Exploring intercultural competency in engineering

Final Report 2013

University of Wollongong (lead)

Queensland University of Technology, University of Technology, Sydney, University of Tasmania

Project Leader: Thomas Goldfinch

Project team: Timothy McCarthy, Catherine Layton, Elyssebeth Leigh, Pamela Abuodha, Les Dawes, Anne Gardner, Giles Thomas, Alan Henderson

Author: Thomas Goldfinch

<engineeringacrosscultures.org>

Support for the production of this report has been provided by the Australian Government Office for Learning and Teaching. The views expressed in this report do not necessarily reflect the views of the Australian Government Office for Learning and Teaching.

Requests and inquiries concerning these rights should be addressed to:
Office for Learning and Teaching
Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education

GPO Box 9880,
Location code N255EL10
Sydney NSW 2001

<learningandteaching@deewr.gov.au>

2013

ISBN 978-1-921916-00-7 book
ISBN 978-1-921916-01-4 PDF

Acknowledgements

The project team would like to thank all the members of the engineering education community who have contributed to the project through workshops, conference presentations and direct correspondence. The engagement of these individuals has been a key factor in the project's success.

The team would also like to express their appreciation to the engineering students who have participated in the project by completing surveys, providing feedback on learning modules, and participating in observation sessions.

The team would like to thank the following people, for specific contributions to the project:

Jade Kennedy (University of Wollongong), for providing guidance and a new perspective on cross-cultural issues.

Professor Caroline Baillie, for supporting the project and her assistance in creating links with other projects internationally.

Associate Professor Greg Hampton (University of Wollongong), for advising on research methods and contributing to data analysis.

Frances Hill, Anna Hiley, Bland Tomkinson, and Rosemary Tomkinson (University of Manchester), for their contributions to the project research and feedback on EAC learning modules.

List of acronyms used

AAEE	–	Australasian Association for Engineering Education
AMC	–	Australian Maritime College at the University of Tasmania
EA	–	Engineers Australia
EAC	–	Engineering Across Cultures
EWB	–	Engineers Without Borders
QUT	–	Queensland University of Technology
REES	–	Research in Engineering Education Symposium
UM	–	University of Manchester
UOW	–	University of Wollongong
UTAS	–	University of Tasmania
UTS	–	University of Technology, Sydney

Executive summary

Since the release of the report 'Changing the Culture', by the Institution of Engineers, Australia (IEAust, 1996), the landscape of engineering education in Australia has been changing. The report recommended sweeping changes to the way engineering graduates were prepared for work in the modern engineering profession. In particular, several recommendations specified a greater emphasis on preparing graduates for a profession that increasingly involves working with communities and other cultures.

These recommendations have since been incorporated into Engineers Australia's Accreditation program through the Engineers Australia stage one competency standards for professional engineers (Engineers Australia, 2011). Similar targets are also present in engineering program accreditation standards overseas, and are one of the attributes of international qualification recognition initiatives such as the Washington Accord (www.washingtonaccord.org). The need for engineers to have the ability to work effectively in multidisciplinary, multicultural and multinational settings is now widely accepted.
This project has undertaken an exploration of the issues and opportunities surrounding intercultural competence in engineering education. This term has been defined through consultation with engineering educators and practicing engineers as *Appreciating, respecting and adapting to other values, beliefs and behaviours and working with differences.* Workshops and consultation with engineering academics and industry representatives both in Australia and overseas have found that there are significant opportunities for improving engineering education in the area of intercultural competence. These opportunities are driven largely by the diverse interests and experience of engineering academics and the targets set by the peak professional body, Engineers Australia.

An exploration of students' current levels of intercultural competence through analysis of assessable work, group observations, and surveys suggests that there is work to be done to meet the targets set by Engineers Australia. To assist in meeting this challenge, the project team and contributors have developed an eBook, Engineering Across Cultures (EAC), covering the key principles in introducing students to the ideas around intercultural competence. The eBook will support educators seeking to utilise a series of learning modules also developed by the project. These EAC learning modules combine student guides, tutor instructions and supporting materials, and cover many of the aspects of culture that affect engineering practice. Together, the Engineering Across Cultures eBook and learning modules provide the engineering education community with an accessible resource upon which to build for further work in this area. These materials can be accessed at <engineeringacrosscultures.org>.

In addition to producing the eBook and learning modules as key outcomes of this project, the project team has made a number of recommendations to ensure the ongoing improvement of engineering education in the key area of intercultural competence.

Recommendation 1: Capitalise on the diversity of student and staff backgrounds
There is a need to encourage students and academics to talk more openly and regularly about intercultural issues. This project has shown that this can be achieved through workshops and the process of implementing new educational practices. Creating a more open dialogue will help students and staff to understand more about overcoming the challenges of working across cultures. The diverse ethnic, socioeconomic and educational backgrounds of students and staff provide an ideal foundation for this.

Recommendation 2: Education of students should be used to promote the importance of intercultural competence to engineering academics
The experience of the project team in implementing EAC learning modules has shown that the preparation needed to run these activities encourages teaching staff to recognise the intricacies and challenges around working across cultures. These modules are an excellent starting point for further staff development in this area.

Recommendation 3: An intercultural competence community of practice should be established
Creating a community of practice with a shared interest in improving intercultural competence among students will provide a sustainable way forward for work in this area. The EAC modules can provide a focal point for the community with participants encouraged to use, modify and contribute to new modules.

Recommendation 4: The importance of intercultural competence in engineering practice must be made clear to students through regular learning activities
In implementing EAC learning modules or other activities targeting intercultural competence in engineering, there is a risk that infrequent encounters with these issues in engineering curricula will mean they are seen as exotic or rare. Care needs to be taken to ensure students not only develop their intercultural competence, but an appreciation of the importance of this in the engineering profession.

Recommendation 5: Further research into how intercultural competence can be measured in the context of engineering education and practice is needed
To ensure learning outcomes are met, more needs to be understood about how to efficiently and effectively measure intercultural competence. This will require further research and ongoing cross-disciplinary collaborations.

Table of contents

Tables and figures

Tables

Figures

1. Introduction and background

Since the release of the report 'Changing the Culture', by the Institution of Engineers, Australia (IEAust, 1996), the landscape of engineering education in Australia has been changing. The report recommended sweeping changes to the way engineering graduates were prepared for work in the modern engineering profession. In particular, recommendations 1 and 3 in the report specified a greater emphasis on preparing graduates for a profession that increasingly involves working with communities and other cultures.

Recommendations from the 'Changing the Culture' report were incorporated into Engineers Australia's Accreditation program through a set of 'graduate attributes' (Bradley, 2006) that closely resemble sets of graduate attributes (or qualities, or capabilities) adopted by universities around Australia and overseas. The need for engineers to have the ability to work effectively in multidisciplinary, multicultural and multinational settings is widely accepted. The most recent accreditation criteria for engineering programs in Australia specifically require this (Engineers Australia, 2011, standards 1.5, 3.2, 3.6). Similar provisions are required in the US (ABET Engineering Accreditation Commission, 2011, Criteria 3c, 3g, 3h), and by signatories of the Washington Accord <www.washingtonaccord.org>.

Australian engineering schools have been coming to grips with the idea of 'graduate attributes' and how they can be incorporated into engineering curricula effectively. While skills like problem solving, teamwork, and written and oral communication have been the centre of many studies and engineering educational development projects, other attributes like ethics and intercultural competence have proven more challenging. A comprehensive audit of graduate attributes oriented learning activities in six engineering degree programs at the University of Wollongong in 2008 highlighted significant gaps in the curricula in terms of the graduate capability 'respect for views, values, and culture of others'. Investigation into how this gap might be closed identified some key issues in engineering education:

- Official graduate learning outcomes and accreditation criteria require engineering schools to prepare engineers to work in an increasingly globalised workplace. However, literature focusing on how to improve cultural awareness and competence among engineering students is limited.
- Despite the multicultural nature of engineering faculty in Australian universities, there is little evidence that this opportunity is being taken advantage of to educate students on cultural issues.
- The popularity of educational programs that incorporate cultural issues such as the Engineers Without Borders Challenge (EWB, 2011) is growing, and overseas exchange programs are being promoted within engineering.

It was clear that there exists an acceptance of the need for developing intercultural competence among engineering students. There is also a wealth of cultural knowledge among engineering academics to draw from. However, the knowledge on how to effectively educate engineering students on cultural issues was limited.

The need to foster students' development of intercultural competency is not limited to preparing graduates for the profession. There is also a significant need to recognise the potential impact of changing student and staff profiles on what happens in the classroom, particularly in group based activities. Vigorous marketing by universities over the past decade has led to increasing numbers of undergraduate international students, particularly in engineering. King (2008, p. 34) reports an increase of 14 per cent of international undergraduate enrollments to nearly one quarter of all enrollments in 2006. Add to this the culturally diverse academic staff that make up modern engineering schools and it is clear that domestic and international undergraduates are already working within a culturally diverse environment long before they enter the profession. This means that preparation is required from year one of their studies.

Recognising these themes, a teaching and learning grant was obtained from the University of Wollongong in late 2009 to develop a pilot program of educational activities to address cultural awareness in a first year engineering design course. This program took the form of a three tutorial session package of tutor instructions, assessable activities, and stimulus materials. The resources developed focused on cultural influences on engineering design, and encouraged students to explore their own cultural background in the context of an engineering design. The encouraging feedback from teaching staff in this project led to the establishment of this project, Exploring Intercultural Competency in Engineering.

This project took a very practical approach to exploring the issue of intercultural competence in engineering. The goal was not to explore or develop models of intercultural competence as has been done elsewhere (Spitzberg & Changnon, 2010), nor to conduct in-depth research into how students grapple with and develop intercultural competence. The primary purpose of this work was to develop a greater understanding of the opportunities available for improving education of engineers in this area and to develop a starting point for achieving this.

1.1 Overview of project plan and revisions

The project plan consisted of four dimensions as indicated in Figure 1. These dimensions were developed simultaneously which facilitated a flexible and incremental creation of the Engineering Across Cultures resources. This eBook and set of resources were the major outcomes of this project. A summary of how each dimension has been approached is outlined below.

