ENGINEERS AUSTRALIA
AUSTRALIAN ENGINEERING ACCREDITATION CENTRE

CONSIDERATION OF BACHELOR OF ENGINEERING (HONS), BACHELOR OF ENGINEERING (R&D) (HONS) & BACHELOR OF SOFTWARE ENGINEERING PROGRAMS

implemented in the
COLLEGE OF ENGINEERING AND COMPUTER SCIENCE

at the
AUSTRALIAN NATIONAL UNIVERSITY
ACTON CAMPUS, CANBERRA

REPORT OF GENERAL REVIEW ACCREDITATION VISIT
6 – 8 OCTOBER, 2015
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1. EXECUTIVE SUMMARY

This document reports on the outcomes of the accreditation visit to the Australian National University (ANU), conducted over the period 6-8 October, 2015.

This scheduled general review visit considered Bachelor of Engineering (Honours) majors, Bachelor of Engineering (Research and Development) (Honours) majors and the Bachelor of Software Engineering. This range of offerings has been relatively stable since the previous general review visit conducted in June of 2010. At that time, the Bachelor of Engineering (Research and Development) had been newly introduced as a derivative of the Bachelor of Engineering. Full accreditation of the BEng outcomes and the BSoftEng, and provisional accreditation of the BEng (R&D) outcomes were each accorded on 8 November, 2010.

Since the 2010 visit, there have been improvements made to curriculum design, content and implementation for these programs. Much of this work was initiated in response to recommendations made by the 2010 visit panel and this has included a documented analysis of learning outcomes at the major and course level and mapping of these outcomes against the Stage 1 competency elements. Compliance with the new AQF 8 Bachelor Honours requirements was also a factor in these review processes. The BEng (Hons), BEng (R&D) (Hons) and the BSoftEng (Hons) considered on this current visit were introduced in 2014, and are each close derivatives of the respective predecessor BEng, BEng (R&D) and BSoftEng structures.

One additional major, in the specialist field of Biomedical Systems, has been introduced for the BEng (Hons) and the BEng (R&D) (Hons). This accompanies the other five majors which have been in place for many years at ANU.

In November of 2011, an interim accreditation visit was conducted to consider the transition of the BEng (R&D) (Hons) outcomes from provisional to full accreditation. Full accreditation was accorded for all outcome majors on 19 April 2012.

This report of the 2015 accreditation visit has been prepared by an Engineers Australia evaluation panel as follows:

1.1 Evaluation panel

<table>
<thead>
<tr>
<th>Major/Specialist Focus</th>
<th>Panel Member</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Mechanical and Material Systems</td>
<td>Em Professor Mark Bush Hon FIEAust CPEng[Panel Chair]</td>
</tr>
<tr>
<td></td>
<td>The University of Western Australia</td>
</tr>
<tr>
<td>• Mechatronic Systems</td>
<td>Dr Jerome Vethecan MIEAust CPEng</td>
</tr>
<tr>
<td></td>
<td>Project Manager[BAE Systems Australia]</td>
</tr>
<tr>
<td>• Biomedical Systems</td>
<td>Ms Kelly Coverdale MIEAust</td>
</tr>
<tr>
<td></td>
<td>Senior Biomedical Engineer</td>
</tr>
<tr>
<td></td>
<td>Biomedical Technology Services</td>
</tr>
<tr>
<td></td>
<td>Queensland Health</td>
</tr>
<tr>
<td>• Electronic and Communication Systems, Renewable Energy Systems</td>
<td>Dr Tim Aubrey FIEAust</td>
</tr>
<tr>
<td></td>
<td>Associate Dean (Teaching and Learning)</td>
</tr>
<tr>
<td></td>
<td>Faculty of Engineering and Information Technology[University of Technology, Sydney]</td>
</tr>
<tr>
<td>• Photonic Systems, Electronic and Communication Systems, Renewable Energy Systems</td>
<td>Professor Michael Austin FIEAust CPEng</td>
</tr>
<tr>
<td></td>
<td>Head, School of Electrical and Computer Engineering[RMIT University]</td>
</tr>
<tr>
<td>• Software Engineering</td>
<td>Dr Jocelyn Armarego MIEAust MACS CP</td>
</tr>
<tr>
<td></td>
<td>Senior Lecturer[School of Engineering and Information Technology]</td>
</tr>
<tr>
<td></td>
<td>Murdoch University</td>
</tr>
<tr>
<td>• Electronic and Communication Systems, Renewable Energy Systems</td>
<td>Em Professor Alan Bradley FIEAust CPEng[Visit Manager]</td>
</tr>
<tr>
<td></td>
<td>Accreditation Consultant, Engineers Australia[Visit Manager]</td>
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</tbody>
</table>
1.2 ACS Panel

The Engineers Australia panel was joined throughout the visit by Ms Penny Collings FACS PCP, Accreditation Manager, Australian Computer Society. Her role was to evaluate the Bachelor of Software Engineering (Honours) for continuing full accreditation on behalf of the Australian Computer Society.

1.3 Accreditation visit and report

The findings and conclusions of the panel are based on a detailed consideration of accreditation documentation submitted by the University and the experiences of the subsequent campus visit.

After summarising the recommendations on accreditation and program details, this report provides a brief review of action already taken by the University in response to recommendations set by earlier accreditation visits. Section 9 presents a detailed analysis of the panel's findings and is referenced to key elements of the accreditation criteria. Additional recommendations have been distilled from this analysis of findings, and summarised in Section 10. These recommendations are intended to support the processes of continuing quality improvement.

The accreditation submission from ANU covered much of the material required for the panel's preparation, however, the panel requested clarification and/or further information on a range of matters identified at its pre-visit teleconference held on 2 September, 2015. This request was adequately addressed by the University with a response document distributed to panel members several days prior to commencement of the visit.

Attachment 1 provides the schedule of activities for the visit.

A draft version of the accreditation visit report was endorsed by the Accreditation Board at its meeting on 17 November, 2015. Editorial work was subsequently completed by the panel and the finalised draft (Version 3) was sent for review to the University, with the objective of identifying any factual or typographical errors. A response was received in January of 2016, and this final report now corrects the four minor errors identified by the University.

In correspondence sent to ANU on 5 February, 2016, accreditation was confirmed in accordance with the recommendations of Section 2 of this report.
2. RECOMMENDATIONS ON ACCREDITATION

The following recommendations on accreditation are made to the Engineers Australia Accreditation Board for programs offered by the Australian National University at its Acton, Canberra campus.

2.1 Full accreditation - BEng (Hons) and BEng (R & D) (Hons) programs

Full accreditation of the Bachelor of Engineering (Honours) and Bachelor of Engineering (Research and Development) (Honours) be accorded through to the first intake of students in 2021, at the level of Professional Engineer for each of the following majors:

- Mechanical and Material Systems,
- Mechatronic Systems,
- Electronic and Communication Systems,
- Renewable Energy Systems,
- Photonic Systems,

including dual degree offerings as outlined in Section 4.5 below.

2.2 Conditional provisional accreditation – BEng (Hons) and BEng (R & D) (Hons) major in the specialist field of Biomedical Systems

Conditional provisional accreditation of the Bachelor of Engineering (Honours) and Bachelor of Engineering (Research and Development) (Honours) be accorded from 2015 through to the first intake of students in 2017, at the level of Professional Engineer for the Biomedical Systems major.

Extension of provisional accreditation to be conditional on the Board’s consideration of an interim report from RSEng, to be received by 30 December 2016, demonstrating that the curriculum strengthening requirement M1 has been satisfactorily addressed. Consideration of this major for transition to full accreditation to be conditional also on the School satisfactorily addressing this requirement, and following the emergence of the first representative cohort of graduates for each of the two program categories.

2.3 Full accreditation – BSoftEng (Hons)

Full accreditation of the Bachelor of Software Engineering (Honours) be accorded through to the first intake of students in 2021 at the level of Professional Engineer, including dual degree offerings as outlined in Section 4.5 below.

2.4 Requirement

M1 For the newly introduced Biomedical Systems major, (BEng (Hons) and BEng (R&D) (Hons)), address curriculum issues associated with the specialist courses which define the major, as discussed in Section 9.2.4.3.

[Accreditation Criterion 4.2.4 – Accreditation Criteria Summary - AMS document S02 (Professional Engineer)]

2.5 Ongoing development of the programs

The above accreditations include ongoing development of the programs over the accreditation period, subject to the provisions set out in the Accreditation Management System documents.

2.6 Next general review

The next general review of all programs at the Australian National University be undertaken in 2020. The University’s consideration of the recommendations set out in Section 10 to provide key input to the 2020 general review.
3. PROPOSED WEBSITE ENTRY/CERTIFICATE DETAILS

As a consequence of the above recommendations, the proposed wording for the website listing of accredited programs, and for the certificate of accreditation, is as follows.

AUSTRALIAN NATIONAL UNIVERSITY

<table>
<thead>
<tr>
<th>PROGRAMS ACCREDITED AND CURRENTLY OFFERED AT THE LEVEL OF PROFESSIONAL ENGINEER</th>
</tr>
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<tbody>
<tr>
<td>Bachelor of Engineering (Honours) (Electronic and Communication Systems)</td>
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<tr>
<td>Bachelor of Engineering (Honours) (Mechanical and Material Systems)</td>
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<tr>
<td>Bachelor of Engineering (Honours) (Mechatronic Systems)</td>
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<tr>
<td>Bachelor of Engineering (Honours) (Photonic Systems)</td>
</tr>
<tr>
<td>Bachelor of Engineering (Honours) (Renewable Energy Systems)</td>
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<tr>
<td>Bachelor of Engineering (Honours) (Biomedical Systems)</td>
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<tr>
<td>Bachelor of Engineering (Research and Development) (Honours) (Electronic</td>
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<tr>
<td>and Communication Systems)</td>
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<tr>
<td>Bachelor of Engineering (Research and Development) (Honours) (Mechanical and</td>
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<tr>
<td>Material Systems)</td>
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<tr>
<td>Bachelor of Engineering (Research and Development) (Honours) (Mechatronic</td>
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<tr>
<td>Systems)</td>
</tr>
<tr>
<td>Bachelor of Engineering (Research and Development) (Honours) (Photonic Systems)</td>
</tr>
<tr>
<td>Bachelor of Engineering (Research and Development) (Honours) (Renewable Energy</td>
</tr>
<tr>
<td>Systems)</td>
</tr>
<tr>
<td>Bachelor of Engineering (Research and Development ) (Honours) (Biomedical</td>
</tr>
<tr>
<td>Systems)</td>
</tr>
<tr>
<td>Bachelor of Software Engineering (Honours)</td>
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*Information Technology degrees not allowed in combination with Bachelor of Software Engineering (Hons)

<table>
<thead>
<tr>
<th>PROGRAMS FULLY ACCREDITED BUT NO LONGER OFFERED AT THE LEVEL OF PROFESSIONAL ENGINEER</th>
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<tbody>
<tr>
<td>Bachelor of Engineering (Electronic and Communication Systems)</td>
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<tr>
<td>Bachelor of Engineering (Mechanical and Material Systems)</td>
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<tr>
<td>Bachelor of Engineering (Mechatronic Systems)</td>
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<tr>
<td>Bachelor of Engineering (Photonic Systems)</td>
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<tr>
<td>Bachelor of Engineering (Renewable Energy Systems)</td>
</tr>
<tr>
<td>Bachelor of Engineering (Sustainable Energy Systems)</td>
</tr>
<tr>
<td>Bachelor of Engineering (Research and Development) (Electronic and Communication</td>
</tr>
<tr>
<td>Systems)</td>
</tr>
<tr>
<td>Bachelor of Engineering (Research and Development) (Mechanical and Material Systems)</td>
</tr>
<tr>
<td>Bachelor of Engineering (Research and Development) (Mechatronic Systems)</td>
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<tr>
<td>Bachelor of Engineering (Research and Development) (Photonic Systems)</td>
</tr>
<tr>
<td>Bachelor of Engineering (Research and Development) (Renewable Energy Systems)</td>
</tr>
<tr>
<td>Bachelor of Engineering (Research and Development) (Sustainable Energy Systems)</td>
</tr>
<tr>
<td>Bachelor of Software Engineering</td>
</tr>
<tr>
<td>Bachelor of Engineering (Interdisciplinary Systems) (Telecommunication Systems)</td>
</tr>
<tr>
<td>Bachelor of Engineering (Interdisciplinary Systems) (Mechatronic Systems)</td>
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<tr>
<td>Bachelor of Engineering (Interdisciplinary Systems) (Manufacturing and Management Systems)</td>
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<tr>
<td>Bachelor of Engineering (Interdisciplinary Systems) (Materials and Mechanical Systems)</td>
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<tr>
<td>Bachelor of Engineering (Interdisciplinary Systems) (Sustainable Energy Systems)</td>
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<tr>
<td>Bachelor of Engineering (Interdisciplinary Systems) (Electronic Systems)</td>
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<tr>
<td>Bachelor of Engineering (Telecommunication Systems)</td>
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<td>Bachelor of Engineering (Mechatronic Systems)</td>
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<td>Bachelor of Engineering (Manufacturing and Management Systems)</td>
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<tr>
<td>Bachelor of Engineering (Materials and Mechanical Systems)</td>
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<tr>
<td>Bachelor of Engineering (Sustainable Energy Systems)</td>
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<tr>
<td>Bachelor of Engineering (Electronic Systems)</td>
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<tr>
<td>Bachelor of Engineering (Digital and Electronic Systems)</td>
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<tr>
<td>Bachelor of Engineering (Environmental Systems)</td>
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<tr>
<td>Bachelor of Engineering (Photonics Systems)</td>
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<tr>
<td>Bachelor of Engineering (Systems Engineering)</td>
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<tr>
<td>Bachelor of Engineering (Interdisciplinary Systems)</td>
</tr>
</tbody>
</table>

For details of all currently accredited programs, and programs accredited but no longer offered, refer to the web listing contained on the Engineers Australia website at:

4. GENERAL INFORMATION

4.1 The educational institution

Name of Institution: Australian National University
Name of Responsible Entity within the Institution: College of Engineering and Computer Science
Institution Awarding the degrees: Australian National University

4.2 Key dates

Date of submission of request for accreditation: 11 March 2015
Date of receipt of initial documentation: 10 August 2015
Panel pre-visit teleconference: 2 September, 2015
Panel pre-visit planning meeting: 6 October, 2015
Panel Campus visit: 6-8 October, 2015
Accreditation accorded: 5 February, 2016

4.3 Programs submitted for consideration during this visit

<table>
<thead>
<tr>
<th>Full title of Program and Degree Award</th>
<th>Abbrev’n of degree title</th>
<th>Campus of delivery</th>
<th>Predecessor program and degree award</th>
<th>Current accredit’n status</th>
<th>Level of accredit’n sought</th>
<th>Year of first offering predecessor program (accredit’n start date)</th>
<th>Final year of offering predecessor program</th>
<th>Proposed accreditation start date – Hons program</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bachelor of Engineering (Honours)</td>
<td>BEng</td>
<td>ANU Acton</td>
<td>Bachelor of Engineering</td>
<td>Full</td>
<td>Full</td>
<td>1999</td>
<td>2013</td>
<td>2014</td>
</tr>
<tr>
<td>Bachelor of Engineering (Research and Development) (Honours)</td>
<td>BEng (R&amp;D)</td>
<td>ANU Acton</td>
<td>Bachelor of Engineering (Research and Development)</td>
<td>Full</td>
<td>Full</td>
<td>2011</td>
<td>2013</td>
<td>2014</td>
</tr>
<tr>
<td>Bachelor of Software Engineering (Honours)</td>
<td>BSoftEng</td>
<td>ANU Acton</td>
<td>Bachelor of Software Engineering</td>
<td>Full</td>
<td>Full</td>
<td>2000</td>
<td>2013</td>
<td>2014</td>
</tr>
</tbody>
</table>

4.4 Majors offered

For the BEng (Hons) and the BEng (R&D) (Hons) above, students must select one of the following major study streams:

- Mechanical and Material Systems,
- Mechatronic Systems,
- Biomedical Systems,
- Electronic and Communication Systems,
- Renewable Energy Systems,
- Photonic Systems.
The Biomedical Systems outcome is a newly introduced major option, and was considered for the first time during this current visit. All other major choices were in place prior to the 2010 accreditation visit.

The original submission document indicated that BSoftEng (Hons), students were able to use available elective slots to optionally pursue Computer Science major study streams such as:

- Computational Foundations,
- Computer Engineering,
- Human-centric Computing,
- Information-Intensive Computing,
- Intelligent Systems.

This was subsequently retracted in the university's response to the teleconference report. The BSoftEng (Hons) does not in fact provide the option for students to focus their elective choices into defined major study streams.

### 4.5 Double degrees

Accreditation is sought for double degrees, allowing the Bachelor of Engineering (Honours), and the Bachelor of Engineering (Research and Development) (Honours) to be combined with a second degree offering over a five-year (full-time) study period.

Under the ANU ‘Flexible Double Degrees’ scheme, a second degree in one of the following fields can be undertaken in conjunction with the engineering bachelor offerings:

- Actuarial Studies,
- Arts,
- Asian Studies,
- Biotechnology,
- Business Administration,
- Commerce,
- Economics,
- Finance,
- Genetics,
- Information Technology*,
- International Security Studies,
- Pacific Studies,
- Science,
- Statistics.

In each case, implementation of the second degree utilises elective slots within the engineering bachelor program structure and incurs no loss of mandated core engineering content.

* The only exception case is that for the BSoftEng (Hons), a second degree in the Information Technology field is not allowed.
5. **BACKGROUND CONTEXT AND KEY DEVELOPMENTS**

This scheduled general review visit to ANU followed the previous general review of programs in 2010 and the interim visit conducted in 2011 to consider transition of the BEng (R&D) (Hons) to full accreditation.

