Proposal for Inclusion in the US National Academy of Engineering (NAE) Grand Challenge Scholars Program (GCSP)

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1. Grand Challenge Scholar Program Vision

Introduction

The Australian National University (ANU) is a research-intensive educational community of global standing emphasising discovery and public policy. Our research priorities address the challenges facing Australia and the world. We believe this provides an educational ecology that strongly supports with the US National Academy of Engineering (NAE) Grand Challenges Scholars Program (GCSP). The GCSP naturally aligns with and extends the systems engineering core at the centre of the engineering degree program at the ANU. The GCSP allows students to contextualise and apply their engineering in areas of personal interest and motivation, resulting in a better understanding of engineering theory, its application and students' future roles as a practicing engineers.

We envision incorporating our current courses and co-curricular activities to support our students and staff in piloting and embedding the GCSP within the ANU Research School of Engineering (RSEng). We then seek to champion and scale the Program at other discipline Colleges at the ANU as well as engineering schools and faculties across Australia, supported by our long-standing relationship with Engineers Without Borders Australia (EWB) who are partnering with us in our vision of designing and implementing the GCSP at ANU and beyond.

The inclusion of the GCSP at the ANU is being supported by the Dean of the ANU College of Engineering and Computer Science (CECS), Prof. Elanor Huntington. Prof Huntington will champion the GCSP across Australia through advocacy via Dean's and Engineering groups and networks. We will describe our administrative infrastructure for the proposed GCSP and existing experiences that will be included as program activities and initiatives.

Administrative Structure

Jeremy Smith will be the inaugural Director of the GCSP at ANU through until mid-2018. He has driven the development of the GCSP at ANU and has worked in multiple relevant roles at the ANU including as a Research Engineer, Engineering Education Associate and Course Coordinator as well as being involved with an ANU start-up. Over the last ten years the focus of Jeremy's activity has been building a framework for humanitarian engineering education initiatives in the ANU engineering program. For this, Jeremy has been acknowledged with a *CECS Dean's Education Award* in 2014, an *ANU VC (Vice-Chancellor) Award for Programs that Enhance Learning* in 2015 and in 2016 a national *OLT Citation for Outstanding Contributions to Student Learning*. Jeremy is working with a cohort of students due for graduation from 2016 and 2017 to pilot the GCSP at ANU. Jeremy will work with the staff and Scholars on planning, implementing, and evaluating their GCSP experiences.

From 2018, the Director will be nominated by the CECS Associate Dean - Education (ADE) from amongst College staff, with the appointment approved by the associated School Director. To integrate with existing administrative structures and align with

similar positions, the role will be a service-role of nominally of 0.2 full-time equivalent load, for a period of three years. The Director will report to the CECS Sub-Dean for Student Engagement and administratively supported by the CECS Student Services team.

An initial steering committee for 2016 and 2017 will be formed to support the implementation and roll-out of the Program. The committee will:
- coordinate and oversee the implementation and operation of the GCSP.
- select Scholars for inclusion in the Program.
- recommend funding and support for Scholars.
- assess Scholar completion.
- evaluate the Program.
- train and support Scholar mentors

The committee members have been identified by the CECS ADE, selected to align with existing administrative and support structures. The roles for the committee and the current members in those roles are listed in Table 1. Committee members for designated roles will serve on the committee while in their service role (typically three year appointments) while other representatives will serve for two year.

Table 1: GCSP Committee roles and initial members.

Role	2016/17 Members
GCSP Director	Jeremy Smith
CECS Sub-Dean Student Engagement	Matt Doolan
RSEng Undergraduate Student Engagement	Fiona Beck
CECS Student Services	Paul Melloy (or delegate)
RSEng Academic Representative	Chris Browne
RSCompSci Academic Representative	From 2018 (once expanded)

Additional RSEng and CECS staff will be involved in supporting the Program. This includes staff currently coordinating the compulsory systems engineering core courses, supervising final year individual research or group design projects, and in student engagement roles (see Table 2).

Table 2: RSEng staff involved with core engineering courses and supervising EWB final year projects.