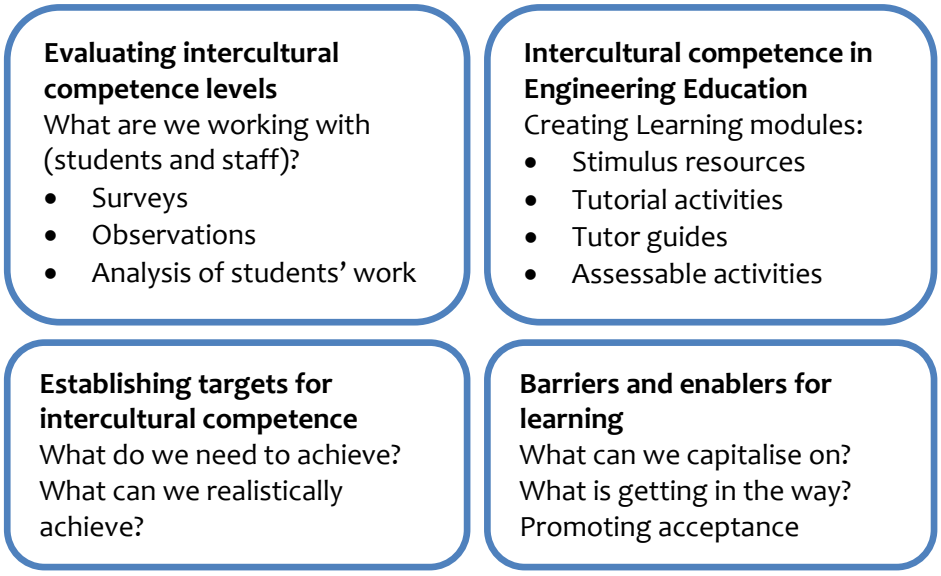

Figure 1 The four dimensions of the project and key elements of them

Evaluating intercultural competence levels

The determination of current student competency levels was carried out through an analysis of students' written work, a survey, and observational research. Student reports relating to issues of culture and diversity in engineering design were analysed to develop an understanding of what issues students are able to recognise and account for at present. This work is discussed in greater detail in 2.1.1.

The survey was based on the MiniCQS tool developed by Ang and Van Dyne (Ang & Van Dyne, 2008). This was coupled with video recorded observations of students working on projects that were analysed using the Interaction Process Analysis framework developed by Bales (Bales, 1950). This study determined the likely work needed to develop students' intercultural competency. The process and outcomes are presented in more detail in 2.1.2 with full details published to the engineering education community as outlined in section 5.

Evaluating the current understandings of culture and intercultural competency among engineering educators and practicing engineers was carried out though a face-to-face and email consultation process. This work overlapped with the identification of targets for intercultural competence. Details on the process and outcomes are presented in 2.1.3 and appendix A.

Establishing targets for intercultural competence

This aspect of the project followed on from the evaluation of students' current competence levels and the distillation of outcomes from consultation with engineering academics and industry representatives. Definitions of culture and intercultural competence were refined from suggestions made by stakeholders. Using these definitions and other aspects of intercultural competence identified over the course of the project, targets for the development of skills and attributes that underpin intercultural competence were identified within existing accreditation standards for Bachelor of Engineering Programs (see 2.1.3 and 2.2).

Intercultural competency in engineering education
This is the most substantial outcome of the project. A series of learning modules targeting the underlying ideas and thought processes around intercultural competency have been developed. The modules are presented in a packaged, ready to implement format. Selected modules have been used in three institutions so far. Most modules take the form of a tutorial session plan, with tutor instructions and supporting resources. These take into account typical tutorial formats in Australian universities. The module design also takes into account the level of preparedness of engineering educators and students that was evident other dimensions of the project discussed above.

Workshops have been run to showcase the learning modules and gain feedback from engineering educators. This feedback has been used to further develop the modules. The learning modules are presented along with an eBook, Engineering Across Cultures (EAC), that supports the educational approaches underpinning the modules. All resources are available at <engineeringacrosscultures.org>.

Barriers and enablers for learning
The fourth dimension to this project involved the development of recommendations across the project's duration. These recommendations arise from the challenges and opportunities identified during the work and are presented as final recommendations in section 6.

1.2 Summary of progress towards stated deliverables

Promotion within the engineering education community of the need for education on cultural issues, and the concepts of intercultural competence

There has been a very positive reception to the project among over 100 engineering academics who have attended workshops and conference presentations. However, reaching those who have not yet considered the need for education of engineering students in this area has been more challenging. The implementation of learning modules developed by the project has created the opportunity to reach engineering educators who were less likely to engage with the project otherwise. In the institutions where they have been implemented, there has been a largely positive response from tutors and lecturers. The project team intend to continue with this approach, using pre-prepared learning modules to reach engineering educators and grow a community of practice. This is a gradual process and is viewed as the most sustainable way of promoting the importance of intercultural competence to the community and to students.

A greater understanding of engineering students' and staff cultural awareness

The research carried out in this project to date has shown limited evidence of deep engagement with intercultural issues among engineering students. There are some indications that students understanding of their experience working across cultures improves as students encounter more of these situations, even in an unstructured or unsupported way. However, there is a need to improve and accelerate this process if engineering graduates are to meet expectations of their ability to work in culturally diverse settings set by the professional body, Engineers Australia.

Outcomes from workshops and consultation suggest that there is an appreciation of the challenges and complexities of intercultural interaction among engineering educators. Responses from engineering academics and practicing engineers present a multi-faceted view of culture and the meaning of intercultural competence that is very encouraging for future work on education in this area. However, understanding of the intricacies of educating engineering students in this area among engineering academics appears to be limited to a number of enthusiastic individuals at this stage.

Targets for improving engineering students' and staff intercultural competence: what is desirable, as well as what might be achievable

From the work to date, the current aspects of intercultural competence incorporated into the Engineers Australia stage one competency standards appear clear, sufficient and achievable. These standards are the measure by which the learning outcomes for Bachelor of Engineering degree programs are compared. More rigorous educational practices are needed to create opportunities for students to develop these competencies to the standard required.

Implementation of improved educational practices aimed at developing students' intercultural competence has also been observed to create discussion among engineering academics on these issues. Whilst targets for the intercultural competence of staff have not been set, the creation of opportunities for sharing of ideas and experience working across cultures through education of students is likely to improve levels of competence.

Learning and teaching resources, in the form of an eBook, which can be adapted to existing engineering curricula to facilitate students' development of intercultural competence, and support staff in delivering effective programs

A set of 12 teaching modules, plus an eBook and teacher preparation materials have been produced. Many of these modules have already been trialled or adopted into existing programs. Each teaching module contains a tutor guide, a student guide and supporting resources to create a ready to use resource. Experience in implementing these modules has shown they are simple to adapt to existing curricula with only minor modification. Several modules can also be divided to support their use in classes of one or two hours' duration.

2. Intercultural competency in engineering

2.1 Establishing learning needs

Determining the learning needs in engineering was approached through a survey, video observations, and the analysis of students work in areas where intercultural competence is relevant. With this approach, the project team were able to identify a number of key themes, and importantly, a number of issues that have fed into the development of learning resources. The work described in 2.1.1 and 2.1.2 was approved by the UOW Human Research Ethics Committee (HE11/164, see appendix D).

2.1.1 Analysis of students' work

In early 2011, a sample of final reports from first year UOW students' 2010 Engineers Without Borders challenge projects were analysed to identify how students had addressed complex dimensions of culture in their designs. This work has been published to the engineering education community previously (see Abuodha, Layton, & Goldfinch, 2011). For the 2010 EWB Challenge (EWB, 2010) students were required to work in groups to develop innovative and cost effective engineering solutions to support the redevelopment of a former sheep station now run by the Kooma indigenous community in southern Queensland. Students were supported in the cultural aspects of the design challenge through a series of tutorials that now form EAC units one, two and four (see 3.2), and a guest lecture by project reference group member Jade Kennedy.

The reports were sorted into six themes, according to the focus of the students' projects: accommodation; education; power management; water management; transport and information, communication and technology (ICT); and horticulture, food control and pest control. The reports were coded in a qualitative analysis software package, QSR NVivo 8. Instances were recorded where students discussed or referred to country, kinship, culture, journey, connectedness as well as community involvement, EWB, teamwork and technical issues. The first five codes were dimensions of Aboriginal culture presented in Jade Kennedy's lecture. The remainder related to the broader issues in which project team were interested.

The results indicated that cultural awareness still remains a relatively new topic among engineering students. The low percentage of references to culture in the reports examined (3-9 per cent) and the largely superficial nature of them could be attributed to several factors. These were considered and recommendations (in bold) that fed into later stages of this project were made:

1. The EAC tutorial materials aimed to help students practice adopting different perspectives, and were designed to elicit and explore cultural assumptions in a concrete and accessible way, but they were solely for the first three weeks of session. **Integration across the session is likely to prove a more powerful and sustainable approach.**

2. Tutors' familiarity with cross-cultural work and/or Aboriginal cultures was not explicitly monitored in this study, but informal feedback in tutor meetings indicated that most tutors had not had direct contact with Aboriginal cultures. **Effective tutor preparation together with a reduced dependence on tutor input in learning activities was needed.**
3. Students seemed to have understood the demands the EWB Challenge imposed on them in terms of considering Aboriginal culture. The findings of this study showed that the choice of theme may have played a role as to whether the students were able to adapt what they learnt from one cultural-based lecture and three tutorials into their EWB challenge projects. **Further investigation of the relationship between selected project themes and consideration of non-technical issues is needed.**
4. One of the four aims of the EWB Challenge was to develop an appreciation of some of the complexities of working cross-culturally (EWB, 2010). Only three out of 21 (14.3 per cent) judging criteria were related to working cross-culturally. **The relationship between assessment/project demands and students consideration of intercultural issues needs more attention.**

A smaller scale analysis of students work for a second year assessment task at UTS was also carried out. This analysis involved the evaluation of students' reflections on issues of culture and diversity in the engineering workplace. In the assessment, students interviewed a practicing engineer and reported the engineer's responses to their questions. Students then reflected on whether the engineer's answers were the same as or different to what they expected and what they found in their research. Twenty five of the 154 reports focussed on the theme of culture and diversity. These 25 reports were examined in more detail to investigate the opinions and attitudes of the practising engineers interviewed, or at least the students' impressions of the engineers' attitudes in relation to culture and diversity.

The concepts included under the theme of culture and diversity were, most commonly, ethnicity or racial background and gender diversity, less commonly, generational differences in the workforce were also addressed. In one instance a student also included sexual orientation as a dimension of diversity. One student focussed on gender as the only dimension of diversity.

The practicing engineers' responses showed that they were aware of the benefits to an employer of having a diverse workforce, eg. *"...cultural diversity was necessary ...to obtain...the best people*"; and "... *he adds that a diverse workforce will generally bring to the organisation a more diverse range of skills, hence not only improving productivity of the organisation but also enhancing versatility*."