5.1 Academic organisation

The College of Engineering and Computer Science (CECS) is one of seven colleges constituting the Australian National University (ANU). The College comprises the Research School of Engineering (RSEng) and the Research School of Computer Science (RSCS). The University has recently taken steps to strengthen its governance in the teaching and learning domain with the establishment of a formal Academic Board and the appointment of a Deputy Vice Chancellor (Academic), Professor Marnie Hughes-Warrington.

The Research School of Engineering (RSEng) focuses its research and teaching in the thematic areas of Energy, Information, Materials and Fabrication. Again there has been a steady student load growth since 2011 and this is particularly apparent in international student numbers which now make up 38% of the students in the undergraduate engineering programs. There are 37 ‘faculty’ academic staff members who are in continuing employment and underpin the teaching and research programs. In addition a large number of professional staff members are employed under research grant funding and contracts. These staff members are able to enrich the undergraduate programs, especially in supporting and supervising project activity. Each the major offered in the BEng (Hons)/BEng (R&D) (Hons) directly couples with specific research programs in the School and also with other research areas at ANU. It is the close research/teaching nexus that has led to the development of the elite, BEng (R&D) (Hons) in this School.

The Research School of Computer Science (RSCS) currently has 24 ‘faculty’ academic staff, with 13 of these contributing to teaching in the BSoftEng. The School is on an aggressive growth trajectory and expects to increase staff numbers and student load significantly over the next three years. Research strengths are identified in Computer Intelligence, Systems and Theory. Software Engineering is listed as part of the research focus within the Computer Systems domain. The panel did not perceive research linkages to be as strong, however, for the Software Engineering program as they are for the RSEng undergraduate programs.

Within the College and schools there are strong academic committee structures and specifically appointed academic leaders to manage the implementation of programs. Positions of Associate Dean (Education) and Associate Dean (Research) at College level are mirrored at School level by the Associate Director (Education) and Associate Director (Research), each reporting to the Director of the School. The College Education Committee focuses on implementation of university policy and quality assurance. The schools then each have a Curriculum Development Committee which develops and endorses curriculum proposals and amendments and focuses on the use of learning technologies and alternate delivery modes, alignment of programs with research strengths and management of student profile.

In RSEng, program leadership has been strengthened since 2010 with the appointment of Discipline Chairs to head-up Discipline Committees, with a committee appointed for each of the major streams, as well as one for the Systems Engineering core of the BEng (Hons) and BEng (R&D) (Hons). Discipline Committee membership is limited, however, to a small number of senior, experienced staff members drawn from the teaching team responsible for the particular major, and from those responsible for the BEng core. For the Photonic Systems major, the Discipline Chair role is actually fulfilled by a member of academic staff from the College of Physics and Applied Mathematical Sciences. This makes some sense as the majority of key courses for this specialisation continue to be taught by staff from this College. Discipline Chairs are ‘ex-officio’ members of the school’s Curriculum Development Committee.

Since 2010, the industry advisory function has also been moved from the College to the individual school level. There is now a School Industry Advisory Board for RSEng, developed in the second half of 2014, and this Board provides input to all specialist majors, including the Software Engineering undergraduate program. A companion Board operates in RSCS, but does not include the Software Engineering offering within its remit.

Schools process the outcomes of the survey-based SELT student feedback process and also operate a Student Representative Committee.

In RSEng, the Program Convenor provides the overall interface between students and the academic administration of the programs. The Associate Director (Education) provides overarching academic leadership at the school level. School Directors report to the Dean of the College of Engineering and
Computer Science. The Associate Dean (Education) provides leadership of teaching and learning at college level, and represents the College on the University Education, Student Experience and Quality Standards committees.

RSEng holds Course Convenor meetings at least twice per semester and these are chaired by the Associate Director (Education). The purpose here is to discuss issues arising in relation to delivery. Annual retreats provide an opportunity for Course Convenors to meet and reflect on the year’s achievements and to plan for the future. Working parties are often initiated to pursue key issues.

In RSCS, the organisational structure mirrors that in RSEng, except that the Software Engineering Program Convenor appears also to provide the academic leadership of the program teaching team. There is no equivalent to the Discipline Committee or Discipline Chair roles which have been established in RSEng in response to the 2010 accreditation visit recommendations. There is a clear synergy between RSEng and RSCS and the College umbrella helps considerably with encouraging interaction and collaborative activity.

5.2 Significant developments and strategic directions

The College has grown significantly since the last accreditation visit in 2011 and now supports 794 undergraduate students, 148 postgraduate coursework students and 217 higher degree research (HDR) students (2014 figures).

The College restructuring in 2010 brought together the teaching faculties and research schools under an integrated umbrella. This development has had proven benefits for undergraduate students with the close coupling of research and teaching within the new ‘research schools’. Active researchers engage seamlessly with undergraduate teaching. This is particularly apparent in the strong ‘Engineering Research and Development Project’ strand of courses within the BEng (R&D) (Hons) program.

Engineering features strongly in the current and planned future profile of ANU. Research contributions continue to be very important to the University, and this has been acknowledged in a $60M investment program which will realise two new buildings, in addition to the recent refurbishment of the ‘Craig Building’, for engineering research and teaching. These buildings will provide the full range of laboratory, workshop and project facilities, satisfying the needs for research and teaching within an integrated setting. The funding covers the building works, but also a complete overhaul of laboratory equipment and practical learning facilities. Model-based commercial learning rigs are being deployed in a number of areas, in a roll-in/roll-out configuration to maximise flexibility and utilisation of space. Large numbers of PhD students provide a ready source of supervisors for laboratory learning and, within timetabling constraints, allow for a single laboratory rig to be re-used by small student groups repeatedly throughout the teaching week.

The ANU educational model provides diverse options for students through generous elective choices and attracts very high calibre candidates into the R&D program stream. This diversity is very well established in the RSEng offerings, but is not as overt in the BSoftEng (Hons) implementation. The diverse options in RSEng provide a reliable basis for monitoring trends and preferences and setting strategic development directions. The facilities in place and under development will be sufficient to support the current educational model, the current range of engineering programs and projected student numbers for the next few years. Further refinement and revision of the educational model in RSEng will occur in line with changing needs and preference trends, and will be essential if student numbers increase significantly.

The Biomedical Systems major has been a recent initiative for RSEng, and reflects the research activity that is occurring in this multidisciplinary field at ANU. The panel was not informed of any plans for launching other new major options in the near future.

There is some innovation in pedagogy, such as successful experimentation with the flipped classroom mode, but the higher resource requirements and the ‘scale-ability’ of this delivery mode are issues currently being considered. The Web Access to Teaching and Learning Environments (WATTLE) is a Moodle-based Learning Management System (LMS) that is available to all courses. WATTLE provides many options, including forums and other collaborative learning possibilities, but the range of utilisation varies considerably between Course Convenors. Automated recording of all lectures is now a routine process, with recordings automatically uploaded to the WATTLE site. This provides a flexible option to students and has had some impact on lecture attendance patterns, but the option to re-engage with a lecture as part of the self-study process is probably a more important benefit.
The College has provided leadership within the ANU context for initiatives such as the TechLauncher integrated start-up project umbrella and the diversification of pathways offered by the RSEng undergraduate model. Key industry partnerships for RSEng have yielded in-kind resources for students and researchers, such as the roof-top PV facility and associated inverter control laboratory provided by local technology innovator, Reposit Power.

5.3 Program philosophy, structure and content

The flagship Bachelor of Engineering (Honours), (BEng (Hons)), (and predecessor Bachelor of Engineering), program is young in the context of Australian engineering education programs, having enrolled the first cohort in 1990. The program was, from the start, conceived to emphasise Systems Engineering principles within an interdisciplinary context. The more recent Bachelor of Software Engineering (Honours) (BSoftEng (Hons)) and Bachelor of Engineering (Research & Development) (Honours), (BEng (R&D) (Hons)) each draw from the same foundation.

The titles – BEng (Hons), the BEng (R&D) (Hons) and BSoftEng (Hons) define the three key programs considered during this visit and provide the basis for the respective awards issued to students. The transition to the AQF 8 Honours degree framework occurred with first enrolments taken from 2014. Current students who commenced prior to 2014 complete their study and graduate under the legacy Bachelor of Engineering, Bachelor of Engineering (R&D) and Bachelor of Software Engineering. The option to transfer to the Honours degree equivalent is open to these students. Transition to the BSoftEng (Hons) would be slightly less straightforward than for the RSEng programs because of changes that have, and will be made, to strengthen research knowledge/skills development in the BSoftEng (Hons). The catch-up process is however quite manageable.

The transition to the AQF 8 Honours degree outcome has been a smooth process for the RSEng programs, because of the original philosophy of the BEng and BEng (R&D). An adequate foundation of research methods knowledge and research and investigatory skills development was argued to have been already in place in the programs, and so little change was necessary to program structure and content to demonstrate AQF 8 compliance. For the BSoftEng (Hons) program, some strengthening in these research and investigatory domains has been necessary, although the intense project activity undertaken in the 3rd and final years of the program provide ample opportunity for structuring the development of such knowledge and skills. Further focus will be achieved with the planned introduction of an AQF 8 compliant Research and Development Methods course in the latter stages of all four-year degree programs in RSCS, including the BSoftEng (Hons) program. This course will build on foundation research skills already explicitly addressed in the Systems Engineering for Software Engineering course and practised in project activity in numerous other courses. It will ensure that students are fully equipped, in accordance with AQF 8 expectations. This new course will be phased into the BSoftEng (Hons) program in 2016, to address learning requirements for students progressing through the new Honours degree. CECS has committed to ensuring that all four-year bachelor degrees are fully compliant with the AQF 8 requirements by 2016. Current students electing to transfer to the BSoftEng (Hons) would need to pick up this additional course.

A choice of six major study streams is offered for the BEng (Hons) and BEng (R&D) (Hons). Students must undertake one of these majors. The selected major defines the engineering specialisation followed by the student, and is clearly identified on the transcript as well as in the graduate’s transcript.

The BEng programs comprise a total of 192 credit units and continue to be based on a mandatory Systems Engineering core. Majors are realised as defined streams of specialist courses totalling just 48 credit units. Capstone project activity is, of course, also based in the nominated specialist field and consists of a 12-unit project sequence, normally implemented over two consecutive semesters. The programs include 6 x 6 credit-unit elective slots and these can be used to take an added engineering minor study sequence or a second engineering major, or alternatively used for broadening through selection of university-wide electives or minor study sequences.

The 192 credit units for the BEng (Hons) are distributed as follows:

- 90 units of compulsory (Systems Engineering core including a 12 credit unit capstone project sequence) courses,
- 12 units from the core “MATH” courses,
- 6 units from the core ‘COMP” courses,
• 48 units from one of the engineering majors,
• 12 units of ENGN electives in final year,
• 36 units of university-wide elective courses.

The BEng (R&D) (Hons) is described by ANU in the following statement:

“The Bachelor of Engineering (Research and Development) (Honours) is a program targeted at very high-achieving students (ATAR of 99 or equivalent) who show an aptitude and interest in research. While the Program has in common the general Program Major structure with the standard BEng (Hons) Program, it differs from the standard Program through an enhanced focus on R&D project work. This comes in the form of several R&D specific units. Therefore the graduates of this program should achieve the expected outcomes from the standard BEng (Hons) Program. Furthermore, they will have the necessary skills to conduct a research project from start to finish, including inception and design, execution, presentation and publication both individually and as a member of a larger team.”

The R&D (Honours) degree is an elite option encouraged by ANU for extremely high ATAR (or equivalent) applicants, who must retain a continuing high-distinction performance average to remain in the R&D stream. Failing this a candidate will drop back into the standard BEng (Hons) program in the same specialist major. To graduate from the BEng (R&D) (Hons) a student must achieve a first-class honours grade, based on the standard merit-based calculation. There are very few, if any, cases of a student being permitted to migrate upwards from the BEng (Hons) into the BEng (R&D) (Hons). This is not encouraged.

The BEng (R&D) (Hons) introduces a core strand of 6 x 6-credit unit Engineering Research and Development Project courses from semester 3 through to semester 8 which includes the 6-unit Engineering Research and Development Project (Methods) course in semester 3. This extends the compulsory core to 102 credit units and displaces one general elective slot, the two additional ENGN electives in the final year and the core COMP course – Computing for Engineering Simulation. The same range of majors is offered as is the case for the BEng (Hons). The capstone project effectively comprises the two Engineering Research and Development Project courses in the final year and these replace the Individual Project capstone project courses in the final year of the BEng (Hons). Advanced Mathematics and Applications courses optionally replace the Mathematics and Applications courses in the first year of the BEng (Hons). Students are strongly encouraged to choose the Advanced level maths courses.

Both the BEng (Hons) and the BEng (R&D) (Hons) are built on a broad, Systems Engineering foundation and interdisciplinary context. The first two years of the program are largely dedicated to establishing this foundation. Discovering Engineering is a project-based unit in the first semester that builds foundation professional competencies and involves students in the EWB project concept. The comprehensive Systems Engineering Design course and Systems Engineering Analysis course each focus on Systems Engineering principles, and build skills in problem appreciation and analysis, structured problem solving, research and investigatory processes, engineering synthesis and the design process, and systematic documentation processes. A substantial research portfolio submission is a major assessment item in these courses.

The Systems Engineering core continues in the third year of the programs with Engineering Innovation and Engineering Management courses and culminates in the final year with the two-unit capstone individual project – Engineering Research and Development Project (BEng (R&D) (Hons)) and Individual Project (BEng (Hons)). In parallel with this is the Systems Engineering Project course which caps off the Systems Engineering skills development strand with a significant, industry-sponsored project activity involving a large student team (10-20 students). The team tackles the requirements analysis, systems specification, conceptual, systems and final design reviews, and project management planning for a large engineering task.

This compulsory Systems Engineering Project course provides for enabling skills and knowledge development, foundation engineering knowledge and skills development, research skills development, complex problem solving, engineering design skills development, systems engineering and project management skills development and is a key contributor to the development of broad professional and personal attributes. Each project team has a management hierarchy and appoints a Client Liaison Officer as a single point of contact with the industry client. Regular meetings are held with the client. Assessment processes are highly structured with declared ‘team deliverables’ and continuing peer assessment
processes. Documentation requirements and project management practices are very much aligned with those utilised by the particular industry client and students gain authentic exposure to engineering practice in the industry context.

In the RSEng programs, the designated major adds eight additional courses, each of 6-credit units, building technical knowledge and application skills in the specialist practice domain. The major study sequence is responsible for building technical depth in this unorthodox program structure, founded on the common Systems Engineering core. A key objective is to prepare graduates to adapt to change, self-developing further specialist skills required during their professional career. The major study sequence provides the opportunity for developing and demonstrating high level technical skills in a particular, but relatively narrow specialist domain. The restricted domain is sufficient, however, to validate the graduate's ability to acquire knowledge and to practice to full depth in a branch of the discipline. In-depth skills and knowledge would not be expected to be as broad as is possible in some other dedicated BEng(Hons) offerings. On the other hand, such technically specific programs would not be expected to address the Systems Engineering aspect as completely as is possible in the ANU core.

In the RSEng programs the strand of elective courses and the sequence of courses that make up the specific major are concentrated in the third and final years of the programs. Students make a final selection on their preferred major in the second semester of the second year. There is sufficient flexibility to allow students to use elective slots to take out a second major, and around 50% of students do this. The degree testamur is titled Bachelor of Engineering (Hons) or Bachelor of Engineering (R&D) (Hons) and does nominate the first and second majors undertaken. The capstone project will normally be set in the field of the first major.

The BSoftEng (Hons) draws upon two courses from the BEng Systems Engineering core, (Discovering Engineering and Engineering Innovation), but otherwise follows a separate and more traditional 192 credit-unit structure. The program does incorporate a Systems Engineering ethos, but this is not as explicit as in the BEng offerings. RSCS has independently developed a Systems Engineering for Software Engineers course which partially mirrors some of the content of Systems Engineering courses in the BEng core.

The BSoftEng (Hons) structure is based on a mandated software engineering core, as well as 6 x 6-credit-unit general elective slots. Students can use these elective slots to tailor their studies by selecting additional computer science courses or for broadening, by choosing courses or minor study sequences from programs offered elsewhere at ANU. The BSoftEng is more rigidly defined then the BEng, with a greater proportion of mandated technical courses. There are no reserved course blocks to provide alternative specialisation pathways, or majors, as is the case for the BEng offerings. The BSoftEng (Hons) is effectively a single major program and is offered only as an AQF8 Honours degree. There is no parallel entry. Research and Development program option as there is for the BEng (Hons), perhaps because the research focus of RSCS does not lend itself as easily to the Software Engineering discipline.

The BSoftEng (Hons) has a unique, two-stage approach to the capstone project. In the third year, students work in teams of 3-5 students, led by a fourth-year student, in executing a major software development project for an external client in the 12-unit, year-long Software Engineering Project course. This provides the first part of the capstone project experience which is matched with the 12-unit Software Engineering Practice course in the final year. Final year student take the lead role in managing the third-year team project activity. A student thus participates as a team member in the third-year and then takes on the leadership role for the following cohort of third-year students.

In 2015 the TechLauncher initiative was first offered by RSCS and provides an overlay to this 24-unit capstone project sequence. This initiative integrates the year-long group projects across RSCS and allows Software Engineering students to work with broader teams, with other computing students, post-graduates and students from other disciplines. The TechLauncher framework focuses on working towards creating a 'start-up' company within the context of the project undertaken. The TechLauncher stream is an option for students in the BSoftEng (Hons) and is widely supported by local government, industry and in particular the innovation sector in ACT. In 2015 there are 120 students in RSCS working on 24 projects, including 11 student-run start-ups. A further option, offered to high achieving students in the final year of the Software Engineering program, is to take a separate, more advanced 24-unit individual research project. This is done in place of the Software Engineering Practice course and consumes two elective slots.