2016 Core Course Coordinators / Academic Roles	2016 Final Year EWB Project Supervisors
Ben Nizette (ENGN1211 Discovering Engineering)	Chris Browne
Chris Browne (ENGN2225/6 System Design and Analysis	Adrian Lowe
Paul Compston (ENGN3221 Engineering Management)	Takuya Tsuzuki
Matt Doolan (ENGN3230 Engineering Innovation)	Andrew Thomson
Wen Zhang and Yuchao Dai (ENGN4200 Individual Research Project)	Jeremy Smith
Jon Kim (ENGN4221 System Design Project)	

For 2017, Scholar mentors will be drawn from Table 2, with the GCSP Director also acting as a mentor. As the Program expands and the number of Scholars increases,

additional mentors will be identified for each of the College Research Themes which provides alignment with the 14 Grand Challenges as highlighted in Table 3. While some Grand Challenges appear across multiple themes, the alignment with a 'home' theme provides support and alignment with existing administrative structures and support, and provides a more even balance across themes and Challenges. These thematic mentors will be identified by the associated Research Chair and align with similar existing roles, which are service-roles and typically made for 2-3 years. Roles and responsibilities for mentors will include:

- identifying opportunities within courses to work on Challenges.
- assist students to link Challenges to current research particularly at ANU.
- identifying opportunities for additional engagement in the five GCSP elements including for-credit and co- and extra-curricula.
- planning engagements in the five GCSP elements across a Scholars degree program.

Table 3: Alignment of CECS Research Themes and Grand Challenges.

CECS Research Theme	Aligned Grand Challenge(s)
Energy	Make Solar Energy Economical Provide Energy from Fusion
Fabrication	Restore and Improve Urban Infrastructure Engineer Better Medicines
Information	Engineer the Tools of Scientific Discovery
Intelligence	Reverse-Engineer the Brain Secure Cyberspace Prevent Nuclear Terror
Materials	Provide Access to Clean Water Manage the Nitrogen Cycle Develop Carbon Sequestration Methods
Systems	Advance Personalised Learning Enhance VR
Theory	Advance Health Informatics

Program Activities and Initiatives:
Pathways and initiatives for students in the GCSP will build upon the common systems engineering core undertaken by all engineering students (see Table 4). The use of the systems core supported by a discipline major with electives and extra-curricula activities provides the opportunity for any engineering student to be involved with the GCSP. This supports student learning by allowing them to apply their theoretical and discipline knowledge to a real-world challenge or opportunity related to the Grand Challenges.

We have several courses that will enrich the Scholars in their academic development and address the Research, Interdisciplinary, and Entrepreneurship components of the GCSP. We will continue to collaborate with EWB and our other community partners Abundant Water (AW), Enable Development (ED) and TADACT (Technical Aid to the Disability ACT) to address the Global Perspectives and Service-learning components. The common systems engineering core in Table 4 provides a number of opportunities for Scholar progression. ENGN3100 Practical Experience is an

accreditation requirement that all students must complete the equivalent of at least 12 weeks full-time work experience outside the University, a component of which must be technical or engineering work. ENGN3100 has 0 credit bearing and is a mandatory requirement for graduation. Alternatively students can undertake a formal 'for-credit' internship under the ENGN3200 Engineering Internship. In this case, students have a staff mentor at ANU and are assessed against Engineers Australia (EA) Stage 2 Competencies for a professional engineer. Both ENGN3100 and ENGN3200 have been used by students undertaking work experience with not-for-profit and community based organisations and social enterprises. ENGN4200 is an individual research project of 12 credit units, 25% of a students' study in their final year. Students work one-on-one with a faculty member undertaking a mini-honours style project. This has been used for service-learning projects with a number of community organisations and partners.

Table 4: Compulsory core courses in engineering at ANU.