Having a culturally diverse workforce was also seen as an advantage as having an awareness of the client's cultural practices was seen as important in successfully managing client relationships, e.g. " *Our patients come from a wide variety of backgrounds, therefore, we benefit from having staff from a wide variety of backgrounds who can help us better relate to our patients. We also benefit by being able to find the best person for the job from when the entire community of suitably trained applicants are welcome to apply*". At one company being multilingual was seen as a necessity as "*English and Spanish were used about equally both in the workplace and when liaising with clients. Come clients were based overseas, so*

[the interviewed engineer] *also had occasion to communicate in Italian.".*

Some engineers expressed the view that a person's culture didn't matter – it is their technical skills that they are being employed for e.g. *"...they're not especially concerned with who you are, as long as you're capable of doing the job to* [their] *satisfaction*". This was not a particularly nuanced view of staff and would potentially overlook the benefits of diversity. The most common response from the engineers interviewed about the issue of discrimination was that because of antidiscrimination laws and their companies' regulations, discrimination wasn't a problem. It is probably a reflection on the naivety of the students involved that they didn't challenge this view. There are two notable exceptions to this view of discrimination:

- Discrimination and bullying still happen:
    - *"...he told me about the time his Polish boss told the Italian office worker to stop speaking in Italian in the workplace whilst on the phone*."
    - "*I could tell he believed that the engineering workplace, in particularly on construction sites, was not suitable for women*."
- It is not always simple to apply the regulations:
    - "*While this worked on paper, he noted that it was hard to distinguish what could be considered a joke or not*"

One engineer suggested that the benefit of a strong company 'code of conduct' was that it promotes a company culture that operates over and above any cultural differences from race, ethnicity, religion or gender, e.g. "*a strictly followed company endorsed culture aiming to reduce culture diversity*"; "*one of the ways that the company alleviates this* [cultural differences] *is by standardising the engineering practice of its employees across the globe*".

This is in contrast to the engineers who suggested that it is preferable to prevent incidents of cultural conflict by creating an environment characterised by open communication between employees e.g. "...*communication between employees is important to prevent these discriminations happening. I did not realise the importance of preventing racial discrimination before the interview. I now learn that in the workplace, prevention of conflicts is always better than taking action after the incident happen[s]."* At another company, "*programs also promote cultural awareness within the workplace as it creates a harmonious environment to improve communication within the workplace which is important to create an effective workplace*."

This analysis provided the project team with insight on both practicing engineers' views on culture and diversity and students' interpretations of them. Between engineering students at different institutions there was no evidence to suggest that differences existed in students' ability to critically reflect on intercultural interactions and issues of culture and diversity. This indicated to the project team that more needed to be understood about students' intercultural competency, and also that current educational efforts in the area were in need of improvement. Another issue arising from this study was the low proportion of students nominating culture and diversity as a theme for their interview (16 per cent). This suggests that **the profile of issues of culture and diversity in the engineering workplace needs to be raised.**

2.1.2 Student survey and observations

Following on from the analysis of students work, a survey and observational study of students working in teams were undertaken. This aspect of the project sought to understand more about how students saw their own intercultural competence and if there were observable indications of the problems students may encounter. Full details of this work have been published to the engineering education community through three international conferences (see 4.2) (Goldfinch, Abuodha, et al., 2012; Goldfinch & Layton, 2011; Goldfinch, et al., 2011).

Both the survey (see questionnaire in Appendix C) and observations utilised the Interaction Process Analysis (IPA) framework developed by Bales (1950) for analysing interactions between individuals in a group, or team setting. This framework has been widely applied in group observation research, particularly in multi cultural contexts (Lingham, Richley, & Serlavos, 2009; Nam, Lyons, Hwang, & Kim, 2009; Vallaster, 2005). The IPA framework as used in this study is presented accessibly by Carney (1976, p. 160), see Table 1.

Table 1 Bales Interaction Process Analysis

Interaction type	***Demonstrated behaviour***
Group maintenance - Positive	1. Shows solidarity: raises other's status, gives help, brings others in, praises
	2. Releases tension: eases over difficulties, jokes, laughs, shows satisfaction
	3. Agrees: accepts, understands, concurs
Task orientation – Positive	1. Gives ideas: suggests alternatives, outlines options, opens up horizons, non-directive
	2. Gives evaluations: offers opinions, analyses; expresses feelings, wishes
	3. Gives direction: clarifies, orients, informs, recalls, confirms, sums up, watches time
Task orientation – Negative	1. Asks for direction: clarification, orientation, information, repeats of information, summaries, prodigal of time
	2. Asks for or challenges evaluations: questions analyses, assessments, feelings, opinions, wishes
	3. Asks for ideas: indicates lacks alternatives, options, direction, possible ways of action
Group maintenance - Negative	1. Disagrees: silent disagreement, insists on formalities, withholds help
	2. Contributes to tension: unhelpful, freeloads, shows discomfort, demands help, promotes misunderstanding
	3. Shows antagonism: imputes motives, judges in value-laden terms, uses irony and sarcasm, plays power games, verbal duelling

The survey used the Templaar (2005) Tutorial Group Evaluation scale, a questionnaire adaptation of Bales IPA which asks students to rate interaction in their project group. Using a scale of one to seven, students rated the common behaviour in their project group from ostensibly negative interactions (one) to positive interactions (seven), based on the behavioural indicators in Table 1. This framework was also used to code events in the observed group interactions, again using the qualitative research package, Nvivo.

For self evaluation of intercultural competence, a slightly modified Mini-CQS instrument (Ang & Van Dyne, 2008) was included on the reverse side of the questionnaire (see appendix C) to capture students' experience of, and self rated competence in, dealing with cultural interactions. There are nine items on the Mini-CQS which are rated in terms of agreement with the statements:

1. I frequently interact with people from different cultures
2. I am sure I could deal with the stresses of adjusting to a culture that is new to me
3. I know the cultural values and religious beliefs of other cultures
4. I know the legal and economic systems of other cultures
5. I know the rules (e.g., vocabulary, grammar) of other languages
6. I am conscious of the cultural knowledge I use when interacting with people with different cultural backgrounds
7. I check the accuracy of my cultural knowledge as I interact with people from different cultures
8. I change my verbal behaviour (e.g., accent, tone) when a cross-cultural interaction requires it
9. I change my non-verbal behaviour when a cross-cultural situation requires it

Both the survey and observations were conducted at four institutions with student groups working on quite different tasks. The points below provide a general overview of the makeup of the classes at each institution for context:

- First year undergraduates at the University of Wollongong (UOW): This cohort was predominantly domestic school leavers with approximately 16 per cent international student enrolments. The survey and observation sessions were conducted in Autumn and Spring semesters with largely the same cohort. In Autumn semester students were given a technical design task focussing on flow properties and projectile motion. The task also had a strong underpinning teamwork component. In Spring session the groups focus was on their EWB Challenge design. The survey was conducted in tutorial classes, and observations were conducted on self selecting participants – student groups working on projects outside normal class times, in a self directed manner.
- Second year undergraduates at the Australian Maritime College, University of Tasmania (AMC): The survey and observations were carried out in semester two on students studying in the second year unit Fluid Mechanics. This cohort was a mix of Tasmanian (18 per cent), Mainland (60 per cent) and International (22 per cent) students. The technical task in the unit which this work focussed on was the design, build and testing of an underwater vehicle, which was an activity

undertaken in teams. These students were observed in a meeting to review their performance on the project over semester. Again, the students were self directed.

- First year undergraduates at the Queensland University of Technology (QUT): This cohort was predominantly domestic school leavers with approximately 15 per cent international student enrolment. The survey and observation sessions were conducted in Autumn semester where the groups focus was on the EWB Challenge design. These students were observed in class working on an activity developed as part of ALTC project to identify differences in engineering requirements across a range of cultures and explain the impact of such requirements on cultural issues and society.
- Postgraduate students at the University of Manchester, UK (UM): These students were all international, working on a Management of Projects MSc within the Engineering Faculty. A variety of first degrees were represented, including various engineering disciplines, architecture, and events management. For the observation sessions, the students were focused on tutorial activities developing groundwork for humanitarian aid projects in Northern Ghana and Haiti. For these observations, the students were working in class time, with occasional intervention from the tutor to keep them on task.

There were some interesting points to be drawn from this the results of this research. Firstly, for students to develop an awareness of their own level of intercultural competency, the results suggested regular interaction with other students from different backgrounds is helpful. Student groups who are less likely to have experienced a diverse range of cultures, first year undergraduates, rated their own competence conservatively (3-5), if not negatively (<3). Although students may be uncertain as to how to rate their own level of experience and knowledge of other cultures, the self ratings and observations against the bales IPA framework are encouraging. Students generally reported a positive view of group work irrespective of task, a view supported by the observations of group work. The results of this also indicate that students are also more positively task focused when working in class with a firm deadline, as was the case for UM students.

To summarise, these findings suggest that in the case of undergraduate students, individuals may or may not have a high level of intercultural competency, but are not likely to be critically aware of what they do and don't know about working with different cultures. In the case of more diverse groups, particularly at postgraduate level, these students have had greater opportunity to progress in their awareness of different cultures and their self reported competence suggests they are aware of this.

The findings of these surveys provided the project team with further insight on the challenges and opportunities in our efforts to improve students' intercultural competence. **A key challenge will be improving students' critical self awareness of what they know about other cultures and their ability to identify cultural differences.** This requires more than a content driven approach to learning about intercultural competence.

An opportunity evident from this research is that students *can* develop this knowledge and ability through frequent and meaningful interaction with people from different

backgrounds. Deardorff (2011) makes a case for well supported overseas placements as an ideal context for students to develop their intercultural competence, but that this can also be facilitated with on campus education. So while increasing rates of study abroad participation (in-bound and outbound) are desirable as one pathway, **there is an opportunity to capitalise on increasing international enrolments and the diversifying engineering academic staff profile.** In terms of teaching approaches, students' self reported level of **optimism about group work in this study creates another opportunity for doing this through well supported group projects such as the EWB challenge, and in class simulations**.

2.1.3 Consultation with educators and industry

Consultation with academic and support staff involved in teaching engineering students was undertaken through a series of workshops held in Sydney, Wollongong and Brisbane (see 4.2). Participants in these workshops were asked to respond to and discuss three questions:

1. What is culture?
2. What is intercultural competence?
3. What challenges relating to intercultural competence will graduates face?

These questions were designed to capture participants' understanding of the broader concept of 'culture', and then focus these ideas into the practical meaning of intercultural competence. Industry consultation involved a simple email based survey with the same three questions. A list of unedited responses is included in Appendix A. In these responses, nationality was a strong theme. However, there was clear understanding among those who contributed that culture goes far beyond this. Key themes emerging from both academics' and practicing engineers' responses were distilled into draft statements. These were refined in three subsequent workshops with engineering academics to form three simple, high level statements that inform the skills and knowledge students need to develop to prepare them for the profession:

> ***Culture:*** *Values, beliefs and behaviours*
>
> ***Intercultural Competency:*** *Appreciating, respecting and adapting to other values, beliefs and behaviours and working with differences*
>
> ***Challenges faced by graduates:*** *Identifying and understanding values, beliefs, and behaviours of one's self and others*

2.2 Intercultural competency targets

Academics' and practicing engineers' views on intercultural competency outlined in 2.1.3 contained many of the elements found in Engineers Australia's stage one competency standards (Engineers Australia, 2011). These standards form the basis of Engineers Australia's accreditation program under which current engineering degrees on offer in Australia are covered. The standards specify the broad educational outcomes that all

engineering graduates should have progressed towards. Below are the specific stage one competency standards (major headings) and indicators of attainment (statements below) relevant to the focus of this project. The key themes that align with the outcomes of the consultation are highlighted in bold font.

