A model for research supervision of international students in engineering and information technology disciplines

Final Report 2013

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2013

Executive Summary

There is increasing enrolment of international students in the engineering and information technology disciplines and anecdotal evidence of a need for additional understanding and support for these students and their supervisors due to differences both in academic and social cultures. This project aimed to *identify a set of factors influencing the success of culturally and linguistically diverse (CALD) Higher Degree Research (HDR) students in engineering & information technology (IT) disciplines in order to provide effective supervision and support services.*

A five-fold approach to the project was undertaken, consisting of focus groups, student survey, supervisor survey, a comparison of support services across the three universities and critical incident interviews with HDR supervisors from Queensland University of Technology (QUT), The University of Western Australia (UWA), and Curtin University (Curtin).

A mixed methods approach was taken to data collection. Initial workshops and focus groups conducted at the three universities provided the material for the student online questionnaire surveys; followed by a supervisor survey. A total of 229 CALD students from engineering and technology and 69 supervisors took part in the student and supervisor surveys. The majority of students were from China (25 percent) and were male (81 percent) while nearly half of supervisors were from Australia (48 percent) and with HDR and CALD supervision experience. Critical incident interviews with 12 supervisors from the three universities were conducted. In addition to these, institutional data on international HDR numbers, completions times, and countries of origin and support services for HDR students was collected. The survey data from both student and supervisor surveys was analysed in a number of ways, including descriptive statistics, principal components analysis (PCA), linear regression, and Bayesian Network (BN) analysis.

Key Findings

Institutional data gathered during the course of this study showed the number of HDR students in the three universities has increased including international and CALD HDR students and that these students come from wide geographic regions. Furthermore the data showed that generally, international HDR students performed better when compared with their domestic counterparts (for example slightly shorter completion time, more publications and lower attrition rate for international HDR students).

Support services across the three universities were classified under academic, administrative, social and settlement, language and miscellaneous support and analysed with regards to availability, location and accessibility. Similarities were seen in the academic support services across the universities with marked differences in social and settlement and language support services, in terms of the location and the level of accessibility of these services. The three universities also showed differences in their emphasis in catering to CALD needs in the allocation of resources.

Students were satisfied overall with their supervisor's involvement in their academic research project and expressed a high level of personal responsibility and shared responsibility with their supervisors in areas of project planning, reporting and keeping in mind deadlines and key processes. Main differences between HDR and CALD HDR students were related to language and culture that affected the student-supervisor relationship as well as issues concerning knowledge gaps, supervisor attitude and supervisory style that may be more generic HDR issues pertaining to engineering and technology disciplines. Nearly 80 percent of students expressed that their supervisors were considerate of their cultural or religious background, with over 30 percent never feeling supported by the supervisor in the areas of work-life balance, economic and social needs. Another 85 percent of students perceived their supervisors as considerate of their non-English speaking background and yet felt unsupported in developing their language and communication skills. Student perception of supervisor involvement in research and social interaction declined significantly with increase in age. BN sensitivity analysis predictions indicated 'improving social interaction' made the greatest positive change in supervisor attribute outcomes (4 percent), while a decline in 'supervisor obligations', 'help in understanding the research environment' or 'social interaction' were detrimental to the supervisor attributes by 17 percent, 16 percent and 15 percent respectively.

The supervisor survey results indicate that 70-90 percent of supervisors demonstrated a high level of involvement in student academic research projects from sharing their expertise to helping them understand the research and helping to show relevance in a local and global context. More than 90 percent of supervisors believed in a supervisory style that encouraged critical thinking and respected the knowledge and expertise of their students and were keen in the overall development of their students. Yet, a majority of supervisors did not actively support CALD students in developing their communication and networking skills with as many as 55 percent of the supervisors failing to invite students to their lectures/talks related to their research. In terms of attributes, students preferred to have supervisors who were not dictatorial but willing to help, even when discussing personal problems.

Supervisors felt their own learning was mainly through personal reflection of their own experiences and dialogue with senior colleagues, with only 31 percent of supervisors indicating literature on effective supervision as useful to their learning. As for university support, 50-60 percent of supervisors felt supported by adequate high performance computing access and funding to support HDR students to conferences. Only 30 percent agreed their support was adequate in management of HDR supervision workloads. Only 15 percent of attendees found non-compulsory training at university level useful. Bayesian Network predictions show improvements to supervisor participation in training and developing their supervision activities (referred to as supervision style) had 13 percent and 12 percent positive change in 'supervisor attributes'. Improving university support can affect their attributes by 11 percent. The highest negative influence on 'supervisor attributes' was from reduced supervisor involvement (-10 percent) and supervisor obligations (-7 percent).

The supervisor survey identified a range of attributes, behaviours and factors relating to HDR and CALD HDR success. Problem solving skills were seen as the most valued to qualify for a HDR program (77 percent) and one of the strengths that would ensure their academic

success (95 percent), along with critical thinking (97 percent). Research skills (66 to 92 percent) and problem solving abilities (from 77 percent to 95 percent) are two of the highest developed qualities through the HDR experience. Motivation was seen as the highest personal attribute for student success from start (66 percent) to finish (96 percent). Overall attributes and behaviours that fell under "positive outlook" were considered more important than "Ethics" (or values) or "Skills". The supervisory role was seen as helping maintain and develop these essential qualities for success during the different stages of the HDR experience. The results for general factors for HDR and CALD did not show any significant differences, except that supervisors preferred CALD students to have a prior postgraduate qualification, 10 percent more than for general HDR students.

Bayesian Network sensitivity analysis showed, 'student prior experience' contributed to the greatest positive outcome in HDR student success, improving HDR success by 13 percent. Conversely, 'student obligations' and 'student attributes' were seen to contribute to the most negative outcomes by 15 percent and 12 percent respectively. The combined negative effect of losing motivation was seen to contribute a total of 28 percent drop in the HDR success according to model predictions. It is therefore crucial to maintain student motivation and enthusiasm. CALD student success can be largely improved through supervisor involvement in helping CALD students develop communication and networking and this, according to model predictions, can lead to a 17 percent improvement.

Qualitative data from surveys, suggest supervisor attributes, expertise, budget, industry contacts, workloads, feedback and advice, knowledge of student support services, professional development and cross-cultural awareness as relevant in the supervisory relationship. Supervisors identified a successful HDR student as one who is capable of independent thinking and analysis, one who is self-motivated and has a genuine interest in research. Language and communication were identified as essential in the initial stage of the candidature, coupled with discipline-specific skills and knowledge for ongoing success in research. Other factors include project development, academic and cultural mores and academic professional development as well as exogenous elements such as international research networks, industry and scholarship funding, and global competition for HDR students driving a quality agenda. Interviews for critical incidents pertaining to challenging episodes in supervisor-student relationship suggest that most of the incidents occurred in mid-to late-candidacy. Several were related to levels of English language proficiency compounded by weaknesses in background discipline knowledge and research skills; however social concerns were also presented. Narratives covered hygiene issues, disagreements with principal supervisors, relationship problems, ill-health and family financial responsibilities. Weaknesses in assessment for admission were cited. This rich source of data will be used to develop learning resources.

Recommendations and Future Directions

- To improve the quality of supervision, it is recommended that supervisor training should include a personalised approach which involves incorporating supervisors' personal experiences and equips them to cater for all students from diverse cultural backgrounds.

- The coaching approach to providing support for students is suggested to enhance service delivery of supervisors as pastoral care givers. Reducing administrative workload on supervisors and fostering their increased engagement in roles pertaining to supervision is also recommended. This is in a bid to reduce the supervisor workload and enable supervisors to better deliver service to their students.

- It is also recommended that universities factor HDR supervision into the workload allowing for extra time with students from culturally and linguistically diverse backgrounds.

- The need to remove excessive administrative workload on supervisors is reiterated and that funding be made more accessible and available for supervisors and for the training of supervisors. The training should be delivered through seminars and workshops that address issues of personal development.

- Communication between supervisors and students from culturally and linguistically diverse backgrounds is to be encouraged to increase interaction at an academic and social level. Awareness of student/supervisor involvement is strongly encouraged so that supervision needs and student obligations are constantly reviewed to cater for differences or changes in needs.

- Five areas of specific issues pertaining to CALD, international students who are seeking a higher education degree by research are proposed for future research;

    1. determining communication barriers specific to language;
    2. determining potential impact of cultural pressures on a candidate;
    3. identifying a genuine researcher in a potential candidate prior to commencement;
    4. assessing genuine ability of student in writing and formulating a proposal with minimal help from the supervisor; and
    5. assessing the need for mandatory coursework requirements for overseas students pursuing higher degree research in Australia, similar to the United States of America.

A total of seven key deliverables were identified for the project. These include a literature review; a classified table of HDR support services across the three institutions; quantitative report; qualitative report; critical incident training resource; final report; and a special report on research supervision of international students in engineering and information technology disciplines.

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List of Acronyms

ALTC	Australian Learning and Teaching Council
BN	Bayesian Network
CALD	Culturally and linguistically diverse
CATL	Centre for Advanced Teaching and Learning
C&C	Careers and Counselling
CELT	Centre for English Language Teaching
CUPSA	Curtin University Postgraduate Association webpage
DEEWR	Department of Employment, Education and Workplace Relations
DR Web	Doorway to Research Website
e-Grad Aus	e-Grad School Australia
ELC	English Language Centre
FLDP-SEF	Faculty Language Development Program
GRS	Graduate Research School
HDR	Higher Degree Research
HDR-D	Higher Degree Research Directors
HPC	High Performance Computing Support
IGR	Office of Director of International Graduate Research
ISS	International Student Services
IO	International Office
IC	International Centre
IT	Information Technology
ITS	IT Services
MR Space	My Research Space
OTL	Office of Teaching and Learning
ORD	Office of Research Development
PGRSnet	Post graduate Research Support Net
RSC	Research Student Centre
UWAPA	The University of Western Australia Post Graduate Association

1. Project Overview

1.1 Background

Australia is the preferred destination for many international students for high quality education and research with an annual growth rate of 12.1 percent in Engineering and related technologies (Australian Education International, 2010). Australian universities have responded to this continuing growth of international students by putting in place a range of supervisory frameworks to help students settle easily into the different research culture. Efforts to improve research training performance have emphasised the achievement of timely, quality research degree completions. Examples of programs include the Research Training Scheme (RTS), University of Technology Sydney's first Consortium, QUT's IRIS (Introduction to Research for International Students), and UWA's Facilitating International Research Students Transition Program. While most universities offer resources for improving the support to international students and their supervisors, funding limitations and development costs are often high and a targeted approach to where support would be better directed and more cost-effective is needed.

As the number of international students entering HDR study in Australia continues to grow, identifying factors that influence international HDR studies is vital. Research has shown that cultural, linguistic and/or academic differences between student home cultures and/or institutions and the Australian context may impact students' progress. Culture is a filter through which we perceive and experience the world. Thus, cultural differences may affect communication between students and their supervisors, students and other students, or students in the greater community (Marcus and Gould, 2000).

Linguistic challenges may include high level, and often highly specific, language skills and/or knowledge. For example, graduate students are expected to be able to write appropriately in a specific genre or discipline, present orally in seminars and at conferences, as well as interact appropriately with colleagues and others. They are expected to know and be able to use discipline-specific terminology appropriately, and to read academic journal articles regularly.

Finally, different countries and different institutions often have distinct academic cultures. Differences may include expectations regarding student and teacher/supervisor roles and responsibilities, discipline-specific skills expectations, or even different understandings of approaches to research (e.g., what it is, how it's done) and requirements for different types of research degrees (Briguglio, 2006).

Thus identifying the interaction of individual factors (e.g., personality, learner style, motivation, etc.) and more general cultural and/or academic factors (e.g., educational background, role expectations, understanding of research paradigm, etc.) will provide a sound basis from which to develop support materials and networks for both students and supervisors.

1.2 Rationale

A pilot survey was administered to 200 international and culturally and linguistically diverse (CALD) HDR students at QUT and UWA in the engineering and IT disciplines. The survey was based on the hypothesis that these cohorts face challenges that are discipline-specific and that the existing support frameworks are not fully assisting these students and their supervisors towards high quality research degrees. For example, engineering and IT international students who come to Australia from many developing countries find themselves in an advanced and unfamiliar research culture, and are often technically and scientifically challenged to pursue their research goals early in their programs. This is in addition to challenges of new culture, environments, living conditions, social and religious isolation and linguistic barriers. The survey asked questions related to English language proficiency, duration of stay in Australia, previous enrolment in Australian universities and the nature of their postgraduate programs, interaction with supervisors at scientific and social levels and perceptions of the roles and responsibilities of students and supervisors.

The results of the survey indicated a common theme across both disciplines: students not previously enrolled in an Australian university were less prepared for their postgraduate program and mentioned culture shock, language barriers and social isolation that created difficulty to their 'settling in' period as compared to their previously enrolled counterparts. In addition,

- Although 90 percent of the respondents were very satisfied with their supervisor(s)' expertise and supervisory style, only half of the respondents indicated that their supervisors allowed them to plan their research while over 20 percent indicated that they were forced to follow the supervisors' directives;
- 75 percent of the respondents said they faced some level of difficulty in finding and processing information related to their programs through university web portals while 15 percent had to seek personal help from their supervisors or the research administrative staff to find and/or understand the relevant information;
- Only 55 percent of the respondents said that they were comfortable in the new research culture while the remaining 45 percent felt varying levels of discomfort;
- With respect to social interaction with supervisors, only 22 percent of the respondents interacted with their supervisors socially, while 20 percent said they never discussed issues unrelated to their research with their supervisors;
- Over 80 percent of the respondents were unaware about the university workplace health and safety practices while 30 percent claimed difficulty in approaching technical personnel for guidance in this respect;
- Only 30 percent of the respondents said that their supervisors being sensitive to their linguistic challenges, socio-economic and religious backgrounds, while only 5 percent claimed that their supervisors recommended them to various self-development programs to improve their language skills and knowledge about Australian culture; and
- 30 percent of the respondents said that there should be more than one HDR induction program to help them better understand the research process.

The results of the survey clearly underscore Cahill's (1997) observations that a number of issues need to be considered to assist students settle in the HDR environment. These include:
- formal assessment of relevant previous knowledge in the discipline;
- relevance of previous professional experience;
- student's educational and occupational expectations and aspirations;
- student's learning styles, and
- English language competency and associated needs.

QUT's Bruce et al (2009) undertook an ALTC sponsored study that identified and examined various supervisory styles and approaches to supervision in the technology disciplines at QUT. They highlighted that:
- Contexts in which there is rapid (albeit planned) growth of research student numbers place significant strain on both experienced and less experienced supervisors;
- Supervisors did not draw attention to any externally available resources or development opportunities in discussing helps and barriers to supervision; and
- Some supervisors appear to remain uncertain about the alignment of graduate capabilities with their research directions.

English language competency is an essential component of international students' ability to understand the professional and industrial/business environment in Australia. Birrell et al (2006) point that even two years of study at an Australian educational institution cannot guarantee mastery of professional level English. Although a certain level of English skill is required for international students to enrol in Australian universities, further development of language and communication skills enhances students' chances of doing well in their courses and beyond. While most universities have both generic and discipline specific language skill development programs for such students, they are not consistently or adequately implemented and it is often assumed that international students will 'pick it up' as they progress in their studies.

A changing facet of HDR studies is the high propensity for students undertaking interdisciplinary research. The unlimited combinations across disciplines such as mechanical-medical, engineering-IT, infomechatronics often means that students are supervised by a team of supervisors from more than one discipline. Some students undertake such research to realise their personal ambitions and many are found to be wanting in one discipline or the other. This has the potential to give rise to more complex supervisory issues in terms of conflict of interest, bias towards one discipline, mobilisation of resources for the timely execution of various research tasks etc. Further, the nature of engineering and IT research usually revolves around developing a combination of theoretical and experimental research methodologies aided by the use of sophisticated computer technology (software). Apart from managing research in a timely and efficient manner, this could place the additional burden of communicating with workshop technicians, computer personnel and other service providers.

International students find it difficult to adapt to Australian research culture as a result of misunderstanding local social conventions and assumed rules of communication. For example, some international students may struggle to comfortably ask questions, communicate assertively with their supervisors, or have difficulty understanding Australian approaches to time and self-directed learning (Ingleby and Chung, 2009). These issues can be compounded when an international student is required to interact with a supervisor who is also a non-native speaker of English but from a different culture/linguistic group than the student. Support and frameworks are clearly needed that can assist with such social, vocational and cultural integration, adjustment and understanding as well as to create an open environment.

1.3 Aims

It was clear from the pilot survey and the reviewed literature (e.g., Bruce et al, 2009) that in addition to the need for support strategies and resources for international and CALD students, targeted approaches are needed to ensure that research cultures are welcoming, helpful and sensitive of this cohort's particular needs. Anecdotal evidence has shown that some academic staff may be reluctant to supervise international students. There is a need to engender culture change through system-wide 'social marketing' of the inherent benefits of adopting more openness, acceptance and support towards international students. This underscores the need to identify a set of factors that takes into account not just linguistic and cultural diversities; but also the unique discipline-specific dimensions which will lead to their effective integration into the HDR learning environment in Australia.

The aim of this project has been to:
> *Identify a set of factors influencing the success of culturally and linguistically diverse HDR students in engineering & information technology (IT) disciplines in order to provide effective supervision and support services.*

To achieve the aim of this project, the following areas were targeted for investigation: research culture; social, ethnic, cultural and linguistic barriers; economic/lifestyle issues; religion; domestic/personal factors; technology driven factors and Interdisciplinary subject areas.

1.4 Objectives

This project undertook the following objectives to satisfy the above project aim:
- To identify factors that provide effective support to CALD/international students in the engineering and IT disciplines to help them do well in their studies,
- To identify factors that will help improve and provide effective support for HDR supervisors in the supervision of CALD/international students in engineering and IT disciplines,
- To help improve the supervision of CALD/International HDR students through encouraging a more open, accepting, and supportive attitude towards students from diverse socio-ethnic backgrounds, as well as greater recognition of their potential contributions to the research agenda of universities.

1.5 Definitions

1.5.1 CALD:

The term is an abbreviation for 'culturally and linguistically diverse' and refers to the wide range of cultural groups and individuals in Australia. It includes groups and individuals who differ according to religion, race, language or ethnicity from those whose ancestry is Anglo-Saxon, Anglo-Celtic, Aboriginal or Torres Strait Islander[1]. While CALD as a definition has its limitations too in that, it refers to cultural and linguistic diversity, in the context of the study, it refers to students who are not from an Anglo- Celtic background, who while conversant in English may experience issues due to differences in their culture. This could be their social culture or the academic culture that they are accustomed to.

1.5.2 HDR students:

Higher Degree Research (HDR) students include students doing Masters by research, professional doctorate with more than 50 percent research and doctorate by research. According to the Australian Qualification Framework2, (AQFC, 2011, p 57-64) students at this level will have advanced and integrated understanding of a complex body of knowledge. In terms of skills, they would be expected to have expertise, specialised cognitive, technical and research skills in the area to work independently and systematically to extend existing knowledge or redefine existing knowledge or professional practice.

1.5.3 International students:

International student is any student that requires a student visa to study in Australia.

1.5.4 Supervisors:

Supervisor is a designated member of academic staff with the responsibility for providing research supervision during the candidature of the student. This can include co-supervisors who provide academic support, stand in for the supervisor during periods of absence, or who can provide expertise that is complementary to the supervisor.The role of supervisors is to advise, guide and provide constructive feedback to the student through the processes of choosing a realistic topic, designing a viable project, doing the research and interpreting the findings and writing the dissertation.

1.6 Project Context and Team

The initial idea for this project came from QUT Professor Yarlagadda's personal experience of over 15 years, as a higher degree supervisor of international engineering students in Australia. Having supervised students from many countries, cultures and religious backgrounds, he observed that these students had difficulty fitting into the local Australian research context. He had seen numerous incidents of supervisor student misunderstanding arising from cultural differences that led to confusion and heartache. For instance students

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[1] See the WA Office for Multicultural Interests website at http://www.omi.wa.gov.au) for more.

[2]

http://www.aqf.edu.au/Portals/0/Documents/Handbook/AustQuals%20FrmwrkFirstEditionJuly2011_FINAL.pdf

generally from Asia come from a cultural background that assumes that teacher is always correct. As a result they don't question the supervisor's view on things even if they feel they are wrong but instead remain silent, which leads to the student languishing over the decision and suffering silently, leading to an overall loss of motivation and time.

While sharing a car ride from Geelong to Melbourne, Professor Yarlagadda shared his views with Professor James Trevelyan from The University of Western Australia and learnt that he too had an interest in the supervision of international HDR engineering students in Australia. The concept of the current project was developed out of this meeting. Back in Brisbane, Professor Yarlagadda made further inquiries of his colleagues in other faculties and obtained the necessary support to formulate the framework for this research project.

Professor Yarlagadda along with his associates in QUT conducted an initial pilot study among international HDR students and the results confirmed their initial belief that the cultural differences among international HDR's lead to challenges in their research degrees. This study provided some strong ground work for the successful ALTC research grant to commence this project.

This project was formulated within the QUT Project Management Framework3 which has already been successfully used in other teaching and learning project. The Project Management structure consisted of a Project Team with a single point of accountability and a Project Advisory Group (PAG) as close partners and interested parties to the project and a Project Reference Group (PRG), who contributed in the capacity of external consultants to the project.

1.6.1 Project Team

Professor Prasad Yarlagadda was the overall project leader of the team and was responsible for the strategic direction and guidance to the team and the main liaison person between the project team and OLT. Professor James Trevelyan of UWA and Dr Ramesh Narayanaswamy of Curtin provided leadership for their teams in their respective institutions. Dr Pujitha Silva (QUT) and Dr Shamim Samani (UWA) as the project managers were mainly responsible for communication with the project team, external evaluator and coordination of project meetings at various levels and project deliverables Dr Samani was responsible for conducting the literature review and most of the qualitative data collection and analysis for the project. She also designed and wrote the online critical incident resource. The other members of the project team were Dr Karen Woodman, Professor Acram Taji, Dr Tony Sahama (QUT), Professor Hema Sharda Professor Yinong Liu (UWA) and Professor Anthony Lucey (Curtin), who were engaged in the project at various levels of data collection, data analysis, designing project dissemination strategies and contributing critical input into the publications. The project team coordinated their activities through monthly meetings conducted via videoconferencing between QUT and UWA universities.

1.6.2 Project Advisory Group

The PAG consisted of partners and interested parties of the project and was led by Professor

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[3] See http://www.tils.qut.edu.au/initiatives/ppo/framework/

Yarlagadda in his capacity as the project leader. The other members of the PAG consisted of project team members Professor James Trevelyan, Professor Hema Sharda (UWA), Dr Ramesh Narayanaswamy, Professor Anthony Lucey and Professor Steven Reddy (Curtin), Professor Acram Taji in her capacity as the Director of International Graduate Research at QUT and Mr Ray Kelley who is the Executive Director of QUT International at QUT. The PAG met once a quarter.

1.6.3 Project Reference Group

The PRG was chosen from among the 3 partner universities and consisted of a group of experts with wide experience in the area of higher education research and particularly OLT funded projects. The PRG consisted of:
Professor Paul Burnett-Dean Research & Research Training at QUT,
Professor Christine Bruce-Professor, Science and Engineering faculty, QUT
Professor Karen Nelson-Director, Student Success and Retention, QUT,
Professor Shelley Yeo-Dean, Teaching & Learning (Science & Engineering Faculty Office, Curtin
Dr Krystyna-Haq Graduate Education Officer at UWA

1.6.4 Project Evaluator

The project engaged the services of Associate Professor Sophia Arkoudis, who is the Deputy Director of the Centre for the Study of Higher Education at The University of Melbourne, as the external evaluator to this project. Her role was to monitor the progress of the project according to the project evaluation plan developed and give feedback on suggested improvements. Dr Arkoudis joined some of the team and PRG meetings via phone and was actively involved with the project. Dr Arkoudis' evaluation report is at Attachment A.

2. Literature Review

Drawing on the aim of the project to identify a set of factors influencing the success of culturally and linguistically diverse HDR students in engineering & information technology (IT) disciplines in order to provide effective supervision and support services, the scope of this review is very broad. It situates the project in the wider discourse on supervision of HDR students in Australia and abroad. The discourse on supervision is present in the academic literature on supervision, the institutional policies and procedures at universities, as well as the government frameworks that guide the overall direction of HDR teaching and learning. This literature review is thus a synthesis of various government and other reports, journal articles, university databases and guidelines, online data, and books on the subject of HDR and supervision in general and in the engineering and IT disciplines in particular. It starts by discussing the broader significance and contribution of international HDR students to the Australian economy, followed by a brief profile of international students and support services available to them at the three participating universities, QUT, UWA and Curtin. It goes on to review contemporary supervision models for effective and good supervisory practice and continues with a discussion of literature on challenges for international students and then looks at discipline specific pedagogical practices in engineering and IT. It concludes with the general findings of the review.

2.1 Significance and contributions of international students

In addition to contributing to a global workforce, international HDR students are a resource for developing and maintaining a diverse, modern, globalised Australian economy[4]. They bring with them knowledge, skills, talent and opportunities for collaborative research, as well as economic and social links that can potentially not only help Australia sustain a high quality of human capital, but also maintain competitiveness in the global market (Trice 2003 and 2005; Andrade, 2006; Robson and Turner, 2007; Banks and Olsen, 2008; and DEEWR, 2008 and 2009)[5].