For all of the programs under consideration on this visit, the inclusion of six, unconstrained general elective slots allows students to pursue a dual degree outcome, using the newly introduced ANU 'Flexible Double
Degree’ provisions. Double degree outcomes in a wide range of combinations can be realised over five years of full-time study without loss of any of the mandated core content, or mandated major study stream requirements from the host engineering bachelor degree structures. In the BEng (R&D) (Hons) the number of general elective slots in reduced to five, to accommodate additional research and development project and methods courses. A double degree outcome is still possible, but students would have to take a slight overload to create an additional elective slot to accommodate the six-unit second degree content.

The interdisciplinary context and the unique, Systems Engineering emphasis in the BEng (Hons) and BEng (R&D) (Hons) has long been a dominant feature of the engineering programs at ANU. These key characteristics are not conveyed in the current program titles, but this has not always been the case. A record of program title changes over the years of implementation is provided below.

5.4 Chronology of engineering program titles at ANU

Commencing in 1994, engineering was offered as one program: Bachelor of Engineering (Interdisciplinary Systems). This program was offered without specialist streams, and was accredited until 2001.

In 2002, the then Faculty of Engineering and Information Technology introduced ten new specialist named outcomes for the Bachelor of Engineering – the Interdisciplinary Systems label was discontinued at this time:

- Bachelor of Engineering in Mechatronic Systems,
- Bachelor of Engineering in Systems,
- Bachelor of Engineering in Telecommunication Systems,
- Bachelor of Engineering in Electronic Systems,
- Bachelor of Engineering in Manufacturing and Management Systems,
- Bachelor of Engineering in Materials and Mechanical Systems,
- Bachelor of Engineering in Sustainable Energy Systems,
- Bachelor of Engineering in Photonic Systems,
- Bachelor of Engineering in Environmental Systems,
- Bachelor of Engineering in Digital and Electronic Systems.

These programs received accreditation from 2002 to 2005, after which the Interdisciplinary Systems label was reintroduced and accredited as an outcome of the 2005 general review visit. At this time, the programs presented for accreditation were:

1. Bachelor of Engineering in Interdisciplinary Systems with specialisations in
   - Telecommunication Systems,
   - Mechatronic Systems,
   - Manufacturing and Management Systems,
   - Materials and Mechanical Systems,
   - Sustainable Energy Systems,
   - Electronic Systems.

2. Bachelor of Software Engineering.

At this time four of the specialist streams, as follows, were discontinued:

- Digital and Electronic Systems,
- Environmental Systems,
- Photonic Systems,
- Systems Engineering.

Between the 2005 and 2010 general reviews the following further changes were made:

- the Interdisciplinary Systems program label was again deleted;
• the Electronic Systems and Telecommunication Systems majors were combined into the single Electronic and Communication Systems major;
• the Materials and Mechanical Systems major was renamed to Mechanical and Material Systems;
• the Manufacturing and Management Systems major was discontinued; and,
• the Photonic Systems major was re-introduced.

For this 2015 general review visit, for the BEng offerings, the Sustainable Energy Systems major has been retitled as Renewable Energy Systems and the new major in Biomedical Systems has been introduced.

The Bachelor of Software Engineering title has been unchanged since its introduction in 2001.

5.5 New Biomedical Systems major

Implementation of the new Biomedical Systems major has been a significant development over the past couple of years and has been systematically established, with the first step being the recruitment of staff expertise to form a critical mass in the field. Once the core staff team was in place, the major was offered as an alternative specialisation pathway for existing students. The major, like all others, is defined by eight specialist units, four of which are unique to this particular specialisation. The major embraces the emerging field of bio-nanotechnology which can be exploited to create new materials for advanced medical outcomes. The field also applies to imaging sensors for medical and security applications, hybrid bio-electronic devices and even nano-machines. Like the other BEng (Hons) majors, high level technical knowledge and skills are developed and demonstrated in a narrow subset of a broader discipline. In this case the focus is largely on Nanotechnology and Materials, Biomaterials and Tissue Engineering.

5.6 Student profile – entry standards, progression and graduates

Enrolment figures provided in the submission document for 2014 are summarised in the table below:

<table>
<thead>
<tr>
<th></th>
<th>Total commencing - EFT (HECS+AFPS +OFPS)</th>
<th>% female all commencing students</th>
<th>ATAR rank threshold – HECS intake</th>
<th>% OFPS commencements</th>
<th>Total enrolment numbers - EFT (HECS+AFPS +OFPS)</th>
<th>% of total enrolments undertaking double degree</th>
</tr>
</thead>
<tbody>
<tr>
<td>BEng (Hons)</td>
<td>177</td>
<td>27%</td>
<td>87</td>
<td>42%</td>
<td>624</td>
<td>38%</td>
</tr>
<tr>
<td>BEng (R&amp;D) (Hons)</td>
<td>37</td>
<td>14%</td>
<td>99</td>
<td>18%</td>
<td>89</td>
<td>51%</td>
</tr>
<tr>
<td>BSoftEng</td>
<td>34</td>
<td>12%</td>
<td>87</td>
<td>20%</td>
<td>118</td>
<td>28%</td>
</tr>
</tbody>
</table>

There has been a growth of almost 50% in intake numbers for the BEng (R&D) (Hons) between 2012 and 2014. For both the BEng (Hons) and BSoftEng, the growth has been more steady, at around 10% over this period.

The HECS entry ATAR cut-off rank was lifted to 90 from 2015 for the BEng (Hons) but, in conjunction with this change, a new ‘Special Admissions Scheme’ has been introduced to allow for potential consideration of applicants in the ATAR range 80-89.9. The ATAR cut-off for the BSoftEng (Hons) from 2015 remains unchanged at 87.

A significant proportion of the BEng (Hons) international engineering student cohort is made up of students following a 2+2 articulation pathway which has been formalised through a partnership with Beijing Institute of Technology. In this case, the foundation courses are undertaken during two years of study in China, after which students articulate and complete the remainder of the BEng (Hons) program in two years at ANU
Acton. Most of the Systems Engineering core courses, including the individual capstone project courses and also the specialist courses which constitute the particular major(s) are undertaken at ANU.

The range of majors offered for the RSEng programs has been stable over a long period of time, apart for the recent introduction of the Biomedical Systems major. Numbers of students selecting particular majors shows a reasonably consistent pattern, with significant variation in the number selecting individual streams. The Photonic Systems major is by far the least popular, with only 2% of students selecting this option.

Specialist courses in the majors are sometimes re-used for other degree programs. This is certainly the case in the Photonics program, with Optics and Photonic courses used in other Physics offerings. In such cases the issue of viability is avoided and the specialist major can be maintained wherever an industry demand is sustained.

5.7 2015 accreditation submission - reported progress in actioning 2010 and 2011 visit recommendations

As an outcome of the 2010 general review and the 2011 interim visit, the respective panels each formulated recommendations to the schools, intended as input to the processes of continuing quality improvement.

The 2010 and 2011 recommendations are reproduced in the table below. Paraphrased summaries of action taken by ANU, as reported in the 2015 submission documentation, are shown in *italics* in the second column. Observations and issues earmarked for follow-up during the visit are provided in **bold italics text**.

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Reported Action Taken &amp; Observations</th>
</tr>
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<tbody>
<tr>
<td><strong>R1, 2010 BEng and BSoft Eng</strong></td>
<td>A comprehensive rationale and description has been developed for each major, as well as for the Systems Engineering core in the RSEng programs. These include a brief statement of learning outcomes for the major/core. A 10-point statement of Learning Outcomes has also been recently developed for the BSoftEng. For all courses in all programs, a brief statement of Learning Outcomes has been developed and published within course outlines. 'Ticked-box' mapping has been undertaken to crosslink learning outcomes with the Stage 1 competency elements. More recently, ticked-box mapping has been undertaken to cross-link the aggregation of course-level learning outcomes with the specified learning outcomes at the program level. The learning outcome specifications for majors/core/programs are brief in nature. Cross linking these specifications with the Stage 1 competencies has been attempted, but the broad nature of the graduate outcomes specification makes it difficult to fully correlate synergies. The same difficulty arises in tracking the ticked-box links between individual course learning outcomes and the attainment of designated graduate learning outcomes as well as with the Stage 1 competency elements. Further discussion is provided in Section 9. Recommendations R1, R2 and R3 address the need to establish an integrated specification of graduate outcomes for each program/major and to strengthen the course level mapping of learning events and assessment measures to track the measured attainment of these outcomes.</td>
</tr>
</tbody>
</table>

<p>| <strong>R1 2011 BEng (R&amp;D)</strong> | Ensure that the current process of course mapping extends to the systematic demonstration of program-level outcomes. |</p>
<table>
<thead>
<tr>
<th>The mappings should demonstrate a top-down approach and cover both the generic Stage 1 competencies and clearly stated discipline-specific outcomes.</th>
</tr>
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</table>
| **R2 2011 BEng (R&D)**  
Ensure that by completion of their program, students have attained all of the 13 specified Learning Outcomes for the Engineering Research and Development Project courses. |
| Amendments have been made to the Engineering Research and Development Project (Methods) course to improve reflection, critical analysis, collaboration and presentations skills. This improves the ability of students to undertake independent research and their overall engagement with developing the learning outcomes stated for the program.  
**Delivery of specified graduate outcomes was investigated thoroughly by the 2015 panel and an analysis of findings is provided in Section 9 to follow.** |
| **R2 2010 BEng and BSoftEng**  
Program leaders should have their roles and responsibilities defined so that they, with their teaching teams, are accountable for generating a rigorous educational design and review process for each major; for interacting with their partner teaching teams from other majors; for interacting with both student and external stakeholders; for developing and reviewing the ‘big-picture’ major objectives; and for mapping and tracking the aggregation of subject learning outcomes into graduate capabilities and specified program outcomes. |
| In RSEng, the introduction of Discipline Committees, led by Discipline Chairs, has focussed the program leadership task at the individual major level and also for the Systems Engineering core. Discipline Committees have a role in maintaining communications with key stakeholders and report to the school-level Curriculum Development Committee. The Discipline Committee Chair interacts closely with Course Convenors within the major to ensure coherence and sound structuring of the program. The Curriculum Development Committee provides the mechanism for formal interaction between the disciplines. The Discipline Chairs work under the leadership of the Associate Director (Education) for the School. Discipline Committees are aligned with cognate research themes, but go beyond such boundaries and cross to other disciplines.  
In RSCS, teaching leadership is the responsibility of the BSoftEng Program Convenor, again working with the School’s Associate Director (Education). |
| **R3 2010 BEng**  
Program leaders and academic staff should share and be conscious of the objectives of the majors and continue to develop them accordingly. A structure, inclusive of the whole teaching team, should be in place for each major to support its teaching and development, and to provide student support and outcomes monitoring. |
| The 2015 panel investigated the coherence and effectiveness of program leadership and the level of engagement of all members of the teaching team in ‘big-picture’ issues concerning the assured delivery of designated graduate outcomes. Some concerns and suggestions are raised in the Section 9 discussion to follow. Recommendation R5 addresses the need for strengthening the leadership function, accountability and level of engagement of the Discipline Chairs (RSEng) and Program Convenors (RSCS). |
| **R4 2010 BEng**  
The relationship between research areas and BEng majors be reviewed so that a dynamic strategic approach is taken to ensure currency of the outcomes of each major stream. In particular, majors should be organised around teaching teams, rather than research teams. |
### R5 2010 BEng

Ensure that an active Consultative Advisory Group for the BEng programs is in place with membership relevant to all programs and majors, and that these panels engage systematically with the work of program teaching teams and relevant School committees in the ‘big-picture’ task of setting, reviewing and tracking attainment of the designated specification of graduate outcomes.

In 2012, the CECS Consultative Advisory Group was re-convened at school level and the RSEng School Advisory Board emerged. The first meeting was in the second half of 2014. The stated key function is to provide advice to the Director of RSEng on the education programs in relation to industry current and future needs, to assist in creating opportunities for student-industry exchanges and to foster research and collaboration opportunities with industry.

The Board has 11 industry representatives along with the Director of RSEng, the Associate Director (Education), Associate Director (Research), Associate Dean (Education) and the BSoftEng Program Convenor. The Chair of the Board is Dr Peter Campbell of KPMG Melbourne.

The panel investigated the level of engagement this Board (and the equivalent Board in RSCS) has had, at the ‘big-picture’ level, in establishing the graduate outcomes specification, and tracking the contributions that academic courses are expected to make to assure the delivery of these outcomes. Findings are presented in Section 9. Recommendations R9 and R10 capture the panel’s suggestions for improving the breadth of representation, functionality and nature of engagement of the Industry Advisory Boards.

### R6 2010 BEng and BSoftEng

Ensure that student feedback continues to be obtained and acted upon, particularly during a period of structural reorganisation. Specifically, it must be ensured that there is meaningful and formal engagement with students as true partners in the processes of continuing improvement at the individual program and major level, and that students are contributing meaningful input through focus groups and/or direct consultation and input to the work of program/major teaching teams. Such engagement must be embedded as part of the educational culture from the beginning of the study program and must be accompanied by systematic processes for feeding back to students the details of actions taken.

Student feedback continues to be obtained and acted upon through a variety of channels. The Student Representative Committee (SRC) operates at School level and provides two-way feedback and discussion between students and the schools on research and teaching matters. The SRC consists of one student representative from the various year levels of each program, one post-graduate student representative, and representatives of ANU student associations as well as senior staff representatives.

Anonymised feedback from the SRC is claimed to be passed to the relevant course convenor and to School Course Convenor meetings. It is also claimed that subsequent actions are relayed to students. In the case of the SELT survey system there does not seem to be a systematic process for advising the student body of action taken to respond to issues raised in course survey responses. There does not appear to be systematic mechanisms for the student body to engage with program teaching teams in the processes of setting, reviewing and tracking attainment of an integrated graduate outcomes specification. Student feedback mechanisms were investigated in further detail by the panel and reported in Section 9. Recommendation R6 and R7 capture the key issues that the panel feels need to be addressed in relation to student engagement and feedback.

### R7 2010 BEng

The content of the Photonics major should be reviewed to ensure that it is more engineering oriented; staffing and succession planning must be reviewed; and ongoing quality control of this major taken by CECS, but with strong links into significant changes have been claimed to be made to the Photonic Systems major since the 2010 visit. These changes provide the major with a greater engineering focus. Since 2012 the 8 courses comprising the major contain 3 PHYS and 5 ENGN courses. Two of the ENGN courses are co-badged with existing PHYS courses.

The panel acknowledged these changes, but had on-going concern for the depth of engineering content and the fact that the majority of teaching of the specialist courses that make up the major is undertaken, somewhat in isolation, by physics staff.
the partner College. There does not seem to be a regular forum where engineering staff responsible for the Systems Engineering core and the physics staff responsible for the courses within the major come together to review the big-picture outcomes for graduates and to track learning and assessment contributions flowing from the various courses across the program as a whole. The integrity of the engineering ethos within the Photonics major was further investigated by the panel and reported in Section 9. Recommendation R13 expresses the need for a collaborative review of the Photonic Systems curriculum content.

<table>
<thead>
<tr>
<th>R8 2010 BEng and BSoftEng</th>
<th>A commitment was made to keep Engineers Australia advised of future changes to the engineering program offerings. Engineers Australia was advised at all stages of the recent creation of the Biomedical Systems major.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systematically inform Engineers Australia of future changes to program offerings, both at the planning stage and at the point of implementation.</td>
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<tr>
<td>R8 2010 BEng and BSoftEng</td>
<td>Reflective practices are now well in place for the first R&amp;D project course (Engineering Research and Development (Methods)) within the R&amp;D program stream. This course has been significantly redesigned since the 2010 visit and utilises learning logbooks on the WATTLE LMS for fortnightly reflection on project progress. Use of reflective practices as part of a self-assessment regime was investigated more generally by the panel and comments are recorded in Section 9. Recommendation R8 addresses the need to broaden the culture of reflective practice amongst students, with reflection on professional development referenced to an integrated graduate outcomes specification.</td>
</tr>
<tr>
<td>R3 2011 BEng (R&amp;D)</td>
<td>Require for all Engineering Research and Development Project courses an assessed, reflective journal to assist students to track their learning.</td>
</tr>
<tr>
<td>R3 2011 BEng (R&amp;D)</td>
<td>Structural changes to the Systems Engineering core since the 2010 visit have seen the addition of the Engineering Innovation and Engineering Management courses to the 3rd year of the programs. The Systems Engineering Project course in final year serves as a capstone event for group-based projects. It is not designed as a pre-requisite requirement for the Individual Project course in the final year of the BEng (Hons), nor for the final year Research and Development Project courses in the BEng (R&amp;D) (Hons). The 2015 panel accepted the argument for the retention of the Systems Engineering project as a final year course run in parallel with the individual student capstone project activity in each of the programs.</td>
</tr>
<tr>
<td>R4 2011 BEng (R&amp;D)</td>
<td>To improve students’ preparation for their Final Year projects, make ENGN4221 Systems Engineering Project a third year core course. Consideration should be given to offering ENGN3211 Investment Decisions and Financial Systems an elective course for Year 4.</td>
</tr>
<tr>
<td>R5 2011 BEng (R&amp;D)</td>
<td>The study of Human Factors in engineering design and analysis is now an explicit topic in the 2nd year Systems Engineering Analysis course. The panel was satisfied with this development.</td>
</tr>
<tr>
<td>R5 2011 BEng (R&amp;D)</td>
<td>Enhance the understanding of the engineering context, including human dimensions, in the BEng (R&amp;D) program. This may be achieved through further contextualisation in courses such as ENGN3221 Engineering Management and ENGN2226 Systems Engineering Analysis.</td>
</tr>
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6. PRE-VISIT TELECONFERENCE

In preparation for the general review visit, the evaluation panel came together for a teleconference, held on Wednesday, 2 September, 2015 to consider the initial documentation submitted by the University.