3.2 Effective oral and written communication in professional and lay domains.

a) Is proficient in listening, speaking, reading and writing English, including:

- ***comprehending critically and fairly the viewpoints of others**;*
- *expressing information effectively and succinctly, issuing instruction, engaging in discussion, presenting arguments and justification, **debating and negotiating** - to technical and non-technical audiences and using textual, diagrammatic, pictorial and graphical media best suited to the context;*
- ***representing an engineering position, or the engineering profession at large to the broader community;***
- ***appreciating the impact of body language, personal behaviour and other non-verbal communication processes, as well as the fundamentals of human social behaviour and their cross-cultural differences**.*

3.5 Orderly management of self, and professional conduct.

*a) **Demonstrates commitment to critical self-review** and performance evaluation against appropriate criteria as a primary means of tracking personal development needs and achievements.*

*e) **Thinks critically** and applies an appropriate balance of logic and intellectual criteria to analysis, judgment and decision making.*

3.6 Effective team membership and team leadership.

*a) **Understands the fundamentals of team dynamics** and leadership.*

*b) **Functions as an effective member or leader of diverse engineering teams, including those with multilevel, multi-disciplinary and multi-cultural dimensions**.*

*c) **Earns the trust and confidence of colleagues** through competent and timely completion of tasks.*

*d) **Recognises the value of alternative and diverse viewpoints**, scholarly advice and the importance of professional networking.*

*e) Confidently **pursues and discerns expert assistance** and professional advice.*

f) *Takes initiative and fulfils the leadership role whilst **respecting the agreed roles of others**.*

Given that **the EA stage one competency standards adequately cover the key elements of intercultural competency identified during the project consultation, the project team does not recommend adding additional target competencies for engineering graduates.** Instead, the team focused on unpacking the ideas behind these standards to create a range of educational modules for undergraduate and postgraduate engineering programs.

2.3 Approaches to teaching intercultural competency

This component of the project is the most substantial outcome of the work to date, and is

the major deliverable of the project. An overview of the eBook and learning modules and their design is provided below. The full range of materials is available online at <engineeringacrosscultures.org>.

2.3.1 Target areas

Much of the existing work concerning intercultural competence in higher education focuses on issues involving international interactions, particularly involving international students or study abroad programs (Deardorff, 2011). Through consultation with academics and practicing engineers, and the requirements set out in the EA stage one competency standards, the broader nature of culture as it relates to engineering practice has been made clear. This project has proposed approaches to engineering education that will facilitate students' learning of intercultural competency in ways that extend beyond a culture-as-nationality paradigm. The development of new learning modules included five perspectives on culture that the research indicated will affect future career prospects of engineering graduates. With the input of many academics and other contributors through workshops and meetings, these five aspects of culture - as they relate to engineering design, practice, and education – are defined as:

1. Living culture – Developing awareness and understanding of how engineering fits into social contexts
2. Workplace culture – Seeing how workplace cultures evolve and their effect on work practices
3. Community culture – Engaging with community issues that engineers often encounter
4. Technical/cultural demands – Exploring links between technical and cultural requirements in design and practice
5. Culture in the classroom – Identifying students' priorities and cultivating a classroom learning culture that is open and accepting of new ways of thinking (for the educator).

The materials developed in this project have been branded under the acronym EAC, Engineering Across Cultures. This brand conveys the nature and intent of the learning modules and creates an identifier for the continued expansion of the set of resources.

2.3.2 Approach and strategies

Conventional engineering education tends to separate the 'social' from the 'engineering'. As Warhafts (2005) noted "*The broader implications of technological innovation are not addressed directly in the engineering classroom. Even in courses that consolidate and integrate knowledge, such as engineering design, the social issues are dealt with narrowly.*" The topics, which are the focus of this work, are easily dismissed by students, and some academics, as 'irrelevant for engineering' or 'for arts students, not applicable to the *real work* of engineering'. To challenge this attitude and assist students appreciate the qualitative side of engineering practice, each EAC module either commences with, or works back to an example of how the focus issues affect – and are affected by – engineering practice.

Critical pedagogy was another principle underpinning the EAC modules. This principle has been heavily influenced by the work of Paolo Freire, a Brazilian educator. In Freire's view, education is not neutral, but either serves the interests of the powerful, or empowers people to act in their own or others' interests. Learners (students and staff alike) are not empty vessels, but have unexamined assumptions about the worlds in which they live. When examined supportively through dialogue, the assumptions are the starting point for learning for students and teachers alike. Freire, drew on anthropological views of culture, suggesting that grasping the distinction between culture and nature (everything that would exist without people being there) is the first step towards self-awareness and self-belief. People can be lifted out of seeing their situation as 'natural' and unchangeable, to engage in dialogue and actions that can change the world they live in (Freire, 2007). Given that the starting point for any journey towards cultural competence is often the jolt of the unfamiliar against 'mindless adherence' to culturally acquired rules and traditions, to the extent that differences are not even noticed (Thomas & Inkson, 2004, p. 66), most modules begin with an exploration of students' current understandings.

One quite significant factor in the implementation of the modules is that direct engagement with these concepts is unlikely to generate enthusiasm amongst engineering students – they may see this as an unusual and somewhat unwelcome departure from their largely technical field. Moreover, tutors and staff may have difficulty, or they may have rich perspectives to bring to the process, and, in both cases, they may need extra support in working effectively in the internationalised classroom. For example, in terms of tutorial design, getting students to the point of considering troubling new perspectives involves concealing the path forward until you judge it time, and helping students reflect on their 'reality' in a process of thoughtful action (Brookfield, 2006, p. 13; Mayo, 1999, in Matheson & Matheson, 2008, pp. 31-32).

To adequately support tutors, the four sets of teaching modules (one for each aspect of culture identified above) are presented in three components, a student guide, a tutor guide, and supporting resources. A fifth set (EAC 13, 14, and 15) is specifically intended for use by academics and tutors to address the fifth aspect of culture and does not include student components. Table 2 shows all sets of modules. The student guides contain an overview of the class activity, learning outcomes, lists of resources and include questions to prompt exploration and guide activities. The intention is to provide students with enough information to aid the tutor in initiating each stage of the class without providing so much information that the flexibility of the class would be limited or the path forward would become obvious.

Tutor materials include substantial detail on how to run the class, how to facilitate group discussions, and how to prompt students to think more deeply about the tasks at hand. There are also strategies presented on how to set up collaborative learning spaces to best support the class activity format. It was evident that this level of detail is necessary to reduce the possibility of apprehensions about managing class activities that do not have pre-set 'correct' answers.

Supporting resources vary in format, content and style among the modules. The intention to

provide a high level of flexibility is a particular feature of the modules. Through developing a range of resources and case studies for educators to choose from, the contexts in which the modules can be run can also vary widely.

Changing teaching

A crucial component of the development of the EAC materials was providing adequate support for the educators responsible for delivering the modules. In addition to tutor guides for each module are the final three, teacher-only modules (EAC 13, 14, and 15). These modules present three overarching theoretical frameworks that underpin various aspects of the EAC teaching modules. All are chosen with the goal of engaging educators in a reflective approach to their own practice as a teaching academic, and detail strategies for how the EAC modules can be delivered.

The first framework (module 13) introduces the concept the "Project Portfolio Manager" as a way of positioning the role of the tutor in the class. All of the EAC teaching modules (1-12) rely upon group based learning. Module 13 asks the educator to conceptualise groups in the class as "projects" with defined outcomes (learning outcomes), limits and constraints, and tasks to be completed. As the project portfolio manager, the educator sits just outside the projects they are managing. They are responsible for monitoring the progress of the project towards its stated goals, and intervening when these goals are not being met, but not to step in and do the work. Taking on board this perspective of the EAC group activities means accepting that groups will progress towards the set goals in different ways and that the educator needs to evaluate and intervene only when necessary – responsibility for the groups' progress towards the goals of the class activity must stay with the group. It also means that each group may produce slightly different outcomes.

The second framework presented in module 14 introduces the knowledge management concept known as the Cynefin Domains of Knowledge (Kurtz & Snowden, 2003) as a way of thinking about the forces found regularly in classrooms. It uses the concept of cause and effect relationships to explore five different conditions that may be found at different times in the classroom. These conditions have informed the structure of activities for each of the EAC teaching modules (1-12). The Cynefin Domains are presented in Figure 2 below. Traditional education mainly focuses on the 'ordered' domains on the right. The 'visible order' describes known cause and effect relationships such as the layout of a lecture theatre and subsequent function of a traditional lecture. The 'hidden order' describes the causes and effects that can be identified and repeated. These are discovered under the guidance of a teacher (i.e. lab classes, simple engineering textbook problems).

Engineering challenges involving intercultural interactions are usually situated in these domains of chaos and complexity. Hence, the EAC materials aim to prepare students for working effectively in the 'un-ordered' domains on the left. The EAC resource materials present cases or topics that simulate those encountered in engineering practice where students need to work with incomplete information. Activities in each module encourage them to work just sufficiently beyond current levels of knowledge so as to stretch their capabilities for absorbing, managing and responding to new information - and develop their self-confidence in doing this.

The shaded area in the middle of Figure 2 is also important to the structure and delivery of the EAC modules. This fifth region is referred to by Kurtz and Snowden as 'Disorder'. It is often the starting point at which the relationship between cause and effect is not known. This region of the model can lead to distress and a retreat to inappropriate or ineffective strategies for dealing with the situation. To illustrate, this is similar to what can be observed in complex debates where participants create an overly simplistic and inaccurate understanding of cause and effect to establish a 'solution' to the problem being debated. In the EAC materials, this reaction is avoided by providing students with just enough guidance to explore complex scenarios and identify patterns which help students to understand the underlying culture apparent in the given scenario.

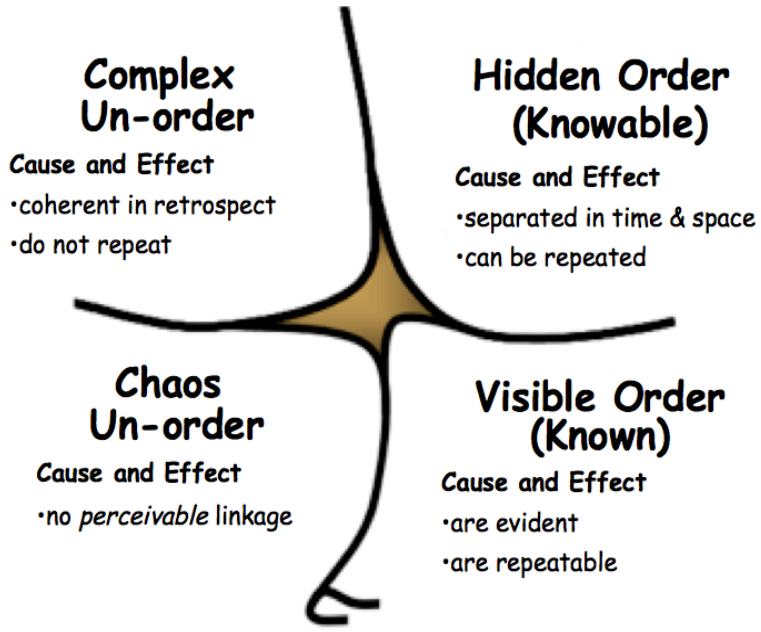

Figure 2 The Cynefin Domains of Knowledge (Kurtz & Snowden, 2003)

Finally, module 15 explores the significance, for educators, of current knowledge about how human beings learn. It emphasises the importance of understanding that there is a diversity of possible learning strategies. The module conveys this through an exploration of learning anecdotes and expected engineering student reactions to the approaches used in the EAC teaching modules. The module suggests ways in which this diversity can be incorporated into the educator's own teaching strategies to better support students in their progress through the 'un-ordered' methodology of each module.