As a knowledge-based economy, Australia is highly reliant on a skilled workforce and in order to remain internationally competitive, it is crucial to have a sufficient and ongoing supply of workers who have advanced training and skills. The Bradley Report (DEEWR, 2008) notes that more students in higher level research degrees could make a significant contribution to Australia's skills needs; that if Australia is to obtain the workforce it requires by 2020, it must widen its international student base. This is also highlighted in the recent Knight Review (DIAC, 2011) which led to the Australian government's plans to streamline the processing of HDR students' visas[6], give them access to a three to four year post-study work visa, unlimited work rights during the study tenure and extended the visa period of all

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[4] The international education industry is Australia's third largest export (Commonwealth of Australia, 2009)
[5] About 12% of the new supply of doctoral qualifications comes from international students who remain in Australia following their qualifications (Edwards et al, 2009).
[6] Students with confirmation of enrolment will be treated as a lower migration risk than other categories (see DIAC, 2011).

by six months to allow for interactive marking of a thesis (DIAC, 2011)[7]. These measures are likely to attract even more international HDR students whose enrolments have increased considerably in the past decade, relative to that of domestic HDR enrolments. While domestic enrolments for doctoral degrees from 2000-2010, for example, increased by 38 percent, enrolments for international students were much higher at 275 percent (Larkins, 2011)[8]. As a broad field of study, a notable sustained rise is seen in engineering HDR completions for international students in relation to other discipline completions (see Figure I below sourced from Edwards et al, 2009, p 23)[9]. This performance has not been matched in Information Technology, where the increases are fairly low compared with other fields. Overseas students make up a substantial proportion of HDR engineering enrolments; about a third of all PhD engineering awards in Australia (Dobson, 2010). While completions are important for the fulfilment of study and career aspirations of the individual students, the implications for universities are related to rankings, future funding, effective use of resources and infrastructure, and the earnings of the university from the Australian Federal Government's Research Training Scheme. Completions and student satisfaction are therefore increasingly important in the HDR sector and government policy in Australia since 1999 (Martin et al, 2001) is directed towards quality of performance and timely completions.

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[7] The Australian Government accepted all of the 41 recommendations in principle made in the Knight Review and these are being implemented in a two stage process. At stage 1, which commenced in 2011, the financial requirements for some applicants have been reduced, a new 'genuine' entrant requirement has been introduced, there are more flexible arrangements for English language studies and visa periods have been extended. See Fact Sheet – Stage One Implementation of the Knight Review Changes to the Student Visa program at http://www.immi.gov.au/students/_pdf/stage-one-knight-review-changes-fact-sheet.pdf. Stage Two is being rolled out this year (2012) and some of the recommendations such as streamlining visas have started to be implemented.

[8] Data in Larkins' article is sourced from DEEWR.
http://www.deewr.gov.au/highereducation/Publications/HEStatistics/Publications/Pages/Home.aspx

[9] Interestingly, a study by Bourke et al (2004) shows that (again by broad field of study), while candidacy time was the same (7.5 semesters), completion rates of PhD candidates (overall - domestic and international), after five years of study in Engineering were also high (83%) relative to the Arts, Humanities and Social Studies (47%) as well as Health (73%).
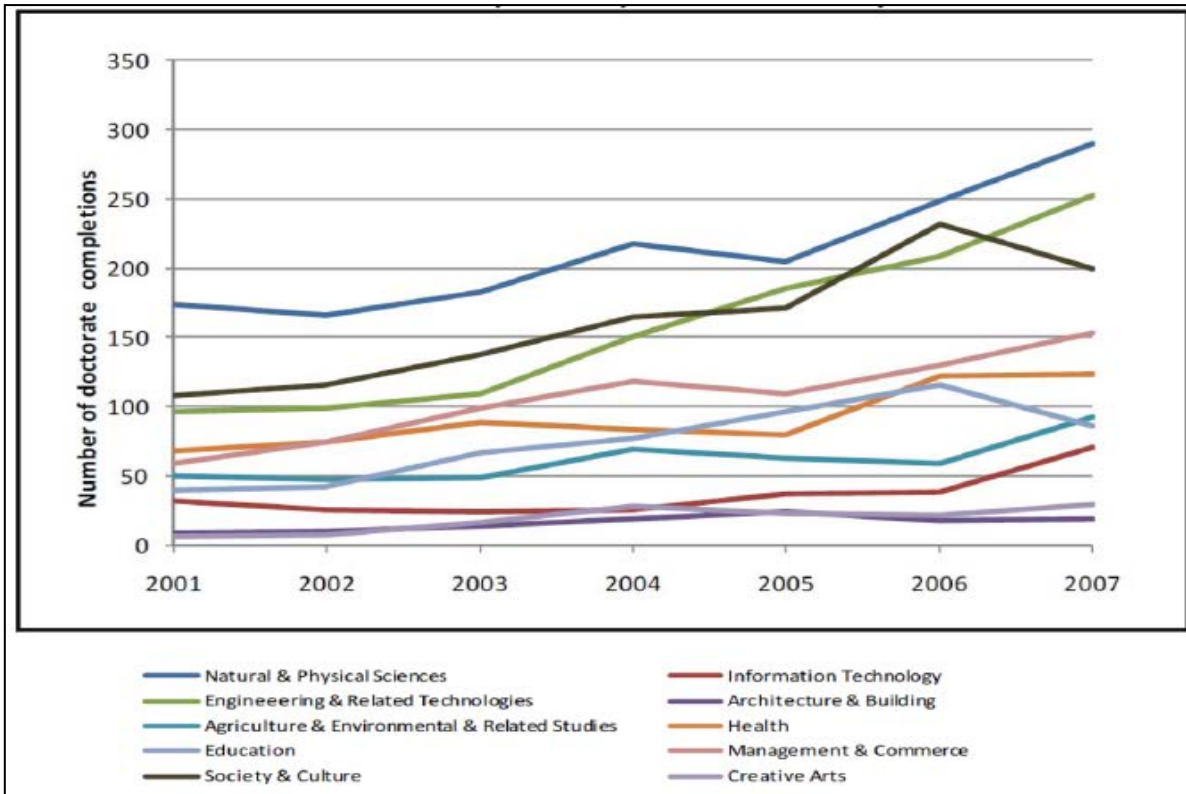
Figure 1 Number of International Student Completions by Broad Field of Study : 2001-2007. Source: Edwards et al, 2009, p 23.

In general, attrition and completion rates are a concern to universities globally with the suggestion that attrition rates are high and completion times too long (Bourke et al, 2004). This however, does not hold for international students at some universities, possibly because of the conditions of their student visas and the fact that many are financially supported through scholarship stipends. Universities are continually looking at investing in support for these students whose challenges are often balanced by the commitment to work hard. Conversely, there is anecdotal evidence that more energy and time is spent on international students for timely completions. The international status of students often means that there is a pressure to complete studies within the scholarship term. Most HDR students are sponsored and have clear performance indicators against which they are benchmarked, including that of completing within four years. It is perceived that there is much more invested (both financially and in other commitments) in their timely completions, relative to domestic students. Supervisors often complain that international students are 'high maintenance' in that, the supervision workload is higher. There is evidence that supervisors may resist taking on international students as it may mean more work than supervising a domestic student[10]. Given the high level of technical and discipline-specific knowledge required to commence on projects in engineering and Information Technology, it is desirable that students are well prepared for an intensive study program that involves working in a demanding advanced technical environment in Australia.

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[10] Personal communication with various support services staff at UWA. However, many domestic HDR students are from also CALD backgrounds.

2.2 Contemporary supervision models

Quality assurance and improvement are two key postgraduate agendas for universities in Australia. A consultation paper defining quality research (DISR, 2011) points out its importance for the international reputation of Australian universities, as well for the future careers of researchers and the innovative capacity of future researchers. Successful completion is seen as highly dependent upon the quality of supervision based on the understanding that 'the quality of the HDR student's experience and the outcomes of their period of study are related in a significant way to the quality of the supervision he or she receives' (McCulloch, 2010, p 175). This also informs the Research Training Scheme funding criterion that considers quality research training supervision as contributing to timely completion rates (DISR, 2011). In practice, this is reflected in the development of professional supervision training programs for supervisors and through the introduction of accreditation of supervisors at some universities.

Perspectives on supervision in much of the emerging literature therefore, are anchored in improving effective supervision, however, they also acknowledge the internationalisation of education (see Boud and Lee, 2009, for example). Perspectives include sharing research interests, needs-based staff and student development, a centralised management of supervision and more, that broaden the base of the supervisory relationship. Whereas, the traditional model of supervision, a master/apprentice relationship was rigid with clearly marked boundaries of roles and expectations (Toncich, 2006), contemporary supervisory relationships are varied. Toncich (2006, p 66) describes the traditional arrangement as one in which 'the apprentice researcher followed behind the master, conducting specified research tasks, and observing the master's research characteristics so that, ultimately, the apprentice would also become a master in the same mould as the original.' Contemporary trends are geared towards student profiles that include industry and professional postgraduate entrants who would like to advance their knowledge and skills in their areas of interest. The changing nature of research itself, in terms of employability leads to what is identified as binary divide (Bills, 2004) in research perception. Along with curiosity- driven research, there is a utilitarian view where the ultimate goal may be economic gain (Taylor and Beasley, 2005). This view is supported by the range of doctoral degrees that have evolved such as the PhD by publication and the professional doctorate and other complexities of interdisciplinary doctorates which are further complicated by institutional requirements for supervisory committees. In terms of supervisory roles and responsibilities, this creates a number of ambiguities as to the roles and responsibilities of the supervisor and the student, which may vary with the nature of the research and the environment in which it is conducted. While these complexities are acknowledged, much of the literature is focused around the key question of what supervision entails and what is the role of the supervisor in the supervisory relationship. Depending on the objectives of the studies a wide-ranging list of roles are found in the literature such as director, facilitator, adviser, teacher, guide, critic, freedom giver, supporter, friend, manager, mentor, gatekeeper, organiser, nurturer, progressing candidature, coach, sponsor, educator and more (Pearson and Kayrooz, 2005; Lee 2007; Delany 2008; Zhao, 2010; Manathunga, 2009) which form the basis of the models on supervision that vary in formulation from simply focusing on approaches to integrating more complex factors for enhancing good practice in supervision.

Applicable to most disciplines, Gurr's (2001) supervisor/student alignment model coordinates the supervisor's style with the student's autonomy. Premised on the fact that the PhD process is one of developing a student's ability to conduct research, the model is based on the view that a student grows academically during candidature. Trialled with four of the author's students, the model asks for an adjustment in a 'hands on', 'hands off' approach to facilitate development of the student from 'relative dependency' to 'competent autonomy' (Gurr, 2001, p85). The two dimensional figure (Figure 2-2) below, shows a combination of four outcomes of the student/supervisor relationship. The alignment is the convergence plane which helps develop autonomy of the student over time. The main argument is that the effective supervisor moves flexibly between these approaches as and when needed, and noticeably as the student progresses in candidature. The effectiveness of the model as a supervisory tool was gauged by six-monthly feedback obtained from students on the alignment of supervisory needs with supervisory practice, over a period of three years and found to be a useful tool for supervision at The University of Sydney, where the research was conducted.
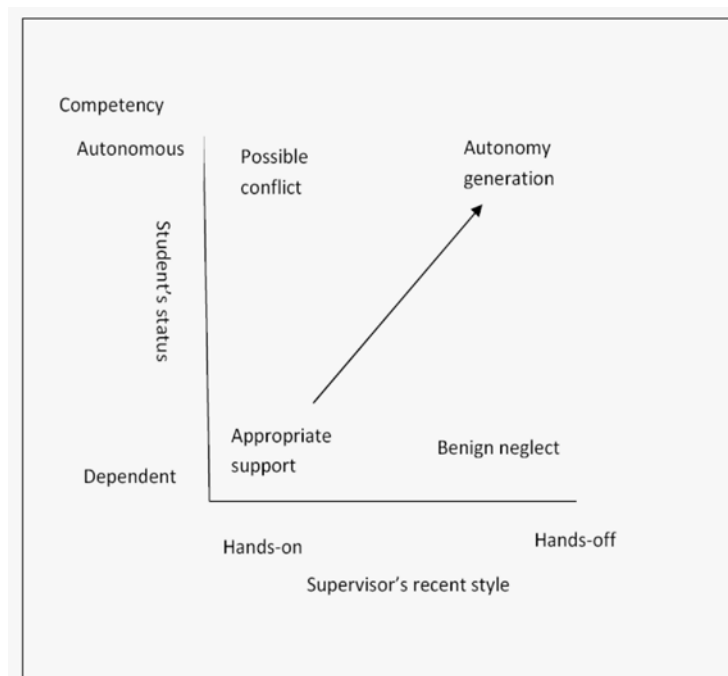
Figure 2 Supervisor - Student Alignment Model. Adapted from Gurr (2001)

Vilkinas' (2002) managerial model for supervisors is built on the parallels of academic supervision to business management. According to Vilkinas, the supervisor performs two important roles; that of a knowledge expert, and that of a supervisor/manager. While the first is accepted as a given, it is the managerial role that is the focus of this model. Using a management 'competing values framework' (CVF), Vilkinas argues that the eight operational roles (innovator, broker, producer, director, coordinator, monitor, facilitator and mentor) identified as the roles of a manager (in a business environment) in the CV framework are applicable to those of the supervisor. In modifying it, Vilkinas added the ninth role of an integrator as central to the process to produce the Integrated Competing Values Framework (ICVF). In her work, Vilkinas admits that though analogous, the role of the supervisor is different to that of the manager, in that the student is more autonomous than an employee and is less monetarily dependent on the supervisor. In a restructured version, the model has

the operational roles reduced to five: developer, innovator, broker, monitor/deliverer and integrator. To assess the ICVF model, Vilkinas performed a study of 25 faculty members at seven Australian institutions to determine how they supervised their PhD students' thesis preparation. In her analysis, she found that the majority of the supervisors were task-focused and some were concerned about the 'humane' aspects of supervision. In her conclusion, she notes that while the ICVF has the desirable aspects of supervision, other elements such as innovation and reflection that would make for effective supervision, were not evident in the sample.

As noted by Walford (1981), the 'role theory' underpinning the above model has its limitations. It reduces the complex process of supervision where the academic aspects of the PhD project development intersect with social and cultural aspects of both the supervisor and student lives. Other identified variables that play a significant part in the relationship are attributes, behaviours, knowledge, skill base and demographics of both the student and the supervisor. Integrating these elements within research training frameworks, some researchers have come up with models that explain and test the complexities of the supervisory relationship.

Such a composite approach is presented in Cullen and colleagues' work (1994) that explores the supervisory relationship over time and places it in a broader institutional context. Their work offers a three-stage model that tries to include the key features of mutual responsibilities, expectations of supervisors and PhD students, dimensions of supervision, institutional support, as well as the processes and strategies within the institutional context of administrative and academic obligations. This study also addresses the varying characteristics of students including international as well as gender and discipline groups. At stage one, significant effort and time are put in to help the student find and explore a topic for the thesis. Subsequently at the second stage, there is less interaction unless there are some signs of needing assistance. At the third, writing up stage, the student needs more frequent feedback on the work. The basic elements of this model (Cullen et al, 1994, p 74-75) are:
- Negotiating and guiding the transition from dependence to independence,
- Adapting the supervisory approach to the individual student's needs, personalities and disciplinary differences, and
- Recognising that the key to the process is the formulation of the research topic or question or problem which will ensure that the focus is sharp and well-directed without undermining the student's ownership of the topic.

While Cullen and colleagues have used interviews and surveys on both students and supervisors for their methodology, an innovative aspect, is their longitudinal approach with a focus on the first six months, the middle year and the last six months of candidature which helped bring out the marked differences in supervisory practice over the course of the student's candidature.

2.3 Challenges for international students

As many of the needs and concerns are similar, there is considerable overlap in the literature on HDR students generally. However, the literature on diversity in the HDR sector

shows significant challenges faced by international students especially those who are culturally and linguistically diverse. These students come from countries that have English as a second language and where the academic culture is characterised by a hierarchy in academia. Additionally adjustment to the new broader social and cultural environment can be disorientating as it is 'unpredictable and uncertain' (Taranuraksakul & Hall, 2011) leading to degrees of unease depending on the personal circumstances of the students.

In addition to common barriers with candidates from 'non-traditional' backgrounds, such as isolation (due to the nature of higher degree study), lack of role models and discrimination, Taylor and Nigel (2005, p 152) also identify factors related to language and culture that may influence successful completion and a positive experience of candidature. Applicants for HDR are expected to demonstrate satisfactory performance in an approved test of English before being admitted into an Australian university. It is anticipated that students have speaking, writing, reading and listening skills in the language in order to carry out study at that level. Higher scores may be required for some disciplines such as Education, Dentistry and Law than others (UWA, 2011). Difficulties with conversing in English language can lead to inability to express and communicate with both supervisors and peers, verbally; however, non-verbal communication related to cultural mores may also adversely affect students. In a Western cultural context, for example, eye contact is a sign of attentiveness, whereas in some cultures, eye contact is a sign of disrespect (Taylor and Nigel, 2011, p 161). Based on the presumption that students from 'Confucian heritage cultures' (Taylor and Nigel, 2011, p 161) have a tendency to be passive learners, some researchers (for example, Cryer and Okorocha, 1999) emphasise the need for sensitivity to different thinking and learning styles. Expectations about academic roles and different thinking styles can differ as some international students come from cultures where the teacher (supervisor) is respected as a source of knowledge (Okorocha, 2000). Making adjustments to a new way of socializing and doing things is a time-related process where the longer one stays in the different cultural environment, the more oriented one becomes to the cultural mores of the society. With regard to this, induction programs at universities are designed to make international students aware of the university related services, but often miss out on what may be more pressing issues for the international student, for example, needs related to relocation to a new country.

2.4 Discipline-specific issues in Engineering and IT

Most studies on supervision concentrate on supervisory practice. While ascertaining the link between supervisory practice and good research outcomes, they obscure the association with discipline pedagogical practices. For this study it is important to consider if supervisory pedagogical practices vary between different disciplines?

An early study by Whittle (1991; 1992, cited and quoted in Cullen et al, 1994, p 128) notes the broader distinctions between Sciences and Arts as differences in communication and styles. For example, with regard to communication, Whittle notes that there is an emphasis on the written form in the Arts. In the Sciences, there is more weight put on both written and spoken communication as well as specialised language symbols to communicate concepts. Table 2-1, below, is a table of the differences between communication styles in Arts and Sciences as noted by Whittle.

Table 1 Communication Styles in the Arts and the Sciences.

Arts	Sciences
Ad hoc, formal	Regular, informal
Emphasis on written form	Both written and spoken form
Plain everyday language	Specialised language symbols
Wide range of journals	Narrow range of journals
Low publication rate	High publication rate
Low level of joint publication	High level of joint publication
Low conference participation	High conference participation

Source: Cullen et al, p126

On a similar note, contemporary practitioner, Finkelstein (2000), differentiates between and explains the importance of technical writing as a fundamental tool for science and engineering: 'It is designed to be objective, direct and precisely defined in an empirical manner…, it avoids the use of rich metaphors and figures of speech, substituting instead precise, empirical data' (p2).The component skills emphasised by Finkelstein, are technical definition, mechanism description and process description; and common applications are producing technical documents, visuals, technical briefings, electronic publishing and reports which are the ways in which science research is communicated to various stakeholders.

Related to the communication styles mentioned before, Whittle (1991; 1992, as cited in Cullen et al, 1994) also notes that while the Arts student can benefit more from a 'hands off' style, the science student needs a more 'closed' form of supervision. The table below shows the differences in supervisory styles in broadly categorised disciplines.

Table 2 Supervision Styles

Supervision Styles in the Arts and the Sciences		
	Arts	**Sciences**
Style:	Hands off	Close
Meetings:	Irregular, infrequent	Regular, frequent
Project:	Individual	Collaborative
Relation to supervisor's research:	Unrelated	Closely related
Joint Publication:	Uncommon	The norm
Mentorship:	Rare	The norm

Source: Cullen et al, p126

Other studies that cover discipline specifics concentrate on aspects of doctoral research education. For instance, Alpay and Mendis-Tatsis (2000) look at the development of the broad science and engineering knowledge of postgraduate students through a teaching assistant scheme that equips postgraduate students with teaching skills as well as a means of feedback to staff on the efficacy of laboratory based courses.

In a more recent study drawing attention to pedagogy in higher degree research, Bruce and colleagues' (2009) work examines the teaching-research nexus by studying higher degree research in technology disciplines through an 'education lens'. Even though it is essentially about teaching and learning, higher degree research is mostly considered a research

undertaking rather than viewed as a teaching and learning process. In focusing around what supervisors want their students to learn and the approaches and roles adopted to accomplish this, Bruce and colleagues examine alternative supervisory pedagogies. Key findings from the research reveal that technology supervisors focus mostly on issues of process rather than 'discipline content' when discussing teaching and learning aspects of supervision. The study also reveals that technology supervisors use a range of supervisory strategies common to other disciplines, seek a broad set of learning outcomes for the higher degree research process aligned to graduate capabilities and do not have a 'signature' pedagogy as a broad group (Bruce et al, 2009a, p1).

Yet another study by Garcia-Perez and Ayers (2012) has addressed misconceptions about research in engineering by bringing together experienced researchers, supervisors and PhD students to think and clarify the research process that PhD students are involved in. They have produced a model of the PhD process based on input, expected outputs, actions and time to help students adopt a strategic view to their PhD research.

As suggested in some of the studies above there are pedagogical differences between the science and Arts disciplines in general, however, there is very little work done in engineering and IT in particular. Based on the fact that that there are distinctive communication styles, different supervisory styles, the lab-based research infrastructure and strategic approaches needed for research project in these disciplines, more research is needed to examine the differences in depth.

2.5 Conclusion

In examining the literature on international students and supervisory practices, this literature review finds that there is a growing population of international HDR students at Australian universities based on the evidence from the three participating universities. A high percentage of these international students are attracted by engineering and information technology disciplines which are forefront of scientific and technological development continue to attract international students. The majority of students at the three participating universities come from Asia, however there are growing numbers from other regions such as Africa and South America

The review also finds that quality assurance and improvement are two key postgraduate agendas for universities in Australia. Following this, perspectives on supervision are based on improving effective & good practice in supervision. Much of the literature on supervision is focused around the key question of what supervision entails and what is the role of the supervisor in the supervisory relationship. Models on supervision vary from simplistic relationships to more comprehensive frameworks that incorporate the broader institutional context. There is growing literature on the challenges faced by international students, though this does not appear as part of any modelling attempts. The review finds that there are common pedagogical practices in supervision between disciplines, but variation in communication and supervision styles in arts and science disciplines. Few studies have tackled engineering and IT discipline-specific needs in relation to supervision and there are no models or frameworks that have focused on engineering and IT in particular.

3. Project Framework and Approach

3.1 Project Framework

As articulated in the overview of the project in Section 1, the aim of the project was to identify a set of factors influencing the success of CALD, international, HDR students in engineering & information technology disciplines in order to improve practice in successful supervision. The project looked at identifying the particular factors related to the needs and supervisory issues that CALD international HDR students and their supervisors face in the engineering and IT disciplines.

While linguistic and cultural (both social and academic) challenges are apparent in the supervision of CALD international students, individual and institutional factors also play a role in their success. Individual factors include attributes and motivations embodied in learning styles. Institutional factors pertain to beliefs around how students succeed, which in turn are contained in the processes of selection, enrolment, progression and examination, as well as factors such as students-to-supervisor ratios. Since HDR students operate on visa and sponsorship timelines they are also constantly under higher pressure to complete studies in a timely manner compared with domestic students. Given the high level of technical and discipline specific knowledge required to commence and execute projects in these disciplines, it is most desirable that students are well prepared for an intensive study program that involves working in a demanding and advanced technical environment. The study was undertaken to identify factors that influence the performance of international and CALD, HDR students in engineering and IT at Australian universities. The main aims of the project were:

- To identify factors that provide effective support to CALD/international students in the engineering and IT disciplines to help them do well in their studies,
- To identify factors that will help improve and provide effective support for HDR supervisors in the supervision of CALD/international students in engineering and IT disciplines,
- To help improve the supervision of CALD/International HDR students through the encouragement of a more open, accepting, and supportive attitude towards students from diverse socio-ethnic backgrounds, as well as greater recognition of their potential contributions to the research agenda of universities.

3.2 The 5-fold Approach

To fulfil the aforementioned aims, a 5-fold approach to the project was undertaken. The five phases consisted of Focus Groups, Student Survey, Supervisor Survey, a comparison of support services across the three participating universities and critical incident interviews with HDR supervisors of the three same universities.

A mixed method approach was taken to data collection. Initial workshops and focus groups conducted at the three universities provided the material for two online questionnaire surveys; one student and the other supervisor. These were conducted between April 2011 and January 2012. Ethics approval was obtained from the three universities prior to the online survey data collection and amended later to include critical incident interviews.

Critical incident interviews with 12 supervisors were conducted from May to July 2012. In addition to these, institutional data on international HDR numbers, completions times, and information on countries of origin and support services for HDR students were collected from September 2011 to October 2012. The sections below discuss the data collection and analyses in detail.