Course	Year	Credit Value
ENGN1211 Discovering Engineering	1	6
ENGN2225 System Design	2	6
ENGN2226 System Analysis	2	6
ENGN3221 Engineering Management	3	6
ENGN3230 Engineering Innovation	3	6
ENGN3100 Practical Experience OR	Any	0
ENGN3200 Engineering Internship	Any	6 - 24
ENGN4200 Individual Research Project	4	12
ENGN4221 System Design Project	4	6

The ANU is one of more than 25 universities in Australia that utilises the EWB Challenge. The EWB Challenge is a design program for first year university students coordinated by the international EWB Challenge team and delivered in partnership with universities around the world. It provides students with the opportunity to learn design, teamwork and communication through real, inspiring, sustainable cross-cultural development projects. By participating in the EWB Challenge students are presented with the opportunity to design creative solutions to real world problems. Each year, the EWB Challenge design brief is based on a set of sustainable development projects identified by EWB and one of its community-based partner organisations. In past years, the EWB Challenge has included developing innovative sustainable project ideas to support communities in India, Nepal, Cambodia, Indigenous Australia, Vietnam and Timor Leste.

At the ANU the EWB Challenge is incorporated into ENGN1211 Discovering Engineering, a first year compulsory course for all engineering and software engineering students which is also taken by IT and Computer Science students. As it has no pre-requisites it is taken by students from across all disciplines at ANU.

Building on the common systems engineering core, students undertake typically one but occasionally two, discipline majors from those in Table 5. Each major consists of

eight courses, a mix of compulsory and electives. Within these discipline majors, some courses that directly align with Grand Challenges are provided in Table 6.

Table 5: Discipline majors in engineering at ANU along with RSEng Research Themes and representative Grand Challenges areas.

Major	Research Themes	Grand Challenge Areas
Biomedical Systems	Biomaterials, Composite Materials, Nanomaterials, Micro and Nano Systems	Engineer Better Medicines, Advance Health Informatics
Electronic and Communication Systems	Acoustics and Audio, Communications, Signal Processing	Engineering the Tools of Scientific Discovering, Enhance Virtual Reality, Engineer Better Medicines
Mechanical and Material Systems	Manufacturing, Micro and Nano Systems, Optical Devices, Sensors	Access to Clean Water, Engineer Better Medicines, Restore and Improve Urban Infrastructure
Mechatronic Systems	Computer Vision, Robotics, Manufacturing	Engineering the Tools of Scientific Discovering, Enhance Virtual Reality
Photonic Systems	Micro and Nano Systems, Optical Devices, Photovoltaics	Make Solar Energy Economical, Engineering the Tools of Scientific Discovering
Renewable Energy Systems	Energy Storage, Photovoltaics, Solar Thermal	Make Solar Energy Economical
Sustainable Systems	Manufacturing, Energy Storage	Manage the Nitrogen Cycle, Provide Access to Clean Water

Table 6: Discipline courses available to engineering students related to Grand Challenges and the majors they relate to.

Course (Code and Title)	Major(s)
ENGN3820 Biomedical Imaging	Biomedical Systems
ENGN4525 Solar Thermal Technologies	Renewable Energy Systems
ENGN3212 Manufacturing Technologies	Mechanical and Material Systems
ENGN3410 Engineering Sustainable Systems	Renewable Energy Systems
ENGN3334 Semiconductors	Renewable Energy Systems
ENGN4511 Composite Materials	Mechanical and Material Systems
ENGN3810 Biomechanics and Biomaterials	Biomedical Systems
ENGN4528 Computer Vision	Mechatronic Systems
ENGN4524 Photovoltaic Technologies	Renewable Energy Systems
ENGN4810 Nanotechnology and Applications	Biomedical Systems
ENGN4516 Energy Resources and Renewable Technologies	Renewable Energy Systems, Sustainable Systems
ENGN4420 Sustainable Product Development	Mechanical and Material Systems, Sustainable Systems
ENGN4820 Bio Micro and Nano Electro-Mechanical Systems (BioMEMS and BioNEMS)	Biomedical Systems

Additional courses related to the Grand Challenges are available as electives, as show in Table 7. Specifically related to the humanitarian engineering program, the *Engineering for a Humanitarian Context* course was established in 2015. This is now offered regularly in winter and summer sessions for students participating in the EWB Humanitarian Design Summit. The VCUG (Vice-Chancellor's Undergraduate) courses are cross-discipline courses specifically designed to engage students from the entire campus.

Table 7: Specific courses relevant for the GCSP as electives.