Module overview

Table 2 presents a summary of each module and how it is intended to operate. This table illustrates the results of what has been achieved so far in our work on developing strategies for exploring cultural issues in engineering education.

Table 2 Engineering across cultures module overview

Module overview	Resources
Living culture – EAC 1-2-3 - Modules on awareness and understanding of engineering in general social contexts	
EAC 1 - How people live and the impact of engineering. An exploratory analysis linking familiar personal living contexts with unfamiliar [even 'strange'] modes from around the world.	Student guide Tutor guide 8 scenarios
EAC 2 - Working with clients. Positions student in either client or consultant teams with the task of exploring client needs on the way to developing an engineering solution to a construction task. Possible assessable components.	Student guides Tutor guide 7 client briefs
EAC 3 - Workplaces as Cultural Contexts. Uses four quite different case studies to examine how working contexts are influenced by cultural forces that may – or may not – be beneficial to those employed there. Possible assessable components.	Student guides Tutor guide 4 case studies
Workplace Culture – EAC 4-5-6 – Modules on issues within the context of immediate experiences	
EAC 4 Analysing Engineering Relevance. Draws on an interview and transcript of a recovery response strategy following the 2004 tsunami. The Module is intended to be an introduction for students who will be completing some kind of engineering project process [e.g. EWB]	Student guides Tutor guide Scenario Transcript
EAC 5 Creating Culture - "Barnga". Employs a card game developed to demonstrate how culture is 'built' by those engaged in it. Invites exploration of forces –seen and unseen – that begin to shape routine behaviours	Tutor guide Game rules Case study reports
EAC 6 Exploring personal cultural stances - "Yes! No! Maybe!" Employs a simple board game strategy to assist students identify and examine their own current cultural values and perceptions.	Tutor guide Student guide Worksheets
Community Culture – EAC 7-8-9 – Modules on engagement with community issues engineers may encounter	
EAC 7 - Engineering in conflict with community. Uses a formal debating structure to draw students into an in-depth exploration of issues involved in a potentially divisive issue that has both social and engineering implications. Possible assessable components.	Coal Seam Gas resources Tutor Guide Student guide
EAC 8 – Culture as values in written texts [Minessence]. Employs a specific form a textual analysis to guide students through a process of analysing how organisational cultures may be expressed in written documents.	Tutor guide Student guide Resources
EAC 9 – Conceptualising engineering projects – My Best Bet. A team based activity that explores the forces identified when using a SWOT analysis of organisational contexts.	Tutor guide Student guide Game materials
Technical/Cultural demands – EAC 10-11-12 – Modules explore links among technical requirements and cultural requirements	
EAC 10 – "Fitting It All In" - culture in professions & trades. Uses a hypothetical building project to examine the kinds of issues that commonly arise when trying to 'fit in' all the essential elements in a building project.	Tutor guide Student guide Resources
EAC 11 - Technical aspects - Designs for the future. Students explore how initial solutions may – or may not – address the 'real' problems facing a design task.	Tutor guide Student guide Resources
EAC 12 – Solutions creating problems - Piper Alpha case study. A case study based on the Piper Alpha oil-rig explosion. Provides incomplete information and invites students to explore the events, and immediate and long-term results. Possible assessable components.	Tutor guide Student guide Resources
Culture in the Classroom – EAC 13-14-15 – Modules for teaching staff - supporting materials to help apply EAC teaching/learning strategies	
EAC 13 - Project Portfolio Management	Tutor guide
EAC 14 - Teaching on the edge of chaos	Tutor guide
EAC 15 - Teaching styles / learning styles	Tutor guide

While the resources have been constructed mainly as class activities, some incorporate outcomes and out-of-class work which can easily be developed into assessment tasks. Where 'possible assessable components' are included in a module this is indicated in Table

2. Each of the EAC modules 1-12 is designed to be used in isolation. The modules do not need to be used in sequence. In some modules, there are references within the tutor materials to other modules. This is done so that where more than one module is used in a course, there are opportunities to link modules to maintain continuity, particularly in the way learning activities operate.

Table 2 illustrates the broad range of focus topics that are covered in the modules. In addition, the modules apply many different educational approaches to ensure the resources are both flexible and diverse. Several of the modules, particularly modules one to four, and seven to nine, are very flexible in how the materials can be used. By just changing the resources package (case studies or focus topics), the student and tutor guides can be reused to form a new and quite different module for use across different subjects and year levels. This strategy has been used to ensure the modules can be adapted to existing curricula effectively. This flexibility will also allow the continuing development of new modules based on the existing set.

To date EAC units one, two, and four have been used in their current form at the University of Wollongong over three semesters to support the Engineers Without Borders Challenge in a first year design subject. The units formed the first three weeks of tutorial exercises. Initial feedback on these modules from staff were promising and have been reported in more detail in Goldfinch, Layton and McCarthy (2010). The modules have been adopted as the norm for the subject, and Spring semester 2012 has seen the implementation of EAC units three and 13 in the same subject.

EAC unit one has also been used in the first year design subject focusing on the Engineers Without Borders Challenge at the Queensland University of Technology and in a postgraduate humanitarian aid course at the University of Manchester. In both cases, the materials received positive feedback from staff and suggestions for further materials. As with any in-class activity, some students have needed more guidance and encouragement than others, but overall the modules implemented so far have been well received by students.

3. Dissemination

Dissemination activities carried out in this project reached nationally and internationally. Five conference papers have been presented in Australia and one in Europe. Nine workshops have been run in Sydney, Wollongong, Brisbane, Launceston, Hobart and the Gold Coast. A final workshop is planned for the Australasian Association for Engineering Education annual conference in Melbourne in late 2012. Feedback from these workshops has been overwhelmingly positive (see section 5).

Conference papers have also been utilised as an effective means of dissemination. Six papers at four conferences have delivered key outcomes and methods of the project to the target community of engineering educators. These papers are all published online also, and are accessible to the public.

3.1 Workshops and meetings

The first three workshops were held at the participating institutions in June 2011. These workshops focussed on exploring some of the key ideas behind intercultural competency and early EAC modules. Outcomes from these workshops contributed to the selection of focus areas for EAC modules and identified some key opportunities for education in this area. In particular:

- Running EAC module one in these workshops encouraged participants to share details about their own cultural background with colleagues. It was noted that opportunities for doing this are rare and that this module may be a way forward for encouraging staff, not just students, to learn more about different cultures.
- The activities in EAC module one provide a good 'ice breaker' for establishing student teams. This module may be useful both as a team formation activity and a learning tool for intercultural competency.
- There was clear recognition from participants that intercultural competency is a complex and important issue. This is an encouraging base for creating a community of practice approach to further developing education in this area (see 5.1)

Four further workshops were run at UTS, UOW and QUT over 2012. These workshops explored the proposed structure and focus of each of the EAC learning modules. Participants in these workshops also developed and refined definitions of culture and intercultural competency, as well as the challenges graduates were likely to face. Like the earlier workshops, a number of opportunities for work in this area were identified:

- Some participants identified areas in their current curricula where particular EAC modules could contribute. This gave the project team confidence that the proposed modules appealed to the target community.
- Some participants contributed ideas and experience from work they were already doing in the area. There is already a wealth of ideas and experience within the community that needs to be consolidated and disseminated.

The project team also ran a further two short workshops focussing only on defining the three questions described in 2.1.3. This workshop was developed with the intention of being 'self-run' and is intended to be lead by participants (see appendix E). The three trial runs of this format (one incorporated into a longer workshop) prompted one of the project team to comment:

> *"I kept coming back to the issue of universities having a multicultural staff but not taking advantage of that as a resource. There is not much discussion in our School around people's culture and I think this is because people are so afraid of being labelled a racist that they do not discuss cultural backgrounds at all... I think the self-run workshop has potential to bring people to a space where it's OK to talk about culture in a non-threatening & hence non-offensive way."*

This workshop format needs to be explored further as a lead-in activity to the introduction of the EAC modules in the future. It is also clear from the quote above that **more opportunities need to be created for staff to discuss culture and their own background.**

While attendance at most of these workshops has been low (5-10 participants at each workshop), the interest following on from them has been strong. This indicates that further promotion of the importance of intercultural competence is needed, and that the EAC modules may provide a tool to achieve this.

A number of meetings with academics and professionals also fed into the development of resources and the eBook. Project reference group member, Professor Caroline Baillie, coordinated a meeting between leaders of similar projects in Australia and Europe. Details of the meeting and presenters are included in the flyer for the event, appendix F. A meeting with the UK Higher Education Academy Engineering Discipline lead, Dr Simon Steiner, has indicated the potential interest in utilising learning modules from the eBook at UK Universities. The team will endeavour to maintain contact with these projects and individuals to promote uptake of EAC resources outside Australia.

The work here is continuing. Further dissemination activities are planned for late 2012 and 2013. To mange dissemination and further development of the work started in this project and consolidate work done by others in the community, a framework for establishing a community of practice around the modules has been presented to the engineering education community at the 2012 Australasian Association for Engineering Education (AAEE) conference in 2012. This framework is detailed in 5.1. A workshop will also be run at this conference to develop ways forward for the project beyond OLT funding.

3.2 Conferences

The AAEE annual conference has been the main forum for dissemination of project outcomes. Five conference papers have been presented at this conference over 2010, 2011, and 2012. One paper was also presented at the Research in Engineering Education Symposium in 2011, the peak forum for new and innovative work in engineering education. These conference papers have provided an effective way to reach larger numbers of people within the engineering education community and manage ongoing evaluation of the project. Details of the focus of the papers are outlined in section 5.

4. Linkages

The project has had links with work in other projects over its duration. The most significant of these has been an internally funded project at the University of Manchester, “Developing Intercultural Competency in Engineering”. The application for funding resulted from discussions between the project leader and staff at UM. This project incorporated the implementation of EAC module one in a postgraduate humanitarian aid subject and the duplication of the survey and observational research carried out at UOW, QUT and AMC. The UM project has resulted in a sustained collaboration with engineering educators overseas.

The involvement of the project reference group members Professor Caroline Baillie and Jade Kennedy also lead to two more project proposals drawing from this project’s outcomes. Professor Baillie planned to submit an application for funding from the OLT for a project focussing on Threshold Capabilities. A component of this proposal seeks to explore intercultural competence as a threshold capability, and would enable a more in depth exploration of how engineering students develop intercultural competence.