3.2.1 Focus Groups

Focus Groups were conducted at UWA and Curtin and included a total of 12 academic staff. Initial data was collected through a pilot study conducted at QUT and UWA. The pilot study involved focus group discussions and a pilot test of the student survey. The inputs from this pilot study and an analysis of informal conversations with academic staff and students on HDR supervision led to a series of formal staff and student workshops in Curtin University and UWA. These workshops then provided the basic material that was used to develop the student and supervisor surveys.

3.2.2 Student Survey

The purpose of the student survey was to establish students' demography, perceived obligations and success and supervision.

An online survey was conducted at QUT, UWA, and Curtin. The survey was completed by international and/or CALD graduate students studying in the areas of engineering Systems and Information Technology at these universities.

The students came from different countries with most being males. A minority had studied in Australia from before. The largest group had resided in Australia for less than 2 years. Most of the students were supervised by a team of supervisors while a minority was supervised by a single supervisor. Most of these had very high scores on the IELTS test. (A detailed analyses on student composition is available in Chapter 4)

3.2.3 Supervisor Survey

The supervisor survey was undertaken to establish the supervisors' demography, perceived student obligation and success factors, styles of supervision and influences on their supervision skills.

An online survey was conducted with supervisors in the areas of Engineering and Information Technology at QUT, UWA, and Curtin. The majority of supervisors were mostly Australian. The pool of supervisors also included those who had studied in Australia and in foreign countries but with some significant Australian experience. The set of supervisors contained both native and learned English speakers. The supervisors came from different fields that included engineering, IT and the sciences (A detailed analyses on supervisor data and its collection is available in Chapter 4).

3.2.4 Comparison of HDR and CALD Support Services

The emphasis of this study was to identify support services that contributed to academic success of the students. Services that were not exclusively HDR related but served to enhance their academic success were also recorded.

Key academics with HDR supervision roles within the three universities UWA, QUT and Curtin were interviewed against a preliminary checklist of HDR support services offered at the three universities. They were consulted with regards to the availability, location and accessibility of these services. A service was considered available, if it was offered directly by the university or indirectly through a university affiliated agency such as a student club. Services were recorded with regards to their location by considering where they were housed, whether at the university, faculty or school levels or located altogether separately. The accessibility of these support services considered who among HDR students these services were accessible to; general students, international students, faculty students, supervisors. A comparative table was developed and the support services were categorised into the following 5 categories; academic, administrative, social and settlement language and miscellaneous support.

3.2.5 Critical Interviews

A total of 12 interviews were conducted across the three participating universities in the last phase of data collection completed in June 2012. HDR supervisors in engineering and Technology disciplines were interviewed individually. A questionnaire was circulated to the participants before the interview and those who were not available for a face to face interview, provided their responses via email. While the aim of these interviews was to provide information on critical incidents that supervisors may face in their supervisory roles, the robust content also provided details of the complexity and context of the supervisory relationship.

4. Quantitative Analysis: Students and Supervisor surveys

This chapter describes the Phases 1-3 and their relevance to the overall aims and objectives of this project.

Phase 1 is described briefly as the qualitative data from this phase is mainly analysed in chapter 7- under qualitative analysis. Phases 2 and 3 are described in detail with regards to the data gathering, quantitative analysis using descriptive statistics and discussion and implication of results.

4.1 Phase One: Focus Groups

4.1.2 Data Collection

Student Qualitative Responses:
The student responses were obtained through a focus group workshop held in June 2011 at Curtin attended by 11 HDR students.

Supervisor Qualitative Responses:
These include responses to an email survey sent to QUT supervisors with 14 supervisor responses, followed by a focus group workshop held in UWA in April 2011 attended by 9 supervisors.

These workshops then provided the basic material that was used to develop the student survey and the student survey used to create the supervisor survey. Furthermore, the survey questionnaire for both staff and students were thoroughly discussed during monthly meetings held for the project among the three participating universities.

The questionnaire was released only after obtaining consensus among project team members on the type of questions used for the 3 participating universities. The qualitative data collected at the focus groups are further included under the qualitative analysis in Chapter 7.

4.2 Phase Two & Three: Student and Supervisor Surveys

4.2.1 Data Collection

Both student and supervisor surveys were based on previous research by the group, including a pilot study using the student survey and focus groups involving supervisors.

Student data was collected using an online survey which was administered to 228 international and CALD HDR students in the areas of engineering, and Information Technology at QUT, UWA, and Curtin (see Appendix C). Online survey data was analyzed using descriptive statistics, regression and Bayesian Network analyses, while comments were analyzed using qualitative methods which identified themes and categories.

Student Survey Design

The student survey was divided into seven sections. The first section collected demographic information, including age, gender, country of birth, length of residence in Australia, course information, previous experience at an Australian university, level of previous education, and mode of current enrolment (e.g., part-time or full-time). The second part of the survey included a series of items related to supervisory satisfaction using a Likert scale of 1 (poor) to 5 (very good). For example, items related to supervisor's expertise in the area, interest shown in the student(s), availability and guidance in the early stages of the postgraduate's candidature, etc. In addition, there were items related to the level of independence and support that was given to the students in planning their research work. The third section of the survey included a series of items about the perceptions of international graduate students in terms of their research environment(s). The items were related to the role that supervisors played in helping the international and CALD students recognise and understand the local research environment, the research culture, and the socio-economic and national implications of their research. The fourth section of the survey explored the level of social interaction that students had with their supervisors, as well as their perceptions of their supervisors" willingness to discuss non-academic (e.g. personal) issues. The fifth part of the survey involved a series of items about the help that supervisors provided in assisting CALD graduate students to develop their communication and social networking skills. Using a 5-point Likert scale (1 - Never, 2 Sometimes, 3 - Most times, 4 - Frequently, 5 – Always), participants were asked to rate their supervisors' support in developing students' English speaking capability, directly them to useful resources, encouraging them to improve their communication skills, etc. The sixth and seventh sections of the survey used a 5-point Likert scale to ask a series of questions on what international and CALD students perceived as their obligations/ responsibilities and those of their supervisors. There was also an open-ended, optional question which allowed participants to comment on "any other aspects of your HDR supervision you want to highlight as part of this survey.

Supervisor Survey- Data collection

Supervisor data was collected using an online survey which was administered to 69 supervisors in the areas of engineering and information technology at QUT, UWA and Curtin(see Appendix D). Online survey data was analyzed using descriptive statistics, regression and Bayesian Network analysis, while comments were analyzed using qualitative methods which identified themes and categories.

Supervisor Survey- Design

The supervisor survey was divided into six sections. The first section collected demographic information and educational background, including gender, country of birth, length of residence in Australia, cultural background, language background, previous experience at an Australian university, educational background and international experience, employment experience, field of expertise, and number of HDRs (CALD and non-CALD) supervised and completed. The second part of the survey was related to supervisory style and included a series of items related to supervisory satisfaction using a Likert scale of 1 (poor) to 5 (very good). For example, items related to the obligations of the HDR supervisor/supervisory team and the obligations of the students, the types of activities or responsibilities related to supervision, factors influencing their style of supervision, perceptions of student perceptions of their style, perceptions of behaviours and attributes of successful HDR students, and any factors which may influence CALD HDR student success.

The third section explored supervisor perceptions of research supervision in the multicultural context, including a series of items related to supervision of HDR students, especially any perceived differences between CALD and non-CALD HDR students. Using a 5-point Likert scale (1 - Never, 2 Sometimes, 3 - Most times, 4 - Frequently, 5 – Always), participants were asked to rate: how relevant cultural, linguistic and/or social factors were to their supervision of HDR students; whether CALD HDR students required different support than non-CALD students; and whether supervision of CALD HDR student had an impact on the supervisors' research. The fourth section focused on Support Structures for HDR supervision. It included items related to availability of HDR support within the individual institutions and whether supervisors made use of such support. The fifth section explored supervisor perceptions of benefits of supervising within a multicultural context. The sixth section provided an opportunity for participants to write in comments related to research in the local and global context in more detail using open-ended, optional questions.

4.2.2 Common Analysis

The survey data from both student and supervisor surveys was analyzed in a number of ways, including descriptive statistics, Principal components analysis (PCA), linear regression, and Bayesian Network analysis. Principal components analysis (PCA) is a method for combining a set of variables into a combined score (also often called an index). Linear regression was used to examine the relationship between the students' personal attributes and their attitudes to supervision (student survey), and supervisors' personal attributes and their attitudes to supervision and student success (supervisor survey). The attitudes were considered as the response and the personal attributes were fitted as possible predictors of the response. The aim was to identify personal attributes that significantly impacted on the students' attitudes to the supervisor, and vice versa. A Bayesian Network (BN) graphically represents and then quantifies the relationship between an outcome of interest and the (possibly many, interacting) variables that influence this outcome. It is a common method for modeling complex systems, so is a natural model for attitudinal surveys.

4.2.3 Results: Student Survey

Students' linguistic, academic and cultural backgrounds
The students came from 33 different countries. The largest numbers of students came from China (25 percent), Malaysia (10 percent), Iran (9 percent), Sri Lanka (8 percent), India (8 percent), and Indonesia (8 percent). 67.4 percent were male respondents and 32.6 percent were female respondents. The age range was 23-47 years old, with the majority of participants (53 percent) between the ages of 20-29; and 38 percent between the ages of 30-39. Only 9 percent were over 40 years old.

Only 25 percent of the respondents had previously studied in an Australian university, while over 75 percent were studying in the Australian higher education system for the first time. In terms of length of residence in Australia at the time they completed the survey, 11 percent had been in Australia for one year or less, 44 percent between 1 to 2 years, 26 percent between 3 to 5 years, 6 percent for 6 to 10 years, and only 3 percent for more than 10 years.

The majority of students were PhD students, with 82 percent enrolled in full time PhD studies and 13.7 percent enrolled in Masters by Research. The remaining students were enrolled part time in either PhDs or Master of Science by Research. In terms of the highest level of qualification participants currently held, the majority (67 percent) had a Master's degree, with 31 percent with a Bachelor's degree. Only four students had cited other qualifications: one had a PhD, and three had graduate diplomas.

The majority of participants (71 percent) were studying in the broad area of engineering, including chemical (3 percent), civil (14 percent), design (2 percent), electrical (6 percent), Mechanical (14 percent), and other or unspecified (32 percent). Other areas included IT (19 percent), life sciences (4 percent) and other (7 percent).

Most (over 70 percent) respondents were supervised by a team of supervisors while the rest were supervised by a single supervisor. In terms of IELTS entry scores, 74 percent had scores 7 or higher on Reading, and 70 percent had scores higher than 7 on Listening. Only 51 percent had scores higher than 7 on writing, and only 56 percent had scores higher than 7 on Speaking.

Supervisors' direct involvement in research
Overall, 80-90 percent of the respondents rated the supervisors' direct involvement in research as either "good" or "very good". This was in response to the supervisors' expertise in the area of research, commitment, availability, timely feedback and general research guidance. For example, 85 percent of respondents felt their supervisor(s)' expertise in their research field was 'good' or 'very good', and 90 percent of respondents were happy with the level of interest shown by their supervisor(s) in their work.

Supervisors and research environment
This set of items related to the participants' perceptions of their supervisors' role in helping them to understand the Australian engineering and IT higher education research environment. For example, 78 percent agreed their supervisors helped them to understand the impact of their research at the national and international level (e.g. good or very good), and approx. 82 percent felt their supervisors educated them on standards of good research practice at the discipline and university level.

Supervisors and social interaction
In terms of perceptions of social interaction between supervisor(s) and students, the majority of students (83 percent) felt their supervisors were considerate of their cultural and religious backgrounds, as well as social needs, 'most times' to 'always'. However, more diversity was seen in terms of supervisor support in the areas of life in the university, where 30 percent indicated their supervisors had sometimes or never provided support. Similar results were found with respect to consideration of student economic needs (31 percent never or sometimes), and helping students achieve work-life balance (30 percent never or sometimes).

Supervisors and linguistic and academic skill development

A series of items examined student perceptions of their supervisors' involvement in their linguistic and/or academic communication skills development. While the majority of students (85 percent) agreed that their supervisors were considerate of their non-English speaking background 'most times' to 'always', they indicated less involvement in terms of directing students to useful resources to help develop language skills (33 percent never or sometimes), recommending readings to help improve English skills (43 percent never or sometimes), or promoting interaction with other English speaking HDR students (33 percent never or sometimes).

Research student obligations

Students were asked a set of 10 items using a 5-point Likert scale, about what they perceived as their obligations as an HDR student. The items related to aspects such as attending induction programs, reading information pertaining to HDR students' responsibilities, initiatives in driving their research, work place health and safety issues and compliance to Office of Research regulations while developing their final theses. The majority of students (70-90 percent) agreed or strongly agreed that it was their responsibility (e.g., the responsibility of the HDR student) to attend orientations, comply with university reporting, plan their research and be aware of deadlines, etc.

Supervisor obligations as perceived by the HDR students

The final part of the survey related to a set of 12 items on the perceptions of students about their supervisor(s') obligations in guiding their research programs to successful completion. These items closely paralleled those described in Section 3.6 (above). The majority of students (70-90 percent) also agreed or strongly agreed that it was their supervisors' responsibility to ensure the students were aware of key processes and procedures such as attending orientations, complying with university reporting, planning their research and being aware of deadlines, etc.

HDR issues versus international CALD HDR issues

There were 65 responses to the open-ended question "are there any other aspects of your HDR supervision you want to highlight as part of this survey?'. These responses were broadly categorised as relating to general HDR issues (e.g., issues common to most HDR students), and international or CALD HDR issues (e.g., relating to issues specific to international and/or CALD HDR students).

One participant clearly underlines this distinction, noting:

> *"The lack in supervision/mentorship, I felt during my PhD, **had nothing to do with potential cultural or language barriers** [our emphasis]. My supervisors practised a lassez-faire [sic] approach in their supervision which certainly made me an independent researcher but did not help at all in finishing within the given time frame of 3 years. It became clear to me that juggling the supervision of HDR students together with teaching liabilities [sic] represents a challenge not every supervisor is able to cope with and I am not sure if the university is undertaking enough to address this issue."*

This quote clearly illustrates that some issues in supervision may be considered 'general HDR issues', and may be common to many HDR students. For example, one student suggests the need for supervisors to give specific feedback, saying: *"Supervisors should*

provide very constructive feedback and give very specific advices [sic]". While another notes their need to fill gaps in their own knowledge in the new context, stating: "*I think I am satisfied with the supervision of my work. But sometimes there are gaps of knowledge which takes [sic] considerable time to fill.*"

Finally, a third identifies the impact of inexperience in supervision, complaining: "*I have bad experience with unexperience [sic] supervisor that let me of thinking to give up [sic] my study*".

By contrast, what we will refer to as CALD or international HDR-related comments specifically identify linguistic and/or cultural factors as underlying the issue. For example, one student identifies the need for CALD students to interact with English speaking students, both for language development and social reasons, commenting: "*I think **non English speaking students** [our emphasis] need to interact with native speaking colleagues or attend some lectures. Research is very lonely job and easily make people isolated.*" Another student reminds supervisors of the need to consider students social and personal needs, suggesting they "*consider about the issues from living overseas, like homesick [sic]*".

The dilemma of the project-based PhD, which is typical of many engineering programs for international students and their supervisors, for both cultural and pragmatic reasons, is outlined by another student who says: "*the need of supervisors to finish their research project, and the **need of an international students** [our emphasis] to study a certain topic which is useful for their country are often unfit [sic]. Out of these confusions and misunderstandings, supervisors and the students are both experiencing hard times.*"

Based on these results, it appears a distinction between 'general HDR' and 'CALD-HDR' issues may be critical to the identification of relevant factors which may influence the supervisory relationship.

4.2.4 Discussion

The student survey provides a picture of a complex, culturally and linguistically diverse group of students in the areas of Engineering and IT at three Australian universities. As a group, the majority of students surveyed were male, relatively young, studying full-time for a PhD in Engineering, and had never studied in Australian institutions prior to beginning their current graduate studies. Most arrived with a Master's degree by coursework or research. The majority came from China, India, Iran, Indonesia, Malaysia and Sri Lanka, or broadly 'Asian' countries. Typically, the students were being supervised in teams, rather than by a single supervisor.

This broad demographic description is not unexpected for the fields of IT or 'eng'ineering, which typically attract more men than women, and tend to supervise using teams (often built around specific projects). The fact that the majority of participants were studying full-time may reflect the conditions of their visa status. Given Australia's location, and the current mining and resource boom, the cultural mix of students predominately from Asian countries, India and the Middle East is also not surprising. However, given the relative distance between some of these cultures and the predominately Anglo-Australian orientation of many Australian universities, the probable need for specific orientation concerning possible cultural and academic/administrative differences becomes clear.

Perceptions of student and supervisor roles

Overall, the students appear satisfied with the core supervisory issues related to their research programs, including their supervisors' level of expertise their fields, and the amount of interest shown in the students' work. They also felt their supervisors helped them to understand the research and/or academic context, including standards of good research practice. In other words, they felt their supervisors provided good support related to academic issues in their programs.

However, confusion appears to exist regarding student and supervisor responsibility, as well as in terms of cross-cultural differences in the definition of student and supervisor roles. For example, students both agreed that it was the student's responsibility AND that it was also the supervisor's responsibility to keep the student informed on program and administrative issues, in the two sections of the survey comparing allocation of responsibility. While some of these results may relate to participants' (mis)interpretation of survey items, there also is evidence the results may reflect cross-cultural differences in the perception of student and supervisor roles. For example, in many countries, the role of supervisor (or teacher) is more encompassing of non-academic and/or personal issues (of one relating more like a parent), than in the traditional Anglo-Australian role expectations, which emphasise a high level of student 'independence' and 'self-sufficiency', which in practical terms is often interpreted by supervisors as expecting students not to rely on or expect the supervisor to organise either academic or personal matters, but rather to do this themselves. Similarly, within this cultural paradigm many supervisors see their role as primarily focused on academic matters, not personal or life issues.

These differences in role perceptions as key factors appear to be supported by survey results show that while students felt that their supervisors were generally considerate of their linguistic and cultural backgrounds, they felt their supervisors were less involved in helping students to access language skill development resources or providing support for non-academic and/or personal issues. For example, while the majority of students agreed that their supervisor(s) were considerate of their non-English speaking background, they indicated less involvement in terms of directing students to useful resources to help develop language skills, recommending readings to help improve English skills, or promoting interaction with other English speaking HDR students. Similarly, while the majority of students felt their supervisors were considerate of their cultural and religious backgrounds, and social needs, they indicated less satisfaction with the level of consideration of their economic needs, and/or achieving work-life balance.

This student preference for their relationship with their supervisor(s) not to be restricted to just academic issues, is clearly illustrated by a student who notes, *I'm satisfied with HDR supervision in UWA, if the Uni can organise more activities for supervisor and Phd student to enjoy together other than working together, it will be much better."*

The impact of linguistic and cultural factors

It is interesting that while many institutions nominate 'language issues' as a key issue with CALD students, the majority of students had IELTS scores in the 6 and 7 range. Although these scores may be expected based on entrance requirements in most Australian universities, it seems significant that the majority of students had higher scores (e.g., 7 or higher) in the receptive skills (e.g., reading and listening), than in the productive skills (e.g., 6 for writing and speaking). While these results may reflect the dominant cultural and linguistic groups who participated in this survey, given the importance of productive skills in academic and social interactions in the Australian context, this difference in score areas may be an important factor in integration and success.

For example, the ability to speak and write clearly in English would theoretically benefit both academic productivity and ease of surviving in a foreign country such as Australia. Within the academic setting, students need to understand both the Australian academic context, as well as the specific institutional expectations of their host university, and the expectations of the various members of their supervisory team. Difficulty communicating in English may make this more difficult, as noted by one of the participants, who states: *"My supervisor sometimes thinks that he knows everything about my research. He does not give me a chance to express my ideas and I feel this is due to my English not being so good. And also I am quite shy."*

The complexity of the cross-cultural permutations of the supervisor(s)-student relationship such as that of a non-Australian-born HDR student and a non-Australian born supervisor is clearly illustrated by a student who notes: *"one of my supervisors is not native English speaker so the difficulty of communication between us is much larger than communication with the other."*

The analysis of the student survey has revealed that the research supervision of international and non-English speaking background HDR students involves a complex range of unique factors that existing supervisory frameworks struggle to fully address. In addition to the cross-cultural and linguistic factors discussed above, Bruce *et al* (2010) notes that supervisors from the technology discipline typically follow a rigid supervisory style modelled around creating groups (drawing key players together), developing a structure (project planning) and generating outputs. In addition, as is the case with other disciplines, supervisors in these disciplines seek many learning outcomes from candidates, which have strong alignment with the university's graduate capabilities. The inflexibility of such protocols may place the international HDR cohort at a distinct disadvantage in the current context where there is rapid growth of their numbers, and place undue strain on both experienced and inexperienced supervisors.

4.2.5 Conclusion

The results of the survey provide support for Cahill's (1997) observations that there are a number of issues that need to be considered to assist students in settling into a professionally organised and a friendly supervisory relationship, including:

- formal assessment of relevant previous knowledge in the discipline
- relevance of previous professional experience
- students' educational and occupational expectations, aspirations and learning styles
- English language competency and associated needs

It is clear from the survey that, in addition to the need for support strategies and resources for international and CALD students, culture and discipline-specific approaches may be needed to ensure that research cultures are welcoming, helpful and sensitive to this cohort's unique needs. Identification of key student and supervisor factors in the complex supervisory relationship equation is a critical step in that direction. Further research within this project will be examining the supervisor side of the supervisory equation.

This research also underscores the need to extend the existing supervisory frameworks to include not only linguistic and cultural diversity, but also the unique discipline requirements of the fields of engineering and IT, which should lead to students' effective sociocultural integration and result in high quality research output. Arguably, a model which includes development of generalizable cultural awareness strategies and skills would benefit both HDRs and supervisors within a general international mobility context (e.g., both those returning home and those living and working in international contexts).

4.3.2 Results: Supervisor Survey

Supervisor demography

Supervisor data was collected using an online survey which was completed by 69 supervisors in the areas of engineering and Information Technology at QUT, UWA and Curtin. In total, 60 percent of supervisors were from QUT, 22 percent from UWA, and 18 percent from Curtin. The majority were male (81 percent). Unlike the students, almost half of the supervisors indicated they were Australian (48 percent), with the next largest nationalities including China (10 percent), UK (9 percent), Germany (6 percent), Hong Kong, the US and Sri Lanka (3 percent each). Other nationalities included India (1 percent), Indonesia (1 percent), Italy (1 percent), Mauritius (1 percent), New Zealand (1 percent), PNG (1 percent), Poland (1 percent), Serbia (1 percent) Switzerland (1 percent), Turkey (1 percent), Bangladesh (1 percent), Czech Republic (1 percent).

In terms of academic experience, 73 percent of the supervisors had previously studied in an Australian university. The majority of non-Australians had significant Australian experience, with length of residence in Australia at the time they completed the survey indicating more than half had more than 10 years (e.g., 28 percent had been in Australia for one to five years; 20 percent for 6 to 10 years, and 53 percent for more than 10 years. The majority (61 percent) indicated English was their first language. 40 percent were monolingual, 37 percent bilingual, and 21 percent multilingual (3-5 languages). Other languages included German (n=6), Russian (n=2), Chinese dialects - Hokkien, Mandarin, Cantonese – (n=8).

In terms of supervisory experience, the majority of participants had supervised PhD students as principal supervisors (72 percent) and/or associate supervisors (74 percent), with most supervising between 2 and 4 PhD students. Fewer supervised Master's students as principal supervisors (55 percent) and/or associate supervisors (49 percent), with most supervising only 1 or 2 Master's students. The majority were currently supervising CALD PhD students (approx. 75 percent), and approx. Some 30-35 percent were supervising CALD Masters students, 38 percent had been at their current university 1-5 years; 26 percent 6-10 years; and 34 percent more than 10 years.

The majority of participants (71 percent) indicated they had worked in universities and/or industry in countries other than Australia, with 41 percent having 1-5 years overseas experience and 40 percent having 6 or more years of experience. The majority of participants were at Level C or higher (e.g., 1 percent Level A, 24 percent each Levels B, C, and D; and 27 percent Level E).

Main fields of supervision and/or research for participants were Built Environment (all areas): 12 percent; engineering (all areas): 44 percent; 14 percent mechanical; IT (all areas): 18 percent; Other: 19 percent math, management, IT security, biological sciences, transport, chemistry, engineering education], and participants experience in their current disciplines were quite high, with 35 percent more than 20 years; 24 percent 10 to 20 years; 35 percent 5-10 years; and 6 percent less than 5 years .

The majority of the supervisors were supervising PhDs as either principal or associate supervisors. Some were supervising Master's students. A total of 34 percent of supervisors had five or more completions, while approximately 45 percent had no completions, and 18 percent had one or two completions. In terms of international and/or CALD HDR completions, 46-48 percent of supervisors had at least one PhD completion (with 19 percent having five or more), and approximately 40 percent had at least one Master's completion.