Panel members who participated in the teleconference were:

- Em Professor Mark Bush Hon FIEAust – The University of Western Australia (Panel Chair),
- Dr Jerome Vethecan MIEAust CPEng – Project Manager, BAE Systems Australia,
- Ms Kelly Coverdale MIEAust - Senior Biomedical Engineer, Biomedical Technology Services, Queensland Health,
- Dr Tim Aubrey FIEAust – Associate Dean (Teaching and Learning), Faculty of Engineering and Information Technology, University of Technology, Sydney,
- Professor Michael Austin FIEAust CPEng – Head, School of Electrical and Computer Engineering, RMIT University,
- Dr Jocelyn Armarego MIEAust MACS CP – Senior Lecturer, School of Engineering and Information Technology, Murdoch University,
- Em Professor Alan Bradley FIEAust CPEng – Accreditation Consultant, Engineers Australia (Visit Manager),
- Dr Lincoln Wood FIEAust CPEng – National Manager Accreditation, Engineers Australia,
- Ms Jill Kiley – Accreditation Officer, Engineers Australia.

The pre-visit teleconference provided an opportunity for the panel to share initial impressions and findings from individual consideration of the submitted documentation. Some aspects of the submission were found to be unclear, and/or partially incomplete. As an outcome of this initial consideration, the panel developed a list of specific requests for issue clarification and additional information from ANU. A teleconference report, subsequently sent to the University, contained the panel’s requests as well as a list of key issues earmarked for deeper discussion or investigation during the visit. This list was later reformatted as a set of question themes targeted for each of the key sessions during the visit.

A response to the panel’s request was received on 1 October, 2015 and was immediately distributed to panel members to aid in their final preparation for the visit. This response comprehensively addressed the additional information and issue clarification requests made by the panel.

6.1 Further clarification and information requests

GRADUATE OUTCOMES SPECIFICATION

1. For the BSoftEng (Hons) has there been any attempt to establish a comprehensive specification of objectives and graduate outcomes (as requested under recommendation R1 - 2010 visit report)? Some evidence of this is apparent for the BEng (Hons) - from the major descriptors (Pp 161-182), and the mapping analysis, but not so for the BSoftEng major descriptor (Pp183-187).

2. For the RSEng programs, could some insight be provided to the development processes which led to the Discipline Description and Learning Outcome statements (in the Major Descriptions P161-182)? What is the status of this development work and is it intended to satisfy the notion of an integrated graduate outcomes specification for each major, as requested under recommendation R1 from the 2010 visit report?

3. Could information please be provided on the consultation processes and key advice that led to the establishment of the Biomedical Systems major. In particular summarise the outcomes of any demand analysis as well as the rationale, primary focus and key objectives set for this new major.
MAPPING DELIVERY AGAINST THE STAGE 1 COMPETENCIES

4. What processes were used to develop the program and course mapping tables provided with the submission? How will the mapping processes, which have been detailed for each major and each course, be utilised in future processes of review and improvement? How will this mapping information be disseminated and used by students?

CURRICULUM STRUCTURE

5. Could a brief summary please be provided of the key changes that were made to the predecessor BEng and BSoftEng programs to address the revised AQF 8 requirements for the Bachelor Honours Degree outcome. Any reporting to TEQSA on this matter would be of interest to the panel. It is presumed that the first year of offering of the revised AQF 8 Honours degrees was 2015. Can this please be confirmed. Are there any students who will continue enrolment in, and graduate from the predecessor BEng/BEng (R&D)/BSoftEng beyond 2014?

6. For the BEng (Hons) program and the BSoftEng (Hons) program outcomes, could the panel please be advised on how the curriculum addresses research knowledge, research methods and research skills development, (as distinct from the strong emphasis on these aspects in the BEng (R&D) (Hons)).

7. Page 81 refers to the “myriad ways in which students are being exposed to professional engineering practice in the ENGN courses”. Some examples are given. Are there further specific examples of site visits, industry teaching input, project work, case studies or industry problem solving that can give the panel confidence that adequate exposure is occurring in the latter years of each individual major offered by RSEng.

8. Could clarification please be provided for the RSEng programs on the requirements and reporting associated with the ‘ENG3200 Engineering Internship’ mentioned on P81 of the submission? Is industrial experience a mandated requirement? What is the implication of the statement on P81 “To encourage uptake of Engineering Internship by R&D students, credit is allowed towards …….”? This seems to imply that the work experience internship is optional?

PROGRAM DELIVERY

9. For the RSEng majors and for the BSoftEng (Hons) are there any further examples of reflective practices used by students to track professional development. On Page 16 of the submission, mention is made of the use of learning logbooks in ‘ENG2706’, but there is little further reference to the use of reflection as a formative, self-assessment practice.

10. Could further information please be provided on the conduct of the capstone project event in the BEng (Hons), BEng (R&D) (Hons) and the BSoftEng (Hons). What processes are in place for project sourcing, proposal and specification, as well as for supervision and moderation of outcomes?

INDUSTRY ADVISORY MECHANISM

11. Could further insight please be provided on the activities of the RSEng Advisory Board? What level of engagement has there been with the graduate outcomes mapping analysis? How does this Board address the very different program structures that apply to the BEng (Hons) and BSoftEng (Hons) outcomes? How does the input from this Board interface to the work of Discipline Committees in tracking the delivery of graduate outcomes and monitoring the overall learning and assessment design?

TEACHING TEAM LEADERSHIP

12. Could further information please be provided on the functioning of the Discipline Committees in the RSEng - P30. Does the membership of these Committees involve all staff members delivering teaching into the particular major? What has been the level of engagement of individual Course Convenors in
establishing and reviewing the graduate outcomes specification, as well as in mapping and tracking delivery of these outcomes through learning and assessment contributions at the individual course level?

13. What is the equivalent of the Discipline Committees in RSCS and how is the engagement of the Software Engineering teaching team managed in relation to the ongoing tasks of setting, reviewing, mapping and tracking delivery of graduate outcomes?

**STUDENT REPRESENTATIVE COMMITTEE**

14. Page 31 describes the functioning of the SRC in RSEng. Are the year level representatives selected from each major? What engagement is there of the student body at the educational design level, providing input to the processes of reviewing, and tracking attainment of targeted graduate outcomes through learning events and assessment. What links are there between the SRC outcomes and the work of the Discipline Committees?

15. What equivalent processes of staff-student engagement are occurring for the Software Engineering program?

**STAFF PROFILE**

16. Could some commentary please be provided by the RSCS on the current teaching staff profile for the BSoftEng program – (to parallel the discussion provided on Pages 36-40 for the RSEng majors). In particular could comment be provided on the mix of seniority and expertise of academic staff in the Software Engineering domain and any perceived shortfalls or recruitment plans.

17. For the RSEng programs, could a consolidated table please be provided to list the name of the Course Convenor and other staff teaching into each course within the systems engineering core and for each of the listed courses for each major. Also identify any teaching input from industry professionals in this summary table.

18. For the Photonics major, please identify in the tabular listing above, Course Convenors and staff delivering teaching input from the College of Physical and Mathematical Sciences. Please ensure that the panel has copies of CVs for each member of staff from CPMS teaching into this major.

19. For the BSoftEng (Hons) program also, could a consolidated tabular listing please be provided to identify the name of the Course Convenor and other staff teaching into each course within the Software Engineering program. Again identify teaching input from industry professionals in this summary table.

**BENCHMARKING**

20. Is there any progress to report from the benchmarking/moderation process that was proposed for the second half of 2015 (Section 2.1.9.6, P97)?

**6.2 Question themes**

As an outcome of the teleconference, the following question themes were developed to steer panel discussion at the various stakeholder sessions during the accreditation visit.
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<td></td>
<td>• Interaction between RSEng and RSCS – sharing good practices, equivalence of standards, outcomes-based educational approach, scope for any more commonality, deeper collaboration?</td>
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<td>• Depth of engineering staff engagement with CPMS for the Photonics major?</td>
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<td>• Research Group engagement and benefits to students P57-58?</td>
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<td>• Benefits flowing from Alumni relationships P60?</td>
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<td>TEACHING STAFF PROFILE</td>
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<td>• Workload polices/practices – student/staff ratios P44-45? Balancing of teaching/research loads?</td>
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<td>• Pedagogical skills development for staff? Learning development support – move to flipped classroom and Wattle-based blended learning modes P53?</td>
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<td>• Extent of industry teaching input to enrich staff skills profile and exposure of students? Proportion of teaching provided by casual/sessional staff?</td>
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<td>• Role of Discipline Chair/Program Convenor – effectiveness of leadership of program/major teaching teams within Discipline Committee framework? Cohesiveness of teaching teams? Discipline Committee membership when majors/programs transcend school or college boundaries?</td>
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<td></td>
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<td>• Strategic planning process – equipment renewal program, capital funding sources?</td>
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<td>• Equipment provision for new initiatives such as Biomedical?</td>
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<td>6</td>
<td><strong>SPECIFIED GRADUATE OUTCOMES AND MAPPING</strong></td>
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<td>• For RSEng programs, any intention to build a unique specification of objectives and graduate outcomes for each major - integrating the Stage 1 Competencies with the technical/engineering application competencies that are unique to the major (Recommendation R1, 2010)? Why cross-map the learning outcomes specified for the major with the Stage 1 Competencies, rather than building a unified specification of outcomes for the major and then a single mapping of course learning and assessment contributions to this integrated statement of outcomes?</td>
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<td>• Intended use of mapping tables – by students, staff, Advisory Board? Staff take-up at this stage?</td>
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<td>• How is the aggregation of individual course contributions to delivery of Stage 1 competencies monitored and balanced?</td>
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<td><strong>PROGRAM TITLES</strong></td>
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<td>• Are majors identified on the graduate testamur for the BEng (Hons) and BEng (R&amp;D) (Hons)?</td>
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## SUGGESTED - ON SITE QUESTIONS

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<td>• Structural differences – 102 credit unit core, 6x6 units of <em>Engineering Research and Development Project</em>, <em>Advanced Mathematics</em> courses year 1, added <em>Engineering Research and Development (Methods)</em> course.</td>
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<td>• Apparent loss of 1x6 units of university-wide electives – (website structural description), disputed by 6 x 6 units of electives statement on P83 of submission? Dual degree implications?</td>
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<td>• Research/investigatory knowledge and skills development – BEng (Hons) and BSoftEng (Hons)? Research methods skills development?</td>
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<td><strong>10</strong></td>
<td><strong>PROGRAM DELIVERY</strong></td>
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<td>• Assessment moderation requirements and process? Management of academic standards?</td>
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<td>• Nature of ‘ENG4200 Individual Project’ - (BEng (Hons) and ‘ENG4712 Engineering Research and Development Project’ - BEng (R&amp;D) (Hons) as individual capstone project events? Details of research content, moderation of project complexity and scope, supervision arrangements, assessment structure, and moderation of standard of deliverables? Nature and role of contrasting, team-based, capstone ‘ENG4221 - Systems Engineering Project’. Any industry engagement with this project?</td>
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<td>• Nature of capstone project event options – BSoftEng (Hons)? Details of research content, moderation of project complexity and scope supervision arrangements, assessment structure, and moderation of standard of deliverables?</td>
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<td>• Managing industry teaching and industry-based course convenor-ship - P90 for BSoftEng (Hons)?</td>
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<td>• Use of reflective practices for students as a self-assessment process to track development of competencies - (Recommendation R3 2011). Extension of foundational reflective skills developed in ‘ENG2706’, P16? Any equivalent processes in BSoftEng (Hons)?</td>
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<td>• Progress on development of online learning resources for individual course Wattle pages? Penetration of flexible learning options for students in various courses? Plans and targets?</td>
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<td><strong>11</strong></td>
<td><strong>PROGRAM CONTENT – DEGREES AND SPECIFIC MAJORS</strong></td>
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<td>• Do majors and specialisations listed for the Software Engineering program – P89 and P184 have the same standing as the majors listed for the BEng?</td>
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<td>• Benefits and mechanics of unique, industry group projects and TechLauncher initiative – Software Engineering program P90-91? Moderation of individual student input and project team student management hierarchy? Extension to other disciplines?</td>
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<td>• Any scope for further commonality with BEng (Hons) structure – especially with regard to Systems Engineering, engineering synthesis and design, project management, engineering management, professional skills and attributes development? Opportunities for sharing resources and successful practices, and for facilitating multi-disciplinary project teams?</td>
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<td>• Further issues to be raised by panel specialists.</td>
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<td><strong>MECHATRONIC SYSTEMS, BIOMEDICAL SYSTEMS, MECHANICAL AND MATERIAL SYSTEMS</strong></td>
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<td>• Consultation, rationale, demand analysis and benchmarking undertaken in the processes of establishing the Biomedical Systems major? Intended focus? Appropriateness of present title? Projected graduate destinations?</td>
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<td>• Further issues to be raised by panel specialists.</td>
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### ELECTRONIC AND COMMUNICATION SYSTEMS, PHOTONIC SYSTEMS, RENEWABLE ENERGY SYSTEMS

- Changes to Photonics major reported P14, against Recommendation R7 2010. What has been done to strengthen engineering focus P14? Split of teaching between CECS and CPMS staff? Role of newly appointed RSEng staff members P14? Discipline Committee Chair for this major is from CPMS – how does this work?
- Do Photonic students see themselves as budding engineers? Engineering ethos – Photonic Systems major?
- Further issues to be raised by panel specialists.

### EXPOSURE TO PRACTICE

- For RSEng majors, what exposure mechanisms beyond those examples referenced in the submission document P80-81? Any industry engagement, sponsorship, assessment of project activity? Teaching input from industry professionals, site visits, case studies, industry problem solving – specific majors, and Systems Engineering core - latter years of program? Integrating exposure to practice with technical courses?
- Managing industry sponsorship/engagement in BSoftEng (Hons) third year ‘COMP 3500 Software Engineering Project’?
- What is the internship option “ENG3200”, and how is it implemented?
- Management of industry internship/work experience requirement ‘ENG3200’, ‘ENG3100’ and ‘COMP4800’? Reporting requirements? Any reflective processes to track learning outcomes against graduate outcomes specification? Fragmented industry experience option for BSoftEng (Hons) P92?

### QUALITY SYSTEMS

- Industry Advisory Board – balance of representation across BEng (Hons) majors and BSoftEng (Hons). Engagement of Board with ‘big-picture’ graduate outcomes specification – discipline specific knowledge and skill requirements. Setting, reviewing and tracking attainment of the graduate outcomes specification?
- Communicating Advisory Board input to the Discipline Committees?
- Effectiveness of year-level representation on SRC? Engagement with the outcomes-based educational design approach? Mechanisms for providing feedback to the student body on action taken to address issues raised in SELT surveys and from SRC discussions.
- Feedback mechanisms and processing of student feedback in the RSCS?
- Communicating SRC outcomes to the Discipline Committees in RSEng?
- Report on progress - planned benchmarking/moderation exercise with another Australian university Page 97?
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<td>• Approach to educational design and review – cycle, big-picture approach, staff engagement/accountability?</td>
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<td>• Closure of loop on delivery of outcomes at program and course level? Tracking development of graduate outcomes in individual students?</td>
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<td>• Disseminating educational philosophy, learning and assessment design and mapping to students.</td>
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<td>• Appropriateness - merit-based Honours outcomes?</td>
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7. COMMENDATIONS

The panel wishes to specifically congratulate the schools on the following aspects of the program implementations.

- The strong learning contributions arising from team-based, multidisciplinary industry project activity, (mimicking the processes and structures which would apply in an industry setting), as occurs in the 6-unit BEng ENGN4221 Systems Engineering Project course and also in the 12-unit COMP3500 Software Engineering Project courses.

- Innovative development of TechLauncher opportunity for Software Engineering students to extend project development into a start-up company as an implementation of the 12-unit COMP4500 Software Engineering Practice project extension course.

- For all BEng majors, an innovative and effective Systems Engineering core within an interdisciplinary context that offers wide options to students, including flexible double degrees and dual majors that do not compromise the integrity of the mandated engineering core and first major requirements.

- Reflective reporting process in RSEng, based on career episode analysis referenced to Engineers Australia Competency Standards, for internship and work experience activities.

- Highly effective research/teaching integration.

- Strong industry-based connections underpinning the BSoftEng (Hons).

- Potential offered by RSEng and RSCS (BSoftEng) alumni networks for strengthening industry linkages for students.

- Planned investment in laboratory and teaching and learning facilities for both Engineering and Computer Science.
8. ACCOUNT OF VISIT PROCEEDINGS

A record of the visit schedule, (including specific discussions with graduates and other external stakeholders, the senior leadership team, academic staff and students), is provided in Attachment 1.

Issues raised in sessions with various stakeholder groups are incorporated within the detailed discussion to follow in Section 9, as well as in the specific recommendations for the schools in Section 10. Additional notes arising from discussions with students are provided in Attachment 2.

The panel wishes to sincerely thank Professor Ian Young – ANU Vice Chancellor and Professor Marnie Hughes-Warrington - DVC (Academic); Professor Elanor Huntington – Dean of College of Engineering and Computer Science (CECS); Dr Jochen Trumpf - Associate Dean (Education), CECS; Professor Robert Mahony - Director, RSEng; Professor Alistair Rendell - Director, RSCS; Ms Leanne Cambridge - General Manager, CECS; the school Associate Directors (Education), Discipline Chairs and Program Convenors as well as the academic staff, administrative and technical support staff and students for their hospitality and enthusiastic cooperation which very much facilitated the accreditation process.