The project leader and Jade Kennedy have developed a proposal for an Indigenous student engagement program which has already secured internal funding. This proposal will draw from the lessons learned in the development of the EAC learning modules to implement an engagement program incorporating high school outreach, engineering curriculum redevelopment to support inclusive teaching practices, and industry/alumni mentoring.

The project team have also held discussions with the organisers of the Engineers Without Borders Challenge in regards to endorsing selected EAC modules that support the EWB challenge. At this stage, the organisers are planning to link to EAC resources for future EWB challenges.

5. Evaluation

Evaluation of the project was broken up into different components of the work: Theoretical frameworks and research; workshops; and learning modules. Each was evaluated on the basis of their purpose and target audience.

Theoretical frameworks and research

By the time of the 2012 AAEE conference in Melbourne in December, 2012, all major outcomes from the project will have been published to the engineering education community. The four conferences in which outcomes have been published use a double blind paper review process. The project team saw this as the most rigorous way of confirming that the work undertaken was interesting, relevant, and of an acceptable standard for the target audience. Review comments have also helped to refine the ongoing work for this project and identify areas for improvement. The points below indicate which components of the project have been published and where:

- Observational and student survey study to determine learning needs: One paper AAEE 2011 (Goldfinch, et al., 2011), one paper at REES 2011 (Goldfinch & Layton, 2011), and one paper at AAEE2012 (Goldfinch, Abuodha, et al., 2012).
- Analysis of student reports: One paper at AAEE 2011 (Abuodha, et al., 2011).
- Definitions of Culture, Intercultural competence, and the challenges faced by graduates: A component of one paper at AAEE2012 (Goldfinch, Leigh, Gardner, Dawes, & McCarthy, 2012).

The response from attendees at conference presentations has been similar to that of workshop participants. Feedback on the goals and deliverables of the project has been encouraging, and some constructive feedback on research methods will contribute to the ongoing evaluation of the success of learning modules.

Workshops

Workshops conducted throughout the project have been evaluated through a simple one page questionnaire distributed to participants (see appendix B). Feedback on the running of the workshops has been overwhelmingly positive. Table 3 Shows average responses to the four evaluation questions that were rated on a 5 point scale (1=strongly disagree, 5=strongly agree).

Table 3 Summary of Workshop evaluations

Question	*Average rating (n=31)*
The information presented was useful to me	4.5
The presenters were well prepared	4.8
Discussion was facilitated effectively	4.7
I was given sufficient opportunity to contribute to discussion	4.8

There has also been significant interest in the learning modules. Selected EAC modules were showcased at all workshops and the interest from participants wishing to investigate further the implementation of these has been encouraging. Most participants requested notifications when the eBook and all EAC modules are finalised. Some participants also commented in the questionnaire that they would like more details about how to assess and

measure improvements in intercultural competence. A small number of participants also expressed interest in the Cynefin model of knowledge management. This has been taken on boards and presented in detail as EAC module 14.

Feedback from workshops to date has been fed forward to a final workshop due to be run at the 2012 AAEE conference. This workshop will focus on a brief introduction to the modules followed by structured activities aimed at identifying where the modules can be implemented, what further modules need to be developed and how we can explore further the measurement of intercultural competence. This will contribute the continuation of the EAC work beyond the timeframe of this project.

Learning modules

Evaluation of the success of the EAC learning modules is in its early stages. Two dimensions to this evaluation have been identified: Appeal and usability; and effectiveness for student learning. The appeal and usability of the modules relates to how interested the key stakeholders are in utilising these modules, and how easily they can be adapted and used successfully within existing curricula. From the early EAC modules first developed at UOW in 2010, one of these has now been adopted at two other institutions, QUT and UM. In addition, the positive reception to EAC modules one, two and four at UOW has led to the Implementation of EAC modules three and 13 in 2012. This is an encouraging early start, considering the modules have only been presented to the rest of the project team and the engineering education community from December 2010 onwards. The strong interest from workshops suggests that the appeal of the EAC modules is strong, and the usability of the modules is high.

Effectiveness for student learning is a more challenging task. The modules implemented so far have been well received by students, according to tutor feedback and a brief, minute paper style survey run at UOW. Student feedback collected in this survey was very positive of the learning experience and its focus on intercultural competence. The following student comments are representative of many similar responses to a survey question asking for feedback on what students consider they are learning through the experience of using the materials:

> *"Respecting the culture/beliefs; different design approaches relating to specific engineering fields."*
> *". . in this tutorial I learned how important it is to research about everything including tradition and cultural value."*
> *" . . how to approach the job with the client's view/needs in mind. Also I have learnt how to approach a project."*

This evaluation of the effectiveness of the modules is limited. A more in depth analysis is planned for coming semesters. However, this falls outside the scope of this project. The proposal for using the EAC modules to develop a community of practice around intercultural competency education in engineering will create the opportunity for this work to carry on.

5.1 Development of a community of practice

During the implementation of EAC modules at UOW, QUT and UM, it became clear that it was often necessary to adapt the modules to suit either the content of the course or class timetables. The adaptability of the modules is an important feature in the uptake and longevity of the material. It is also important in moving the concept of intercultural competency into the mainstream rather than being seen as another 'bolt-on' concept. With this in mind, the modules are available in both Portable Document and Microsoft word document format to enable editing and redevelopment of the resources. The project team intend to use this as a starting point for developing an "EAC" community of practice that builds upon this initial collection of EAC modules.

An approach for this is summarised effectively by Mann and Chang (2010) and Kolikant et al (2006), both drawing from the original work of Wenger (1998). Communities of Practice demonstrate three key attributes: A purpose or focus area; an engaged collection of people; and a shared practice. In this case the focus of the community of practice would be the improvement of intercultural competency for ourselves and within our students and staff. Engineering educators form the collection of people (largely networks formed through the AAEE). The education of undergraduate and postgraduate engineering students is the practice shared by those in the community. Mann and Chang (2010) also summarise a set of seven principles for establishing a community of practice and maintaining it (Wenger, McDermott, & Snyder, 2002 in Mann and Chang, 2010):

1. **Design for evolution** - To do this the research team are asking educators who modify the original modules to suit a particular context to return their modified versions to the collection in a share and share-alike approach. This will mean that the educational resources that form the focal point of the community's domain of knowledge can change and develop as the knowledge among the community grows.
2. It is anticipated that **a dialogue between inside and outside perspectives** can be achieved through feedback from users within the community and workshops with those who have contact with the work produced by the community of practice, but are not engaged with its production or implementation. This will include student feedback in particular informing developments to the modules.
3. There are **opportunities for engagement with the community at different levels** through the use of existing or slightly modified modules, to development of new modules, to collaboration in research around the idea of intercultural competency.
4. Through unrestricted access to PDF versions of the modules online, and limiting word format versions to the community of practice, we aim to create opportunities for **public and private engagement with the community of practice**. This means that access to the materials produced by the community of practice is not limited only to those closely involved with it.
5. The **value** in participating in the community is achieved through ongoing support and guidance around the adaptation and redevelopment of the resources to suit the participant's context. We can also offer opportunities to collaborate on ongoing research around intercultural competency in engineering.
6. Establishing a level of **familiarity between members** to enable open discussions and sharing is a challenge that we hope is to overcome by working through existing AAEE

networks that are collegial, open and friendly. Contrasting this, it is important to **also maintain excitement** about the creation of new teaching approaches and resources to sustain interest in the community of practice through continuing evolution of the materials and sharing of new ideas and perspectives.

7. Methods for establishing a **rhythm for the community of practice** (i.e. Regular correspondence, outcomes, and events) will be a hurdle considering competing workload demands on academics. It is hoped that connections can be maintained effectively by connecting community activities through existing regular commitments like the EWB Challenge and teaching semesters.

Aside from the development of new modules, the community of practice will be encouraged to assist with the in-depth evaluation of their usefulness and effectiveness. Specific research questions that will be addressed in the longer term are:

- What are the barriers and enablers for intercultural competency in engineering education?
- How do students and staff engage with the EAC modules?
- How can we identify and measure improvements in intercultural competency?

6. Conclusion and recommendations

This project has undertaken an exploration of the issues and opportunities surrounding intercultural competence in engineering education. The work has found that there are significant opportunities for improving engineering education in the area of intercultural competence. These opportunities are driven largely by the interest and experience of engineering academics and the targets set by the peak professional body, Engineers Australia.

Exploration of students' current levels of intercultural competence suggests that there is work to be done to meet the targets set by Engineers Australia. There are opportunities for achieving this by capitalising on the diverse backgrounds of both students and staff through structured learning activities.

To assist in meeting this challenge, an eBook, Engineering Across Cultures (EAC), covering the key principles in introducing students to the ideas around intercultural competence has been developed. The eBook will support educators seeking to utilise a series of learning modules also developed by the project. These EAC learning modules combine student guides, tutor instructions and supporting materials have been developed that cover many of the aspects of culture that affect engineering practice. Together, the Engineering Across Cultures eBook and learning modules provide the engineering education community with an accessible resource upon which to build further work in this area.

To continue this work, to ensure the ongoing improvement of engineering education in the key area of intercultural competence, the project team recommends the following actions be taken:

Recommendation 1: Capitalise on the diversity of student and staff backgrounds
There is a need to encourage students and academics to talk more openly and regularly about intercultural issues. This project has shown that this can be achieved through workshops and the process of implementing new educational practices. Creating a more open dialogue will help students and staff to understand more about overcoming the challenges of working across cultures. The diverse ethnic, socioeconomic and educational backgrounds of students and staff provide an ideal foundation for this.

Recommendation 2: Education of students should be used to promote the importance of intercultural competence to engineering academics
The experience of the project team in implementing EAC learning modules has shown that the preparation needed to run these activities encourages teaching staff to recognise the intricacies and challenges around working across cultures. These modules are an excellent starting point for further staff development in this area.

Recommendation 3: An intercultural competence community of practice should be established
Creating a community of practice with a shared interest in improving intercultural competence among students will provide a sustainable way forward for work in this area. The EAC modules can provide a focal point for the community with participants encouraged

to use, modify and contribute to new modules.

Recommendation 4: The importance of intercultural competence in engineering practice must be made clear to students through regular learning activities

In implementing EAC learning modules or other activities targeting intercultural competence in engineering, there is a risk that infrequent encounters with these issues in engineering curricula will mean they are seen as exotic or rare. Care needs to be taken to ensure students not only develop their intercultural competence, but an appreciation of the importance of this in the engineering profession.

Recommendation 5: Further research into how intercultural competence can be measured in the context of engineering education and practice is needed

To ensure learning outcomes are met, more needs to be understood about how to efficiently and effectively measure intercultural competence. This will require further research and ongoing cross-disciplinary collaborations.

References

ABET Engineering Accreditaion Commission (2011). C*riteria for Accrediting Engineering Programs*. Baltimore, MD: Accreditation Board for Engineering and Technology.