Supervisor responses on factors that influence student success, helped create a profile of a successful HDR and HDR CALD students, based on their personal background and their experience in supervision

In terms of completions and discontinuations, both results suggest that international HDRs were more likely to complete, and less likely to discontinue than 'general' HDR students. In addition, the reasons for discontinuation were similar for both groups (e.g., HDR issues, not CALD-specific)

Supervisory roles

Supervisors on supervisory obligations

Supervisors were asked about their obligations and the roles they played. Answers were expressed on a 5-point Likert scale. Most supervisors 'agreed' and 'strongly agreed' that their role was to ensure that the research methods and design of experiments were appropriate (97 percent of supervisors), provided students with timely feedback on their written submissions (97 percent of supervisors) and made themselves available for regular meetings to discuss the research progress (96 percent of supervisors). However fewer

supervisors 'agreed' and 'strongly agreed' that they were obliged to help students collect data and analyse data using appropriate research tools (59 percent of supervisors) and to liaise with the research office to arrange their students' seminars. When the supervisor responses were graphed next to the students' responses on their perceived roles of their supervisors, a general consensus between the roles was identified. Such congruency was however absent between the students and supervisors when it came to who should liaise with the research portfolio or the office for research to plan for seminars as 90 percent of the students felt that it was their supervisors' obligation.

Figure 3 Supervisor obligations;

student and supervisor responses (A) understand all the HDR rules and regulations (B) Make themselves available for regular meetings to discuss the research progress (C) Ensure that students are aware of how their research fits into any research groups or projects which you are part of (D) Provide regular information and guidance about a student's research literature and methods (E) Ensure that the research methods and design of experiments are appropriate (F) Help students collect data and analyse data using appropriate research tools (G) Guide students on workplace health and safety issues (H) Guide students in undertaking accurate risk assessment for any experimental work that their research involves (I) Advise on special courses that students may need to undertake to successfully complete their HDR program (J)Provide students with timely feedback on their written submissions (K) Liaise with the research portfolio/Office of Research to arrange their student seminars (L) Arrange for required examination panel members in time for student seminars.

How supervisors supervise

Supervisors assume different approaches to methods of supervision. A set of questions were posed to supervisors with regards to how often they used certain supervision styles. Answers were based on a 5-point scale Likert system (*'never', 'sometimes', 'most times', 'frequently'* and *'always'*). Of the supervisors: 92 percent *'most times', 'frequently'* and *'always agreed'* that they respect the knowledge and expertise that their HDR possesses, 90 percent of the supervisors *'most times', 'frequently'* and *'always agreed'* that they encouraged their HDR students to question their own ideas and concepts, 90 percent of the supervisors *'most times', 'frequently'* and *'always agreed'* that they demonstrated a high interest in the overall development of the HDRs. However, only 66 percent of the supervisors *'most times', 'frequently'* and *'always agreed'* that they provided advice on logistics for experimental plans. A large proportion of the supervisors (71 percent) did not use a different language other than English in communicating with their HDR students. To better analyse how the supervisors supervise, roles identified by Bruce et al., 2010, were adopted to analyse the specific question on supervisory style. These were categorised into

three supervisory roles which included (1) director, whose emphasis was to make sure research maintained its focus by advising, (2) collaborator, whose emphasis was to provide assistance by working alongside students, and (3) the responsive role, whose emphasis was to respond to current needs of students (research or life related). A fourth role was created and it was exclusively concerned with roles pertaining to maintaining a life focus and was termed a 'global' role. The questions were grouped under one of these four categories to analyse the extent to which supervisors operated within these four roles (Figure 4-2). The supervisors ('*most times', 'frequently' and 'always'*) play a role as collaborators with HDR students (mean+ SD; 85.27 percent +8.24). This role was mostly performed followed by their role in response to life situations as well as research (mean+ SD; 83.87 percent +7.27). This indicated that supervisors serve as pastoral care givers for the students they supervise. Supervisors showed a low and varying participation in their global role (life focus pertaining to resourcing, developing and supporting students for global growth: mean+ SD; 61.67 percent +35.96). This variation was however caused by the ability of supervisors to communicate in a language different from English (mean 8.7 percent). Since supervisors offer pastoral support to students including those from diverse cultural backgrounds, they in turn need to be supported in performing these roles. Supervisors' comments expressed that they wanted their HDR students to '*feel free'* and '*own'* their research, reflecting why supervisors perform their roles ('*frequently'*) as opposed to performing them '*always'*.

Percentages

Figure 4 Supervisors roles.
Most supervisors '*frequently*' and '*always*' carried out their roles as collaborators and acted in a responsive capacity.

Influences on supervisory style

The factors that influence the style of supervision were used to ascertain how supervisors learned and supervised. The answers were based in a 5-point Likert scale. Most supervisors *'agreed'* and *'strongly agreed'* that they learned more from personal reflections of their supervisory experiences (91 percent) and from how they were supervised as an HDR student (82 percent). Some supervisors *'agreed'* and *'strongly agreed'* that their supervision style was influenced by discussions they had with their senior and more experienced colleagues (74 percent), feedback from their HDR students (68 percent), cultural influences on communication style (e.g. formality, deference of authority, status) (60 percent), observations they made while they were associate supervisors (59 percent), participation in research supervision seminars and workshops (56 percent) and reading literature on effective supervision (31 percent).

Student perception on supervisors' involvement in their research

Supervisors' involvement in their students' research was investigated by asking them what they thought their HDR students felt about their involvement in their research. These attributes related to the supervisors' involvement were ranked by the supervisors and students. Most supervisors (94 percent) thought that students ranked their involvement in the students' research as '*good*' and '*very good*' in relation to the extent to which they comfortably raise issues related to their academic issues. Of the supervisors, 93 percent thought that students ranked their expertise in the research field as '*good*' and '*very good*' and 91 percent thought that the interest shown in their students' work was rated '*good*' and '*very good*', while 72 percent of the supervisors rated their involvement in guiding students on research and design and analysis and their support for them to attend conferences/seminars as '*good*' and '*very good*'. The general trend in the involvement of supervisors in their students' research was echoed strongly by 92 percent of students ranking the supervisors' interest shown in their research projects as '*good*' and '*very good*'. Apart from supervisors' expertise, their involvement in commenting on the students' work, and availability of supervisors when needed, were ranked highly (86 percent and 85 percent respectively).

4.3 Supervisors on student success

The factors that make a student successful were investigated using a questionnaire that employed the Likert scale. Success in this part of the research referred only to academic success.

General factors influencing the success of HDR and CALD students

A series of questions relating to the general factors that influence the success of HDR students were asked of supervisors. Supervisors '*agreed*' and '*strongly agreed*' that the students' ability to understand the complexity of issues was most important for HDR and CALD HDR students (96 percent and 94 percent respectively). The ability of students to break problems into manageable segments was highly regarded as contributing to success, as 94 percent and 95 percent of supervisors '*agreed*' and '*strongly agreed*' that this factor influenced the success of a HDR and CALD HDR student respectively. Another factor that most supervisors '*agreed*' and '*strongly agreed*' on is experience in discussing and analysing data, as 91 percent and 92 percent of the supervisors agreed that it contributed to the success of HDR and CALD students respectively. An adequate level of practical background was chosen by only 51 percent and 55 percent of supervisors as a factor influencing the success of HDR and CALD students respectively. Completion of a postgraduate course however did not receive as much recognition amongst all the factors as only 32 percent of the supervisors '*agreed*' and '*strongly agreed*' that it was an important factor influencing success for HDR and 42 percent said it was important for CALD HDR students. Fewer supervisors cited previous research experience as a major factor (mean 61 percent for HDR and 66 percent for CALD HDR). Interestingly, fewer supervisors '*agreed* and '*strongly agreed* that communication skills were as influential as technical skills to the success of the students.

To better understand the impact of the different factors that influence success, they were grouped into five main categories that included previous research experience (EXP), problem solving skills (PRB), interpersonal skills (IP), communication skills (COM) and technical skills (TECH). Most supervisors agreed and strongly agreed that problem solving skills was the most crucial factor (mean 92 percent and 93 percent for HDR and CALD HDR respectively) that determined student's academic success. The general trend however was that factors that affect the success of HDR and CALD HDR students were not significantly different between groups (Unpaired t-test, p>0.05). This was echoed by the additional comment that one supervisor made: '…..*But every student (CALD or not) is a unique individual, they all have their issues (e.g. health problems, family stress, etc) and I think a supervisor needs to understand and be sensitive to these and give more or less assistance in some areas than others accordingly. If you take this point of view, then supervising CALD students is no different to any other -- they have their particular issues and you need to understand and find a mutually acceptable way to accommodate them.'*

In grouping the student responses into the above mentioned groups, it was important to note that the factors affecting student success varied. A one-way ANOVA (p= 0.01) between all the different responses indicated that there were significant differences in the responses for each group. Supervisors '*agreed*' and '*strongly agreed'* that there was a greater need for CALD HDR students to have completed a postgraduate course, than there was a need for general HDR students to have done so (42 percent and 32 percent respectively). This may be reflected in the supervisors' response to the importance of experience in experimental work, where supervisors '*agreed*' and '*strongly agreed'* that CALD HDR students needed this experience, as compared to general HDR students (64 percent and 53 percent respectively).

Percentages
(agreed+strongly agreed)

Figure 5 General factors agreed and strongly agreed on by supervisors as crucial to HDR and CALD HDR success. (EXP) Previous Research Experience, (PRB) Problem Solving Skills, (IP) Interpersonal Skills, (COM) Communication Skills. Bars represent mean + SD.

Student Obligations

Supervisors were asked questions pertaining to student obligations. Their responses were rated using a 5-point Likert scale. Of the supervisors, 96 percent both *'agreed'* and *'strongly agreed'* that student obligations included understanding and complying with the university reporting procedures and exploration into appropriate research methodologies respective of the student's project. A total of 94 percent of the supervisors *'agreed'* and *'strongly agreed'* that it was the student's obligation to gather information and to understand all their duties. Only 68 percent of the supervisors however *agreed'* and *'strongly agreed'* that it was the part of the student's obligation to attend HDR orientation programs. Being proactive in organizing laboratory spaces to conduct any experiments was agreed upon (*'agreed'* and *'strongly agreed'*) by 72 percent of the supervisors as an obligation of all HDR students. This data closely resembled the answers that were obtained from the student survey. In fact, students were more responsive about their obligations than supervisors in all areas directly related to their research. For instance, 93 percent of the students *'agreed'* and *'strongly agreed'* that they were obliged to organise periodic meetings with supervisor/supervisory team and only 79 percent of the supervisors *'agreed'* and *'strongly agreed'*. Supervisors, on the other hand, placed a greater emphasis than students on matters to do with reporting and ensuring that the student had the correct information on HDR duties. However some differences in responses were observed.

P e r c e n t a g e s

Figure 6 Student obligations.
(A) Attends HDR student orientation program (B) Gathers information and understand their duties as an HDR student (C) Understands and complies with the university reporting procedures (D) Takes the initiative of organizing periodic meetings with supervisor/supervisory team (E) Clearly presents research ideas to their supervisor and seek guidance for further action (F) Explores appropriate research methodologies that can be applied to their research (G) Proactive in organizing laboratory spaces to conduct experiments (H) Ensures that they are aware of all related workplace health and safety issues (I) Shows initiative in planning the submission date of their thesis (J) Ensures that their thesis complies with university regulations

Attributes of successful HDR

The importance of different behavioural attributes was indicated by supervisors on a 5-point Likert scale. Supervisors rated motivation as 'important' and *'very important'* (99 percent), followed by persistency (96 percent and a positive attitude (94 percent). These were rated by the supervisors more highly than was importance of technical skills (66 percent) and willingness to work in teams (53 percent). The attributes were divided into three categories that consisted of **outlook** (one's outlook in life based on mindset), **ethics** (reflecting one's core values and morals in life) and **skills** (as pertaining to one's strengths). Outlook was esteemed *'important'* and *'very important'* (mean 92 percent). Since an HDR is a studentship, there are no external rewards (in terms of commercially consummate allowances) other than the love of research, research outcomes and publications necessitating the need for motivation (inward drive).

Percentage
(important and very important)

Figure 7 Personal traits of successful students. These were grouped under Outlook (positive mindset) Ethics (morals and values) and Skills

Successful HDR behaviour

Supervisors were asked about the behaviours that characterise a successful student. The behaviours that were regarded by most supervisors as 'important' and 'very important' included understanding the research project (100 percent), ability to ask questions (96 percent), keeping up to date with literature (94 percent). Good risk management was cited by a few supervisors as *'important'* and *'very important'* (42 percent) and mentoring new students was stated as important and very important by only 26 percent of the supervisors. The same criteria for grouping personal traits was used to group behavioural traits. The questions on the behaviours that characterise a successful student were grouped into ones that reflect a positive mindset; **outlook** (e.g. asks questions, keeps up to date with relevant literature and researches appropriate methodologies) was rated as *'important'* and *'very important'* (mean 92 percent) as compared to one's values, **ethics** (mean 70 percent). These included characteristics like, works independently, contributes to research project, mentors new students and can collaborate. Among supervisors, 76 percent rated **skills**, which includes characteristics like publishes in peer reviewed journals, completes on time, understands the research project, has good time management, requires minimal supervision in lab and keeps accurate lab books, as *'important'* and *'very important'*. Some supervisors, however, showed a lack of understanding as to what skills these were, with others citing

that they were those required to do a PhD or those acquired in the PhD. However, some underscored the need to adopt and learn these skills as they work, citing that HDR students need to learn to *'think on their feet'*.

Percentages

Figure 8 Behavioural traits of successful students. These were grouped under those which reflect Outlook (positive mindset) Ethics (morals and values) and Skills

Previous Experience

Supervisors responded to the importance of experience in research, problem solving, industry experience, lab safety, quality assurance, environmental management and foundation subjects specific to the field (eg. physics, chemistry). Problem solving skills were perceived to be *'important'* and *'very important' by* 77 percent of the supervisors, foundational subjects by 68 percent, research methods by 66 percent, lab safety by 26 percent, quality assurance by 31 percent, industry experience by 16 percent and environmental management by 12 percent of the supervisors. This survey showed that supervisors are mainly concerned with devising research questions and answering them. This is why problem solving skills and foundational subject were highly esteemed as *'important'* and *'very important'*, as compared to industrial experience.

Percentages
(Important and very important)

Research methods Problem solving Industry experience Lab safety Quality assurance Environmental mgt Foundational subjects

Figure 9 Supervisors response to importance of previous experience of their students.

Competencies Related to Research Project

Supervisors were asked about the need for competence in a range of skills, in order to be successful HDR students. Most supervisors (97 percent) rated both engaging in critical thinking and effective reading comprehension as *'important'* and *'very important'*. Supervisors showed that it was also *'important'* and 'very *important'* for HDR students to be competent in conducting literature searches (93 percent). A total of 63 percent of the supervisors did not feel HDR students needed to be competent in having a working knowledge of programming to be successful. Supervisors did not suggest that students needed to be competent in possessing knowledge of chemicals and materials, as only 25 percent thought it was *'important'* and *'very important'.* The questions pertaining to competencies related to the project were arranged into five groups. These included problem solving (PRB), communication skills (CS), research methods (RM), people management skills (PM) and technical skills (TS). Problem solving was cited by most supervisors as *'important'* and *'very important'* (mean 94 percent), followed by research methods (82 percent) and communication skills (81 percent). Thus, the importance of research methods was considered almost the same as the importance of communication skills. People management skills and technical skills were cited as '*important*' and '*very important*' by fewer supervisors (mean 62 percent and 41 percent, respectively). Interestingly, problem solving skills were cited by many supervisors as '*important*' and '*very important*' in terms of previous experience as well as competency-wise, and more supervisors expressed that research methods were *'important'* and *'very important'* during studies (the number of supervisors rose from 66 percent to 84 percent). Results from this part of the survey showed that during the HDR experience, certain skills need to be developed to address certain research questions. These skills are not mandatory upon commencing an HDR degree, but they are supposedly rooted in foundational training or learned during the candidature.

Figure 10 Importance of certain competencies.
The questions were grouped into categories that included problem solving (PRB), communication skills (CS), research methods (RM), people management skills (PM) and technical skills (TS).

Supervisors on CALD specific issues

Supervisors were asked about the input they had had in aiding CALD students with communication and networking skills. The survey questions revealed that supervisors most of the time recommend students to attend other HDR student seminars/presentations (78 percent) and 71 percent considered how a student's non-English speaking background impacts their study. However, 55 percent of the supervisors seldom or never invite students to the lectures/talks related to their research.

Percentage (frequently and always)

Figure 11 Supervisors' responses to how frequently they participated in helping students with their communication and networking.

Questions represented by the symbols A-Z were (A) Consider how a student's non-English speaking background is impacting their study. (B) Direct students to useful resources to help improve language skills. (C) Promote interaction with other English speaking HDR students. (D) Recommend readings to help students improve their English skills. (E) Support students' initiative to participate in English learning workshops. (F) Invite students to informal meetings with other HDR students within their research group (G) Invite students to your lectures/talks related to their research. (H) Recommend students attend other HDR student seminars/presentations.

The support offered by supervisors to address CALD-specific issues was compared to what students thought about their supervisors' involvement in their communication and networking skills. There was a similarity in the responses to the input offered by supervisors to CALD students. Here, 77 percent of the students felt that supervisors 'frequently and 'always' considered that a student's non-English speaking background impacted his or her study. Only 64 percent of the students showed that supervisors 'frequently and 'always' recommended them to attend other HDR student seminars/presentations

Supervisors on their support

The level of support available for HDR supervision was investigated using a panel of questions. A total of 58 percent of the supervisors agreed and strongly agreed that there was access to high performance computing and related support and 52 percent agreed and strongly agreed that there was funding to support HDRs to conferences. However, only 30 percent agreed that there was support for HDR supervision workloads and none (0 percent) strongly agreed. The supervisors reiterated the need for adequate support in work planning

and recognition with others, citing that the amount of administration paperwork has risen immensely. Because of this increased administration workload on supervisors, the university and faculties run seminars and courses aimed at assisting supervisors with the administrative duties they have to undertake as part of their HDR supervision. Courses related to supervising international students were rated very useful and extremely useful by 36 percent of the supervisors and 34 percent of the supervisors rated courses and seminars related to management of HDR candidates as very useful and extremely useful. A set of further questions to assess if the courses and seminars were compulsory, was compiled and administered. In over 80 percent of the cases the training was not compulsory. The percentage of those who did not attend courses that were non-compulsory was more than 50 percent. The overall percentage of those who attended non-compulsory training courses and found them useful was around 15 percent. This pattern reflected that the usefulness of these trainings is of prime importance and hence may influence people to attend or not.

Factors influencing how Supervisors learn to supervise

Supervisors' ability and source of learning was traced and most supervisors indicated that they learnt by refining based on personal reflection (91 percent), or based on how they were supervised (82 percent) and 74 percent through discussions with senior/experienced colleagues. While 56 percent learnt from participation in research supervision seminars/workshops, only 31 percent of supervisors indicated that they learnt from literature on effective supervision. This clearly indicates that the training of supervisors needs to a take a personal approach that relates to their specific issues in supervision rather than generic situations.

Supervisor perceptions of benefits of supervising CALD students

The benefit most supervisors agreed and strongly agreed on as a percentage of supervisors, was greater self-awareness of own conceptions of research and supervisory practice (68 percent) and recognition of specific needs of CALD HDR students at the university level (68 percent). Fewer supervisors agreed and strongly agreed that their benefits from supervising in the multicultural context gave them a better understanding of institutional policy and procedural requirements (28 percent) and gave them a greater understanding of the literature on the scholarship of supervision (26 percent). Further comments from 68 percent of the respondents showed a leaning towards the positive benefit attained from supervising CALD HDR, with some of these citing that it is conditional based on their ability to publish. Other respondents felt neutral about CALD HDR presence in their research, though others indicated that the students were similar, whether CALD or not. However, a few indicated that it negatively impacted their research.

Supervisors on future challenges to supervision

The final part of the supervisor survey served to highlight some perceived challenges in light of the increase in the international HDR population. Less than half of the respondents took part in this part of the survey (43 percent). However, there were presented to them numerous opportunities to comment during the survey and this might have contributed to the few comments received. The most common comments were on *language skills, awareness of CALD related issues, funding, work load, need for high performing students* and *changing the research environment*.

Language skills

Most supervisors felt that there was a greater need to invest in high performing students regardless of the amount of English they speak. The need for good English CALD students was not as high as the need for high performing students. Once comment stated: '*we would be better to take more students with weak English and teach them English skills that cut out a major section of (particularly Chinese) high performing students that don't have the language skills initially'.* This underscored the value of a need for English courses in universities. Another comment said that: '*in general international HDR students require more supervision time due to language problems. Universities need to recognise and support both HDR students and supervisors.'*

Adequate supervision

The need for adequate supervision was also stated as a challenge that needs to be addressed. Some supervisors went on to suggest that HDR supervision style should be more along the lines of collaborating with the HDR students. The comment on this part was: '*Just the same as for local students. Offer the best in postgraduate research education. This means having international level researchers willing to work with their HDR students and not treating them as means to grow their own publication list.'*

Awareness of CALD related issues

Most supervisors indicated the need for the university to raise awareness of CALD related issues. This included information on special events, research projects that cater for their background and lastly, the need for the university to grant more time when it comes to CALD completions as these students face language hurdles that slow their progress down.

Funding

A greater part of the comments included funding concern, as scholarships for students and research funding for supervisors. A comment stated: '*Appropriate funding is important to support students plus supervisors. It is not realistic to expect supervisors to fund their own research + students and do teaching with increasing number of students and also do administrative duties. It is just unrealistic.'*

Research culture and changes

Changes in research were also cited as a looming challenge which needs to be embraced. One supervisor noted: '*We still do PhDs as designed in England 100 years ago, ie lock a student in a room/lab for 3 years and expect them to produce a book at the end on one specific topic. They then go and work as part of a large team working on multiple projects at a time. The PhD needs to become more flexible and aligned to how research is really done.'* Supervisors' challenges were workload-related as has been indicated in the comment above.

Securing jobs

Only one supervisor mentioned jobs in a comment, *'… the ratio of student-available jobs is in great disarray.'* This presents a challenge with the growing rise in HDR enrolments and completions. However, one supervisor felt differently, citing that *'weight should be put on completion not high quality publications so that the community benefits'* from HDR completions.

Discussion

The supervisor survey gives insight into several factors that define academic success of HDR and CALD HDR students at different stages of their research experience. The factors discussed above can be classified under three categories; Pre-entry criteria, Post-entry criteria and successful completion criteria, as they refer to before, during and end stages of the HDR program as summarised in Table 4-1 below.

Table 3 Summary of factors that influence HDR student success during different stages of the HDR program. Percentages shown are combined responses to *'agree'* and *'strongly agree'* or *'important'* and *'very important'* to the supervisor survey questions

	Pre-entry Factors			Post-entry Factors		Successful Completion Factors	
Previous Experience	Problem solving skills	77%					
	Foundational knowledge	68%					
	Research methods	66%					
HDR Student Attributes	Motivation	99%					
	Persistent	95%					
	Positive Attitude	94%					
	Resilient	94%					
HDR Student Obligations				Exploration of research methodologies	96%		
				Comply with university reporting procedure	96%		
				Organise periodic mtgs with supervisors	93%		
HDR Student Behaviour				Undertand research project	100%		
				Ability to ask questions	96%		
				Keeping uptodate with litreature	94%		
General Factors (HDR and CALD)						Ability to breakdown problems/ Complex issues	95%
						Discuss and analyse data	92%
						Maintain motivation	96%
						Time management	90%
HDR Competencies						Critical thinking	97%
						effective reading comprehension	97%
						Conducting litreature searches	93%
Supervision Factors				Stage 1 Start		Stage 2 Mid	Stage 3 End

Supervisor expectations of students

The supervisor expectations of students are seen primarily through their view of student obligations. Supervisors expected students to be clear on their research topic, able to clearly communicate their arguments, be self-initiating with respect to their research activities, and be proactive in getting the supervisor involved to discuss progress through regular meetings. Supervisors expect students to initiate information gathering and be explorative in their research methods, and be able to submit the thesis on time. Results from the CALD student survey indicate that the student responses to their obligations match the supervisor expectations (Figure 4-4) on all of the above criteria through their *'agreement'* or *'strong agreement'* on the above aspects (>85 percent). Lower in the priority list for both supervisors and students were attending student orientation and workplace health and safety type of training.

Supervisors placed the highest importance on problem solving skills (94 percent) and research method skills (82 percent) ahead of communication skills (81 percent), people management skills (62 percent) or technical skills (41 percent), in order to complete their research degree successfully. Identified singularly the top three competencies were: critical thinking (97 percent) effective reading and being competent at literature searches (93 percent). As far as personal attributes are concerned, supervisors rated motivation (66 percent) and positive attitude (60 percent) higher than analytical skills (44 percent) or intelligence (31 percent). Attributes that involved a positive outlook (mean 92 percent) were more important than skills (mean 80 percent) or even ethics and values (mean 78 percent). Responses given to the student obligations by supervisors confirm this, as supervisors rated very highly (>90 percent) those obligations that required student initiative and the need to be proactive.

When behaviours of successful HDR students were analysed, supervisors placed understanding and ability to ask questions about the research (96 percent) and keeping up-to-date with literature (94 percent) as the top three behaviours that lead to academic success. Grouped similarly to attributes, it was found that the behaviours that arose from a positive outlook (mean 92 percent) were regarded more important than from that of natural strengths (or skills) (mean 76 percent) or ethics (or values) (mean 70 percent), further highlighting the importance of motivation and a positive mindset to being successful in Higher Degree Research.

