assessments, supervision and the relation to the wider curriculum. One respondent summed this up when he said "I love the way this report talks about the importance of the process being used rather than the product". Another senior academic said that he hoped to see a "backwash effect" into third year projects.

On the topic of whether the guidelines should be included in accreditation processes, some respondents pointed to a certain redundancy since engineering programs already have to meet Engineers Australia's Level One Competencies, which can be argued to already embody AQF8. One respondent said that it was fair for accreditation panels to expect departments to be aware of the guidelines but of course that would not require any measurable output.

Efficiency

All participants commented on the fact that the exemplars included in the guidelines brought together a lot of hard-earned experience in a usable and efficient form.

Sustainability

As everyone noted, the guidelines need to be used as conversation starters in program review. Suggestions for how this might be done and maintained included:

- selecting a few (perhaps three) most significant recommendations and making a formal presentation to the Council of Engineering Deans to encourage them to get things moving locally, and
- including the guidelines in the series of constructive alignment workshops currently being supported by EA.

Relevant representatives of Engineers Australia thought that there was a possibility that EA could provide some financial support for the dissemination of the guidelines but they need a team member to approach them. One of them called this a "very, very, very valuable project". It is highly recommended that someone makes this approach.

Presentations at AAEE

The annual conference of the Australasian Association for Engineering education is a major venue for Australian engineering academics to report their research and practice. Separate papers were written by the sub-groups for the 2014 conference reporting the results of the project. However, rather than the normal static presentation of papers using Powerpoint, the team made the decision to enact a role play which was light-hearted and engaging but also raised the main issues surrounding why academics should concern themselves about AQF8 standards and what the guidelines could do for them. During Question time members of the audience were complaining that they couldn't find the guidelines online and asking where they were. Of course they will not be uploaded until the team's report is accepted by OLT but there was certainly brisk interest in seeing early copies, on the basis of the presentation.

At the same conference the team presented a workshop to familiarize participants with the AQF8 requirements and what they need to do about it. Around 40 people attended this workshop and 17 filled in exit surveys (see Appendix A). The surveys consisted of eight statements asking for agreement on a five level Likert scale and four open-ended questions. As figure 1 shows, there was high satisfaction with the way the workshop stimulated reflection on how Final Year Projects can and should be delivered and the implications of the AQF8 requirements. The statement with the lowest degree of agreement (No 3) was "The workshop allowed me to articulate the implications for me of AQF8 requirements". Some respondents noted either that they had already started to do this or that they were not directly involved in teaching final year projects.

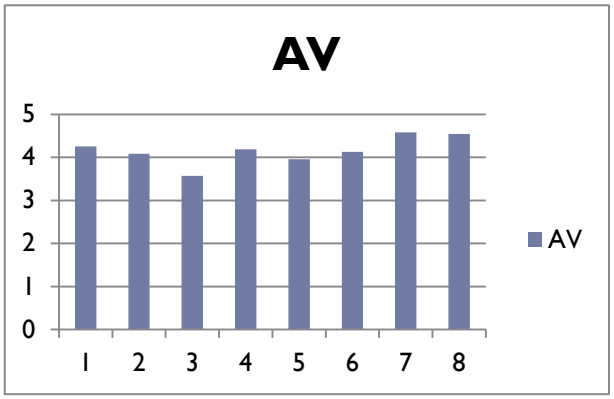


Figure 1: exit survey responses, AAEE workshop

The first open-ended question asked what was most interesting about the workshop and 8 out of 17 respondents nominated the chance to hear how other people organize the projects and the sharing of ideas. Four out of the 17 nominated exposure to AQF8 as most interesting.

The least enjoyable aspect of the workshop for 6 out of 12 respondents was that it was too short. When asked to identify the most important issues raised, 7 out of 16 respondents mentioned the diversity of approaches across institutions that they had been made aware of. Four out of the 16 mentioned assessment and moderation issues.

Considering these responses and having listened to the discussion at the workshop, it seems clear that a major outcome of this project is the potential the guidelines have for focusing academics' attention on wider issues of curriculum, teaching and supervision.