The enthusiasm of academic staff and students to engage in open discussion and the opportunity for the panel to converse with industry advisers and graduates were all highlights of the visit.

Some difficulties were experienced by panel members in tracking evidence through website references and a series of complex links. The assistance of staff in resolving these references and tracking the necessary evidence was very much appreciated.

The panel appreciated the detailed response to the teleconference report which answered questions and helped clarify issues raised by panel members. The panel wishes to specifically thank Mr Phillip Tweedie for his efforts throughout the visit to locate extended examples of student work and other curriculum information that was missing from the initial electronic and hard copy compilation of materials prepared for perusal by panel members.
9. CRITICAL FINDINGS REFERENCED TO ACCREDITATION CRITERIA

9.1 The operating environment

9.1.1 Organisational structure and commitment to engineering education

- The organisational structure at college and school level has been relatively stable since 2010. The introduction of Discipline Committees and Discipline Chairs in RSEng is one change that has potential for strengthening leadership at the program/major level as discussed below. The step taken to re-constitute an Academic Board for ANU was a surprise to the panel. It is hoped that the Academic Board and associated committee structures can drive a more outcomes focussed educational culture at ANU, with quality systems which can systematically track the delivery of targeted graduate outcomes in individual students.

- ANU management has a strong commitment to engineering research and education and a desire to expand the quantum of engineering activity and its impact on the overall profile of the University. The current investment in new buildings and laboratory facilities for engineering is testimony to this level of commitment.

- The committee structures in the two schools and at the College level are appropriate for the management, approval and quality assurance of program offerings. However, for a higher level of collaboration between Discipline Chairs/Program Convenors and between teaching staff members from RSEng and RSCS. This is discussed in more detail to follow, and is embedded in Recommendation R5.

9.1.2 Academic and support staff profile

- The panel was satisfied with the academic staff seniority and expertise profile for the majority of the RSEng declared majors. The one exception is felt to be the expertise and capacity of current staff available for delivering the new Biomedical Systems major. Existing staff expertise appears to be concentrated in the nano-technology/nano-materials domain and lacks the breadth expected. This issue may well be related to the curriculum shortcomings discussed in Section 9.2.4.3 to follow.

- For the Software Engineering discipline, a recruitment plan is in place for the 2016-2017 timeframe, to further strengthen the breadth of staff expertise. Teaching input from research academics, appropriately supervised by internally funded ‘faculty’ academics, can enrich the learning of students through the breadth of specialist expertise on offer.

- For the BSoftEng (Hons) there is a team of some 13 ‘faculty’ staff members from RSCS who teach into the program. There is a strong record of software engineering industry experience amongst the members of the team.

- For the Photonic Systems major, there is still high reliance on teaching input from Optical Physics staff from the College of Mathematical and Physical Sciences (CMPS). The Discipline Chair in this case is from that College and there are three members of Physics staff who provide key teaching input to the specialist courses that define the major. Concerns raised by the 2010 panel in relation to the engineering orientation of this major have again been identified during the current visit. A key dependency here is the staff members who deliver the specialist courses for the major. The panel was not given the opportunity to meet the Physics staff, (other than the Discipline Chair), who provide teaching for these specialist courses. All of the courses which make up the major are common to other engineering majors or common to other programs delivered by CMPS. In this latter case, the question of engineering ethos and the mapping of learning outcomes back to engineering competencies naturally arises. The panel was advised that CECS and CPMS are in the process of establishing a Joint Board of Studies with membership drawn from Associate Deans (Education) and Associate Directors (Education) to oversee such joint educational offerings. It is hoped that this Board can acknowledge the panel’s concerns, and facilitate a greater engagement of Physics staff members with RSEng staff members through the work of the Discipline Committee.
All academic staff members at ANU are expected to be ‘research active’ and adequate provision is provided for this in workload modelling. The typical load for ‘faculty’ academic staff member (internally funded) would be the delivery of two courses per year, but this is flexible and depends on the other activities of each individual. Specialist contributions to teaching come from externally funded research academics, (within funding constraints). The large number of PhD candidates provides for generous assistance in laboratory and tutorial supervision. Student EFTSL to Staff EFT ratio appears to be acceptable, although various figures were quoted depending upon on how post graduate supervision and course work delivery is taken into account.

A centralised unit provides assistance with educational initiatives and provides the opportunity for staff to undertake a Graduate Certificate qualification in the teaching and learning field. This is not a mandated requirement but is highly encouraged. Experimental teaching developments are encouraged. Staff members who perhaps receive a diminished good teaching score in SELT surveys as a consequence of trialling a new teaching method are not required to take remedial action, as would be the case when teaching performance drops below a defined threshold in such surveys.

A key strategy in RSCS is to recruit staff members with appropriate backgrounds who can grow into the research and teaching roles, and to ensure that an appropriate expertise/seniority profile is in place for any new discipline before launching a postgraduate or undergraduate academic program in the field.

In the teleconference response, details were provided of selected teaching input from industry professionals. A substantial list of guest and sessional teaching contributions was provided for the Systems Engineering core, individual majors and also for the BSoftEng (Hons) program. These claims were not broadly substantiated, however, in conversations the panel had with student representatives. The panel could only assume that some of these contributions had been more recently set up, and not experienced by senior students in the current programs.

Academic staff members appeared enthusiastic about their role and were eager to provide input to the panel. There appears to be a reasonable team spirit and good collaboration between staff members at the teaching level. Students report staff to be responsive and accessible and are generally satisfied with teaching performance. Isolated incidences of poor teaching performance appear to have, in most cases, been resolved through student feedback systems.

A capable technical support team manages the RSEng laboratories and workshops, and provides support to students in project-based learning. A Technical Services Review has been initiated to reflect on present processes, governance, management and culture of the RSEng technical services group. The review will help RSEng assess future needs and directions for the next five years.

A restructuring of student services staff occurred in 2014, with responsibilities of RSEng and RSCS administrators re-aligned to report to the Manager, CECS Student Services, thus providing a unified student services function for the College. A survey of students has since been conducted to evaluate the quality of service experienced by students and this is being used as a basis for continuing improvement.

9.1.3 Acadecnic leadership and educational culture

The panel was particularly interested in the evolution of the Discipline Committees in RSEng and the role of the Discipline Chair. It was anticipated that this function might have addressed the concerns expressed in previous visits, for stronger leadership of program teaching teams, particularly in building an outcomes-based educational culture amongst staff, but this need is felt to have been only partially satisfied.

The Discipline Committees align with research strengths and, of course, the majors available under the BEng (Hons) and BEng (R&D) (Hons) frameworks. It was some surprise for the panel to find that Discipline Committee membership comprises only selected ‘senior and experienced’ academics in each respective discipline. Other staff members teaching in the major are able to attend voluntarily or by invitation. It is the role of the Discipline Chair to communicate issues and findings of the Committee with Course Convenors who are not part of the Committee. This structure does not correlate strongly with the concept of an integrated program/major teaching team with accountability for a holistic educational design and review process, tracking delivery of an agreed graduate outcomes specification from the individual course learning experiences and assessment measures. This concept was heavily promoted in the 2010 accreditation visit report.
The panel did not gain the perception that individual Course Coordinators in RSEng were engaging rigorously with ‘big-picture’ graduate outcomes, although they had each been asked to tick-off the perceived contributions that they felt their course was making to graduate outcomes specified for the major and to the Stage 1 competency elements. In neither school did the panel find evidence of a strong, outcomes-based educational culture, or systematic exploration of new learning pedagogies. This was despite active publication by academic staff in the engineering education literature. On the other hand, project-based learning, involving substantial student teams working to deliver outcomes to an industry client, has undoubtedly been developed over a considerable time period with very successful outcomes in both schools.

The published role of Discipline Chair is broadly based and includes extensive, multi-way communication with all stakeholders. It also includes “the maintenance of aggregated learning outcomes across the entire major”. The school-based Curriculum Development Committee is called upon to “provide the avenue and mechanism for formal interaction of the Disciplines”. These committees typically meet twice per semester. In the panel’s view, there is a weakness in this process, particularly given that each student is exposed simultaneously to the Systems Engineering core as well as the defined courses which make up the particular major undertaken. Currently these intertwined program components fall under different Discipline Chairs. Achieving integrated leadership of the ‘program teaching team’ may well be more difficult under this dual-committee structure than it would be for a stand-alone Bachelor of Engineering structure. The need to engage all teaching staff responsible for the major and the Systems Engineering core with an integrated graduate outcomes specification and the processes of mapping and tracking delivery from course learning experiences and assessment tasks continues to be a priority and will need to be developed and managed more explicitly under the current Discipline Committee model.

For the Photonics major, with the Discipline Chair residing in CMPS, the link between the major study sequence and the Systems Engineering core appears to be even more tenuous. The tasks of mapping and tracking the learning experience and assessment contributions made to the attainment of an integrated graduate outcomes specification again will need to be much more structured with the Discipline Chair and Committee for the Systems Engineering core collaborating explicitly with their counterparts, largely located outside of RSEng, for the Photonic Systems major.

There was little evidence in RSCS of the BSoftEng (Hons) program teaching team engaging with the concept of an integrated specification of graduate outcomes or the associated course mapping processes. In this case, leadership would have to come from the Program Convenor, but it is not clear if outcomes-based program teaching team leadership is within the terms of reference set for the role.

There appears to the panel to be a lost opportunity for deeper collaboration between RSEng and RSCS at the educational design level. This extends to sharing best practices, exploring synergies and opportunities for a more common approach, and for improving opportunities for Software Engineering and Engineering students to cross-engage in team project activity across the school boundaries. The opportunity for Software Engineering students to experience the ‘engineering ethos’ in other engineering domains appears currently to be minimal. A more substantive role definition for Discipline Chairs and for the Software Engineering Program Convenor could perhaps help facilitate this greater collaboration to the benefit of all parties. It was argued that the ‘small College’ environment and a ‘grass roots’ sharing of ideas helps with bridging the school boundary, but in the panel’s view the lack of a systematic process and commitment has left untapped, these substantial collaboration opportunities. Strangely, the TechLauncher initiative invites students from other disciplines across the University to join student teams, but there was no mention made of explicitly involving RSEng engineering students in such teams.

The program leadership and engagement issues discussed above have been addressed in Recommendation R5.

9.1.4 Facilities and physical resources

The panel was largely satisfied with current provisions for laboratory and practical learning and followed with interest the state of development and future plans for the major building works for engineering at ANU. The transition to modern, model-based laboratory rigs that can be rolled in and out of laboratory spaces appears to be soundly based. In some instances limited facilities will mean complex scheduling of many student groups to provide the required access. Students in some areas
complained about the current laboratory session self-booking system and the difficulties they sometimes have in juggling conflicting commitments. The on-line booking system opens at a scheduled time and was reported to be immediately overloaded with students attempting to make their selections. There is a need to establish an improved system that will properly address the flexible access arrangements that are projected for the new laboratory, workshop and project facilities.

- Students also raised the issue of computer access within the RSEng environment. Engineering software not available for installation on BYO devices is installed on RSEng computers, but bottlenecks do occur and this causes considerable frustration. Students feel unwelcome in accessing computer workstations in RSCS and it is surprising that some collaborative arrangements could not be made to balance utilisation across the resources. Recommendation R18 addresses this particular issue.

- Another issue raised by students was the lack of collaborative learning facilities, such as meeting rooms and common areas. The panel was advised that provision would be made for these learning facilities in the building development underway.

- The existing and planned facilities development adequately accommodates current student profile and short term projections within the current delivery framework. Scaling to significantly larger student numbers in some specialisations could be difficult with limits on specialised apparatus and equipment sets.

9.1.5 Funding and budget process

- The University allocates base funding annually on a per-college basis, using performance indicators such as grant income, HERC points and HDR load, and this includes an allocation based on SCGS and HECS income. This latter component is based on enrolment trends and a predicted enrolment figure. These allocations flow through to the schools minus a college overhead. The CECS is in a strong budget position, with unlikely shortfalls in the foreseeable future. The College is benefiting strongly from the additional $60M capital investment funding which is underpinning the current buildings and facilities development program.

9.1.6 Student profile

- The panel considered student selection processes, as well as progression and other performance data provided. The enrolment statistics are summarised in the earlier background discussion - Section 5.6 above. Clearly ANU selects high calibre students into the programs offered. This is reflected in the progression data and in the observed standard of student work. The calibre and maturity of students was clearly apparent in the discussions the panel had with groups representing the various majors and programs.

- For articulating students from the Beijing Institute of Technology, the study program is structurally adapted to the strong theoretical and didactic pedagogy in place at the originating campus. Adequate provision is made for them to pick up the Systems Engineering core courses from the earlier years, thus transitioning them to the unique ANU undergraduate engineering ethos. The panel met with representatives of this articulation cohort. Students expressed specific hardships experienced with the transition process and the panel suggests in Recommendation R17 that a formal mentoring scheme be established to assist with adjustment to the new learning regime.

- Student selection of electives and minors in the RSEng programs shows a strong preference for Engineering and Computer Science courses (and second majors), then, in order of popularity, Business, Commerce, Law and Arts offerings.

9.2 The Academic Programs

9.2.1 Graduate outcomes specification and mapping processes

- For each of the majors in the BEng (Hons) and BEng (R&D) (Hons) and for the Systems Engineering core in these programs, a comprehensive Major Description document has been published.
provides a Discipline Description and a very brief list of Learning Outcomes, targeting skills, knowledge and some professional attributes that are unique to the major/core. The major-specific outcome statements need to be combined with the outcome statements for the Systems Engineering/R&D core to obtain an overall statement of outcomes for each specialisation. Unfortunately these outcome statements are all very broad in nature and lack the detail provided by the attainment indicators that are associated with each element of competency in the Stage 1 Competency Standard. This makes it difficult to interpret expectations and to assess adequacy of coverage of the Stage 1 competency requirements.

- The original submission did not provide an equivalent program overview document for the BSoftEng. The teleconference report response from ANU corrected ambiguities in the original submission concerning the structure of the program. An appendix in this response document provided a 10-point statement of graduate outcomes for the BSoftEng that had not been submitted to the panel previously.

- A more comprehensive, graduate outcomes specification is really needed for each major in the BEng programs and for the BSoftEng, to more explicitly integrate the generic, Stage 1 competency requirements. Ideally each element in this specification would incorporate performance indicators to help with interpreting the intent of each element, as well as for tracking attainment. Such a specification would then provide a unified foundation reference for mapping and aggregating the contributions that individual courses make to the assured delivery of the targeted outcomes. Ideally such mapping needs to track learning outcomes/activities and assessment tasks and grade individual contributions from each course. Contributions could be graded, perhaps using Bloom, CDIO or other appropriate taxonomies. The aggregated mapping would help identify any gaps in curriculum coverage and serve to demonstrate the balance of these contributions to realise the full graduate outcomes specification.

- At this stage two separate mapping exercises have been undertaken for the majors offered in the RSEng. First, a mapping table has been devised for each individual course. These tables use a ‘ticked-box’ approach to indicate the relationship between individual course learning outcomes and each element of the Stage 1 Competency Standard. There has been no apparent attempt to grade the relative significance of contributions made from learning and assessment measures as a means of monitoring the delivery of the Stage 1 competency elements/attainment indicators. There is a table in each course outline document which ticks linkages between course assessment items and the delivery of the individual course learning outcomes. Aggregating ticked-box tables to track the accumulation of course contributions to the balanced delivery of the Stage 1 competency elements is only useful for identifying significant gaps in coverage. The relevance and measured summation of individual contributions is not communicated.

- In the second mapping exercise, ticked-boxes indicate synergies between the learning outcomes specified for the particular major as well as for the Systems Engineering core with each element of the Stage 1 Competency Standard. Cross correlating such an independently derived graduate outcomes specification to demonstrate congruence with the Stage 1 Standard may be a valid process, but the broad nature of these ANU graduate outcome statements makes it difficult to assess the true coverage of the Stage 1 requirements.

- A similar stage of progress was reported in the original submission for the BSoftEng. In this case, only the mapping of course learning outcomes to the Stage 1 competency elements has been realised. Again a ticked-box approach indicates synergies between learning outcomes and Stage 1 elements for each individual course. The appendix attached to the teleconference response document providing the 10-point statement of graduate outcomes for the BSoftEng, and also included a ticked-box cross-mapping that had been recently completed to show links between course learning outcomes and these program-level outcomes. Again these outcome statements are very broadly based and make it difficult to assess how well the program addresses the generic Stage 1 competencies.

- Much of this mapping activity appears to have been undertaken recently and, in the panel’s view, is at a fairly preliminary stage of development and implementation. There is a need to consolidate this work, first building for each program/major the detailed specification of graduate outcomes, (integrating or more explicitly embedding the generic Stage 1 competency elements, as discussed above). A single mapping process then should track and aggregate the measured (graded)
contributions that individual course learning outcomes/learning experiences and assessment measures make to achieve a balanced delivery of this integrated specification of graduate outcomes. This consolidated mapping process would provide a snapshot check of the educational design integrity and be a powerful reference for:

- program teaching teams reviewing and improving the learning and assessment process, both at a structural and course content level;
- Industry Advisory Boards developing, evaluating and tracking the delivery of designated graduate outcomes in each program/major;
- students progressively reflecting on their personal development, and the contributions made from learning experiences, exposure to professional practice and work experiences.

- The need for developing an integrated and detailed graduate outcomes specification and for a unified mapping of course learning and assessment contributions is captured in Recommendation R1.