As far as previous experience is considered as a precursor for course preparation, problem solving skills (77 percent), high level of foundational knowledge (68 percent) and research methods (66 percent) were identified as the top three criteria. Industrial experience was not considered important in comparison (16 percent). This indicates that the supervisors expect those who are good at problem solving, coupled with foundational knowledge, to be stronger HDR candidates over those who may have purely industrial experience. It is possible that the problem solving ability sought by candidates will only be measured in a research capacity, given the low priority placed on industrial experience, leading to HDR projects taking on a more theoretical approach rather than a practical one.

Supervisor expectations of CALD students

The supervisor expectations of CALD HDR students didn't differ at a statistically significant level with those of general HDR students, as far as general factors for success were concerned. Ability to understand complex issues (96 percent and 94 percent), ability to break down problems to small segments (94 percent and 95 percent), adequate practical background (51 percent and 55 percent) showed the same trends as far as the key factors were concerned for general HDR and CALD HDR students respectively. When classified under specific categories they indicated the same level of importance for both groups. Problem solving skills (90 percent) and interpersonal skills (90 percent) were regarded as more important than previous research experience (61 percent) and communication skills (as they related to general presentation skills) or even technical skills (41 percent).

When asked about their perception of CALD HDRs in comparison to general HDR students, 40 percent of supervisors felt CALD students needed *'frequently'* or *'always'* more time to adapt to the research culture and another 35 percent felt they needed encouragement to freely discuss their views than non CALD HDRs. On all other issues, including finding it challenging to embrace new state of the art technology, extra help needed in critiquing literature, extra help in guidance on referencing, experiencing a steeper learning curve and direction and goal setting, the percentage of supervisors agreeing that any one of those factors *'frequently'* or *'always'* was true about CALD students ranged from only 6-25 percent. This highlights that the main differences between CALD and general HDR are more language and culture-related than technical, technology or knowledge-related. Consequently these cultural and language factors are likely to contribute to extra time and skill spent with the student on clarifying issues, as expressed by this supervisor comment: '*Language and especially scientific writing in English is a major factor and challenge, and takes significally (sic) longer in editing. This cuts into writing time*' and was indicated by 47 percent of the supervisors in "*strongly disagreeing*" or "*disagreeing*" to the notion that supervision of CALD students doesn't require extra skills outside of the research discipline (e.g. pastoral care).

Yet, despite the language and cultural barriers that may lead to a slowing down of the progress of research, supervisors show a willingness to continue to work with CALD students as they see the perceived benefits of supervising CALD students outweighing the draw backs. The willingness of supervisors to take a chance on students who may have language difficulty yet are high performing in other areas was stated. This willingness of supervisors to work with CALD students, despite their language and cultural differences, seems to be paying rich dividends, given that completion data from 2003-2008 available from QUT, UWA and Curtin reveal that CALD students take shorter times for completions compared to domestic students (See Chapter 6 - Institutional data), indicating that CALD students perform just as well, if not better, than domestic students once they get oriented into the research culture of the academic institution.

CALD Student expectations of supervisors

Academic expectations

Supervisor and CALD student responses on the supervisor obligations show important similarities in their agreements and the order of priority of these obligations. Supervisors and students both saw the role of the supervisor primarily as an advisor or a consultant. Supervisors were seen to help shape the scope and the direction of the research project within the local university and the global research context. They functioned less as a trainer and least of all as an administrative coordinator. Both groups saw the supervisor involvement in the design stage of the research methods and experiments as critical (89 percent and 97 percent by students and supervisors respectively). One notable exception is that while students expected their supervisors to be involved in their research data gathering and analysis stage (72 percent), supervisors placed less importance on this (59 percent). Consequently, this change in expectations could be interpreted as supervisor *active* involvement reducing from Stage 1 (design and conceptualisation) to Stage 2 (data gathering and analysis) more dramatically than expected by students, given the student expectations of supervisor involvement show a reduction by 17 percent from design stage to the data gathering stage, whereas for supervisors the drop is more than twice at 38 percent between the two stages.

Furthermore It is seen that 60-65 percent of supervisors expected their students, both general HDR and CALD, to have some knowledge of research methods by the time they started the project as suggested in Figures 4-3 and 4-7 and over 80 percent of them considered these as *'important' or 'very important'* for students to be successful in their research project (Figure 4-3). Hence there is a segment of supervisors (in excess of 20 percent) who believe that students will pick up these skills along the way. Yet as discussed above, 41 percent of supervisors don't see it as their role to teach students these methods but only as discussing the usefulness of the results and advising and directing students where necessary to acquire the skills where they lack competencies in these areas. This observation is significant from a student's point of view, since a given student may select a supervisor based on their expertise, with an expectation of learning certain research methods or experimental techniques from their supervisors, only to find that the supervisor may not be available in that capacity. This difference in expectations needs to be addressed earlier in the supervision process to avoid any potential misunderstanding that may cause the student to feel distressed, withdrawn and isolated.

Social expectations

Although supervisors strongly agreed (75 percent) it was important to support CALD students in scientific and social interaction, the results show that only 40 percent of the supervisors *'frequently'* or *'always'* invited students to informal meetings with other HDR students within their research group and only 45 percent of supervisors promoted interaction with other English speaking HDR students. Instead, 68 percent of supervisors *'frequently'* or *'always'* invited CALD students to their lectures and talks related to their research and a further 68 percent highlighted the need to recommend that students attend other HDR seminars and presentations. This indicates that supervisors gave preference to scientific interaction by emphasising the formal seminars and research-related lectures but did not see or emphasise the value in informal meetings in a smaller setting with other HDR

students. Even then, the student responses to the same questions on supervisor invitations to talks and directing them to other HDR seminars indicate a response of 10-15 percent less than those of the supervisors; this may mean that students did not feel as invited or saw the emphasis placed by the supervisor.

The role of the supervisor in facilitating social interaction in small groups, such as a research group, is fundamental to fostering internal relationships with students and staff, and is a very important step towards helping a CALD student build their support network for academic and social needs to be met. This level of informal social interaction may prove valuable to students who, for cultural or personality related reasons, may prefer to relate to a smaller group and may find getting to know individuals easier in such settings where there is no clear agenda in place. Additionally such interaction will also be essential for building confidence in language and communication and adapting to the Australian research and social environment.

The social obligations or expectations students have of their supervisors are likely to extend beyond academic research-related matters to other areas such as research-life balance, finance, family, career and general cultural integration. Given that most CALD students, especially from Asia, come from largely patriarchal societies with an authoritative father figure influence in decision making, they are likely to associate the supervisor in this role and expect them to be integrated into their lives as a whole. In that regard the role that the supervisor plays in the holistic care of the student may need to extend more into functioning in the global role of caring and supporting in non-research, specific life issues, according to the supervision role distinctions made in Figure 4-2.

Cultural expectations
A majority of the supervisors (77 percent) saw the need to be aware of a student's cultural background as '*relevant*' or '*very relevant*', and one supervisor comment showed a practical application at the very start of the project where there is an opportunity for supervisors to be '*culturally sensitive when approaching research questions*'. That this may be appreciated and even expected by CALD students is seen by a student commenting that: *"the need of supervisors to finish their research project, and the need of an international student to study a certain topic **which is useful for their country** [our emphasis] are often unfit [sic]. Out of these confusions and misunderstandings, supervisors and the students are both experiencing hard times."* (as quoted in Chapter 4.2.4 - Results Student Survey).

That the cultural expectations of the students may extend beyond research and that they would expect consistency across the university in relation to their culture is seen by the supervisor comment: *"Curiously we bring in CALD students (particularly Islamic ones) and in some parts of the university's operation do it. My favourite example is the swimming pool. Female Islamic students need to swim unobserved by men, but our pools are viewable by any passerby and we have no womens-only sessions;"* indicating the complexity of cultural expectations as it relates to religion and gender in some cultures.

Language expectations
In relation to research supervision of CALD students, although supervisors felt it was *'relevant'* or *'very relevant'* to advise HDR students on improving their language skills (85 percent) and the need to recommend their HDRs to any language development programs (82 percent), yet only 46 percent of supervisors directed students to useful resources to help improve language skills and 45 percent supported a student initiative to participate in English learning workshops. This is likely to indicate how the prioritising of different tasks in research, especially when working towards milestones, can lead to aspects like the acquisition of language skills becoming neglected. The deficiency in language skills can possibly aggravate the social interaction difficulties that some CALD students already face in discussing their research ideas with other students and staff, especially in seeking assistance when learning new research methods or programs.

Supervisor expectations of Academic Institutions
The expectation of the supervisors of their academic institutions are mainly expressed through their concerns, mainly in the areas of workload management, funding and the need for support in order to engage in quality supervision of students.

Workload management
Supervisors commented on the need to acknowledge their workload in relation to HDR supervision and especially in relation to CALD supervision as the following supervisor comment suggests: *'Universities need to acknowledge that supervision of international students is MUCH more demanding, and modify workloads appropriately. This may mean employing more research fellows of project contracts to help the supervision.'* Another comment highlighted the current policy in relation HDR supervision and how it impacts supervisors in their approach to supervision: *'work load model doesn't take into account HDR supervision, makes supervision of HDR students risky, can only take the best students'*. These concerns of supervisors have been met with changes to workload management of supervisors by factoring in an additional 20 percent for management of CALD students and further considerations if the supervisor is also in the capacity of a mentor (Supervision Load Guidelines for QUT Academics, 2013)

Support in Funding & Facilities
Supervisor comments such as *'inadequate time for supervision', 'increased number of students with no additional support", 'maintaining quality HDR completions and not being diluted by increased work load and increased number of students with no additional support'*, indicate that the facilities have not grown in proportion to the significant increase in numbers of CALD and international HDR students and that supervisors are concerned about the overall dilution of HDR standards. Supervisors expect more funding in areas of research scholarships and facility building to accommodate a larger student population. That this is not a CALD specific issue but a general issue pertaining to growth and expansion of universities is highlighted by the supervisor comment: *'Maintaining quality in light of increased numbers. This is not a CALD-specific issue, but rather a **massification** [emphasis ours] issue more generally.'*

Conclusion

The supervisor survey has given valuable insights into factors that influence HDR and CALD HDR student academic success and factors that influence HDR and CALD HDR supervision in three Australian Higher Education Institutions. With an increase in HDR population and universities aiming to grow in research capacity and quality, the role of the supervisor becomes a very crucial one. Supporting supervisors in their workload management and helping them meet CALD student expectations becomes very important in this regard. With increased internationalization of the Australian Higher Education sector, greater demands will be placed on the supervisors to supervise within an increasingly culturally diverse cohort of students and in that regard, the current definition of engineering academic success may have to be broadened towards a more holistic definition of engineering success (Silva and Yarlagadda, 2012a). These changes are currently being considered within the Australian Higher Education context (Silva and Yarlagadda, 2012b) and will have increasing bearing on supervision training for the future.

5. Bayesian Networks

5.1 Student Survey

Introduction

A Bayesian Network (BN) graphically represents and then quantifies the relationship between an outcome of interest and the (possibly many, interacting) variables that influence this outcome. It is a common method for modelling complex systems, so is a natural model for attitudinal surveys.

A Bayesian Network was constructed based on the student survey questions to identify factors that will help improve and provide effective support for HDR supervisors in the supervision of CALD/international students in Engineering and IT disciplines,

Method

The Bayesian Network was constructed in three main stages: *model creation, model quantification* and then *model interrogation* as described below.

Model creation

The student survey questions were used to construct the model, where the individual questions in the survey formed the 51 outer nodes of the BN (Figure 5-1).

These outer nodes were linked to 9 nodes representing the survey components: student IELTS score, student demographics, student preparation for course, involvement in research program, understand research environment, supervisor involvement, social interaction with supervisor, supervisor obligations and student obligations.

These 9 nodes were in turn linked to 3 primary nodes: personal profile, supervisor attributes and student obligations. The 3 primary nodes were linked to an overall outcome node, overall student perception of supervision.

Model quantification

Each node was divided into a set of categories or states, whereby a given question answered on a 5-point Likert scale was divided into two categories: Low=1-3/ High=4-5. The other questions were also divided into categories.[i]

For each of the outer nodes the proportion of respondents that answered 4 or 5 for that question was taken to estimate 'the probability of 'High'. The probabilities for the inner nodes were estimated using a Principal Components Analysis (PCA), which is a means of weighting each question (or node) based upon the variation shown in the responses to a given question along the 5-point Likert scale. The three final nodes connecting to the overall outcome node were also weighted accordingly.

Model Interrogation

This step involved changing the probability of a given variable and observing its effect on the variables connected to it. Interrogation allowed the sensitivity of different factors to be studied over their full range by considering the two extremes L=100% and H=100%. The maximum likelihood scenario with respect to a given factor can be stated in terms of the likelihood or probability of the factor being 'High' as represented by the H value or being 'Low' as indicated by the L value, where the probabilities for H and L are determined as indicated above under *Model Interrogation*. A sensitivity analysis was run on a number of factors and their effects were recorded.

Linear Regression

Linear regression was used to examine the relationship between the students' personal attributes and their attitudes to supervision. The attitudes were considered as the response and the personal attributes were fitted as possible predictors of the response. The aim was to identify personal attributes that significantly impacted on the students' attitudes to the supervisor.

Linear regression models were employed as follows:

- A separate model was fitted for each survey component, using the respective index (combined score) as the response.
- A model was also fitted to the combined score for overall Supervisor Attributes, using the Supervisor Attributes index as the response.
- The explanatory variables used in all of the analyses comprised age, sex, country of origin, years of residence in Australia, years of previous study, research field, course and qualifications.
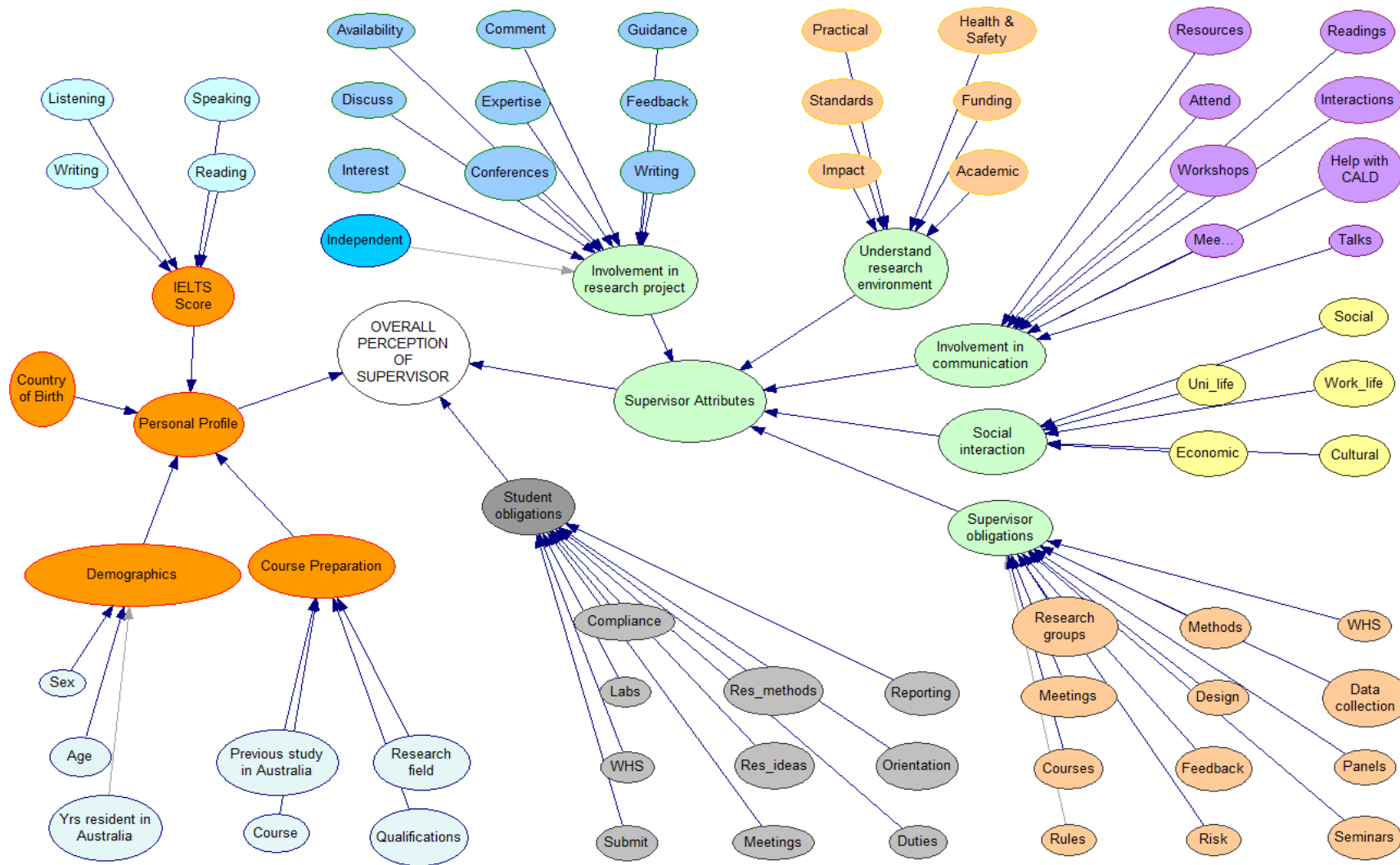
Figure 12 Complex Systems Model for PhD Student Survey – Bayesian Network Structure

50
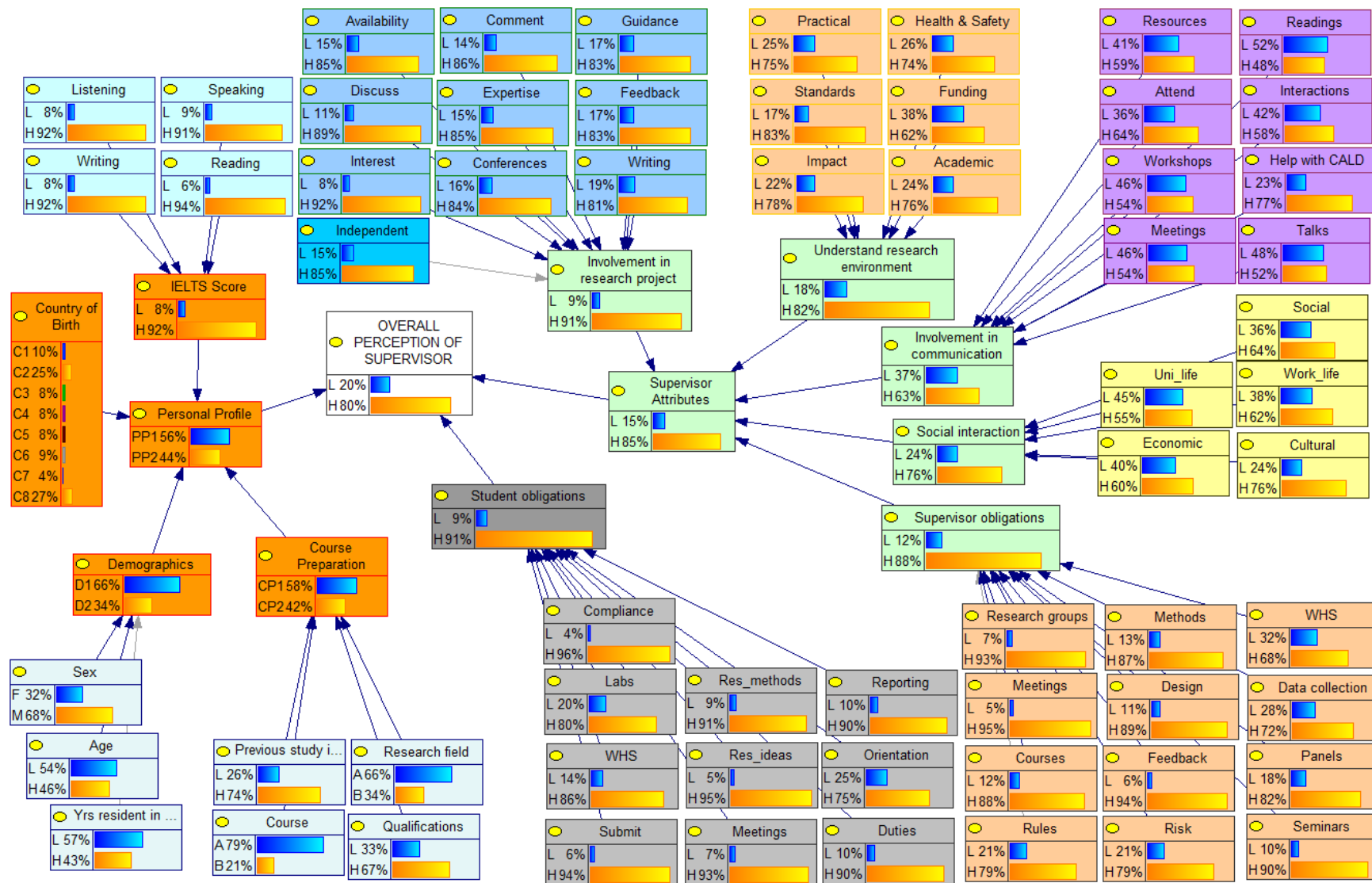
Figure 13 Complex Systems Model for Student Survey – Quantified Bayesian Network.

Results

The overall CALD student perception of supervisors (OSPS) was high (H 80 %), indicating that the students had a high level of satisfaction with their supervisors and the supervisory process.

The two main factors influencing the CALD student perception of their supervisors were student obligations (H 91%) and supervisor attributes (H 85%). The effect of student profile (demographics, research field, type of course) on the overall student perception of supervisors was minimal.

Students on Student Obligations

OSPS was mostly influenced by student obligations more than any other factor (H 91%). Students overall showed a strong response of (H 91%) towards being proactive in duties that were directly seen as related to completing their HDR research project. These areas of pro-activeness were seen in:

i) Research efficacy as seen by the willingness to explore better research methodologies (H 95%),
ii) Obtaining feedback and support on progress that included organising progress meetings with supervisor (H 93%) and seeking guidance from on research ideas (H 95%)
iii) Planning, protocol and compliance issues as seen by planning submission dates (H 94%), compliance with university reporting procedures (H 90%), and the responsibility to understand their roles and responsibilities as HDR students (H 90%)

Administrative duties such as booking lab spaces for experiments (H 80%), work place health and safety issues (H 86%) and general orientation related activities (H 75%) were lower in the list of priorities under obligations.

Supervisor Attributes & Impact on CALD Student Success

Supervisor attributes was made up of a few categories that included supervisor involvement in research project, supervisor help in understanding research environment, involvement in communication, social interaction and supervisor obligations. Of these supervisor's involvement in the research project (H 91%) and supervisor obligations (H 88%) were the two most influential factors.

Supervisor Involvement in Research

Students rated their supervisors' involvement in their research as the highest factor influencing their attributes (H 91%). Supervisors showed interest in the student's work (H 92%), were approachable for students to raise issues of concern (H 89%) and made efforts to discuss and comment on students' work (H 86%). Students rated these qualities ahead of the supervisor's expertise in their area of research (H 85%).

Students valued their supervisors' availability when needed (H 85%), and rated high the independence to plan their own project (H 85%). They felt guided on research design and analysis (H 83%) and were supported to attend conferences and seminar (H 84%) and given help in writing their thesis (H 81%)

Supervisor Obligations

Under supervisor obligations, students rated supervisor's availability to discuss research progress as the top priority of a supervisor (H 95%), closely followed by feedback on written submissions (H 94%). They also expected their supervisors to make them aware of how their research fitted in with that of the research group or project that they were part of (H 93%) and expected the supervisors to guide them in design and refinement of their research methods (H 88%) and arrange for seminars where students were meant to present (H 90%).

They considered supervisor's role in helping students carry out a risk analysis of their project (H 79%), helping gather and analyse data (H 72%), and making students aware of health and safety issues (H 68%), as lesser priorities.

Supervisor Help in Understanding Research Environment

Students also felt that their supervisors helped them understand their research environment (H 82%) including education on good research practice both at university level and at a discipline specific level (H 83%). The supervisors also helped students understand the nature of impact their research had on a national and international level (H 78%) as well as its academic and commercial importance (H 74%)

Supervisor Role in Social Interaction

Overall the supervisor engagement in social interaction (H 76%) was lower by 12% at least when compared to their commitment to research related activities and obligations. Students felt that the supervisors were considerate about their cultural and religious background (H 76%), but felt less supported by supervisors in the areas of work life balance (H 62%), social needs (H 64%), economic needs (H 60%) and very little support in educating about university life (H 55%).

Supervisor Role in Communication and Networking

Students felt the level of involvement by their supervisors in the area of developing their networking and communication skills was at a probability of (H 63%). The supervisors were considerate of their non-English speaking background (H 77%). However their efforts at directing students to resources (H 59%), relevant workshops (H 54%), encouragement to read (H 48%) or network with other English speaking (presumably local Australian) HDR students (H 58%), was fairly low in comparison.

Personal Profile impact on Supervisor Rating

Compared to student obligations (0.72) and supervisor attributes (0.72), the impact of personal profile on supervision weighed in considerably less (0.2) on a scale of 0-1. The personal profile was constructed as a weighted combination of IELTS, y1 and y2 with different weightings for each country (Table 5-1). The scores obtained using these weights were then dichotomised into two 'personal profile' groups, denotes PP1, PP2. The respondents in the group PP1 have a lower score than respondents in PP2.