Course (Code and Title)	Type
ENGN3013 Engineering for a Humanitarian Context	Engineering Elective
VCUG1001 The Art of Computing	Engineering Elective
VCUG2001 Creating Knowledge	Engineering Elective
VCUG2002 Leadership and Influence in a Complex World	Engineering Elective
VCUG3001 Unravelling Complexity	Engineering Elective
VCUG3002 Mobilizing Research	Engineering Elective
MGMT3027 Entrepreneurship and Innovation	University Elective
DESA2017 Multiples and Production: The Unique Offering	University Elective
ANTH1003 Global Citizen: Culture, Development and Inequality	University Elective
ENVS1008 Sustainable Development	University Elective
INDG1001 Indigenous Peoples, Populations and Communities	University Elective

Around 40% of engineering students undertake a double degree, which is typically five years. Formal qualifications students can take through degrees, major or minors related to the Grand Challenges are provided in Table 8.

Table 8: Non-engineering program options available to engineering students at ANU.

Program	Type
ANU Leadership and Research	Minor
Asian Studies	Bachelor, Major, Minor
Australian Indigenous Studies	Major, Minor
Design	Minor
Development Studies	Bachelor, Major, Minor
International Relations	Bachelor, Major, Minor
Pacific Studies	Bachelor, Major, Minor
Science Communication	Major, Minor
Southeast Asian Studies	Major, Minor
Sustainable Development	Minor

Extra- and co-curricula activities support students and further enhance student learning and engagement. Some of these within CECS are provided in Table 9. A number of international field schools which relate to GCSP elements are available across the ANU for credit, as listed in Table 10.

Table 9: Co- and extra-curricula activities available to engineering students.

Initiative or Activity	Focus
EWB Design Summits	Two-week immersive in-country program, with Summits in Nepal, India, Cambodia and Malaysia, led by EWB Australia.
Enable Futures Study Tour	Ten-day study tour to Singapore with a focus on disability and ageing, led by Enable Development
GlobeX	Summer Program at Peking University (PKU) College of Engineering.
IARU Global Summer Program	Attending intensive courses at one of the 11 IARU (International Alliance of Research Universities) partner universities internationally.
School Outreach	Workshops delivered by ANU groups from RoboGals and EWB, which am to encourage non-traditional groups into STEM careers.
Tutoring	Later year undergraduate students work as tutors for early year courses in particular ENGN1211 where the EWB Challenge is utilised.

Table 10: International field schools available through courses at ANU.

Field School Course	ANU College
Vietnam Field School	ANU Joint Colleges of Science
Island Sustainable Development: Fiji Field School	ANU Joint Colleges of Science
Pacific Island Field School	ANU College of Asia and the Pacific
Indonesia Field School	ANU College of Arts and Social Sciences

Pilot Study

An initial explorative study with seven engineering students was conducted to determine how and to what extent the ANU engineering program already meets the requirements of the GCSP. The tables below include information about the focus of research done across the 14 identified Grand Challenges (Table 11) and the initiatives and experiences across the five GCSP components (Table 12). Students evaluation of their level of performance across each of the five GCSP based on rubrics used at The University of Texas GCSP are provided in Table A in the supporting material.

Table 11: Number of references to Grand Challenges identified by students (N = 7).

Challenge	Number of Instances	ANU Research Themes
Make Solar Economical	2	Energy
Manage the Nitrogen Cycle	1	Energy, Fabrication
Provide Access to Clean Water	4	Materials, Fabrication
Restore and Improve Urban Infrastructure	4	Information, Fabrication
Advance Health Informatics	1	Information, Fabrication
Engineer Better Medicines	4	Materials, Fabrication
Advanced Personalised Learning	4	Information
Engineering the Tools of Scientific Discovery	1	Information, Fabrication

Table 12: Activities and initiatives identified by students contributing to GCSP elements.

Initiative / Activity	Number of Responses
Intra-Curricula (Formal Course)	
Individual Research Project (ENGN4200)	5
Engineering for a Humanitarian Context (ENGN4520)	3
EWB Challenge (Discovering Engineering ENGN1211)	3
Systems Design / Analysis (ENGN2225/6)	2 / 2
Composite Materials (ENGN4511)	2
Engineering Innovation (ENGN3230)	2
Group Systems Engineering Project (ENGN4221)	1
Co-Curricular	
EWB Humanitarian Design Summit	3
Extra-Curricula	
Work Experience	2
School Outreach (EWB and RoboGals)	2
Tutoring at ANU	1
Hobbies	1

Program Funding

As highlighted, the Program will be supported by CECS through existing roles and responsibilities during the initial establishment of the Program.