9.2.2 Titles of programs and awards

- Current BEng (Hons) and BEng (R&D) (Hons) titles do not reflect the interdisciplinary context and unique Systems Engineering basis of the programs as they have done for some periods in the past. The traditional Bachelor of Engineering title and attached field descriptor does suggest a more orthodox program structure, built on an intense technical curriculum within the particular engineering specialisation. The ANU programs are dominated by the Systems Engineering foundation, a strand of development which clearly spans the four years of the curriculum and delivers unique problem solving, analysis and design skills. In-depth knowledge and skills within a traditional engineering specialisation are developed through one or two major study sequences, currently identified in the field descriptor. There is a lost opportunity to promote these unique characteristics and to differentiate and clarify the intent of these programs.

- A primary title that includes the ‘Systems Engineering’ intent is very much encouraged. In the panel’s view, the RSEng programs are primarily targeting the field of Systems Engineering with students additionally taking one or two major study sequences in nominated specialist fields. Possible negative marketing implications of a title change are understood, but in the panel’s view there should be a compromise which can provide the necessary differentiation, but still carry the marketing force of the Bachelor of Engineering. A possible title is suggested in Recommendation R4.

9.2.3 BEng (Hons), BEng (R&D) (Hons) program structures and implementation framework

- The Systems Engineering core provides a unique breadth to foundation engineering knowledge and skills that is unmatched in classical, discipline-dedicated engineering bachelor degrees. This core strand occupies more than 50% of the course slots in the ANU programs and delivers underpinning mathematics and sciences, engineering foundations, professional competencies development and extensive project-based learning. Highlights noted by the panel were the Systems Engineering Analysis, Systems Engineering Design and Systems Engineering Project courses which validate the attainment of systematic problem solving and design abilities for large scale projects embedded within a complex setting.

- In-depth technical knowledge and engineering application skills are developed within the relatively narrow major study sequence selected by the student. Knowledge depth and engineering application skills in the specialist field of the first major are validated in the individual, 12 unit-capstone project experience for both the BEng (Hons) and BEng (R&D) (Hons). Students using elective slots to take a second major are not likely to exercise this second specialisation directly in the capstone project experience. The panel was satisfied with the standard of the project tasks and the volume of effort, supervision arrangements, assessment rubrics and the performance moderation processes associated with the capstone project event. Sample student reports confirmed an adequate standard of outcome, commensurate with the assessment level awarded. The panel was satisfied that students were being sufficiently extended in the specialist field of the major to achieve in-depth knowledge and skills, even if this was demonstrated within a narrow subset of the discipline. A second major, in a related field, is often taken by students to improve their breadth of coverage.
• After discussion and investigation, the panel feels that there is sufficient opportunity for developing knowledge and skills in research and investigation, embedded within the systems engineering core of the BEng (Hons), to satisfy AQF 8 requirements. For the BEng (R&D) (Hons) this development is taken significantly further in the dedicated Engineering Research and Development Project (Methods) course which is the first in a strand of six Research and Development Project courses that provide the project-based learning backbone for this elite degree stream. In Recommendation R12 it is suggested that the content of the standard BEng (Hons) program be checked, however, to ensure the adequacy of the embedded research methods and skills development. A gap analysis is suggested, referencing the content of the Methods course prescribed for the R&D stream students. Development of research and investigatory skills needs to be made more explicit in the stated learning outcomes of relevant courses.

• The BEng (R&D) (Hons) is differentiated from the BEng (Hons) by the 6x6-unit Engineering Research and Development strand. This project-based learning sequence closely aligns with the School’s research activities and engages students in the full research and development process, including professional publication of outcomes. In some instances the capstone project activity can extend to cover four of the Engineering Research and Development courses. It is important that the learning outcomes and assessment measures for these courses are differentiated and thoroughly aligned with the integrated graduate outcomes specification. There was little evidence available to the panel, however, to show how progressive contributions to graduate outcomes are tracked and validated as this sequence of courses is delivered across three successive years of the program.

• An internship option constitutes an alternative implementation pathway for the RSEng programs. Students seek selection for one-semester industry internships offered by the School in conjunction with industry partners. The internship is formalised as the 24-unit Engineering Internship course which replaces four elective slots in the standard program. Alternatively it can encompass the capstone project as an industry project with an added two elective slots. The panel was satisfied with the value of learning outcomes emerging from the typical internship and impressed with the reporting arrangements, based on a Stage 2 competence demonstration report. Some 10-15 students take the internship option in any given semester.

• The panel questioned the claimed Systems Engineering orientation of the BSoftEng (Hons) program. This is largely established through the 6-unit Systems Engineering for Software Engineers mandated course in the third year of the program. The rationale for establishing such a new course in light of the availability of courses such as Systems Engineering Design and Systems Engineering Analysis, and indeed the entire Systems Engineering core structure in the RSEng was questioned. The BSoftEng (Hons) has been clearly established as a traditional, discipline-focussed structure with broad knowledge and skills development and a project-based learning backbone. Incorporating the RSEng Systems Engineering Design and Analysis courses had been considered, but rejected on the basis that a two-course sequence was more than required for introducing undergraduates to Systems Engineering principles and practices. The view was expressed to the panel that if Software Engineering students were to undertake the RSEng Systems Engineering core and then take a limited set of Software Engineering specialist courses to form a Software Systems major, this would yield a very different outcome to that delivered by the classical Software Engineering program structure. This was agreed by the panel, but of course this differentiation already applies to all of the other majors in RSEng and uniquely characterises the ANU engineering graduate in these other fields.

• The panel was impressed with the structured reporting for the mandated, 12-week Practical Experience requirement and the optional Engineering Internship. Self-assessment of professional development, referenced to the elements of competency and attainment indicators set out in the Engineers Australia competency standards (Stage 1 for standard work experience and Stage 2 for internship) is highly commended. Such reflection helps students to assess the contributions that this exposure to practice makes to the development of targeted graduate outcomes. A reflective self-assessment strategy is also developed with the use of learning logbooks in the Engineering Research and Development Project (Methods) course undertaken by the BEng (R&D) (Hons) students. There are other isolated examples of reflective practice that were identified in both the RSEng and BSoftEng (Hons) programs. In some instances, reported reflection was confused with the peer assessment process. In Recommendation R8, the panel suggests that the principles of reflective practice be deployed more widely, as part of a learning culture which engages students as
stakeholders and involves them in systematically monitoring their professional development, tracking progress with reference to the integrated graduate outcomes specification targeted for the program and its included specialisations.

9.2.4 Curriculum content – individual majors

Additional comments raised by individual panel experts, in relation to the BEng (Hons) and BEng (R&D) (Hons) program majors are quoted below.

9.2.4.1 ELECTRONIC AND COMMUNICATION SYSTEMS, RENEWABLE ENERGY SYSTEMS

- Closure of the loop on delivery of professional competencies at the individual course level does not always seem to consistently follow mapping claims. Evidence of assurance not always apparent.
- Depth of technical courses in the majors is adequate, within narrow specialist domains, and generally satisfies the need for in-depth knowledge and skill development, as well as fluent application of engineering techniques, tools and resources. Possibly some lack of cohesion in the Electronic and Communication major.
- Systems Engineering core provides an excellent foundation for developing complex problem solving skills as well as systematic synthesis and engineering design capability.
- Delivery of professional outcomes claimed in mapping analysis may not always be fully validated at course level. Closure of the loop on learning outcomes and assessment could be strengthened and a gap-analysis review needs to be part of the on-going improvement cycle.
- Connections between teaching and research are exemplary. As a consequence, staff members are enthusiastic and engaged. Students are exposed to leading edge knowledge and techniques.
- The panel gained the impression that students do not see a strong coherence in the overall program design. This appears to be better appreciated by teaching staff, but there is clearly a need for improved articulation of the overall educational philosophy and objectives. This must include the targeted graduate outcomes specification and a constructive alignment process, mapping delivery of these outcomes from the contributions of individual learning experiences and assessment measures.
- The current ‘ticked-box’ mapping of learning and assessment contributions appears to be unaudited and not effectively driving an outcomes-based educational design culture.
- Industry-based projects for the Systems Engineering Project and for the Individual Project/Engineering Research and Development Project are highly regarded. There are a number of examples of guest presentations from industry professionals within individual courses. Some appear to be better integrated into the learning design than others.
- Students expressed a lack of transparency in the survey feedback processes, with little information provided on any action taken to address issues raised. Minutes of SRC process indicate more systematic closure of the loop.
- Students report staff to be responsive when directly approached, and this is a preferred approach for addressing delivery issues.

9.2.4.2 PHOTONIC SYSTEMS

- Depth of technical content felt to be marginal. Despite action taken, Physics emphasis and delivery by CPMS staff are dominating characteristics of the specialist courses that characterise the major. Six out of the eight courses that define the major are taught by Physics staff. The Semiconductors and Photovoltaic Technologies units included in the major are drawn from the Renewable Energy Systems major. The Fibre Optics Communication Systems course should cover communication systems but this aspect seems to be very limited, other than for propagation in optical fibres. There is no exposure to modulation techniques, receiver noise, calculation of S/N ratio or bit error rate, or
other engineering aspects of a fibre-optic communication system. Typical telco specifications and standards, link budgets should be introduced.

- There is no evidence of a cohesive educational design, which brings together the contributions of the Systems Engineering core and the specialist courses that define the Photonic Systems major and maps delivery of an integrated graduate outcomes specification for this specialisation. Engineering staff and Physics staff members responsible for these separate components of the program do not appear to meet for the purposes of review and improvement or to focus on tracking delivery of outcomes.

9.2.4.3 BIOMEDICAL SYSTEMS

- Mix of courses and targeted course content are generally appropriate to the specialist focus that has been set for this major.

- Development of professional competencies within the context of Biomedical Engineering is not readily apparent. Foundation professional skills established within the Systems Engineering core are not felt to be carried through into the Biomedical major context. For example there is insufficient reference to standards and codes of practice, and in particular regulatory issues which are so important in this practice domain. It is critical that professional practice issues are integrated with embedded project work in the specialist courses associated with the major.

- The Biomechanics and Biomaterials course should be a foundation for this major, but disappointingly, it fails to deliver the content and level of outcomes expected. Analysis of course schedule and assessment tasks shows minimal focus on the Biomaterials topic. The targeted knowledge and skills, as reflected in the standard of reviewed assessment tasks, is not felt to be adequate for an engineering bachelor outcome in this specialist field. Examination questions in particular were felt not to be set at an appropriate depth of understanding or application skill level. Content was felt to be deficient in expected areas such as bio-compatibility and materials, human movement quantitative analysis including multi-plane analysis, diseased state influence on movement and body function, interaction between tissues (eg muscle and bone) during human movement and comparisons between diseased state and normal healthy movement. There were concerns in fact that the course co-ordinator had a limited understanding of the subject matter.

- Learning outcome statements, as an indication of exit level capability for the four courses that are unique to the major, tend to be shallow in comparison with the specialist knowledge and engineering application competencies targeted in comparable courses in other majors. The argument that learning outcome statements should demonstrate a hierarchy of learning development over the course delivery period was disputed by panel members. Learning outcomes should describe the terminating contributions that a course makes to the overall competencies targeted for the graduate. In the case of the Biomedical Systems major, there tends to be a predominance of learning outcome statements that are oriented at the recollection and understanding levels of the learning taxonomy. A higher proportion of learning outcome targets would be expected at the analysis, application, evaluation or synthesis levels for specialised courses delivered at this level within a Bachelor of Engineering program. A strengthening of the standard of knowledge and skill outcomes, the expectations of learning activities and the depth of higher level learning tested in assessment tasks is needed to fulfil mandated Requirement M1.

- There is little evidence of systematic exposure of Biomedical Systems students to specialist engineering practice in the field. There is little evidence of teaching input flowing from external practising professionals in the specialisation.

- Actual assessment tasks in courses such as Biomedical Imaging do not always appear to match assessment summaries in the course outline documentation, making it difficult to judge if course learning outcomes are in fact delivered.

- Laboratory facilities established for the new Biomedical Systems program are impressive and very much suited to the specialist focus targeted by the four courses that are unique to the major.
9.2.4.4 MECHANICAL AND MATERIAL SYSTEMS

- The depth of knowledge and skill development is adequately validated in the specialist courses which define the major, but as a consequence of the Systems Engineering core, in-depth studies span only a limited domain within the field. Life-long learning skills will equip graduates for broadening their field of specialisation as needed. This adaptability was confirmed in discussions the panel had with external stakeholders.
- Risk and safety issues are adequately embedded throughout the program, but there is no obvious integrating course. Students confirmed regular exposure to risk management in project courses.
- There has been a strong effort to integrate industry speakers/clients into courses, but there appears to be some lack of appreciation by students of the importance of this exposure. Recording of lectures and on-line learning support has heavily impacted lecture attendance.
- Retreats for staff members provide an effective forum for considering the interconnection between courses. Mapping of course learning outcomes has been attempted in the past on an earlier database system, but now replaced by the current mapping provided in the submission document. There is a need to advance this mapping process as a key driver in tracking learning and assessment contributions and for driving an outcomes based learning improvement culture. A graded taxonomy is crucial to underpin this.
- Exposure to practice through guest presentations by industry professionals now appears to be substantial, but this appears to be a recent initiative.
- Students report that staff members who are involved with the Systems Engineering core tend to be more receptive to suggestions for improvement than those who teach the specialist technical courses in this major.
- Students are overall satisfied with the quality of teaching and the commitment of staff in this area, although there are exceptions where research seems to be the clear priority and there is not much interest in the teaching task.
- The range of laboratory exposure is sometimes limited in particular courses and perhaps biased to the research expertise of the course convenor. For example the only materials testing that appears to be undertaken is on composite materials with no apparent exposure to the yield behaviour of metals.

9.2.4.5 MECHATRONIC SYSTEMS

- Again the depth of the major is a trade-off with the strength of the Systems Engineering core and follows the breadth-depth balance that characterises all majors.
- Discussions with alumni affirmed the overall strategy, with graduates considering themselves to be adequately prepared to enter professional practice in the field. Employers also were reported to confirm the outcomes of the program largely satisfy needs. Some discussions the panel had with Advisory Board members did reveal a contrasting view, that perhaps there was a case for a slight rebalance of the breadth/depth to strengthen discipline specific content.
- Some mapping claims from the ‘ticked-box’ presentations provided to the panel do not seem to be realistic and do not always appear to be validated from learning activities and assessment measures revealed in course outlines and other documentation. For example the Introduction to Electronics course ticks multiple contributions to the Competency element 1.3 – “In-depth understanding of specialist bodies of knowledge within the engineering discipline”. This does not seem to be a credible outcome for a first-year course in the Systems Engineering core. There appears to be a tendency to over-generously tick linkages between course learning/assessment outcomes and the Stage 1 competency elements, rather than tracking a key thread of contributions that advance in measure as the program progresses, and demonstrate a balanced and graded coverage of the competency element. Mapping analysis for courses such as System Dynamics and Dynamics and Simulation on the other hand reveal more credible linkages between learning outcomes and the elements of the Stage 1 Standard.
- Consistency of mapping can only be achieved with strong coordination at the program teaching team level, focusing on a holistic educational design which tracks learning and assessment contributions from throughout the program in a balanced and cohesive manner.

- Learning outcome statements for individual courses need to be crafted to more accurately reflect the terminating contribution that is made to the graduate outcomes. Use of a stricter hierarchy of learning taxonomy and learning outcome statements which are measurable through assessment are encouraged.

- A study of benchmark, stand-alone Mechatronic programs and relevant guideline publications may provide a broader insight to the range and depth of dedicated Mechatronic content that is emerging as the key underpinnings of this discipline. This should better inform decisions and compromises that arise as a consequence of the Systems Engineering model and the use of the eight dedicated course slots available to the major. There is little evidence of systematic benchmarking at the major level at this stage.

- A ‘whole of systems’ design focus in the Mechatronics sense means:
  - the decisions made in mechanical design affect actuator choice, energy allocation, and the control strategies needed due to the governing system dynamics;
  - the desired system dynamics and required sensing capabilities affect the choice of computer hardware; and
  - the chosen control strategies can affect the integrity of mechanical components and actuators.

The only integrative learning opportunity that appears to exercise this broad interconnection of knowledge and skills for this major is the capstone learning event. This exposure needs to be ensured through project selection and validating delivery of outcomes.

9.2.5 BSoftEng (Hons) program structure and implementation framework

- Curriculum coverage appears to be largely adequate. The only perceived gaps are in the areas of network security, secure software design and user-interface/web design. There is not strong evidence of significant exposure to advanced technologies, emerging developments and interdisciplinary linkages in the field of Software Engineering.

- Other than for project courses, targeted knowledge and skill outcomes are not consistently classified in learning outcome statements to reflect a level associated with a formal learning taxonomy – eg Bloom or CDIO.

- Mapping course contributions to delivery of the Engineers Australia Stage 1 competencies appears haphazard. There is little in the way of an integrated, ‘big-picture’ specification of graduate outcomes or overall understanding of the educational design that is conveyed to students.

- There is a need to explicitly link stated learning outcomes with assessment measures to close the validation loop at the individual course level, and then to map these contributions to confirm delivery of the graduate outcomes specification for the program as a whole.

- Capstone Software Engineering Project/Practice outcomes generally are of good to very-good standard with assessment outcomes reflecting the variance in performance.

- Exposure to professional software engineering practice does occur across the program, but personal and professional competency development could be more systematically addressed at earlier stages. There is currently heavy reliance on the Software Engineering Project and Practice courses to address these development needs.