Table 4 Overall Student Perception of Supervisors according to student demography[11]

Country		Weight	PP2	OSP
1.Malaysia	IELTS	0.5		
	y1	0.65	0.53	0.79
	y2	0.56		
2.China	IELTS	0.01		
	y1	0.7	0.39	0.79
	y2	0.71		
3. Sri-Lanka	IELTS	0		
	y1	0.71	0.39	0.79
	y2	0.71		
4.Indonesia	IELTS	-0.64		
	y1	0.47	0.29	0.77
	y2	0.61		
5.India	IELTS	0.67		
	y1	-0.18	0.67	0.82
	y2	0.72		
6.Iran	IELTS	-0.05		
	y1	0.71	0.37	0.78
	y2	0.7		
7.USA Western Europe	IELTS	0.64		
	y1	0.25	0.6	0.81
	y2	0.72		
8.Other	IELTS	0.15		
	y1	0.75	0.43	0.79
	y2	0.64		

Country of Birth

An analysis of the country of birth and their perception of supervision reveal that students from India and Western Europe (including USA) had the highest overall perception of supervisors at (H 82%) and (H 81%) respectively. They were more likely to be younger than 31 years of age, hadn't lived in Australia long and were likely male, already in possession of a higher degree qualification, most likely a Master's degree.

Indonesian students had the lowest OSP (H 77%) and the lowest PP2 indicating they had a very low IELTS score and low y1 meaning they were of a younger age, with less years in Australia and likely male and with less qualifications with little or no previous Australian studies as shown by the low y2 value.

Students from China, Malaysia, Sri-Lanka and other countries had the same perception of supervisors (0.79). Malaysian students generally had a higher IELTS score than Sri-Lankan or Chinese, but the latter two groups had more qualifications and possibly a longer length of stay in Australia.

Regression Analysis also revealed that in the area of supervisor involvement in research, there were differences in attitudes based on the country of birth. Compared with the attitudes of students from Malaysia, the attitudes of students from Iran and Western Europe were not significantly different, whereas the attitudes of students from the other countries were very different

The same trend continued in student obligations, help in understanding of research environment and social interaction.

Age
The regression analysis results showed that as age increased the response on supervisor involvement declined ($p=0.007$).

Age was almost significant ($p=0.07$) in social interaction where with increased age, the index decreased

Course
PhD students had significantly different overall attitudes to social interaction compared with other students ($p=0.009$).

Qualifications
Students with existing doctorates had significantly different overall attitudes compared with other students ($p=0.051$).

The students overall felt that their supervisors were considerate of their cultural and religious diversity and yet did little to help support them meet their social, economic or work-life balance needs nor help them integrate better into the Australian context through better interaction with the English speaking HDR students, presumably local Australians. This shows that the students were not supported pastorally by their supervisors in a holistic sense to the degree they expected.

Bayesian Network Sensitivity Analysis

A sensitivity analysis of the Bayesian network shows that Supervisor Attributes is the most important predictor of student perceptions contributing to a 46 percent difference in OSPS. Student obligations contributed to 32 percent change and personal profile to only 10 percent change (Figure 5-3).

Sensitivity of Overall Supervisor Perception by parent node
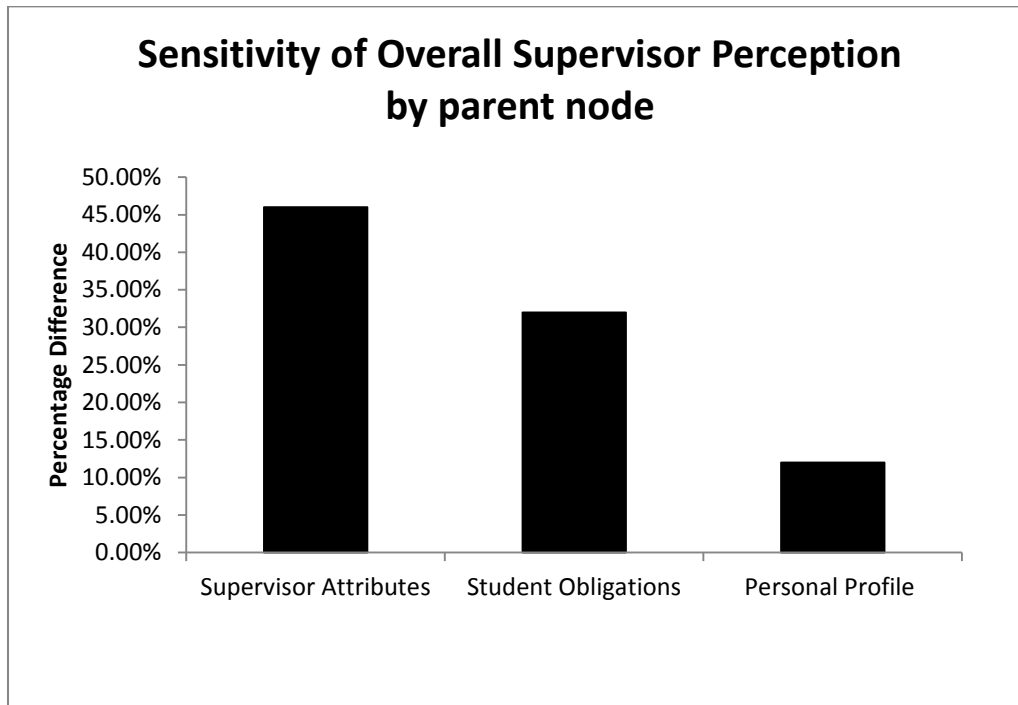
Figure 14 Sensitivity of Overall Supervisor Perception by parent node

Supervisor attributes is also the most critical factor that if allowed to decline can adversely affect the overall perception of students by the greatest margin of 39 percent, while the maximum gain is 7 percent (Figure 5-4). Student obligations too can have a detrimental effect of up to 29 percent if allowed to degrade. Student profile can improve the perception of supervisors by up to 7 percent, but is not considered to be a likely scenario in the current context of diversity of student populations. This would mean that university will have to closely monitor supervisor accreditation and also maintain funding for their training and development. Similarly student inductions at university and faculty level will need to maintain an emphasis of clearly communicating student obligations, in order that the responsibility and initiative will continue to remain with the students.
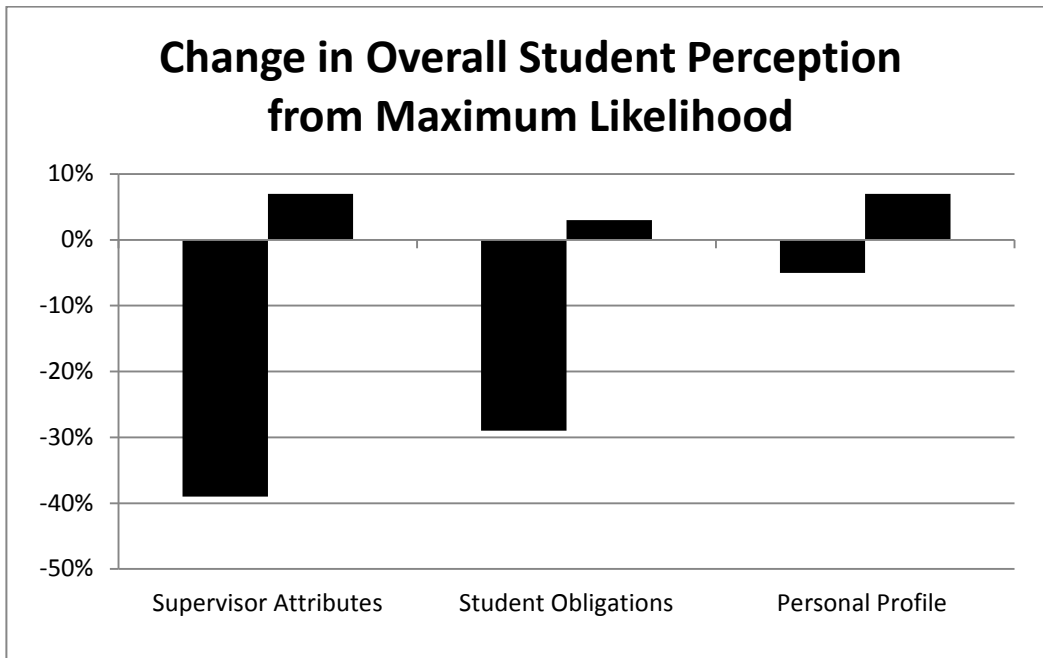
Figure 15 Change in overall Student Perception from maximum likelihood

A sensitivity analysis on the student attributes reveal that the perception of students is subjected to a 19 percent change by each of three factors; supervisor help in understanding research environment, supervisor obligations and social interaction (Figure 5-5). While these factors have less than 5 percent probability of improving from their current state, the impact of the current standard decreasing can be of greater consequence (Figure 5-6).
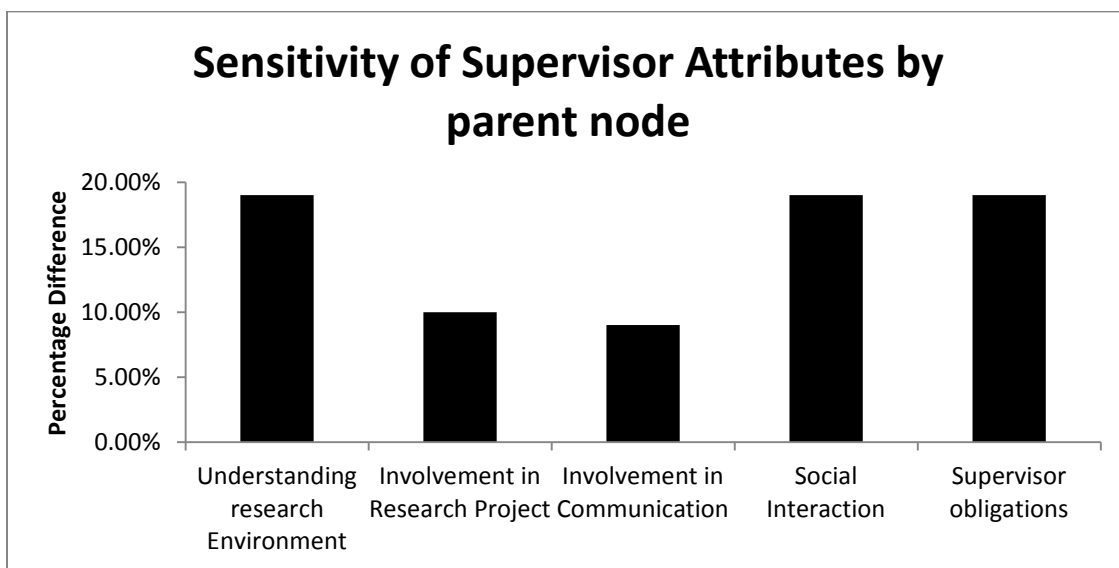
Figure 16 Sensitivity of Supervisor Attributes by parent node

The detrimental effects of declining supervisor attributes would result from a decline in the obligations of supervisors (-17 percent), their understanding of the research environment (-16

percent) and social interaction (-15 percent) (Figure 5-6). University protocol and accreditation processes can ensure that supervisors are kept informed and accountable for their obligations and their continued assistance to students. On the other hand, social interaction is harder to ensure given its intangible nature, which is further complicated by the nuances of culture and context.
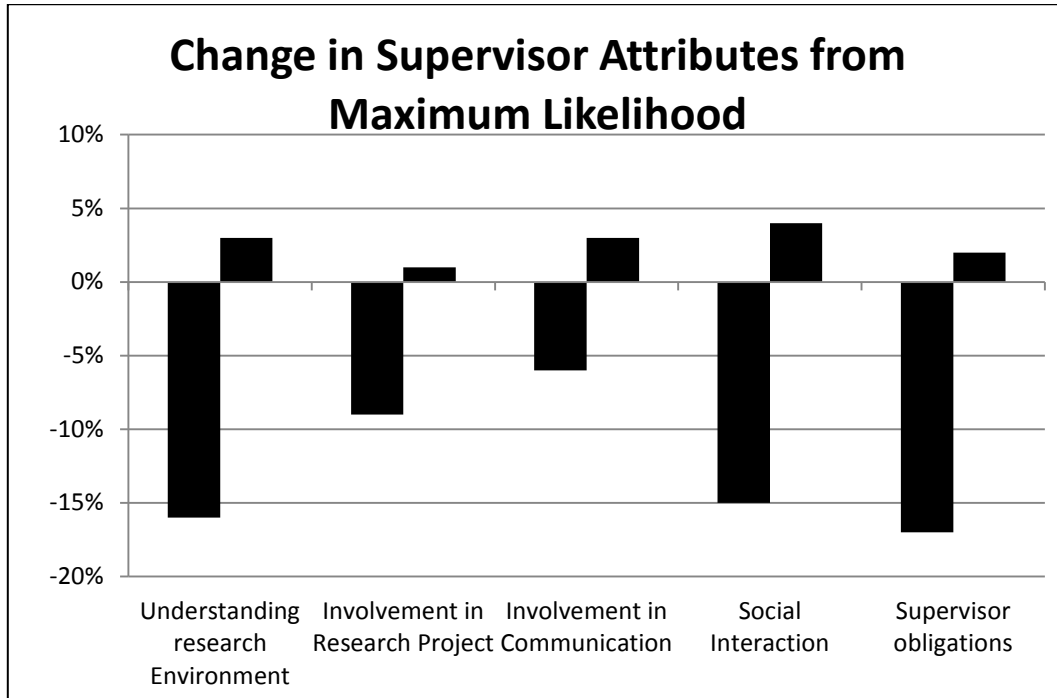
Figure 17 Change in Supervisor Attributes from Maximum Likelihood

Student obligations are sensitive to changes in all areas considered over a 5-10 percent range (Figure 5-7), with compliance and orientation related activities the most responsive at 10 percent each followed by research methods and ideas at 8 percent each. A decline in any of the obligations can cause a drop in student obligations between 5-9 percent (Figure 5-8). However the negative effect can have a compound effect leading to a greater overall decline in obligations since whatever causes a student to fail in one area of their obligation is likely to affect them in other areas of obligations. Hence rather than delineating between individual tasks within the obligations student obligations need to be treated as one block and the reasons that affect students to become less responsive towards their obligations or causes for losing motivation need to be examined, along with strategies and incentives to keep students engaged in their work.
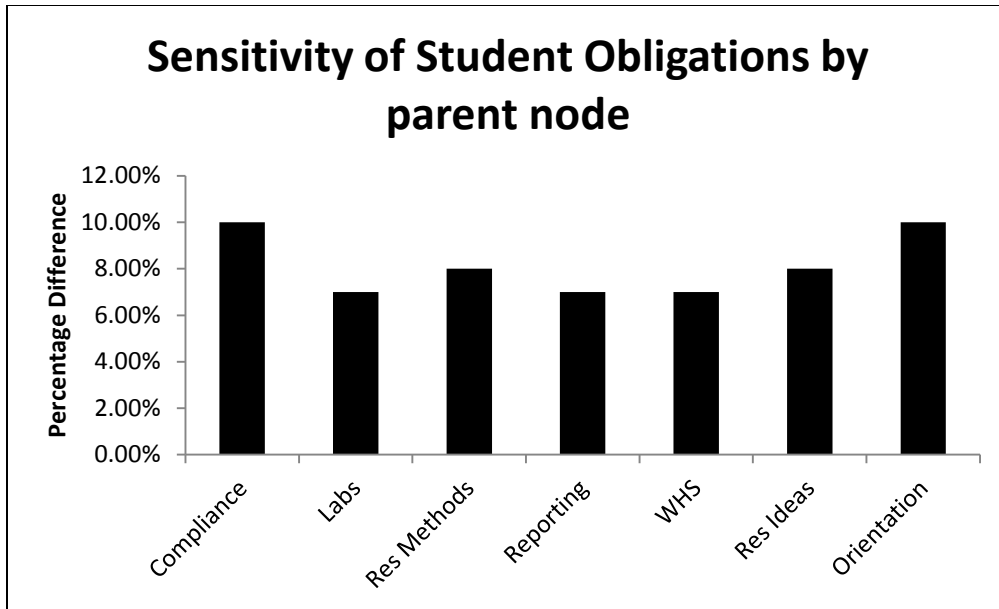
Figure 18 Sensitivity of Student Obligations by parent node
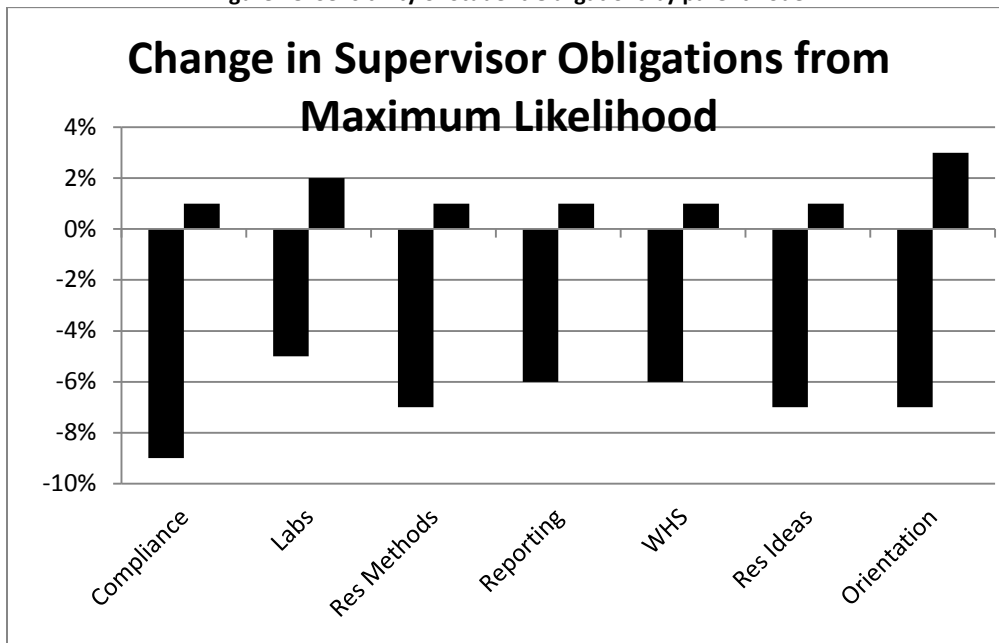
Figure 19 Change in Supervisor Obligations from Maximum Likelihood.

Discussion

The results of this study identify CALD student obligations as the highest contributing factor influencing their perception of their supervisors. The higher the level of responsibility students felt towards their obligations, higher the overall expectations they placed on their supervisors' role in helping them achieve academic success.

Students believed in self-initiative and ownership of their projects and valued their independence to plan and manage their projects, with help from their supervisors at the initial stages in the design and conceptualization stages. It could be said that the extent of student motivation to navigate their project is a strong determinant in their interaction with their supervisors and their view of their supervisors. Managing student motivation in this regard is critical to ensuring overall academic success and engagement of supervisors. Motivation for many of the CALD students can be both extrinsic and intrinsic and both these aspects are important in the healthy management of these students. Most of the CALD students show that they are intrinsically motivated, based on their ownership of obligations and the fact that they are choosing a research career at a higher degree level, demonstrating their willingness to pursue knowledge and achieve academic success. They will be extrinsically motivated through the requirements of the educational institution and of their research team and other stakeholders such as their families, sponsors of their scholarships and deadlines imposed by the conditions of these scholarships to finish by a certain time (Cahill, 1997). From an institutional point of view it is important to manage a balance between these two sources of motivations, through encouragement of the former by giving incentives for achieving personal success while not allowing the external motivations imposed by institutional requirements to add undue stress which can be detrimental to their progress, thus inhibiting innovative thinking and creativity, two factors essential to creating new knowledge, as is expected in research.

The role of the supervisor becomes crucial in this regard in helping maintain a balance between the intrinsic and extrinsic motivation of the student and meeting their expectations through a variety of roles in guiding them towards academic success. The grouping of supervisor attributes is the most dynamics of factors in this network and is further evidence of this. In the current model, supervisor attributes can negatively influence student perception by up to 39 percent, which may mean the difference between continuing a candidature and giving up in a time of crisis.

With regards to their academic role, students valued the availability of their supervisors to meet them at their point of need ahead of their technical expertise. A close second was timely, written feedback by their supervisor, as well as help in conceptualization of the research topic and establishing context for the research both within the university and in the global context. This implies that in the initial stages of the project the expectations of the students to meet their supervisor will be high and needs to be allowed for by the supervisors as much as possible. This need for more one-on-one time in the initial stages of the project is expressed in the supervision model proposed by Cullen (1994), where the aim of the supervisor is to gradually change their supervisory role from being a nurturer at the initial stages requiring substantial

time, to collaborator providing assistance in the experimental stages, to facilitator offering feedback in the write up stages, thus progressively reducing the time commitment at each stage of the supervisory process.

The "availability" of the supervisors is not limited to an academic role as far as the CALD students are concerned. Their need for social interaction with their supervisor had the same level of influence on student perception as the two academic roles of supervisor involvement and help in understanding the research environment. Social interaction featured as the one factor that can help improve student perception of supervisors more than any other factor (4 percent) and can also contribute to creating a negative image of supervisors by up to 15 percent. While students felt their supervisors were aware of their cultural backgrounds, that knowledge was not strongly matched up with the expectation for them to support students reach work-life balance, integrate into the Australian culture and offer help financially, which are all social roles expected of the supervisors. The expectation of CALD students were greater in this area of social interaction as they got older and had more prior qualifications, suggesting changes in their social needs. Older students are more likely to be married and have more social and financial burdens on them and be technically less savvy and possibly socially less engaging than their younger counterparts, and would look to the supervisor as the mediator and facilitator of these needs. With greater prior qualifications, the students would expect a different level of social exchange and would see themselves more as colleagues rather than students and would therefore expect to be engaging in social activities with their supervisors. The cultural background of the student also complicates this sense of student expectation as seen by the different responses that student country of birth elicited for social interaction. Some cultures are far more relational and would expect to establish a trusting relationship before establishing the business relationship between the supervisor and the student (e.g. Middle Eastern), while in other cultures (e.g. Western) business is of foremost importance and socialising takes place after the business relationship has been established. It is therefore important for supervisors to establish the expectations of students within their cultural context at the outset of the project in order to navigate the student-supervisor relationship where expectations on both sides are evenly met.

The discussion so far has shown the student-supervisor equation from the student's point of view and it is equally important to investigate this relationship from the supervisor's perspective, which will be addressed in the next chapter through the supervisor Bayesian network model findings.

Conclusion

The Bayesian network identified factors that affect student perception of their supervisors and examined their influence over a range of scenarios. The usefulness of these findings can help prioritise areas of university funding towards the development of CALD supervisors.

5.2 Supervisor Survey

Introduction

This chapter describes the design and development of a Bayesian Network for the supervisor survey to determine the effectiveness of different factors related to supervision and student success. The Bayesian Network was constructed based on the supervisor survey questions to identify factors address the following objectives:

- To identify factors that provide effective support to CALD/international students in the engineering and IT disciplines to help them do well in their studies,

- To help improve the supervision of CALD/International HDR students through encouraging a more open, accepting, and supportive attitude towards students from diverse socio-ethnic backgrounds, as well as greater recognition of their potential contributions to the research agenda of universities.