2. Scholar Engagement

Scholar Application and Selection

For the implementation stage in 2016 and 2017, admission will be open to students from any year level, to engage with students who are likely to achieve the 5 elements before they graduate. From 2018 the focus will be on students starting their first or second year of studies although later year students will be able to apply. Our experience is some students enter engineering with a passion for humanitarian engineering or specific global challenges, while others are inspired by particular activities or initiatives along their pathway. Selection preference however will be given to earlier year students, to enable them to more fully plan their GCSP pathway and experience.

An application for inclusion will consist of an online submission through the ANU community learning-management system (LMS) Wattle site that will be established to support the Program. The application will take into account student:

- completeness;
- relevance and achievability; and
- motivations, commitment and previous extra-curricular activities and efforts at university and school.

The evaluation of previous efforts will align with current admission policies being established by the university to support university entrance offers, which are expected to be finalised in 2017.

Student motivation will be assessed on the ability of applicants to identify potential Challenges they are interested in pursuing and the alignment of those with College research themes, interests and opportunities. Scholars would be able to commit to challenges within the GCSP and be able to change these choices. This enables students to take advantage of research opportunities as well as the inherent advantage of a single Research School with multi-discipline research groups.

For students applying in later years, preference will be given to those who have significant attainment of the Program components, in particular extra-curricula, interdisciplinary and service-learning activities, and are hence more likely to complete the requirements. Applications will be assessed by the GCSP Committee.

Students can elect to leave the Program at any point. Students may be removed from the Program if they fail a course, are asked to leave an associated extra-curricula activity or are unlikely to complete the requirements of the Program in the timeframe available. Such decisions will be made by the GCSP Committee. Students can appeal the decision of the Committee to the CECS ADE.

We anticipate building to 16 students per year in our implementation of the GCSP. This number have already been identified to potentially join the program from the 2017, and is based on experiences in 2016 with Humanitarian Engineering initiatives (particularly the EWB Humanitarian Design Summit). The EWB Design Summit also uses a similar selection process as outlined for the GCSP, and our experience is around 60% of students who apply meet the criteria set, and we expect a similar yield rate for Scholar applications.

Student engagement with core GCSP initiatives in 2016 are summarised in Table 13. We have 330 students in Discovering Engineering taking part in the EWB Challenge. Approximately 180 students a year undertake a final year individual research project, of which about 15 in 2016 are completing service-learning projects with our existing community partners. Although only introduced in 2015, we anticipate 30 students a year taking part in a relevant supported international experience including the EWB Design Summits and Enabled Futures study tour.

Table 13: Student numbers in potential GCSP initiatives and activities in 2016.

Initiative	2016 Numbers
EWB Challenge via ENGN1211 Discovering Engineering	330
EWB Design Summits, Cambodia and India	24
Enabled Futures Study Tour, Singapore	6
Final Year Service-Learning Research Projects (ENGN4200 or equivalent)	15

Scholar Support and Funding
For first and second year Scholars, support and mentoring will be provided by the GCSP Committee, in particular the Director, and by the course coordinator and academics roles identified in Table 2. For third year students, from 2018 support and mentoring will be provided by the research theme mentors as highlighted in Table 3. For final year students, additional mentoring will be provided through the

existing final year individual research project mechanism, where each student conducts a year-long individual research project supervised by a researcher. This provides specific one-on-one mentoring and aligns with the research element of the GCSP. Scholars will also be peer-supported through community that will be formed around the Program. Further existing mentoring programs, including the BE (R&D) research mentoring program and Tuckwell Scholars, will be utilised.

Opportunities for external industry mentoring will be pursued, in particular with professional members of the local ACT Chapter of EWB and other Canberra based partner organisations. ANU graduates with humanitarian engineering or related experience will be also be invited to be involved. This is an expanding pool, as three ANU engineering graduates have completed or are currently on placements with EWB, and both Abundant Water and Enable Development were established by ANU engineering graduates and have already been involved with guest lectures and workshops and research projects. The GCSP will provide a structured framework for alumni to engage with and mentor students.