Discussion

The first two evaluation questions refer to issues of the **appropriateness** of the project processes and the guidelines proposed by the project team:

> How well did informants respond to the AQF focus – was this part of their planning?
>
> Were the methods used and questions asked appropriate in all of the institutions?

While most academics were aware of AQF8 as a looming issue few had more than "vague ideas" about what it would mean for them. The wide consultation carried out by this project thus helped people to start to get organized around the issue. Data gathering and reporting processes were innovative and well received throughout, allowing for many voices from the engineering education community to be heard.

The **effectiveness** of the project deliverables is covered by the questions:

How well did academics within and outside the project team understand the model and guidelines?

What kinds of changes did participants foresee could be possible as a result of the guidelines?

While the full guidelines are yet to be distributed, the series of workshops and presentations was so exhaustive as to give most interested parties the chance to get some idea of what they would look like and contribute to their formulation in such a way sa enhance the transparency of the guidelines. It was found that across Australia there is a great diversity in the way Final Year Engineering Projects are handled and that the guidelines needed to be applied with due respect for local contexts. The discussions needed to do this are likely to lead to pedagogic changes beyond the projects themselves.

Downstream **impact** of the project was addressed in the following evaluation questions:
Did academics feel they could use the guidelines?

Did professional bodies see benefit in the guidelines?

What permanent embedding (such as in accreditation measures) has happened or can be expected?

Engineers Australia sees great benefit in these guidelines and are likely to be in a position to fund future dissemination if approached. Given the diversity of context for Final Year Projects, simple embedding in accreditation processes was not seen as useful, although they were seen as useful background information to inform departments' preparation for accreditation.

The **cost-effectiveness** aspect of the project was covered by the evaluation questions:

To what extent were resources (time etc) a barrier to implementation?

How were resource problems overcome?

Do participants feel that the model provides return on their investment of effort?

Participants felt the time they spent on the project was worthwhile, leading to enhanced knowledge and increased networks. The splitting of the project team into working groups appears to have been efficient. Participants feel that the final guidelines accurately reflect their findings and discussions and are well worth the effort.

In considering what needs to be done to make the project outcomes **sustainable**, the following questions were addressed:

What needs to be done to foster implementation in particular institutions?

Are there review processes which will maintain quality control?

What resources would be necessary to widen the impact of the guidelines?

Encouragement from senior staff such as Deans was felt to be helpful to begin the local discussions of how each institution could apply the guidelines. It was suggested that some member of the project should make a short presentation to ACED to alert them to this need. It is the local discussions which will provide quality control in the application of the guidelines.

Further dissemination could be carried out through the auspices of EA and they have expressed an interest in doing this, for example through including this material in their workshops on constructive alignment. This opportunity should be pursued by the project team.

APPENDIX A

Final workshop exit survey

Workshop Evaluation

Thank you for attending the Final Year Engineering Project workshop in Wellington. We would appreciate it if you take the time to evaluate the workshop by answering the following questions. Your feedback will assist the Project Team to maximise dissemination and feed into the official evaluation of the OLT project.

For the following questions please indicate your preference by selecting one of the following statements: Strongly Disagree; Disagree; Neutral/Undecided; Agree; Strongly Agree.

Question	Strongly Disagree	Disagree	Neutral/ Undecided	Agree	Strongly Agree
1. The workshop helped me think effectively about the way FYEP is delivered in my institution.					
2. The workshop helped me think about the way I personally work with students doing FYEP.					
3. The workshop allowed me to articulate the implications for me of AQF8 requirements.					
4. The workshop gave me the chance to see how other people and places handle FYEP.					
5. I can see how at least some of the guidelines may be used in my institution.					
6. The car analogy worked well for me.					
7. I am interested in reading more of the guidelines.					
8. The project team did a good job of facilitating the workshop.					

Other feedback

What aspects of the workshop did you find most interesting? .....

What aspects of the workshop did you least enjoy? .....

What was the most important issue raised by the workshop, in your opinion? .....

Any other comments? .....

Thank you for providing feedback