Method

The supervisor survey questions were categorised into four main areas (or nodes) as shown in Figure (5-9), consisted of;

a) Supervisor demographics covered areas of personal background (consisting of cultural background, gender, country of birth, area of research) and personal experience in Australia (consisting of length of residence in Australia, previous study in Australia).

b) Supervisor perception of a successful CALD student covered the areas of general factors for success and CALD supervision factors.

c) Supervisor perception of a successful HDR student covered the areas of general factors for success, student attributes, student behaviours, student experiences and student obligations.

d) Supervisor perception of supervisor attributes covered areas of supervisor obligations, supervisory style, influence on supervision, support on supervision, participation in training and experience

The Bayesian Network was quantified using the coded questionnaire variables. Each variable was coded as 0 or 1, reflecting a 'low' or 'high' score. Exceptions were personal demographics. Details of coding are provided in the Appendix A. An overall score was calculated for each component of the questionnaire. The score was calculated as the sum of the coded values of the questions in that component. The component scores and the (binary) supervisor demographics variables were used in the regression analyses. The component scores were coded as High (top quarter of scores) and Low, for entry into the Bayesian Network. Linear regression analysis was carried out for determining associations between individual factors.
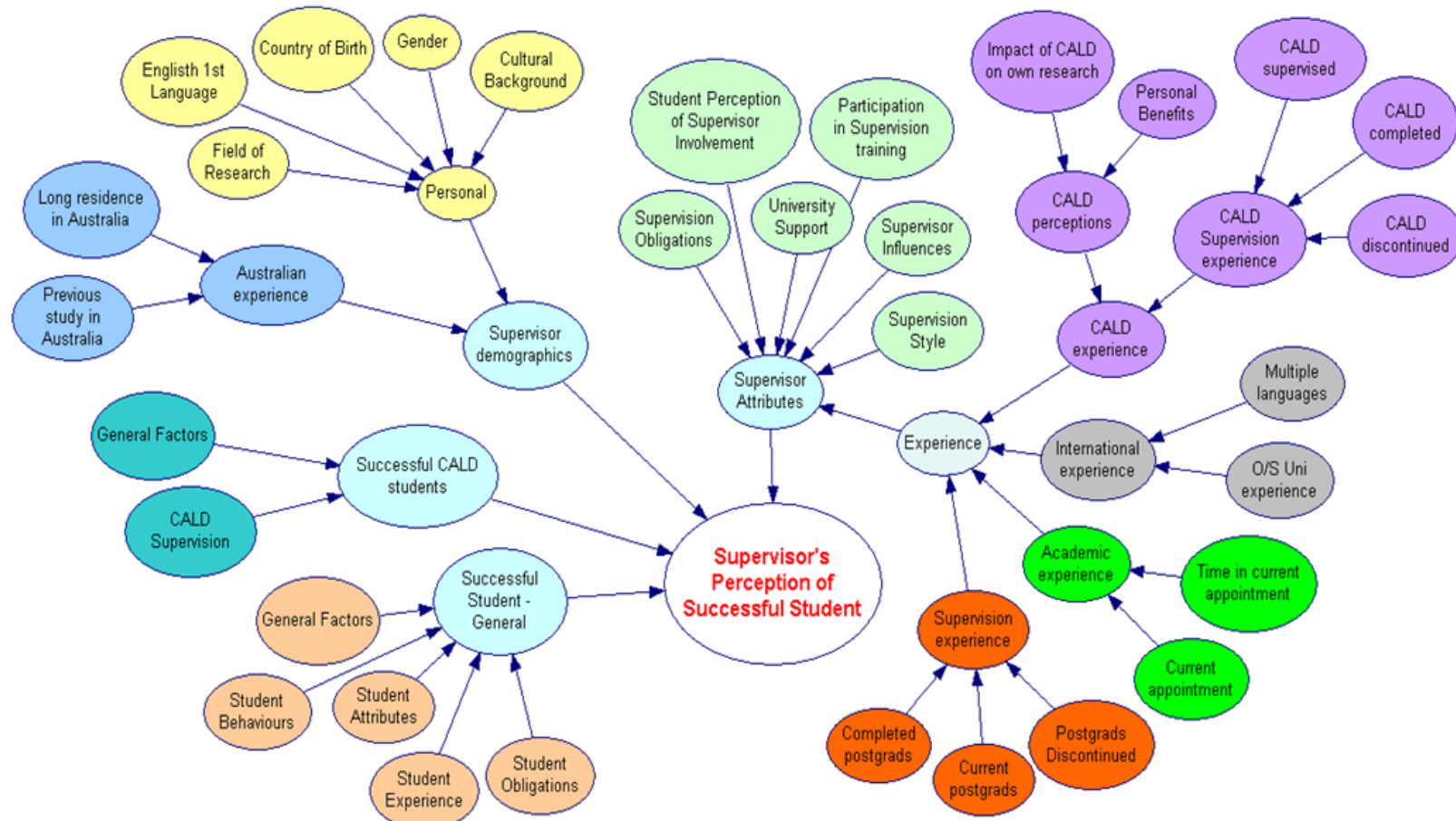
Figure 20 Complex Systems Model for PhD Student Survey – Bayesian Network Structure
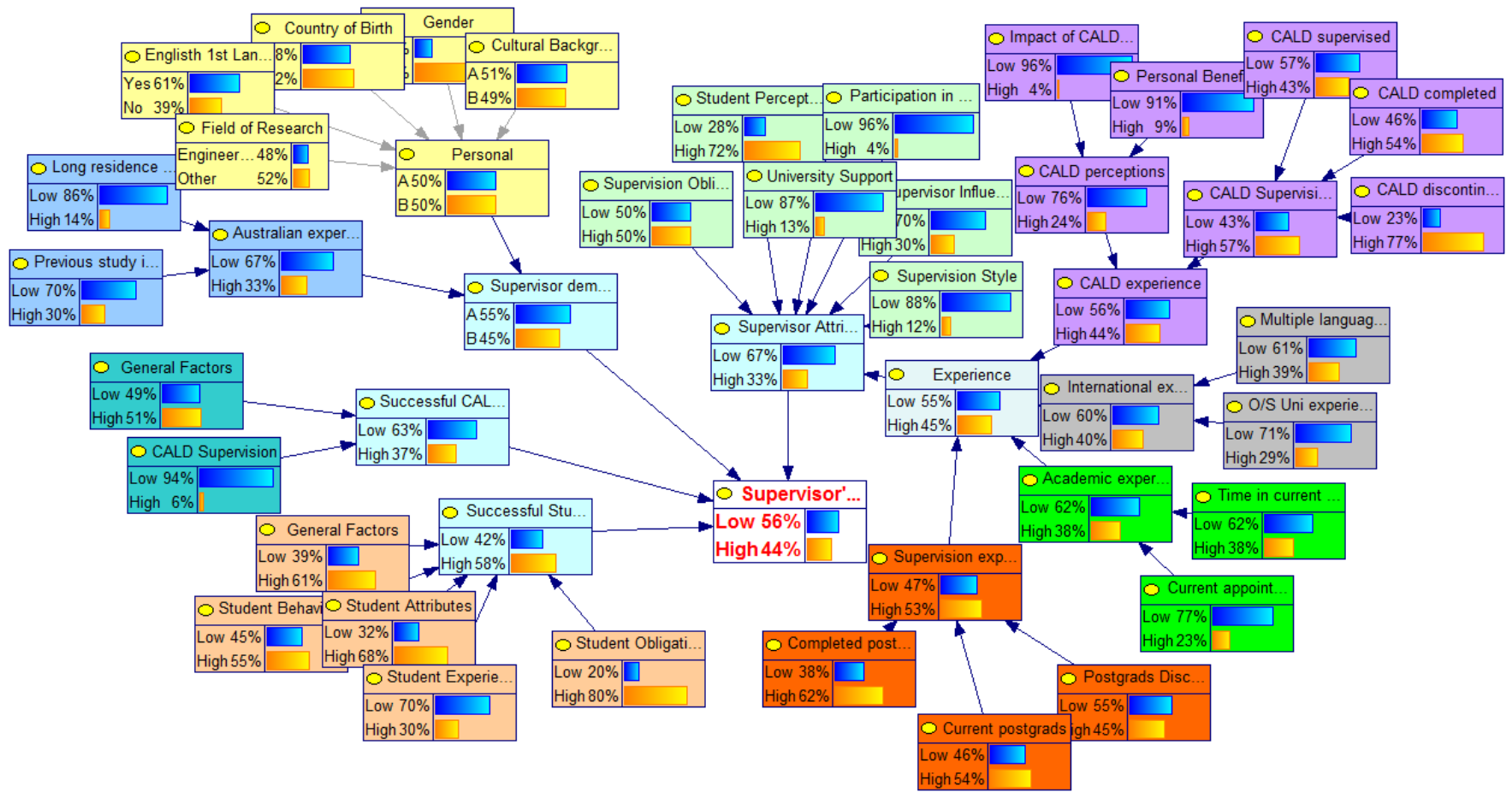
Figure 21 Complex Systems Model for PhD Student Survey – Quantified Bayesian Network

5.3 Results: Bayesian Network

The Bayesian network consisted of four primary parent nodes contributing to a single outcome node named overall supervisor perception of CALD student success (OSP). Each parental node represented a sub network of categories pertaining to either student or supervisor related aspects.

The Bayesian Network identified the following:

The overall perception of supervisors of a successful CALD student (OSP) of H=44% meant that the likelihood of CALD student success being high was 44 percent for the set of conditions investigated.

The four parent nodes contributing to this overall perception indicated the following probabilities; Supervisor perception of a successful HDR student (H 58%), supervisor perception of a successful CALD student (H 48%), supervisor demographic (A= 55%, B=45%) and supervisor attributes (H 33%).

The node successful HDR (H 58%) had a greater likelihood of being high when compared to that of a successful CALD student (H 48%). The contribution that node supervisor attributes made towards student success was only a 33 percent likelihood of being high. Overall this meant that qualities that defined HDR success in students contributed more towards the overall perception of CALD success than pure CALD supervision related factors or supervisor attributes.

Supervisors from demographic B showed a greater confidence and awareness of CALD success compared to their counterparts in demographic A, although the physical distinction of what that means in terms of a set of qualities and attributes is harder to describe given that A and B are a combination of factors involving nodes personal attributes and Australian experience, which are in turn connected to another level of parent nodes. Suffice to say that the distinction between demographic A and B was minimal indicating that supervisor demographic did not influence the success of CALD HDR.

Supervisor Attributes

Supervisor attributes in the context of this model can be seen as supervisory quality or competence as they contribute towards the success of CALD HDR students.

The maximum likelihood scenario indicates that student perception of involvement in the research project showed the highest likelihood of being positive towards supervisor attributes (H 72%). Regression analysis shows a significant association between two other factors (nodes); overseas university experience (p=0.056) and time in current appointment (p=0.035). A positive response for overseas university experience and a longer time in the current appointment were each associated with a significantly higher score.

The supervisor experience also contributed to supervisor attributes with a 45 percent likelihood of being high and contributed more than external influences on supervisory style (H 30%). The node, supervision style which was defined by the degree to which supervisors engaged in different supervision related activities, contributed poorly towards supervisor attributes (H 12%). The regression analysis results indicated that the length of residence time in Australia was positively correlated with participants' responses regarding supervisory style and almost significant at the 5 percent level (p=0.052). This indicates that supervisor style was influenced by the length of stay in Australia. The other significant variable associated with responses on supervisory style was whether the supervisor has had CALD students who have discontinued (p=0.015). A positive response to this question was associated with lower scores regarding supervisory style, meaning the discontinuation of a CALD student was directly related to the lower level of engagement by the supervisor on supervision-related activities. This may mean that supervisors became less certain of their role and engagement in relation to CALD discontinuations and they need to be given an opportunity to evaluate, self-reflect and discuss these matters in a relevant manner so as to improve their confidence.

The node, Supervisor obligations, remained neutral in its contribution to supervisor attributes (H 50%) indicating that the current level of supervisor engagement in their obligations neither helps improve their learning and development, nor influences negatively on them. No personal demographic variable significantly explained the participants' responses regarding supervisor's obligations.

The node, supervisor participation in workshops, least contributed towards supervisor development and competency (H 4%). Regression analysis indicates higher scores on supervisor participation were associated with increased time in current appointment (p=0.029). Scores for this component were also substantially affected by the nodes, field of research (p=0.081) and currently supervising many postgrads (a positive response led to a lower score, p=0.068. These results show that the chances of participating in workshops increase with duration on the job which may indicate a likely change of perception on the usefulness of the workshops. The results also show that as supervisors increase the number of students they supervise, they either find it hard to devote time for training or don't see the usefulness of the workshops beyond a point, and as a result decrease their involvement.

Given that supervisor confidence of support given at the university or faculty level was low (H 13%), increase in support at the university level could free up supervisors to make better use of the training opportunities.

Sensitivity Analysis

The overall perception of a successful CALD student was most sensitive to changes in supervisor demographic B (24 percent), while each of the other three categories indicated a 22 percent change. Of this, supervisor attributes can be improved by 15 percent and successful CALD success by 14 percent (Figure 5-11). A decline in the roles and responsibilities of a successful HDR student can lead to a decline of 13 percent in overall perception of CALD success, followed by 12 percent decline for changes in supervisor demographic B (Figure 5-12).
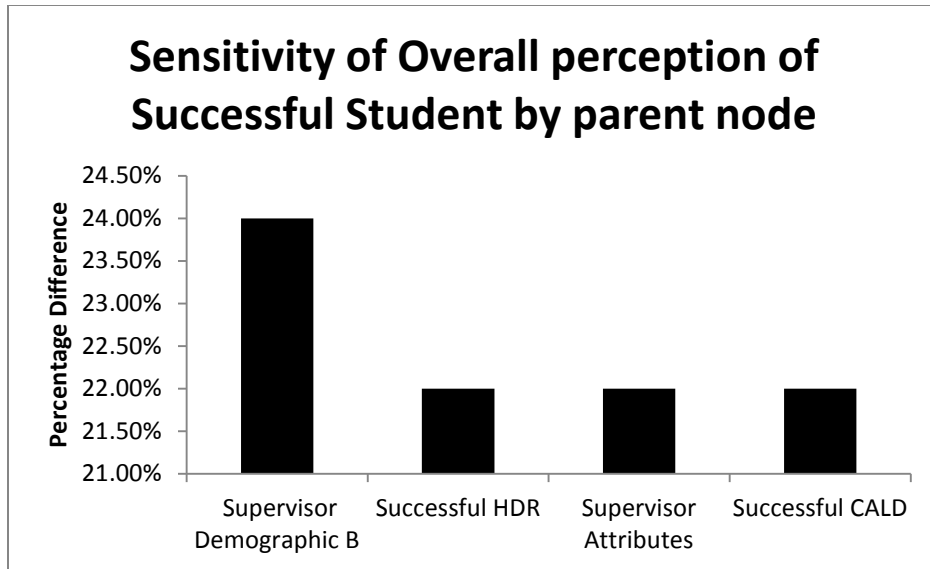
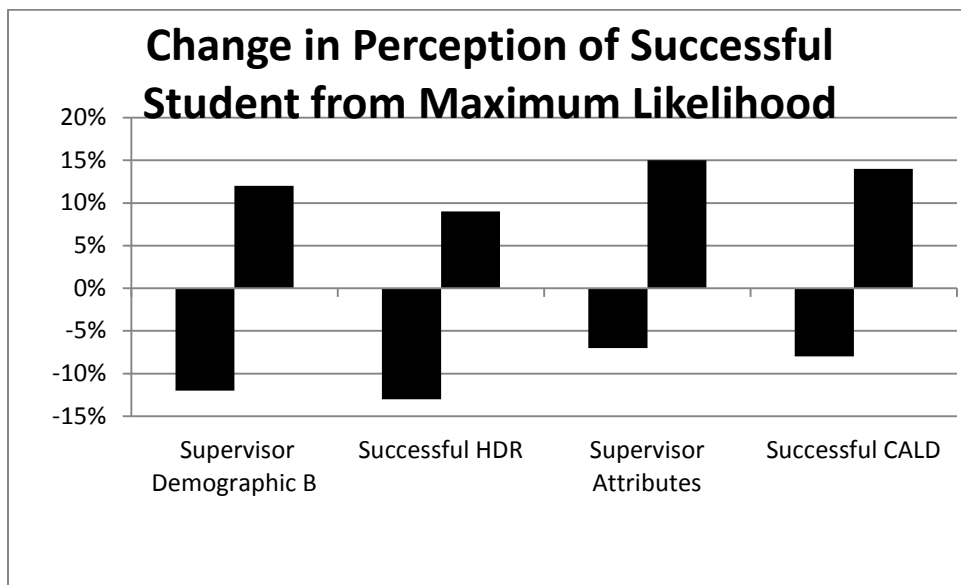**Figure 22 Sensitivity of overall perception of CALD student success to changes in parent nodes**

Figure 23 Change in CALD-HDR success from Maximum Likelihood scenario by parent node

Supervisor Attributes

A sensitivity analysis of the supervisor attributes sub-network suggests that participation in supervisor training is the most important factor to predicting perceptions of supervisor attributes, contributing to a 14 percent difference in that node. Equal to this were supervisor style and university support which were equally important to perceptions of supervisor attributes, and contributed to a 14 percent difference.

Student perceptions of their supervisor's involvement in research were the next most important factor in the analysis, contributing to a 13 percent difference in supervisor attributes.

This was matched by supervisor influences which also contributed to a 13 percent difference, along with experience and supervisor obligations.

Figure 5-13 below shows the relative perceived effect of each factor in the model as far as it contributes to supervisor attributes.
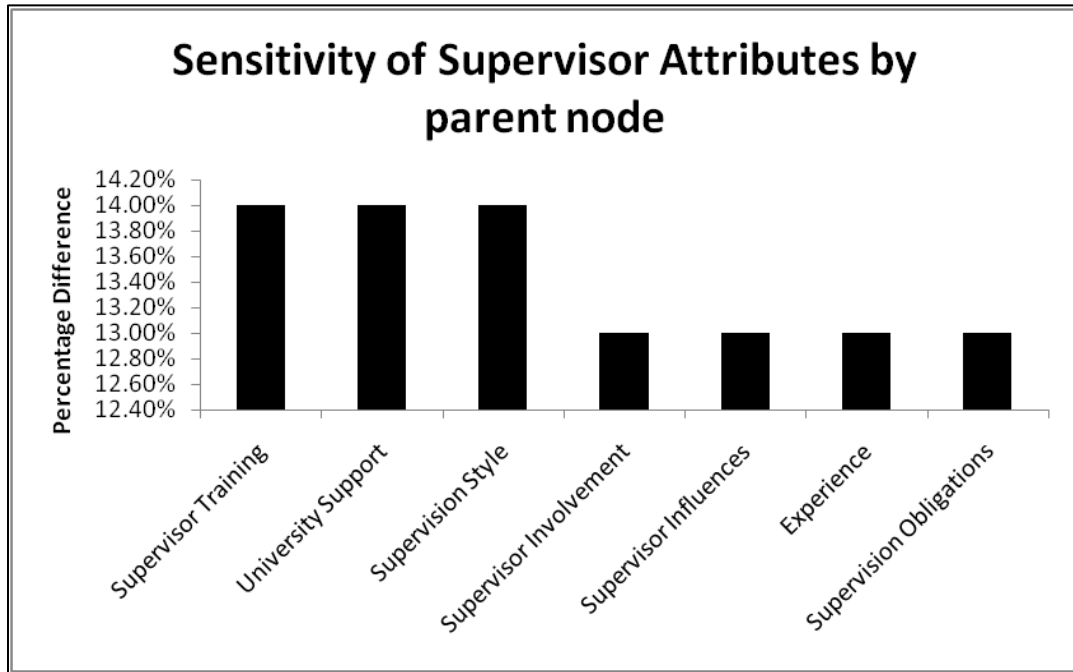
Figure 24 Sensitivity of supervisor attributes to changes in parent nodes

The full results of the sensitivity analysis are depicted in Table 5-2. The results of this analysis suggest that increasing supervisor participation in training is the most effective strategy in improving the effectiveness of support for HDR supervisors in the supervision of CALD and international students. This is of particular interest, given that the model suggests that currently very few supervisors are engaged in such training, despite believing it is an important factor in the success of their students.

Supervisor style as it relates to the model consisted of a series of activities carried out by supervisors as part of their supervision. While supervisory style is most likely to improve with the length of time a supervisor has been resident in Australia (almost significant p=0.052), the fact that supervisor activity significantly decreases with discontinued CALD students (p=0.015), means it is important to particularly focus on the reasons for discontinuation and offer solutions to supervisors in order to restore confidence in their supervision.

Table 5 Sensitivity of supervisor attributes to changes in parent nodes

Parent Node		Probability of Supervisor Attibutes being High	Difference from ML	Difference
Supervisor Training	Low	32%	-1%	
	High	46%	13%	14%
University Support	Low	30%	-3%	
	High	44%	11%	14%
Supervision Style	Low	31%	-2%	
	High	45%	12%	14%
Supervisor Involvement	Low	23%	-10%	
	High	36%	3%	13%
Supervisor Influences	Low	29%	-4%	
	High	42%	9%	13%
Experience	Low	27%	-6%	
	High	40%	7%	13%
Supervision Obligations	Low	26%	-7%	
	High	39%	6%	13%

Given the similarity in importance of the parent nodes for supervisor attributes, it is interesting to note the difference in supervisor attributes from the most likely situation as perceived by the supervisor. This is a combination of both the most likely state of the parent node as judged by supervisors, and its relative importance to the child (supervisor attributes).

By examining this we find that supervisor training is the most likely factor in influencing positive change in supervisor attributes, while student perception of supervisor involvement is the most likely factor to influence a negative change in supervisor attributes. The relative positive and negative influence of each factor on supervisor attributes is depicted in the graph below. This suggests that increasing the likelihood of participation in supervisor training is the most important strategy for improving support for supervisors working with CALD and international students, followed by increasing university support and improving individual supervisor's style.

Conversely, managing supervisor involvement is the most important strategy for avoiding the degradation of supervisor attributes followed by supervision obligations. Supervision influence is best addressed by recognising that supervisors learn best through self-reflection of their own experiences and resorting to an approach that would enhance awareness of their own specific situations and also equip them to address the same. It is likely that supervisors would be more responsive to being coached through their specific issues rather than being mentored or trained through generic workshops, which have so far made little or no impact on improving supervision quality. As always, finding a balance between improving factors with a highly

positive influence and managing factors with a highly negative influence is crucial, if overall gains in supervisor attributes are to be observed.
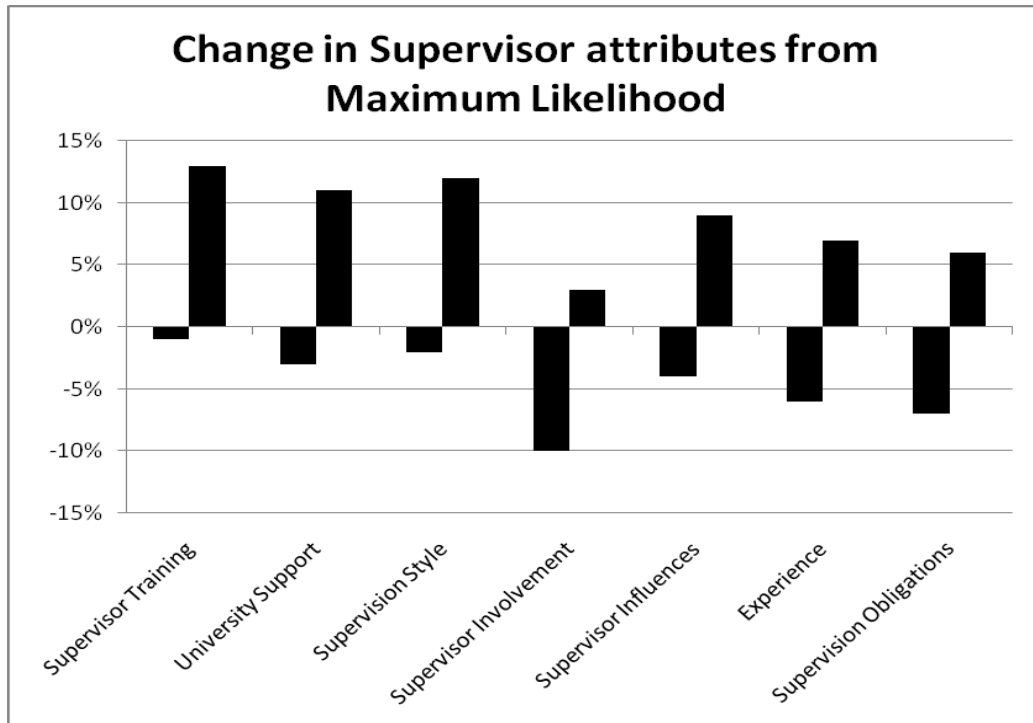
Figure 25 Change in supervisor attributes from Maximum Likelihood scenario by parent node

5.4 HDR versus CALD Student Success

General HDR Success

Successful HDR students' category was a general term used for all HDR students including CALD students. Supervisor perception of student obligations was high (H 80%) followed by student attributes (H 68%), general factors (H 61%) and student behaviour (H 55%). Previous student experience was perceived to be least important (H 30%).

Regression analysis results indicate that student behaviour (H 55%) was significantly associated with gender (higher score by female supervisors, p=0.023), long residence time in Australia (longer residency associated with higher scores, p=0.038) and overseas university experience (positive response associated with higher scores, p=0.003). Previous study in Australia was close to significance (positive response associated with lower scores, p=0.067). This indicates that successful student behaviour is widely acknowledged both in Australia and overseas and that female supervisors in particularly are more perceptive in endorsing these behaviour traits.

Similarly, student attributes were significantly associated with overseas university experience (positive response associated with higher scores, 0.027) and through currently supervising many postgrads (positive response on this variable was associated with lower scores on student attributes, p=0.015). Higher scores in the general factors component were significantly

associated with the supervisor reportedly having had overseas university experience (p=0.022) and the supervisor not having had CALD students who have discontinued (p=0.006).

Three variables were associated with student attributes at the 10 percent level: English as first language (positive response associated with higher scores, p=0.078), current appointment (positive response associated with higher scores, 0.063) and supervisor has had CALD students who have discontinued (positive response associated with lower scores, p=0.067). This emphasises the important point that supervisors' long term association with the Australian culture helps them identify successful student attributes, and that lack of such awareness is likely associated with CALD discontinuations.

Two variables almost significantly impacted on Student obligations: long residence time in Australia (p=0.056) and overseas university experience (p=0.057). For each of these, a positive response was associated with a higher score. Note that although these are not significant at the 5 percent level, they are very close, and still substantially associated with the response, hence their inclusion here.

Positive response to previous study in Australia was associated with a lower score for student experience (p= 0.035) while positive response to overseas university experience was associated with a higher score for this component (p=0.012). These two associations may indicate different research cultures between Australia and some other parts of the world and hence needs further investigation to identify these differences.

CALD specific success

Successful CALD student category (H=37%) was influenced by general factors (H 51%) and CALD supervision (H 6%). CALD supervision related to three areas of supervisor's previous experience with CALD students, supervisor awareness of what was important for success of CALD students and supervisor input into what they did to develop CALD students. It shows the overall input from supervisors into CALD-specific supervision was very low (H 6%), despite the fact that supervisors who spoke English as their first language saw their association with CALD students as having a significant positive impact on them (p=0.021) and that CALD students personally benefitted their own research (p=0.058).