Funding has already been secured to support students on EWB Design Summits to Cambodia and India, with 30 students supported on scholarships in 2015 and 2016, and a further 40 scholarships available from the start of 2017 to mid-2019. These scholarships from the Federal Government New Colombo Plan (NCP) provide $3k per student, which is around 60-70% of the total cost of taking part in the Summit. The six ANU students on the pilot Enabled Futures trip were supported by NCP funding. Further applications to the NCP will be made through the regular annual rounds, with the GCSP expected to strengthen the applications.

Funding of up to $150 is available for each final year research student, with additional grants of up to $500 in total available. We will seek scholarships to support Scholars across the pathway to support involvement with international experiences and research. Funds will be available to support specific initiatives and activities linked to the GCSP and the humanitarian engineering pathway.

Scholar Monitoring
In 2016 a Humanitarian Engineering and Education Research group in RSEng was established with a particular focus on supporting final year individual research project students. This will be used as the base for a learning community for Scholars. A community learning-management system (LMS) within the ANU (Moodle-based) Wattle site will be established to support the Program. This will provide discussion and news forums and access to resources and material. A Scholars workshop will be run once a semester (twice a year), open to Scholars across all years, and to welcome new Scholars as well as opportunities for guests and site visits.

Scholar Completion
Upon completion of their component requirements, each Scholar will be required to complete a written personal statement, details of their attainment, and an artefact (such as a video or prototype) capturing their journey. The applications would be

assessed by the GCSP Committee for completeness against the 5 GCSP elements and Grand Challenges. Submissions would be made at the end of each university examination period, being the end of June and November, to align with the completion of formal studies by students. An ANU community Wattle site (LMS) will be used by students to apply for the program, track their progress and submit their final application.

3. GCSP Components

The GCSP is structured around five components through which students explore the Grand Challenges. Students must complete activities in all five components, although the level of engagement with each will vary. A single activity may contribute to multiple components. Each component can be engaged through a substantial experience or several smaller activities. Three different levels of engagement, or achievement, are set for each component. Students should expect to achieve the exemplary achievement for at least two components, and proficient for the others. Emerging achievement is are provided to assist students and support networks to plan activities and engagements. The elements are summarised below with Table B in the supporting material providing more detail for each level of achievement.

Research
The ANU is a research intensive university, and research is central to all that we do. All engineering students undertake an individual research project in their final year, contributing to 25% of their course load. This will provide a proficient level of achievement. For exemplary achievement students will be expected to engage in active dissemination of their research to support appropriate impact. This can either be through peer-reviewed channels or engagement with external stakeholders. This allows dissemination to be more tailored to the goals of the project.

Service Learning
Engineering students have opportunities to be involved with service learning projects and assignments across their year levels. Existing relationships will continue to be utilised to provide internship, work experience and research opportunities identified by community partners including EWB, AW, ED and TADACT. To attain the exemplary level, Scholars will need to be involved in formative reflective practice during their activities. Across the proficient and exemplary levels, Scholars will need to ensure they have appropriate accreditation and compliance to take part in service learning which could include First Aid certificates, Working with Vulnerable People registration and an understanding of ACFID (Australian Council for International Development) code of conduct.

Interdisciplinary Curriculum
Students are able to undertake courses in other discipline Colleges at the ANU through their university electives (see Table 5). Of particular relevance are the VC (Vice-Chancellors) courses, which are specifically designed to engage with multiple

disciplines across the campus on areas such as research and leadership. The exemplary achievement is gained through a formal qualification in a second discipline such as a double degree or major or minor from another College (see Table 6 for examples).

Global Perspectives

A number of courses are available on campus with a global focus, providing an emerging achievement. For proficient, student must more actively engage with global dimensions, through a service learning project with a global or international aspect or time overseas with an organisation. An exemplary achievement can be gained through an international immersive experience such as those available including EWB Design Summits, Enable Futures study tour or other field schools offered at ANU (see Tables 7 and 8). Through the structure of these, students are required to live in another culture and reflect on and critical evaluate their experiences.