Abuodha, P., Layton, C., & Goldfinch, T. (2011). *Evidence of intercultural competency from engineers without borders challenge projects*. Paper presented at the Australasian Association for Engineering Education Annual Conference.

Ang, S., & Van Dyne, L. (2008). Handbook of Cultural Intelligence: Theory, measurement and applications (pp. 391). Armonk, NY: Sharpe, M.E.

Engineers Australia (2011). *Stage 1 Competency Standard for Professional Engineer*. Melbourne, VIC.

IEAust (1996). *Changing the Culture: Engineeirng Education into the Future*. Barton, ACT: Institution of Engineers Australia.

Bales, R. F. (1950). *Interaction Process Analysis: A Method for the study of small groups*. Cambridge, MA: Addison-Wesley.

Bradley, A. (2006). *Australian Engineering Competency Standards - Stage 1 Competency Standards for Professional Engineers*. Melbourne.

Brookfield, S. D. (2006). Authenticity and Power. *New Directions for Adult and Continuing Education, 11*(Fall).

Deardorff, D. K. (2011). Assessing Intercultural Competence. *New Directions for Institutional Research, 149*.

EWB. (2010). EWB Challenge. Retrieved 15th July, 2010, from http://www.ewb.org.au/explore/initiatives/ewbchallenge

EWB. (2011). 2011 Engineers Without Borders Challenge. Retrieved 2nd June, 2011, from http://www.ewb.org.au/explore/initiatives/2011ewbchallenge

Freire, P. (2007). *Pedagogy of the Oppressed*. New York: Contiuum.

Goldfinch, T., Abuodha, P., Hampton, G., Hill, F., Dawes, L., & Thomas, G. (2012). *Intercultural competence in engineering education: who are we teaching?* Paper presented at the Australasian Association of Engineering Education Annual Conference.

Goldfinch, T., & Layton, C. (2011). *Observational Research Methods to Explore Intercultural Competence in Engineering*. Paper presented at the Research in Engineering Education Symposium.

Goldfinch, T., Layton, C., Gardner, A., Thomas, G., Henderson, A., & McCarthy, T. (2011). *Observing Cultural Interactions in Engineering Design Projects*. Paper presented at

the Australasian Association for Engineering Education Annual Conference.

Goldfinch, T., Layton, C., & McCarthy, T. (2010). *Encouraging Cultural Awareness in Engineering Students*. Paper presented at the 20th Annual Conference for the Australasian Association for Engineering Education.

Goldfinch, T., Leigh, E., Gardner, A., Dawes, L., & McCarthy, T. (2012). *Engineering Across Cultures: New learning resources for intercultural competency in engineering*. Paper presented at the Australasian Association for Engineering Education Annual Conference.

King, R. (2008). *Addressing the Supply and Quality of Enigneering Graduates for the New Century*. Sydney, NSW.

Kolikant, Y., McKenna, A., & Yalvac, B. (2006). The Emergence of a Community of Practice in Engineering Education. *New Directions for Teaching and Learning, 108*(Winter).

Kurtz, C. F., & Snowden, D. J. (2003). The new dynamics of strategy: Sense-making in a compex and complicated world. *IBM Systems Journal, 42*(3).

Mann, L., & Chang, R. (2010). *Creating an Engineering Education Community of Practice within an Institutional Setting: A Blueprint for Action Research*. Paper presented at the Australasian Association for Engineering Education Conference.

Matheson, C., & Matheson, D. (2008). Community development: Freire and Grameen in the Barrowfield Project, Glasgow, Scotland. *Development in Practice, 18*(1), 30-39.

Spitzberg, B. H., & Changnon, G. (2010). Conceptualizing Intercultural Competence. In D. K. Deardorff (Ed.), *The SAGE Handbook of Intercultural Competence*. Thousand Oaks, CA: SAGE.

Thomas, D. C., & Inkson, K. (2004). *Cultural Intelligence: People Skills for Global Business*. San Francisco, CA: Berrett-Koehler.

Warhaft, Z. (2005). Teaching enigneering in a social context. *Technology and society Magazine,* 32-39.

Wenger, E. (1998). *Communities of Practice: Learning, Meaning and Identity*. Cambridge: Cambridge University Press.

Wenger, E., McDermott, R., & Snyder, W. (2002). *Cultivating Communities of Practice*. Boston.

Appendix A – Consultation responses

What is culture?

Academics:

- Values and beliefs influenced by upbringing and environment
- Beliefs
- History
- How people behave internally and externally
- The combination of a person's experience that comes from growing up under a system of beliefs
- Way of life
- Ways of doing and thinking
- Ideologies shared by groups of people
- A framework outside of our awareness, and noticed only at points of contrast (as right or different or questionable)
- The way one behaves, dresses, their beliefs and actions
- A hard term to define but can be seen in what you do daily.
- It defines a community, a group, an organisation in how people behave
- Perceptual framework rooted in a particular socio-natural context
- Can be learnt
- A potential barrier to communication between people with different backgrounds
- Habitual ways of responding in familiar settings
- Tacit rules of engagement
- Can be passed on from one generation to the other
- A way of categorizing groups of individuals
- An array of celebration customs, attitudes and responses to others' behaviours
- A commonly understood set of practices/protocols that are often unwritten
- Classification of positive/negative behaviours, acceptable/not acceptable reaction and values
- MISTAKENLY associated with ethnicity and race
- Related to background: geography, society, wealth, language, religion etc.
- A matrix of values, perspectives, practices shared by a given population/community including unity, language and traditions
- Ways of thinking and interacting
- A 'grab bag' of assumptions about accepted (or acceptable) values or norms that are used to differentiate others from one's preferred group
- Shared or common beliefs, values, attitudes
- The way one views the world and operates. This could be similar to a particular group in a particular setting
- A 'set' of 'common' norms relating to a group

Industry:

- Culture is a person's attitude and beliefs bought on by their upbringing and geographical location.
- culture is the complex reflection of the customs, attitudes, achievements and way of

life of a particular people or group
- There are racially-based cultures where people of different ethnic backgrounds may display different “cultures”.
- There are environmental cultures where people are influenced by the “culture” of the place of their upbringing
- There are workplace cultures where different management styles will inevitably result in different workplace “cultures”
- Culture is the collective set of values, behaviours and customs which are accepted by any social grouping as the norm.

What is intercultural competence?

Academics:

- Understanding key aspects of different cultures that may affect communications and interpretations
- Valuing different perspectives
- Being mindful of differences in other cultures
- Ability to work with a multicultural group
- Being mindful of requirements of other cultures
- To understand others: How a person from other cultural background reacts in response to my action.
- Being able to adapt design techniques, adjusting to the limitations or differences required.
- In the case of an engineer, being able to practise your profession in a sensitive way
- Knowing about another culture.
- Ability to take into consideration other cultures in your work situations
- To be able to accommodate other cultures without seeing your culture as superior
- Understanding the rules of engagement in other cultures
- Understanding and appreciating how others work
- Ability to fit well in a different culture
- Ability to adapt personal behaviour to suit different contexts
- Being aware of being in places that have unfamiliar expectations of us.
- Ability to keep your confidence and motivation in a different culture from your own.
- Social norms shared by a group of people.
- Acceptance of diversity and acting on that acceptance.
- Having relevant knowledge and empathy
- Being able to communicate effectively
- A capacity to participate, engage with cultures outside one’s own and interperet across cultures, eg. In education
- Understanding that there can be different cultures in the same group (class , office, city, country etc.)
- Having skills to adapt based on the interaction
- Not being deterministic until understanding is reached
- Coming out from one’s own shell and accepting other people’s culture
- Understand the rules of working
- Ways of communication

- Interpersonal relationship
- Requires understanding of cultural 'norms', empathy with others from different cultures, respect
- Ability to relate to others through shared or common attitudes
- Literacy in practices/protocols and understandings of a group, community or organisation
- Ability to work successfully in a multicultural setting

Industry:

- Being able to communicate, tolerate and co exist with other cultures
- Intercultural competence requires an appreciation of those who display cultures which are different from your own and the ability to allow, honour and embrace the rich interaction of a group of people from different cultures.
- There are two primary aspects to intercultural competence and these are the theoretical (knowledge and awareness of different cultures) and applied (actually developing relationships with those from different cultures)
- Intercultural Competence comes when a person is aware of their own cultural frame of reference but understands that others have different cultural norms which they then understand, appreciate and respect.

What challenges relating to intercultural competence will graduates face?

Academics:

- Communicating with colleagues who have limited English.
- Few classes deal with other cultures so there is limited exposure to how things may need to be done differently here in Australia.
- To accept, adjust and work with people from other cultural backgrounds
- A small percentage of engineering students are international, so domestic students don't have much exposure to different views etc.
- Racism
- Different levels of training and expertise
- Domestic students could be inclined to put up barriers to cultural aspects
- Overcoming personal views of different cultures
- Transferability of cross-cultural encounters
- Graduates confronting workplace situations they do not understand
- Knowing the 'right' behaviour for different contexts
- Being able to adjust hearing to cope with different accents
- Rapid changes in numbers and types of people being met
- Australian graduates learning to navigate a new culture
- Powerlessness as a new person in established context
- Ability to learn from other cultures
- Ability to understand other cultures and incorporate it in your designs
- Frustrations brought on by miscommunication
- Assumptions that affect perception and reception
- Being aware of socially-enacted or developed bias in favour of one's own culture
- Cooperation and communication

- Listening, trust and knowledge
- Working with others form different professions and groups: to directly question; develop common understandings; to find solutions
- Interacting with others on what matters (e.g. problem-solving) instead of with waded interpretations of cultural values
- Monolingualism, acquired prejudices, fear and anxiety, lack of intercultural experience, lack of preparation e.g. in education
- Relating to others in non-discriminatory ways
- Individual approach/focus vs. Collective approach/focus
- Different languages and values
- Working with and appreciating others
- Knowing the rules
- Online interactions, e.g. skype
- Obtaining relevant knowledge and understanding and how to apply it
- Developing sensitivities to and skills in diplomacy and negotiating difference
- Building empathy and awareness (particularly for the techie types)
- Working with companies from different cultures
- Belonging to a dominant culture sometimes and a minority culture at other times
- Working with others who are interculturally competent and others who are not
- Working in many different cultural settings and changing ones
- Working in different cultural settings in many different ways, i.e. in companies, with clients, in countries, from a distance, face to face
- Occupational and national mobility
- Global working

Industry:

- how to communicate, tolerate and come to a beneficial outcome for their projects/companies when dealing with engineers and sales people from all over the world whose first language may not be English and whose beliefs may not be the same as ours
- this depends on the engineering undergraduate (race, sex, age, personal circumstances, etc) and the environment into which they are immersed when they start work. We would not be addressing the whole issue if we only considered racially-based culture and ethnic intercultural issues, however they are a major consideration if we are to address and resolve the challenges. I would need to suggest that in the workplace, this will not be wholly within the control or influence of the new graduate as it depends on the "culture" of the workplace with respect to male domination, bullying, diversity, etc.
- The challenges to be faced may include victimization, bullying, racial vilification and similar in an immature or crude workplace but there could also be cliques, groups and other informal 'clubs' in a more mature workplace and these would also have the ability to exclude and isolate a person of a different culture from that group.
- In my experience, the most appropriate response is to develop a strong character and personal habits that will generate assertiveness and self-confidence and from this position it is easier to avoid being a victim of "cultural" victimization and rather to become an interculturally intelligent and competent person with empathy and

understanding for others who may be slightly different from yourself.