- Students reported that use of the ANU Moodle-based LMS is inconsistent, with staff often bypassing this system and requiring students to access an alternative facility at the individual course level. The rationale for this is not clear to the students and perhaps needs review.
9.2.6 Exposure to professional engineering practice

- The panel has already expressed its satisfaction with the reflective-based reporting model for assessing learning contributions gained from the work experience requirement and internship option. Other key opportunities for students to gain exposure to professional engineering practice arise from industry-sponsored group project activity in the Systems Engineering Project (BEng programs) and in the Software Engineering Project and TechLaunch option (BSoftEng program). These activities, together with the claimed use of industry professionals in teaching roles and the contributions to teaching from research specialists have the potential to provide an adequate exposure of students to practising engineers and the nature of industry practice. Again, the importance of reflective self-analysis of learning contributions arising from exposure events is very much emphasised as an overall component of student assessment and also as a means of gathering feedback on learning effectiveness. There was not strong evidence of an integrated learning design process, where the contributions of industry exposure events are intertwined with traditional learning episodes to track the systematic development of targeted graduate outcomes.

- Opportunities for gaining work experience were not reported to be an issue for most students. The Canberra location tends to have a concentration of small to medium industry enterprises, many of which are innovation-based and appreciate the unique skills and attributes that the ANU engineering degree offers. The Systems Engineering foundation and technical focus of the major streams in the RSEng programs is very much aligned with the needs of this industry sector. Key partnerships with industry have underpinned industry sponsored project activity and led to opportunities for work placement, internships and final employment for graduates. The Practical Experience course and the Engineering Internship course each have an external Course Convenor, Dr Liam Waldron CPEng FIEAust, EngExec, FAIM, MAICD, SMIEE, who is very well positioned in terms of expertise and industry connections. He oversees the competency-based reflective reporting of work experiences in the style of the Engineers Australia competency assessment process.

- There is a need to formalise industry linkages in the Biomedical Systems domain to help facilitate opportunities for students to gain exposure to industry and clinical settings and also to establish opportunities for participation in external project work and employment. This would, of course, complement the opportunities for students to engage with research activities at ANU, but perhaps open up wider experience options, as well as essential exposure to engineering industry practice. This need has been captured in Recommendation R14.

9.3 Quality systems

9.3.1 Engagement with industry stakeholders

- The RSEng Industry Advisory Board now focuses on overarching, strategic issues and provides subsequent advice, at the School level. The Board was established with its inaugural meeting in 2014. One further meeting has been held in 2015. The membership of the Board is drawn largely from local industry and community stakeholders. The terms of reference for the Board suggest two meetings per annum.

- Members have been appointed on the basis of their expertise with the objective of balancing the mix against the research and teaching majors within the School. There are gaps in this expertise profile, and the most obvious of these is the Biomedical Engineering field. A limit of 12 industry members is defined in the Terms of Reference. The RSEng Advisory Board currently has 11 external industry members as well as a College Director from one of the top ACT secondary Colleges. The Chair of the Board is Dr Peter Campbell from KPMG in Melbourne. It is claimed that the BSoftEng (Hons) program gains advice from both the RSEng Advisory Board as well as the RSCS Advisory Board. How these two sources of advice are utilised and how any diversity of opinion between the two advisory bodies is managed is not clear.

- The School’s Director and the Associate Directors (Research and Education) are all ex-officio members of the Board. It is suggested in the terms of reference that the Program Convenor for the BSoftEng (Hons) should also be a member representing RSCS. The terms of reference confirm the broad and strategic nature of the expected advisory task. The panel was advised that the Board does intend to delve into the graduate outcomes mapping processes in 2016, but there has been
little evidence of this in the past. A key expectation expressed in the accreditation guidelines is that industry advisers and other external stakeholders will be an integral part of the educational design and review task at an overview level. In particular, having input to setting, reviewing and tracking attainment of a detailed and integrated graduate outcomes specification in each program specialisation. A simple mapping of the measured contributions that individual courses learning events and assessment tasks are expected to make to the aggregated achievement of the targeted graduate outcomes specification provides a key reference for any advisory body to work with.

- In RSEng, the Advisory Board seems to be a little remote from the Discipline Committees and the program teaching teams. There will have to be heavy reliance on communication flowing down from the Associate Director (Education) on any advice that is given in relation to the overall program design and implementation. It is suggested by the panel that perhaps there is a need for a second tier of advice, coupling much more closely with the individual majors and Discipline Committees. This second tier in each discipline could be composed from the one or two members of the Board that are specialists in the particular field, but perhaps joined by other appointed alumni and employer representatives who are working in that discipline. In that way, the second tier of the Board could be co-opted to work more directly with the Discipline Committee and program teaching teams during review and planning retreats and meetings, particularly in the top-down learning and assessment review process and tracking delivery of targeted graduate outcomes.

- There was little evidence available to the panel to indicate the nature of advice flowing from the RSCS Advisory Board in relation to the BSoftEng (Hons) program.

- Recommendations R9 and R10 capture the key suggestions from the panel for strengthening the contributions that the Advisory Boards can make to reviewing and improving the teaching and learning process.

### 9.3.2 Student stakeholder engagement

- The Student Representative Committee is the main channel of formal communication between staff and representatives of the student body at School level. Membership comprises the Associate Director (Education), the Associate Dean (Education), the School Manager and the Student Services Manager plus one student representative from each of years one to three, and two from years 4 and 5 of the undergraduate programs, one postgraduate student representative as well as one ANUESA and two ANUSA representatives. The nature of business raised would be expected to be very much of an operational nature, focussing on aspects such as welfare, teaching matters, workload and supervision. Again the Committee is somewhat removed from the Discipline Committees and program teaching teams. Any feedback would need to be passed via the Associate Director (Education).

- The BEng (R&D) Honours students enjoy a monthly forum and lunch, where academics give presentation on personal research work, but this opportunity does not flow to the BEng (Hons) students. Occasional student forums have been held to seek input to proposed administrative and structural changes.

- The SELT survey system analyses student satisfaction with teaching in individual courses. Discussion of outcomes occurs at both college and school levels. Courses with scores below a 50% threshold are identified for remedial action. There appears to be a strong record of improvement as a result of this process.

- When action is taken to address issues raised in the SRC or through the survey feedback system, it is felt important that the student body is advised of this to close the loop on the continuing improvement process. It was not apparent to the panel that there was a formal mechanism for documenting and disseminating the details of action taken in response to feedback.

- Student consultation and feedback processes are felt to be largely reactive in nature, and focus on improving delivery processes and operational effectiveness. There does not seem to be an avenue for academic staff forums such as the Discipline Committees and Course Convenor meetings or indeed the program teaching teams themselves to engage and consult with student representatives on ‘big-picture’ learning and assessment design matters. In the panel’s view, the student body should have input to the maintenance of the integrated specification of graduate outcomes for each major,
as well as considering the effectiveness of learning events and the validity of assessment measures which are mapped as contributing elements to the attainment of these outcomes in the overall educational design.

- These findings and suggestions are picked up in Recommendations R6 and R7.

9.3.3 Processes for setting and reviewing the educational outcomes specification

The panel's findings in relation to this criterion are covered in Sections 9.1.3 and 9.2.1 above.

9.3.4 Approach to educational design and review

- The panel’s findings in relation to this criterion are covered in Sections 9.1.3 and 9.2.1 above.

9.3.5 Approach to assessment and performance evaluation

- The panel was largely satisfied with the range, depth and standard of assessment processes, as well as general compliance with most other aspects of this criterion. Relevant comments have been made in Sections 9.2.1, 9.2.3, 9.2.4, 9.2.5 and 9.2.6 above. Some issues are identified for further improvement and these include reflective, self-analysis undertaken by students, and tracking the integrity of individual assessment tasks at the individual course level, as contributing elements to the attainment of the targeted graduate outcomes.

- The panel found a dominant weighting on examination-based assessment in many courses and felt that there was scope for a more comprehensive assessment model, with assessment weighting better matching the diversity of learning activity and assessment tasks. Practical, project-based learning activity provides a diversity of knowledge, skills and attributes development, (and is the primary vehicle for the development of professional competencies and engineering application abilities), but the assessment weighting of these activities, in any given course, is not felt to always be sufficient to reflect the student effort involved and the range of learning outcomes that are expected. The difficulties of designing reliable assessment systems, particularly in team-based project work are understood, however, there are tools which can assist with this, and the effort to develop rigorous approaches is very much warranted. This need has been addressed in Recommendation R16.

9.3.6 Management of alternative implementation pathways

- The Industry Internship option, as discussed above, is the only incidence of an alternative implementation pathway. The panel was satisfied with the equivalence of learning outcomes delivered by this alternate pathway, and strongly endorses the processes of reflective self-assessment that is used as part of the assessment process. Resources provided to students via the WATTLE student management system are supplementary to the learning processes and do not extend to an alternative, distance learning option.

9.3.7 Dissemination of educational design philosophy

- The need for establishing an integrated graduate outcomes specification for each program/major specialisation has been discussed in detail. The graded mapping of learning and assessment contributions from the courses which make up the program is a key resource for teaching staff teams, external industry advisers and, most importantly, for students, to help them appreciate the overall philosophy of the program design and to provide a basis for their self-reflection of the progressive attainment of knowledge, skills and attributes.

- The panel considered published teaching materials and in particular the course outline documents. There is scope in these documents to improve the presentation of these graduate outcome
considerations, and to demonstrate more comprehensively how the loop is closed on learning outcomes, learning events and assessment processes. Course information documents need to demonstrate to students how the loop is closed at the course level, linking learning outcomes and assessment measures, and then at the program level, linking course outcomes, learning and assessment to the attainment of the integrated graduate outcomes specification. Currently there is only limited information made available on these linkages, based on ‘ticked-box’ mapping tables. The need for a more comprehensive dissemination of the learning design philosophy and links between learning outcomes, learning activities and assessment tasks is taken-up in Recommendations R2, and R3.

9.3.8 Benchmarking
- Limited external benchmarking has occurred in the past, mainly final year project activity and selected courses, as well as participation in systematic benchmarking undertaken by Go8 Engineering Deans. A current RSEng plan to implement a systematic benchmarking of individual courses, for each major and year level, over a 5-year period is very much encouraged by the panel. Appropriate benchmarking of Biomedical Engineering programs, both nationally and internationally, is felt to be crucial in resolving the curriculum issues raised in Section 9.2.4.3 above and mandated in Requirement M1. Support for benchmarking is also reinforced in Recommendation R11.

9.3.9 Approval processes for program development and amendment; student administration
- The panel was satisfied with formal policy and practices implemented within organisational committee structures at the school, College and University levels.
10. REQUIREMENTS AND RECOMMENDATIONS

10.1 Requirement

The following requirement has been set by the panel and is associated with the conditional accreditation recommendation in Section 2.

M1 For the newly introduced Biomedical Systems major, (BEng (Hons) and BEng (R&D) (Hons)), address curriculum issues associated with the specialist courses which define the major, as discussed in Section 9.2.4.3.

[Accreditation Criterion 4.2.4 – Accreditation Criteria Summary - AMS document S02 (Professional Engineer)]

10.2 Recommendations

The following recommendations to the schools capture the perceptions and findings of the panel and are intended to assist with the processes of continuing quality improvement.

GRADUATE OUTCOMES, MAPPING AND DISSEMINATION

R1 For each major in the BEng (Hons) and BEng (R&D) (Hons), and for the BSoftEng (Hons), establish a more detailed specification of graduate outcomes that fully integrates the Stage 1 competency elements/attainment indicators with the unique skills, knowledge and attributes set out for each specialisation. Then build on the course level mapping work that has already been undertaken to aggregate measured contributions that individual course learning outcomes, learning events and assessment tasks are making to delivery of this integrated graduate outcomes specification.

Identify any weaknesses or gaps in addressing specific elements of the outcomes specification, utilising associated attainment indicators such as those included within the Stage 1 Standard to help guide this detailed evaluation.

(Reference discussion in Section 9.2.1)

[Reference – discussion in Section 9.2.1 above and Accreditation Criteria 4.2.1 and 4.3.4 – Accreditation Criteria Summary - AMS document S02 (Professional Engineer)]

R2 Disseminate the mapping analysis from R1 above as a fundamental reference for the ongoing learning and assessment review and improvement process undertaken by staff teaching teams, and to help steer the input from industry advisers. Provide the integrated graduate outcomes specification in program outline documentation and include details of the above mappings in individual course information documents, so that students are able to systematically reflect on the progressive development of skills, knowledge and attributes. Mapping information in course information documents should demonstrate:

- how the learning activities and assessment tasks provide measured contributions towards assuring delivery of the integrated graduate outcomes specification;
- how the ‘loop is closed’ at the course level to validate delivery of Course Learning Outcomes through the designated learning activities and assessment measures.

(Reference – analysis in Section 9.3.7 above and Accreditation Criteria 4.3.4 and 4.3.7 – Accreditation Criteria Summary - AMS document S02 (Professional Engineer)]

R3 Strengthen communication of the program structural philosophy, the integrated graduate outcomes specification and mapped delivery of these outcomes to the student body from the very early stages of each program.

[Reference - discussion in Section 9.3.7 above and Accreditation Criterion 4.3.7 – Accreditation Criteria Summary - AMS document S02 (Professional Engineer)]
BACHELOR OF ENGINEERING TITLE

R4 To more accurately reflect the true intention of the program objectives and avoid misperceptions by stakeholders, review again the retention of the ‘Bachelor of Engineering’ main title for the RSEng programs. An alternative such as ‘Bachelor of Engineering (Systems) with major study streams in – (list majors undertaken)’ is highly recommended as a more appropriate title, which conveys the intention, but perhaps also preserves the Bachelor of Engineering reference for marketing purposes.

[Reference – rationale presented in Section 9.2.2 above and Accreditation Criterion 4.2.2 – Accreditation Criteria Summary - AMS document S02 (Professional Engineer) and also in particular Section 4.2.2 Accreditation Criteria Guidelines – AMS document G02]

TEACHING TEAM LEADERSHIP AND STUDENT ENGAGEMENT

R5 Strengthen the leadership function and accountabilities of Discipline Chairs/Program Convenors in each specialisation and the formal engagement of staff teaching teams in:

- mapping and tracking delivery of the integrated graduate outcomes specification through the systematic aggregation of learning experiences and assessment tasks;
- sharing best practices between majors, and between the BEng and BSoftEng programs;
- considering further opportunities for collaboration and course commonality across the RSEng/RSCS boundary;
- expanding opportunities for multi-disciplinary project teams to include students from various engineering majors as well as from the Software Engineering program, further strengthening the simulation of an engineering practice setting in industry.

[Reference - discussion in Sections 9.1.1 and 9.1.3 above and Accreditation Criterion 4.1.3 – Accreditation Criteria Summary - AMS document S02 (Professional Engineer)]

R6 Engage the student body more concretely in the work of the Discipline Committees/program teaching teams and Course Convenors in tracking delivery of the integrated graduate outcomes specification as part of the continuing improvement cycle.

[Reference - discussion in Section 9.3.2 above and Accreditation Criterion 4.3.2 – Accreditation Criteria Summary - AMS document S02 (Professional Engineer)]

R7 Include a formal entry in course outline documentation to provide systematic feedback to the student body on action taken to address and/or remediate issues raised in SELT surveys, through the Student Representative Councils/student representative system.

[Reference - suggestions made in Section 9.3.2 above and Accreditation Criterion 4.3.2 – Accreditation Criteria Summary - AMS document S02 (Professional Engineer)]

REFLECTIVE PRACTICE

R8 Extend the WATTLE-based reflective practices occurring in the Engineering Research and Development (Methods) course and the impressive reflective reporting that applies for work experience and the industry internship activities to a broader cross-section of learning activities across the RSEng and the BSoftEng programs. As part of independent learning skills development, strengthen the culture amongst all students for systematic, reflective self-assessment of their individual professional development against the integrated graduate outcomes specification for the program and embedded specialisations.

[Reference - discussion in Section 9.2.3 above and Accreditation Criterion 4.3.5 – Accreditation Criteria Summary - AMS document S02 (Professional Engineer)]

INDUSTRY ADVISORY BOARDS

R9 Strengthen membership breadth and specialist expertise on the RSEng Industry Advisory Board to ensure that all major study streams are adequately represented. In particular address the shortfall in representation for the new Biomedical Systems major.

[Reference - discussion in Section 9.3.1 above and Accreditation Criterion 4.3.1 – Accreditation Criteria Summary - AMS document S02 (Professional Engineer)]
R10 Increase the meeting frequency and strengthen the terms of reference for the School Industry Advisory Boards to:

- build more direct and pro-active engagement with the work of Discipline Committees/teaching teams in setting, reviewing and tracking attainment of the integrated graduate outcomes, and in the learning and assessment design task;
- build further linkages which can facilitate the engagement of students in engineering industry practices and projects.

[Reference - discussion in Section 9.3.1 above and Accreditation Criterion 4.3.1 – Accreditation Criteria Summary - AMS document S02 (Professional Engineer)]

BENCHMARKING

R11 Action the proposed benchmarking of individual course activity across all RSEng majors and the Systems Engineering core. Initiate a systematic benchmarking process for the BSoftEng. Use the outcomes as input to the ongoing review and improvement cycle undertaken by Discipline Committees/program teaching teams. Undertake national/international benchmarking of Biomedical Engineering programs as input to the curriculum revision mandated for the Biomedical Systems major in Requirement M1.

[Reference - discussion in Section 9.3.8 and 9.2.4.3 above and Accreditation Criterion 4.3.8 – Accreditation Criteria Summary - AMS document S02 (Professional Engineer)]

CURRICULUM CONTENT AND ASSESSMENT

R12 Review the BEng (Hons) core structure to ensure adequacy and more explicitly identify the development of research methods knowledge and skills. Use the ENGN2706 Engineering Research and Development Project course as a reference for this review.

[Reference - discussion in Section 9.2.3 above and Accreditation Criterion 4.2.4 – Accreditation Criteria Summary - AMS document S02 (Professional Engineer)]

R13 In collaboration with appropriate teaching staff from the College of Physical and Mathematical Sciences, review content of the 8 courses which form the Photonics major.