Entrepreneurship

All engineering students at ANU are required to complete a third year Engineering Innovation course which provides a base-line only. Scholars will be expected to expand on this for the proficient achievement requiring immersion in the culture of innovation and entrepreneurship. This can be through involvement in the ANU TechLauncher program, which has a specific focus on start-ups and entrepreneurship. Alternatively, students can be involved in external business activities such as start-up camps, workshops or hackathons. In Canberra, many of these are provided by the Canberra Innovation Network (CBRIN) and its programs, of which the ANU is a founding partner. The exemplary achievement is direct involvement with a start-up business or involvement in a business accelerator program, such as that offered by CBRIN. Experience with social enterprises and not-for-profits will also be taken into consideration here.

4. Program Support, Evaluation and Tracking

Program Promotion

As ENGN1211 Discovering Engineering has no pre-requisites and is taken by all engineering and software engineering students as well as any discipline at ANU, it provides the ideal vehicle to introduce the Grand Challenges and the GCSP. The Program will be introduced with and linked to the EWB Challenge in the course. The GCSP will be promoted through the local ACT EWB Chapter, particularly the outreach program which attracts numerous students. ANU+ will also be used to promote the Program. ANU+, to be developed and launched in the second half of 2016, will provide a framework to recognise student volunteering, either at the ANU or beyond. For students who volunteer but then wish to extend their extra-curricula efforts and align them to their studies, the GCSP framework provides that structure and hence ANU+ is seen as an avenue to promote the Program particularly to other Colleges. The second year compulsory ENGN2225 and ENGN2226 courses will also be used to promote the program to second year students.

Program Development

As highlighted, a brief study has already been conducted to gain initial insights on student activities linked to the GCSP (see Tables 11, 12 and A). The Program, and in particular, the component rubrics, are being developed incorporating this initial feedback. Review of the proposed elements will be sought from EWB, academic networks, EWB's University Partners, other community partners the ANU works with (AW, ED and TADACT), leaders in Humanitarian Engineering in Australia, and students from ANU.

Program Evaluation

An evaluation of the Program and the student outcomes achieved will be incorporated into postgraduate research currently being conducted by Jeremy Smith. This will capture experiences of students in the first 18 months of the program (the remainder of 2016 and all of 2017). This will be disseminated through academic channels including AAEE (Australasian Association for Engineering Education) annual conferences and relevant journals. Outcomes will also be used to shape the Program at the ANU and assist learning at other universities. Ongoing evaluation will be supported through the learning community established.

Staff Support

There are a number of avenues in place, particularly through final year individual research project supervision, for staff to be involved in the GCSP. Staff are able to be involved as an academic mentor on the EWB Design Summits, to provide education support to participants but also experience community development and humanitarian engineering themselves. Over the 2015/16 summer, three CECS staff members were academic mentors to Design Summits in Cambodia, each provided with support by CECS to assist with the costs. These opportunities are regularly available during Summits in the winter and summer semester breaks.

It is expected the GCSP Director will be supported to be involved with regular conferences and workshops, such as the annual AAEE Conference and EWB Academic workshops. The GCSP Director should have been, or will be, an academic mentor on EWB Design Summits.

Inter- and External Networking

We will work closely with EWB who are helping lead the launch of GCSP across Australia at multiple universities. Currently, the number of students participating in EWB programs in an academic year is shown in Table 14. As ANU learn the strengths and areas for program medication during our first 18 months, EWB will continue to evolve the GCSP to meet the local ANU needs as well as help the other universities as they implement their own GCSPs. EWB will incorporate these learnings and experience into workshops it conducts such as those at AAEE and with academic coordinators responsible for the implementation of the EWB Challenge. Existing university partnerships, of which EWB has 11, will also be used to support discussions around the GCSP.

Table 14: Students and universities in Australasia involved with EWB Education Initiatives in 2016.

Initiative	Students Participating	University Involved
EWB Challenge	8000	28
Design Summits	400	21
Research Projects	50	12

Program Launch and Promotion

It is planned to launch the ANU's involvement in the GCSP as the first Australian university at the end of 2016 or the start of 2017. The Program will be promoted to networks and organisations including the Canberra Innovation Network (CBRIN) and the Australian Federal Government Department of Foreign Affairs (DFAT).