- In the first instance Graduates must assimilate into the culture of their employing organisation, the broader cultural community of the industry in which they are employed and also respect the cultures of other organisations and the individuals with whom they interact in their workplace.

Appendix B – Workshop feedback form

EAC
ENGINEERING ACROSS CULTURES

Participant Feedback Form

	Strongly Disagree				*Strongly Agree*
The information presented was useful to me	1	2	3	4	5
The presenters were well prepared	1	2	3	4	5
Discussion was facilitated effectively	1	2	3	4	5
I was given sufficient opportunity to contribute to discussion	1	2	3	4	5

What could be improved?

_____

_____

What outcomes are you most interested in for this project?

_____

_____

_____

Is there more you would like to know about this project?

_____

_____

_____

If you would like a personal response to any of the questions or comments above, please include your email address here: _____

Thankyou for your responses.

Appendix C – Student questionnaire (UOW S1 2011)

Faculty of Engineering Survey

The Faculty is preparing for the 2011 Engineers Without Borders (EWB) Challenge. This year's Challenge asks students to use their problem-solving and design skills to support the development of the Community of Devikulum, located in Tamil Nadu, India. The aim will be to provide sustainable solutions in a range of areas such as energy, water and sanitation, housing, industry development, ICT, transport and waste management. Because the community is deeply divided between social classes, or "castes", part of the brief involves helping to break these social barriers, to allow a common sense of purpose to develop and encourage cooperation.

Part 1: Preparing for the EWB Challenge 2011

Completing this part of the survey will assist us in preparing support materials for you.

Questions 1 - 9. Please circle the number which most applies to you, where 1 = Strongly disagree, and 7 = Strongly agree.

	Question	**Rating**						
		Strongly disagree						Strongly agree
1	I frequently interact with people from different cultures	1	2	3	4	5	6	7
2	I am sure I could deal with the stresses of adjusting to a culture that is new to me	1	2	3	4	5	6	7
3	I know the cultural values and religious beliefs of other cultures	1	2	3	4	5	6	7
4	I know the legal and economic systems of other cultures	1	2	3	4	5	6	7
5	I know the rules (e.g., vocabulary, grammar) of other languages	1	2	3	4	5	6	7
6	I am conscious of the cultural knowledge I use when interacting with people with different cultural backgrounds	1	2	3	4	5	6	7
7	I check the accuracy of my cultural knowledge as I interact with people from different cultures	1	2	3	4	5	6	7
8	I change my verbal behaviour (e.g., accent, tone) when a cross-cultural interaction requires it	1	2	3	4	5	6	7
9	I change my non-verbal behaviour when a cross-cultural situation requires it	1	2	3	4	5	6	7

Question 10: Demographic information. Please tick the appropriate boxes.

10a) Gender: Male ☐ Female ☐

10b) Home background: Urban ☐ Rural ☐ Remote ☐

10c) Schooling: Largely mono-cultural ☐ Largely multicultural ☐

Part 2: Reviewing teamwork in a context of change

In this section, we would appreciate your rating of how your team managed with today's problem-solving task. Please circle the appropriate number on the rating scale for each item. The first section considers group processes, and the second the way you managed the tasks.

Group processes								
Opting out, monopolising, disagreeing without offering ideas	1	2	3	4	5	6	7	Assisting each other, bringing everyone in to discussion & decisions
Creating tension by being unhelpful, free-loading, or demanding	1	2	3	4	5	6	7	Friendly, easing over difficulties, contributing to a positive atmosphere
Making sarcastic remarks, playing power games	1	2	3	4	5	6	7	Accepting others' ideas & input, trying to understand other views
Task management								
Going over old ideas, wasting time	1	2	3	4	5	6	7	Providing new ideas, options, In timely way
Questioning everyone's ideas, wishes & directions	1	2	3	4	5	6	7	Expressing views & wishes about the task & directions
Denigrating & devaluing ideas	1	2	3	4	5	6	7	Clarifying, recalling, summarising, staying on task

D: T:	T:	No.

Appendix D – Human research ethics approval letter

University of Wollongong

INITIAL APPLICATION APPROVAL
In reply please quote: GH:LP HE11/164
Further Enquiries Phone: 4221 4457

27 April 2011

Dr Thomas Goldfinch
Faculty of Engineering
University of Wollongong

Dear Dr Goldfinch

Thank you for your response dated 20 April 2011 to the HREC review letter dated 15 April 2011 of the application detailed below. I am pleased to advise that the application has been approved.

Ethics Number:	HE11/164
Project Title:	Exploring Intercultural Competency in Engineering
Researchers:	Dr Thomas Goldfinch, Prof Timothy McCarthy, Dr Catherine Layton, Dr Pamela Abuodha
Approval Date:	21 April 2011
Expiry Date:	20 April 2012

The University of Wollongong/SESIAHS Humanities, Social Science and Behavioural HREC is constituted and functions in accordance with the NHMRC *National Statement on Ethical Conduct in Human Research*. The HREC has reviewed the research proposal for compliance with the *National Statement* and approval of this project is conditional upon your continuing compliance with this document. As evidence of continuing compliance, the Human Research Ethics Committee requires that researchers immediately report:

- proposed changes to the protocol including changes to investigators involved
- serious or unexpected adverse effects on participants
- unforseen events that might affect continued ethical acceptability of the project.

You are also required to complete monitoring reports annually and at the end of your project. These reports are sent out approximately 6 weeks prior to the date your ethics approval expires. The reports must be completed, signed by the appropriate Head of School, and returned to the Research Services Office prior to the expiry date.

Yours sincerely

Associate Professor Garry Hoban
Chair, Social Sciences
Human Research Ethics Committee

Research Services Office University of Wollongong NSW 2522 Australia
Telephone: +61 2 4221 3386 **Facsimile:** +61 2 4221 4338
research_services@uow.edu.au www.uow.edu.au/research
CRICOS Provider No: 00102E

Appendix E – EAC self run workshop guide

EAC self run workshop: What is intercultural Competence

Location: 1.105, University of Wollongong
Date: 28th March 2012
Time: 12.30 pm -1.30 pm Duration: 1 hour
Lunch is provided during this workshop.

Purpose of workshop

Awareness of the importance of intercultural competency in practicing engineers is growing. At this point, support for engineering academics to incorporate teaching and learning practices to facilitate students' development of intercultural competency is limited. The purpose of this workshop is to develop a picture of what the terms 'culture' and 'intercultural competency' means to engineers and how we need to prepare students for a career in engineering. We hope to use the outcomes of this workshop and any follow up workshops to determine exactly where learning resources and educational methods need to be developed or adapted for engineering education. This workshop will contribute to the OLT funded project Engineering Across Cultures (EAC), which aims to produce an eBook containing learning modules and related materials that can be implemented into existing undergraduate, or postgraduate engineering courses.

Instructions

This is a self-run workshop with the facilitation role taken on by a nominated participant. The steps below provide the guide to running the workshop including approximate running times, just follow these steps and have fun!

1. On the participants' details table provided, please fill in your details and your role at the university.
2. Three key questions are provided to be discussed during this workshop. These are:

    i. What is culture?
    ii. What is intercultural competence?
    iii. What challenges relating to intercultural competence will graduates face?

3. Each participant writes down their responses to the 3 questions above on post it-notes. Each idea should be written on a separate post-it note. It is expected that participants may have multiple answers to each question. Allow 15-20 mins for this.
4. Once all participants have developed their responses to all the 3 questions, lay out all of the ideas (post-its) on the table. In an open discussion, arrange all the ideas into a mind map on a whiteboard or table. This will be a lengthy, negotiated process.
5. Ideas may emerge that are not covered by the 3 questions, take not of the new emerging questions.
6. Once the group is satisfied with the arrangement of ideas, as a group, summarise the hot issues in intercultural competence that arose during the discussion.
7. Fill free to suggest as a group further questions that needs following or how to improve this self- run workshop.
8. The workshop is complete. Please take a high resolution photo or transcribed copy of the mind map, new questions, and hot issues and send back to the EAC project team at UOW.

Over the course of this workshop, it is likely that discussion on what we can do (or even not

do) about intercultural competency in engineering education may emerge. At the conclusion of this workshop, you may wish to arrange another 1 hour follow-up workshop (following the same process as this one) for further discussion around the question 'What could educators be doing to support students' development of intercultural competence?'. The EAC team would appreciate any feedback from this workshop also, please contact the EAC team if you would like to run the follow up workshop.

Participants' Details Table

Who are you?	What is your role in the university?

Appendix F – Education for engineering in a social and global context flyer

Date: October 31st
Time: 10.00-1300
Location: Engineers Against Poverty
246 High Holborn, London

We have pleasure in inviting you to a morning of talks, conversation and debate on the theme of:

Education for engineering in a social and global context

This will be a rare opportunity to learn from, and share ideas with project directors from four international projects related to these themes:

A global dimension for engineering education is a project directed by Petter Matthews of Engineers Against Poverty supported by DFID, in collaboration with Engineering Council, Engineering Professors Council, Centre for Engineering and Design Education, and the Institute of Education. The purpose of the project is to strengthen the commitment and capacity of UK HEI engineering faculties to embed global issues into the curriculum.
Engineering education for social and environmental justice is a project directed by Caroline Baillie of the University of Western Australia, supported by the Australian Learning and Teaching Council. This interdisciplinary international project explores and implements curricula and pedagogies which aim to develop engineering graduates with a better understanding of social and environmental justice.
Exploring intercultural competency in engineering is a project directed by Tom Goldfinch of the University of Wollongong, supported by the Australian Teaching and Learning Council. This project explores how engineering students work across cultural differences and the key challenges to be addressed through engineering education. It will develop and pilot educational resources that help students explore cultural factors in engineering and develop their intercultural competency.
Program of research in opportunities and challenges in environmental education in Denmark (PROCEED) is coordinated by Andrew Jamison from Aalborg University and supported by the Danish Strategic Research Council. It is an alliance among engineers, humanists and social scientists at four Danish universities aimed at finding ways for educators to better respond to the environmental, societal and technological challenges facing engineering.

10.00 Arrivals, morning coffee

10.15 Introduction to speakers and attendees
10.30 Short presentations by each project director
12.00 Plenary discussion and ways forward
13.00 End

The meeting will be held at the Engineers Against Poverty Offices in Holborn, London http://www.engineersagainstpoverty.org/about_eap/contact_us.cfm.There will be no charge for attendance but places are limited so please make a reservation by sending your RSVP to P.Matthews@engineersagainstpoverty.org