[Reference - analysis and suggestions in Section 9.2.4.6 above and Accreditation Criterion 4.2.4 – Accreditation Criteria Summary - AMS document S02 (Professional Engineer)]

R14 Formalise linkages with industry in the Biomedical domain to build opportunities for student project activity, internships, work experience and collaborative research and project activity in the new Biomedical Systems major.

[Reference - discussion in Section 9.2.6 above and Accreditation Criterion 4.3.1 – Accreditation Criteria Summary - AMS document S02 (Professional Engineer)]

R15 Strengthen mandatory content in the BSoftEng in the areas of network security, writing secure software and user-interface design.

[Reference - discussion in Section 9.2.5 above and Accreditation Criterion 4.2.4 – Accreditation Criteria Summary - AMS document S02 (Professional Engineer)]

R16 Reduce the reliance on traditional examination-based assessment, by strengthening the use of project and problem-based assessment processes that incorporate effective moderation and proctoring systems.

[Reference - discussion in Section 9.3.5 above and Accreditation Criterion 4.3.5 – Accreditation Criteria Summary - AMS document S02 (Professional Engineer)]

MENTORING SUPPORT - ARTICULATING STUDENTS

R17 Consider providing mentoring support to assist with the transition of 2+2 articulating students into their new program structure and philosophy.
[Reference - discussion in Section 9.1.6 above and Accreditation Criterion 4.1.2 – Accreditation Criteria Summary - AMS document S02 (Professional Engineer)]

COMPUTER WORKSTATION ACCESS

R18 As part of the buildings and facilities development project, address laboratory scheduling and computer access limitations that were raised by students – see record of discussion with students to follow.

[Reference – record of student discussion points Attachment 2 to follow and Accreditation Criterion 4.1.4 – Accreditation Criteria Summary - AMS document S02 (Professional Engineer)]

Attachments to follow
### 11. ATTACHMENT 1: VISIT SCHEDULE

#### Tuesday 6 October 2015

<table>
<thead>
<tr>
<th>Time</th>
<th>Description</th>
<th>Venue</th>
</tr>
</thead>
<tbody>
<tr>
<td>1300-1500</td>
<td>Initial Private Panel Training Session - with access to displayed teaching, QA materials and student work</td>
<td>Ian Ross Seminar Room, R214, Ian Ross Building #31</td>
</tr>
<tr>
<td>1500-1630</td>
<td>MEETING WITH SENIOR LEADERSHIP TEAM</td>
<td>Ian Ross Seminar Room, R214, Ian Ross Building #31</td>
</tr>
<tr>
<td>1630-1730</td>
<td>PANEL PRIVATE SESSION - with access to displayed teaching, QA materials and student work</td>
<td>Ian Ross Seminar Room, R214, Ian Ross Building #31</td>
</tr>
<tr>
<td>1730-2100</td>
<td>Panel members return to University House</td>
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#### Wednesday 7 October 2015

<table>
<thead>
<tr>
<th>Time</th>
<th>Description</th>
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<tbody>
<tr>
<td>0830-0900</td>
<td>PANEL PRIVATE SESSION - with access to displayed teaching, QA materials and student work</td>
<td>Ian Ross Seminar Room, R214, Ian Ross Building #31</td>
</tr>
<tr>
<td>0900-1000</td>
<td>MEETING WITH RSEng ASSOCIATE DIRECTOR EDUCATION, RSCS ASSOCIATE, DISCIPLINE CHAIR - Systems Engineering Core, and PROGRAM CONVENOR - Software Engineering major</td>
<td>Ian Ross Seminar Room, R214, Ian Ross Building #31</td>
</tr>
<tr>
<td>Time</td>
<td>Activity</td>
<td>Venue/Location</td>
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<tr>
<td>1000-1030</td>
<td>PANEL PRIVATE SESSION - with access to displayed teaching, QA materials and student work -</td>
<td>Venue: Ian Ross Seminar Room, R214, Ian Ross Building #31 (includes morning tea)</td>
</tr>
<tr>
<td>1030-12.00</td>
<td>MEETING WITH RSEng ASSOCIATE DEAN EDUCATION AND DISCIPLINE CHAIRS - Biomedical Systems; Mechanical and Material Systems; Mechatronic Systems; Electronic and Communication Systems; Photonic Systems; Renewable Energy Systems majors</td>
<td>Venue: Ian Ross Seminar Room, R214, Ian Ross Building #31</td>
</tr>
<tr>
<td>1030-12.00</td>
<td>MEETING WITH RSCS ASSOCIATE DEAN EDUCATION AND PROGRAM CONVENOR - Software Engineering major</td>
<td>Venue: Ian Ross Conference Room, R212, Ian Ross Building #31</td>
</tr>
<tr>
<td>1200-1400</td>
<td>PANEL PRIVATE SESSION - with access to displayed teaching, QA materials and student work -</td>
<td>Venue: Ian Ross Seminar Room, R214, Ian Ross Building #31 (includes light lunch)</td>
</tr>
<tr>
<td>1400-1500</td>
<td>SUB PANEL 1 MEETING WITH CURRENT STUDENTS Mechanical and Material; Mechatronic; Biomedical Engineering majors</td>
<td>Venue: Ian Ross Seminar Room, R214, Ian Ross Building #31</td>
</tr>
<tr>
<td>SUB PANEL 2</td>
<td>MEETING WITH CURRENT STUDENTS Electronic and Communication; Photonics; Renewable Energy Systems majors.</td>
<td>Venue: Venue: Ian Ross Graduate Teaching Room, R221, Ian Ross Building #31</td>
</tr>
<tr>
<td>1500-1600</td>
<td>PANEL PRIVATE SESSION - with access to displayed teaching, QA materials and student work</td>
<td>Venue: Ian Ross Seminar Room, R214, Ian Ross Building #31 (includes afternoon tea)</td>
</tr>
<tr>
<td>1600-1630</td>
<td>Meeting with VC Professor Ian Young and DVC(Academic) Professor Marnie Hughes-Warrington</td>
<td>Venue: Vice-Chancellor’s Conference Room, on level 3, Chancellery Building 10</td>
</tr>
<tr>
<td>1630-1700</td>
<td>PANEL PRIVATE SESSION - with access to displayed teaching, QA materials and student work</td>
<td>Venue: Ian Ross Seminar Room, R214, Ian Ross Building #31</td>
</tr>
<tr>
<td>1700-1730</td>
<td>Meeting with all graduates - prior to informal meeting with combined external stakeholders</td>
<td>Venue: Ian Ross Seminar Room, R214, Ian Ross Building #31</td>
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<tr>
<td>Time</td>
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| 1730-1830 | Informal Meeting with all external stakeholders, External Advisory Board members, employers and graduates, including some members of the Senior Leadership Team. (includes light refreshments and finger food)  
Venue: Ian Ross Tea Room, R102, Ian Ross Building #31 |
| 1830-2130 | Engineers Australia Private Panel Working Dinner - University House private function room. |

**Thursday 8 October 2015**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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</table>
| 0845  | PANEL RECONvenes  
Venue: Ian Ross Seminar Room, R214, Ian Ross Building #31 |
| 0900-1000 | SUB PANEL 1  
MEETING WITH Academic Staff  
Mechanical and Material; Mechatronic; Biomedical Engineering Disciplines  
Venue: Ian Ross Seminar Room, R214, Ian Ross Building #31 |
| 1000-1100 | SUB PANEL 1 & 2  
TOUR OF FACILITIES - Engineering Teaching & Research Facilities  
Meet in Ian Ross Foyer. |
| 1100-1130 | SUB PANEL 3  
MEETING WITH Academic Staff  
Software Engineering Discipline  
Venue: Ian Ross Conference Room, R212, Ian Ross Building #31 |
| 1130- | INFORMAL MEETING WITH TECHNICAL AND ADMINISTRATIVE STAFF -  
Morning tea with selected Technical and Professional staff from all Disciplines  
Venue: Ian Ross Graduate Teaching Room, R221, Ian Ross Building #31 |
<table>
<thead>
<tr>
<th>Time</th>
<th>Event Description</th>
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</table>
| 1130-1430| ENGINEERS AUSTRALIA PANEL PRIVATE SESSION - with access to displayed teaching, QA materials and student work  
Venue: Ian Ross Seminar Room, R214, Ian Ross Building #31  
(includes a light working lunch) |
| 1430-1445| CLOSING SESSION - with Senior Leadership Team -  
Venue: Ian Ross Seminar Room, R214, Ian Ross Building #31 |
12. ATTACHMENT 2: ADDITIONAL NOTES FROM MEETINGS WITH STUDENT REPRESENTATIVES

Sub-panels met with separate groupings of current students. The students were spread across the various majors/programs and year levels. The panel also had the opportunity of a formal meeting with a representative group of graduates.

Many of the views and perceptions gleaned from the panel’s meeting with students and graduates have already been reflected in the Section 10 discussion above. For completeness, remaining points raised by students have been recorded as follows.

STUDENT MEETING – MECHANICAL AND MATERIAL SYSTEMS, MECHATRONIC SYSTEMS, BIOMEDICAL SYSTEMS

- The big picture - The Discovering Engineering course resonated with students as a useful vehicle for introducing the profession of engineering practice.
- Perception of how learning outcomes contributed to their development as engineers – How this works is not immediately clear to students during the early years, but becomes clearer as they get into internships and begin to engage in forms of professional practice. Students who had done internships were able to articulate how their learning outcomes mapped into professional engineering needs. Internships were regarded as extremely valuable. Students were convinced that the program’s focus on industry experience was useful to their professional development.
- Team-based learning – Students were unanimous about the benefit of team based exercises. It allows them to exercise initiative. They agree that team work adds value in helping them identify and assess their strengths and weaknesses, and that being required to work with students of different backgrounds was valuable in building up the necessary skills for collaboration. Those with internship experience identify the value of team work in a professional environment and quoted examples of where they were able to seamlessly fit into a professional culture.
- Feedback processes - There is a reasonable structure for student feedback, but with mixed levels of responsiveness. Some feedback is acted upon quickly (the systems courses) and in other instances the response was slower (usually the technical courses within the major). Students acknowledged that there could be reasons for these variations in response, and were generally satisfied.
- Laboratory work - Students differentiated between labs that provide some form of 'hard skills' and labs that don't. Particularly noted that labs which were less interactive (where the tutor demonstrated a lab test rather than having the students conduct it themselves) were less likely to provide the hands-on 'hard skills' that they expected. Some of the Mechanical labs were identified here (e.g. CNC exposure). Nevertheless, on a positive note, students did still believe that all lab classes had value in complementing their classwork and theory learning.

STUDENT MEETING – ELECTRONIC AND COMMUNICATION SYSTEMS, RENEWABLE ENERGY SYSTEMS, PHOTONIC SYSTEMS

- Regardless of information and promotional literature, awareness of the Systems Engineering curriculum model was not apparent to a number of students upon entry to ANU. A classical, specialist technical degree had been expected. There is a need for a comprehensive explanation of the educational philosophy, the objectives, the graduate outcomes specification and curriculum mapping to be provided at the very beginning of the program and reinforced during delivery. The potential benefits of the Systems Engineering approach are not appreciated until students are exposed to industry.
- Group and collaborative learning in the Systems Engineering core lead to stronger engagement of students.
- Problems reported by students included – lack of computer workstations equipped with dedicated engineering software such as ANSYS simulation and design software, WiFi system dropouts, broken chairs, dirty keyboards, lack of collaborative learning spaces in current buildings and difficulties with the ENG 2217 Mechanical Systems and Design course – quality of teaching issues and unfair, late changes to assignment details and assessment requirements before hand-in date.
• Most staff members are passionate and responsive to students’ needs. There are exceptions, and there is not always the expected acknowledgement by the School, or appropriate action taken to address concerns reported.
• There needs to be more transparency in the feedback cycle, with action taken to address issues raised in SELT surveys and in other forums systematically reported.
• Disappointment with breadth of Renewable Energy Systems major and its primary focus on Photovoltaics.
• Chaotic systems for booking laboratory sessions and inevitable clashes which occur cause much frustration.
• Articulating students from Beijing Institute of Technology appear to have a stronger knowledge foundation and technical advantage and this is somewhat unexpected.
• Squeezing multiple courses that would be delivered separately in a classical, technical degree into a single course in an ANU major is perceived to limit potential depth and result in some superficiality of coverage.
• Students are confident that they have developed life-long learning skills that will enable them to broaden and deepen their knowledge and skills base as required.
• Peer assessment in Systems Engineering Project has some flaws and leads to some disputes, with inappropriate scores sometimes being awarded to individuals who do not contribute accordingly.
• Laboratory learning experiences are generally regarded highly, building good foundations as well as design skills.
• Weighting on examination-based assessment tends to be excessive, need more weight to formative assessment tasks such as assignments and projects, based on open-ended problem solving. Examinations tend to be very predictive.
• Differences between the BEng (R&D) (Hons) and the standard BEng (Hons) appear to be “massive” with a far greater emphasis on reflective practice and research and investigatory skills development in the R&D program. This is somewhat concerning for BEng (Hons) students who feel they may not be adequately equipped.
• Title of degree under the BEng heading is misleading and infers a classical ‘technical’ curriculum. The unique structural nature of the Systems Engineering model is not getting out, especially to interstate applicants for the ANU programs.

STUDENT MEETING – SOFTWARE ENGINEERING

• Although students are in the Research School of Computer Science and share classes with students enrolled in the Bachelor of Information Technology and the Bachelor of Advanced Computing, they are quite clear that they identify as Software Engineers.
• In sharing classes, students in different programs sometimes enrol in a course with a similar name but different code with slightly different assessment (or they might all be in the identical course).
• Characteristics of Software Engineers include having an engineering approach and an interest in clients. Students find the course convener of the year 3 capstone project and year 4 project to be an excellent role-model of a Software Engineer.
• Skills students see as critical professional outcomes are teamwork, management, project management, communication, managing teamwork expectations, learning how to learn. The students believe they are taught these skills but learn most from their experiences in team settings.
• The labs and workspaces are excellent but wireless facilities are abysmal. Wireless is better everywhere else on campus.
• Academic staff members were reported to be approachable and helpful.
• The results of course evaluation through the SELT system are available online. Students can guess what action or impact this might have on course delivery, but there is no formal feedback on action that has been, or will be taken.

Improvements students would like to see include:
• Making user interface design part of the core, preferably in a web development course.
• Having a course that specifically addresses current practice in Software Engineering to ensure that the most current developments in the field are included every year.
• Addressing the area of security generally, for example how to write secure software; network security; ‘security and software engineering’.
For international students, particularly those undertaking 2+2 programs such as the BSoftEng (Hons), it is difficult to understand the significance and pre-requisite content of particular courses for which they have gained credit and are assumed to know. This is generally difficult to identify. To this end some way of accessing this knowledge would be helpful.

UNSOLICITED SUBMISSIONS FROM STUDENTS

Panel members were handed two separate, unsolicited statements from unidentified students, commenting on aspects of the curriculum and delivery approach.

Adverse comments were made with respect to the value of the curriculum content and the quality of delivery in the courses - Engineering Management, Sustainable Product Development and Composite Materials.

Other documented points included:

- Some disillusionment with the nature of the learning experience, not matching the highlights promoted in advertising brochures. For example the opportunity to engage with special extra-curricular projects such as solar car and race car and advanced CNC machines which have not come to fruition.
- Computer workstation availability and other resource limitations.
- Poor moderation of assessment grading by different project supervisors.
- Lack of research knowledge and skills development, poor preparation for undertaking capstone thesis.
- Poor communication from some Course Convenors. Poorly presented WATTLE pages for some courses.
- Information is not communicated to students in first year about the internship option and the need to preserve elective slots for this purpose. No assistance from ANU in finding work experience placement.
- Outstanding value of 6-month internship not strongly communicated.
- Plagiarism rule interpretation and subsequent action seem to vary inconsistently between staff members.
- Report writing skill expectation varies inconsistently between staff members.
- Development of personal and professional competencies needs to be strengthened and more heavily promoted as a key part of an integrated set of graduate outcomes.
- Exposure to professional software tools for Systems Engineering practice is limited and below the expectation of some potential employers.
- A greater awareness and detail needs to be established of the inherent attributes that are targeted for ANU graduates and how these competencies are developed through learning and project experiences.

MEETING WITH GRADUATES – ALL PROGRAMS/MAJORS

- Industry recognition of the Systems Engineering approach is not widely appreciated, other than from within some government and defence employer bodies. This makes job hunting sometimes difficult.
- On the other hand, graduates heavily supported the Systems Engineering framework and found it to be strong foundation for practice.
- Employers familiar with the unique ANU approach to engineering education value the approach and recognise the superior problem solving abilities of graduates. Abilities to deal with ill-defined and complex problems, to cope with uncertainties and ambiguities and to acquire new knowledge are key attributes that are firmly developed at ANU.
- Graduates reported only a few incidences where guest presenters from industry contributed teaching input. Overall engagement with industry practice during the study period had not been very significant, but in contrast, engagement with research laboratory staff had been extensive. There is scope for a significant strengthening of industry-based teaching.
The 6-month internship was seen to be a very valuable option, as is industry sponsorship of the capstone project event.

Project management was not felt to be taught at all adequately.

The Engineering Management course was felt not to be aligned with engineering industry practice and set at an academic level.

Graduates are undoubtedly equipped to take a ‘big-picture’ view of a problem, and to establish the knowledge and skill base to tackle a problem in a systematic manner. This is not well understood by students, however. There needs to be stronger communication about the philosophy and uniqueness of the program design. Also a better understanding established of the graduate outcome expectations and how the individual course components come together to deliver this.

End Report