Supporting Material

Table A: Student identified self-evaluations of component achievements for performance description for rubrics (N = 7, green is 4 or more students identifying the level of achievement representing a majority, orange is 3 students, red is two).

Performance Description	Emerging	Proficient	Exemplary
Research Rubric			
Identification of Area		2	**4**
Mission Statement		3	2
Problem Identification and Scope	1	2	1
Focus and Relevance		1	3
Functional Modelling		3	2
Concept Generation Techniques	1	1	3
Concept Selection		1	**4**
Concept Embodiment		2	3
Variety of Sources	1	1	3
Data Collection	1	2	2
Validity of Data	1	1	3
Representing Data		**4**	1
Verify and Evaluate Information		**5**	
Draw Conclusions		3	2
Justify and Support Decisions		3	2
Service Learning			
Meeting Community Needs		**4**	2
Fosters Community Coordination		2	2
Initiatives Academic and Learning		1	2
Facilitates Reflection		2	2
Develops Caring	1		3
Improves Quality of Life		2	2
Entrepreneurship			
Opportunity Identification		3	1
Start-up Process		**4**	
Goals and Objectives		1	3
Elevator Pitch		**4**	
Advantages and Disadvantages			**4**
Marketing	1	2	1
Opportunity Assessment		**4**	
Skills, Competencies and Knowledge		2	
Scope		2	2
Budget		**4**	
IP and Patent	2	2	
Future Goals	1	3	
Network	1	2	1
Global Awareness			
Technology Impact	1	1	2
Understanding Impacts of Decisions	1	2	1
Understanding Impacts of Factors		3	1
Awareness of Culture		3	1
Stereotyping and Bias		3	1
Celebrating Culture		2	2
Interactions with Individuals	1		3
Use of Resources		**4**	

Understanding Impacts of Context	1	3	
Interdisciplinary Curriculum			
Engage in Perspective Taking		3	
Structural Knowledge		1	2
Integration from other Disciplines	2		1
Explore Alternatives		3	

Table B: GCSP Elements and achievement descriptions.

Component	Emerging	Proficient	Exemplary
Research	6-credit-unit research project.	Final year individual research project (ENGN4200) OR 12-unit R&D Project.	As for proficient with results of research disseminated via peer-reviewed channel such as a conference, technical presentation or article, or sharing with external stakeholders via engagement, summary, or workshops.
Interdisciplinary Curriculum	A course outside home School.	Completion of a course or short-term immersive experience with a specific cross-discipline perspective such as an ANU VC course OR structured engagement with additional discipline or qualification (degree, major or minor) in a second program or discipline.	Completion of a multi-discipline program or award, or program that takes a cross-discipline perspective. Examples are the ANU Leadership and Research Minor and the Innovation and Professional Practice Minor or Major.
Entrepreneurship / Innovation / Implementation	ENGN3230 Engineering Innovation OR business development workshops OR ANU ENGN4221	Completion of ENGN3230 Engineering Innovation or equivalent and involvement in ENGN4221, ANU TechLauncher, business development workshops or hackathons.	Active participation in start-up or social enterprise, completion of business accelerator program, or multiple activities from proficient.
Global Dimension	Completion of a course within a global focus.	Engagement in a project with significant global dimension or involvement in an international organisation including time overseas.	Participation in global program such as an EWB Summit, Enabled Futures, IARU course, GlobeX, semester on exchange, field school or international volunteer work.

Service-Learning (SL)	Completion of a project with engagement with external stakeholders	Completion of 6 week service-oriented internship or work experience or ENGN4221 project with appropriate external partner AND Completion of requirements to undertake SL, such as First Aid certification, Working with Vulnerable People accreditation and/or awareness of the ACFID Code of Conduct.	SL with direct external engagement and a structured formative reflection process. Could be ENGN4520 utilising the EWB Design Summit, a 12 credit-unit service-learning project (through ENGN4200 or R&D equivalent) or completion of ENGN3100/3200 with a community-based organisation. Includes completion of requirements to undertake SL, such as First Aid certification, Working with Vulnerable People accreditation and/or awareness of the ACFID Code of Conduct.