5.5 Sensitivity Analysis

The sensitivity analysis of HDR success shows that all categories are equally sensitive (17 percent) except for student experience which is 16 percent, (Figure 5-7). Improving on the student experience makes the highest impact on overall HDR success at 12 percent, followed by student behaviour at 9 percent and general factors at 8 percent (Figure 5-7).
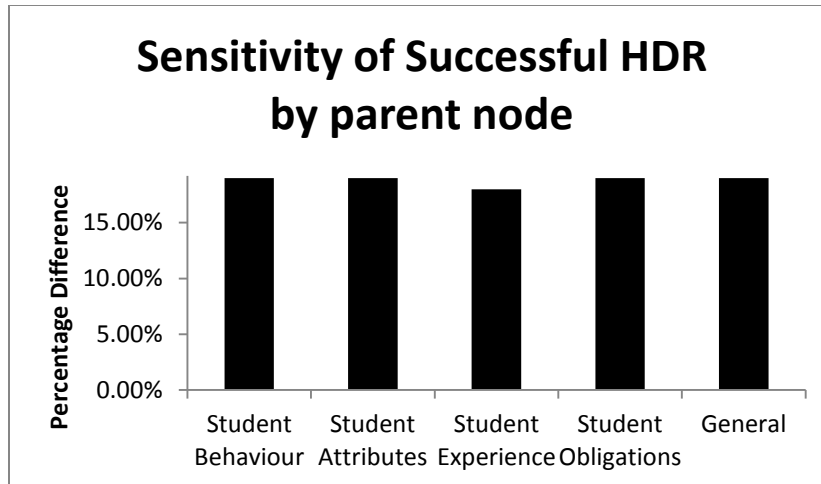
Figure 26 Sensitivity of successful HDR by parent node
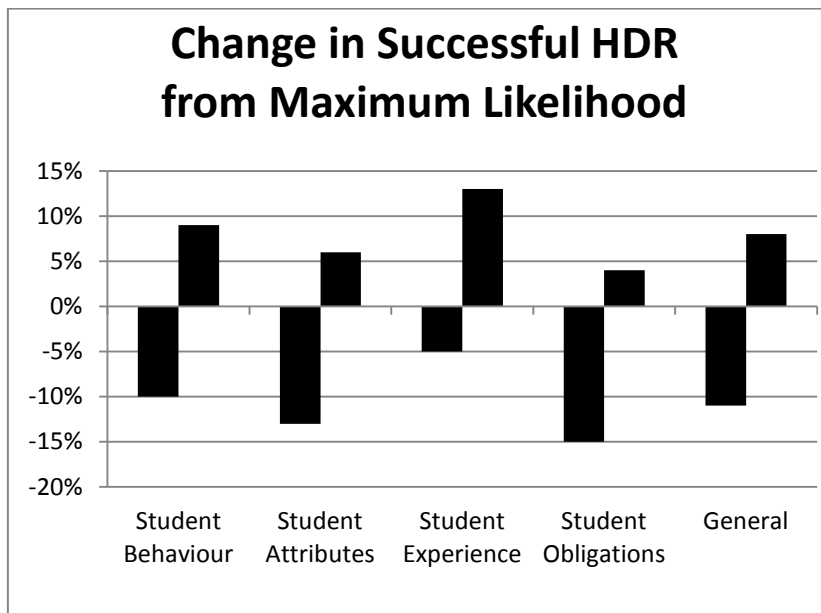
Figure 27 Changes in successful HDR from maximum likelihood

A drop in Student obligations on the other hand can cause the HDR success to reduce by 15 percent and by 13 percent for a decline in student attributes. General factors and student behaviour are also sensitive to losses of up to 10 percent. While seeking students with more experience seems the best solution towards improving the probability of HDR success, universities can equally invest towards developing existing students in the behaviours and general factors which in the long term will prove beneficial to the universities in their development of successful research programs and HDR graduates. It is equally important to maintain programs and other avenues towards helping students continue with their current obligations and create environments to nurture attributes which are deemed beneficial for HDR success and ensure sustainability of these practices within the HDR student communities.

Discussion

The OSP value of only 44 percent likelihood of being high indicates that there is much more room to improve in terms of better understanding the factors that relate to CALD student success. The current results can be categorised into two main sections; HDR student success related factors and supervision success related factors.

HDR student success related factors

The overall perception of success of a CALD student was most influenced by node HDR student success which was 58 percent likely to be positive, followed by node CALD student success which was 48 percent likely to be positive. This meant that the supervisor perception of success of a CALD was more influenced by their perception of a successful HDR student than factors that were specific to CALD supervision. The most negative influence on OSP was by node HDR student success which was 14 percent followed by supervisor demographic which was responsible for a 12 percent e change.

A sensitivity analysis on sub network HDR student success shows that the node student experience has the highest positive change in outcome of 13 percent and nodes student obligations and student attributes overall contribute to the most negative outcomes by 15 percent and 12 percent respectively.

Previous experience

Improving the success of HDR students on the basis of previous experience is not a practical solution for existing students. For academic institutions this may mean making entry requirements more stringent and ensure candidates at entry level display advanced problem solving skills, have a good foundational knowledge in the area of research discipline experience and research experience as outlined in (Table 4-1, Chapter 4). Although supervisors did not consider having a postgraduate qualification as important experience for higher degree research, the emphasis on experience in research methods and problem solving ability implies that a postgraduate qualification is needed.

Student obligations

The management of students in relation to their obligations is important to ensure their ultimate success and in that regard the supervisors play an important role in ensuring that students are both aware and comply by university requirements and protocols. Having a formalised milestone preparation requirement would help both supervisors and students remain on track, leading to overall improved completion times. A greater concern is that of students failing to fulfil their obligations through losing focus and motivation, as the key obligations require students to be proactive in organising their own research related activities and actively engaging the supervisors through regular meetings. Lack of motivation and positive focus may result from either unmet expectations in the student-supervisor relationship, or through distress due to external factors, such as financial issues, the main reason why CALD students discontinue. (The reader is referred to chapter 4.3.2-Supervisor Survey Results for a detailed discussion on the supervisor's role in relation to student expectations).

Student attributes

Furthermore, motivation and a positive mindset are key attributes for success as identified through the supervisor survey (Table 4-1, Chapter 4) and when these attributes are negatively impacted it the effect on the overall HDR success will be far greater. For the current model a worst case likelihood scenario of losing total motivation and consequently dropping all student obligations causes the HDR success to decline by a total of 28 percent, indicating that the combined effect of these two nodes is greater than the sum total of the individual effects.

CALD student success related factors

OSP was positively influenced by the node CALD student success by up to 14 percent change. CALD student success can be largely improved through supervisor involvement in helping CALD students develop communication and networking, which has been shown to have only a 6 percent probability of being high. Currently CALD outcomes were very low for CALD supervision, meaning that supervisor input in to CALD specific issues was very low, despite being aware of their specific needs. This should be addressed as a primary importance. The model predicts a change of CALD student success to have a 65 percent likelihood of being positive (up from 48 percent) as the maximum outcome scenario from improving supervisor involvement in communication and networking. (The reader is referred to chapter 4.3.2- Supervisor Survey Results for a detailed discussion on the supervisor's role social and communication involvement in relation to CALD students)

HDR supervision success related factors

According to the sensitivity analysis results on the sub network supervisor attributes, supervisor participation in training (13 percent) and supervision style (12 percent) were the two most influential nodes for a positive change in outcome, followed by node, university support to supervisors at 11 percent. The most negative influences on Supervisor attributes was from nodes supervisor involvement (-10 percent) and supervisor obligations (-7 percent).

Supervisor Training

Participation in training can be improved by catering to a style that involves personal experience and a personalised approach involving self-reflection, since that it the most effective way supervisors learn. The emphasis in training should be expanded to include cross cultural communication issues, pastoral care emphasis and coaching towards building motivation in students.

Improving Supervisor Style

Improving supervisor style in the context of this model means getting supervisors to be engaged in the specific activities of supervision to a greater degree. This should be increased by giving supervisors more time in these activities and removing other constraints that may be a hindrance to spending more time supervising.

University Support

University support can be improved by addressing the issue of supervision time by factoring in HDR supervision into the workload equation and adjusting for extra time for CALD students, reducing administrative paper work are all useful means of helping engage supervisors more in supervision. Support can also be increased in the funding available for HDR scholarships and research facilities and improving on the type of training available for supervisors including personal development seminars and workshops.

Improving supervisor support, supervisor style and supervisor training lead to an overall improvement in supervisor attributes up to 37 percent (from 33 percent to 70 percent likelihood) according to the current model.

Supervisor involvement

Means of enhancing supervisor involvement is by opening up communication between students and supervisors and improving CALD student interaction socially and academically. A drop in supervisor involvement can result between stages 1 & 2 of the supervision process due to difference in student and supervisor expectations as described in chapter 4.3.2.

Supervisor obligations

Currently supervisor obligations show a 50 percent likelihood of being high. This means that the current manner in which supervisors meet their obligations as a whole has a neutral effect on their attributes. Their obligations don't have a positive or negative effect on them. While causing them to meet more of their obligations would lead to improving their attributes as a supervisor, not engaging at the current level can have a greater negative impact. The same approach of improving communication between students and supervisors mentioned above can be employed.

Improvements to the Bayesian Network Model

There are a number of limitations of BN models when attempting to model abstract systems such as supervisor beliefs.

The first major limitation of such models is their inability to cope with cyclical phenomena without introducing new elements to the modelling paradigm. This excludes the modelling of certain aspects of systems that are known to be complex, as feedback loops leading to emergent behaviours are critical aspects of this type of system (Scholl, 2001).

Another limitation noted by Uusitalo (2007) stems from the discretisation of nodes when modelling any unobservable system. Most applications of BN models (including this one) require nodes to be broken into discrete states in order to create Conditional Probability Tables. In most cases nodes are broken into two states, which requires that some threshold or cut-off must be arbitrarily created by the researcher. By doing this it is difficult to tell whether each expert that quantifies the model has the same definition of the threshold, or that the threshold that has been chosen is most appropriate to modelling the system of interest. An

inappropriate choice of threshold could easily lead to a model that is either overly sensitive or not sensitive at all to changes in the state of the system.

In the particular case of this study there were some limitations due to the requirements of the method. Specifically, the survey used to quantify the supervisor model was written and completed before the construction of the BN model. The BN model was then derived using a Principle Components Analysis based on the supervisor's answers to questions on the survey. This is not the most desirable method of model construction and quantification, as it relies on the survey being constructed from random questions. For example, if the survey was written to measure levels of five constructs, it is likely that the PCA would produce five nodes. As such, modelling the answers in such a way may tell us little more than the survey alone about what supervisors think, however it does allow for some simulation of hypothetical scenarios based on survey results. In particular, there is little indication of whether unnecessary factors have been included, or necessary factors excluded when using this method.

Future research should look at developing a complete and parsimonious model at the outset, using a validation framework such as that proposed by Pitchforth and Mengersen (2013) to ensure its validity. One test used in this framework is the Principal Components Analysis, which is more enlightening to the researcher when applied in this fashion. Once a valid BN structure has been derived from expert opinion, published research and validity test results the survey can be constructed to allow for quantification of the model. An advantage of this approach is that it produces both a model capable of simulation, as well as clean and easily interpreted descriptive statistics.

Conclusion

The current Bayesian model helps identify and prioritise factors that influence HDR and CALD HDR students and supervision academic success. Improvement in the model to include a broader definition of engineering success in the Australian context will give greater insight into managing student supervisor interactions and help improve the overall effectiveness of the HDR experience for both students and supervisors alike.

6. Institutional data and Support services

6.1 HDR international students' profiles:
The University of Western Australia, Queensland University of Technology and Curtin University

Below are brief outlines of the profiles of international HDR students at the three institutions with data on the number of international students, completion times and major source countries of students.

6.1.1 The University of Western Australia

At The University of Western Australia, currently there are about 2000 HDR enrolments; 86 percent of these are Doctoral students, the rest are Masters. There were 377 commencements in 2011 (of which 33 percent were international students) and 304 completions in 2010. The mean time for completion for doctoral degrees across all disciplines was 4.13 years (from 2003-2008). While the mean time for completion for domestic students remained fairly constant, the mean time for international students has fallen over the years. In engineering, Computing and Mathematics there were 217 domestic completions (over 2003-2008), with a mean time to completion of 4.31 years, slightly higher than the average for all disciplines over the years, however in comparison, the mean time to completion for international students was noticeably lower at 4.09 years (See Table 6-2 below).

In terms of home international residence, the majority of HDR international students (in 2005-2010) came from Asia including the Middle East. This was followed by Europe, North America and South America. The largest number of international students has traditionally been from Singapore and Malaysia. In recent years however, there has been a marked increase from China and other significant countries of origin including India, Indonesia, Iran, Jordan and Oman.

6.1.2 Queensland University of Technology

At QUT, from 2002 to 2011 the total number of HDR students' enrolments (domestic and international) across all faculties increased by 43 percent. The increase is more pronounced for international HDR students (a 272 percent increase) compared with 12 percent increase in domestic enrolments. At present (April 2012), 2185 HDR students are enrolled at QUT from which 22.4 percent are Masters, 7.2 percent are Professional Doctorates and 70.4 percent are PhD students. Across all fields (not just engineering and IT), international HDR students compose 32 percent of the total enrolments. Across all fields in 2011, 252 HDR students commenced their studies and 295 students completed their higher degree by research courses. In the newly formed Faculty of Science and engineering where Information Technology discipline is also located, 46 percent of the students are international students. In 2010, the top source countries of international HDR students were China, Malaysia, Sri Lanka, Saudi and Iran. From 2002 to 2011, the mean number of years to completion for PhD in all fields of study for domestic students was 3.9 years, and for international students was 3.6 years (see Table 6-2 below). Completion time has been reducing every year and international students complete

sooner than domestic students. International students publish more papers compared to domestic students (Higher Education Research Data Collection (HERDC), 2008-2010)[11]and their theses examinations results are marginally better than those of domestic students (QUT internal reports).

6.1.3 Curtin University

In 2011, Curtin University had an equivalent full time student load of approximately 1400 HDR students, out of which 38 percent constitute international students, and 62 percent consist of domestic students. Out of this, the Faculty of Science and engineering has approximately 42 percent international HDR students and 58 percent domestic HDR students. There were about 106 completions for the year 2010 and about 101 completions for the year 2011 for the Faculty of Science and Engineering (Curtin internal sources).

6.1.4 Comparison between the three institutions

The ratio of completions of international to domestic HDR students in the engineering and IT disciplines was the highest for Curtin University (0.81), followed by UWA (0.36) and then QUT (0.26). The total number of international HDR completions was the highest for Curtin University at 214, followed by QUT at 112 and then UWA at 78.5. The mean time to completion for international HDR students was the lower for QUT (3.6 years), compared with UWA (4.09 years); no data on completion rates was available for Curtin University.

The major source regions (home residence) for international students (in all schools) were similar. In absolute terms, the major source region for all the three universities was Asia including the Middle East. However, the percentage changes in intake for the different source regions varied a lot. For instance, UWA had a 44 percent increase in intake from Africa over 2005-2010, there was no change in intake at Curtin University for that period and a -5.6 percent change at QUT. Overall, UWA had a 35 percent change in international enrolments, QUT, 51 percent and Curtin University 19 percent from 2008 to 2010

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Source:http://www.innovation.gov.au/RESEARCH/RESEARCHBLOCKGRANTS/Pages/HigherEducationResearchData Collection.aspx

Table 6 Number of doctoral completions and mean-time to completion

Number of doctoral completions and mean-time to completion: School of Engineering, Computing and Mathematics, UWA. 2003-2008 Data source: UWA, Review of Graduate Research Training, 2010			
	Total number of completions (EFTSL)	%	Mean-time to completion
Overall	295.5	100	4.26
Domestic	217	73.4	4.31
International	78.5	26.6	4.09

Number of HDR completions and mean-time to completion: Faculty of Science and Engineering and its predecessor (Faculties of Science [all fields of science], Information Technology, Science and Technology, and Built Environment and Engineering), QUT. 2003-2008 Data source: QUT Corporate Reports			
	Total number of completions (EFTSL)	%	Mean-time to completion for PhD
Overall	535	100	3.8
Domestic	423	79	3.9
International	112	21	3.6

Number of HDR completions and mean-time to completion: Faculty of Science and Engineering, Curtin University. 2003 – 2008. Data source: Curtin University internal sources			
	Total number of completions	%	Mean-time to completion
Overall	478	100	NA
Domestic	264	55.2	NA
International	214	44.8	NA

Table 7 International HDR students' home residence

HDR students' home residence international, UWA (2005-2010) Data source: UWA, Review of Graduate Research Training, 2010							
Overseas	Year						Percentage increase 2005-2010
	2005	2006	2007	2008	2009	2010	
Africa	4	5	8	9	12	13	225%
Asia (inc Middle East)	246	292	271	340	427	455	85%
Europe	30	37	47	53	52	63	110%
North America	16	20	22	25	25	31	95%
Oceania	-	1	2	2	4	4	-
South America	13	10	7	7	16	21	62%
Total	309	365	357	436	536	587	90%
HDR students' home residence international QUT (2008-2010) Data source: QUT Corporate Reports							
Overseas	Year						Percentage increase 2008-2010
	2005	2006	2007	2008	2009	2010	
Africa	-	-	-	13	15	13	0%
Asia (including the Middle East)	-	-	-	291	361	469	61%
Europe	-	-	-	51	55	59	16%
North America	-	-	-	20	27	27	35%
Oceania	-	-	-	5	3	3	-40%
South America	-	-	-	3	5	6	100%
Total	-	-	-	383	466	577	51%
HDR students' home residence international, Curtin University (2006-2010) Faculty of Science and Engineering Data source: Curtin University Internal Sources							
Overseas	Year						Percentage increase
	2005	2006	2007	2008	2009	2010	2006-2019 except Oceania
Africa	-	8.8	9.3	8.9	9.9	8.4	-4.50%
Americas	-	25.3	21.6	20.5	21.8	20.3	-19.80%
Asia	-	129.2	132.8	132.5	143.3	166.1	28.60%
Europe	-	11.3	18.3	19.7	23.9	22	94.70%
Oceania	-		0.9	2.6	3.2	1	11.11%
Unspecified	-	0.3	-	-	0.7	1.8	-
Total	-	174.9	182.7	184.1	202.8	219.6	25.60%

6.2 Support Services

In response to academic and other challenges faced by HDR students, support services, training and development opportunities at the three universities have also grown to keep up with the surfacing needs of a changing student demographic. A comparison of support for international HDR students in science and IT at the three universities (below) shows developments in academic, language, administration, settlement and other support. While most of the support is general to other HDR candidates, some of the services are tailored for the needs of CALD/international students as well as the discipline specific needs of engineering and IT. The institutional data collected also reveals additional support for supervisors.

6.2.1 Administration support

At UWA, candidature for higher degrees by research is governed by the Graduate Research School that is also responsible for promoting the university's graduate research program and recruiting graduate research candidates. International offices (International Students Services, QUT; International Office, UWA; and Curtin International, Curtin University) at the three institutions, offer additional assistance with grievances and appeals, sponsorships and referrals for relocation issues such as housing. At QUT the Director of International Graduate Research, a unique position amongst all of the Australian universities, is dedicated to providing pastoral support for international and CALD HDR students.

6.2.2 Academic and resource support

Postgraduate inductions are held every six months at UWA, three times a year at QUT and twice a year at Curtin University. International students at UWA receive a personal invitation and continual reminders to attend induction as part of the first at UWA program. Ongoing support regarding academic issues is provided by Graduate and Education Officers at UWA. Several resources including a postgraduate handbook, calendar of events, an almanac provide useful information on various aspects of candidature, academic life and trainings at UWA. Similar resources are available at QUT such as the SEF Survival Guide. Postgraduate students also have access to web-based resources such as the Doorway to Research. This is a web based portal which supports international students on issues relating to social and research based topics central to the student experience. The faculty also provides one-on-one training for supervisors in academic tasks.

Various resources are available to HDR students at the three universities. High performance computing and research support in the areas of scientific engineering, data analysis software, data visualization, high-end computing platforms and advanced information and communication technologies are provided to both students and staff. Liaison librarians work in partnership with faculties and divisions to advise on information literacy needs and information access and reference queries. QUT has a portal for student publications called QUT e-prints where students can publish their work. This helps students to extend their early track record in research. Workshops on managing data are run periodically as well as courses on statistical analysis. IT skills trainings are also available.

6.2.3 Language support

English language support is provided at the three institutions through writing, speaking and readings skills workshops through programs funded by the individual faculties or the university. In addition supervisors also have funding for specific language support when needed.

6.2.4 Social support

There are over a hundred clubs and societies affiliated with the UWA Student Guild and a comprehensive range of sports club memberships available for students to join. The Council for International Students of WA offers various social programs accessible to international students at UWA. The Council produces a booklet on everyday living in WA. LACE, a postgraduate intercultural program that is also open to staff offers social events on a regular basis. At QUT postgraduate research students network (PGRSnet) runs both academic and social events for international and CALD HDR students and their families. Some faculties however, have their own HDR Student Societies.

6.2.5 Supervision support

A number of supervisor support resources are available at the three institutions and training workshops conducted at intervals. QUT has an effective supervisory accreditation scheme in place utilising the expertise and the experiences of the senior and experienced academic researchers and supervisors in the support and development of younger, newer and less experienced supervisors in a 'mentoring style' supervisory teams (QUT – to give a source for this information). Building on conceptions and practice of supervision, UWA has workshops on supervising international students. Web-based resources giving guidelines[12] (QUT and Curtin University to add their web links) about the role of the supervisor are easily accessible to both supervisors and students.

6.3 Support Services

A study was undertaken to investigate the support services available to HDR students across three universities. The results of this study will be useful to HDR supervisors and university administrators towards improving support services within their universities in a bid to meet the current and future demands of HDR and CALD HDR students.

Data Collection & Analysis

Key academics with HDR supervision roles within the three universities were interviewed against a preliminary checklist of HDR support services offered at the three universities. The emphasis of this was to identify support services that contributed to academic success of the students. Services that were not exclusively HDR related but served to enhance their academic

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[12] For UWA, see:http://www.postgraduate.uwa.edu.au/schools/appointment-of-supervisors-of-higher-degree-by-research-students; http://www.postgraduate.uwa.edu.au/supervisors/supervisors

success were also recorded. They were consulted with regards to the availability, location and accessibility of these services. A service was considered available, if it was offered directly by the university or indirectly through a university affiliated agency such as a student club. Services were recorded with regards to their location by considering where they were housed, whether at the university, faculty or school levels or located altogether separately. The accessibility of these support services considered who among HDR students these services were accessible to; general students, international students, faculty students, supervisors. A comparative table was developed and the support services were categorised into the following 5 categories; academic, administrative, social and settlement language and miscellaneous support.

Academic Support:

Academic support covered research methods, technical writing skills, computer support, milestone preparation support and research commercialization support and were considered essential services that were directly related to student academic activities.

Research methods – Qualitative and Quantitative data analysis

All three universities have dedicated offices to cater to research student needs (RSC-QUT, OTL-Curtin, GRS-UWA). In addition the library plays an important role in supporting the research activities, by offering specialised courses on research and research related skills. These include, referencing tools like endnote and use of databases. Specialised liaison librarians are available at faculty level. Support at faculty level can also be thematic and where research centres are present (IHBI in QUT), there is a more dedicated focus through themed workshops for students conducted at the faculty/research centre level. These may or may not be compulsory to students.

Technical Writing

Technical writing skills support is catered for in one of three ways across the three institutions; dedicated workshops on technical writing for HDR students (QUT, UWA), workshops for international students (ISS-QUT) or language support that covers technical writing (Curtin). The frequency may vary from weekly writing forums (QUT) to less frequent but specialised writing retreats and scientific workshops that include publishing skills (UWA).

High Performance Computer (HPC) Support

All three provide HPC support which is generally available at the university level with specialised help also available at the school level. This includes specialised software support for statistics and engineering and also consulting on statistics (UWA). In addition, IT services located at university level offer a range of technical support on general computer issues at university level (QUT).

Milestone Preparation

This is a formalised process at QUT involving specific requirements for milestone 1 (3 months into candidature), milestone 2 (confirmation of candidature) and so on, whereas in both Curtin and UWA it is an informal process, facilitated largely between the supervisor and the HDR student. Support for milestone preparation is done at regular specific research group forums

where attendance of research seminars is considered important and compulsory in some cases. Peer support is encouraged and whereby more experienced students are expected to help the newer students (UWA) although no formal process exists.

Commercialisation of Research

All three universities have a dedicated arm for commercialisation of research and its findings. QUT offers the service via e-Grad school, a virtual program offered by all the Australian Technology Network (ATN) member universities designed to help researchers and their students with resources.

Table 8 Different levels of academic support offered to HDR students at QUT, UWA and CU

Support Type	Description of Support	QUT Provider U- University F- Faculty S- School		Curtin Provider U- University F- Faculty S- School		UWA Provider U- University F- Faculty S- School		Accessible to				
								Int'nal students	All HDR students	Faculty Students	Supervisors	Other
Academic Support	Research Methods- Qualitative and Quantitative Data Analysis	-RSC .Library and specialised courses on publishing, end note training, copyright issues. .Liaison Librarians	U F	.OTL .ORD .Specialised library courses .Faculty level liaison librarians	U U U F	.CATL .GRS- 1st point of contact .Faculty level liaison librarians .Research themes/disciplines/centres provide support across faculty on research methods appropriate to theme.	U U F U		■	■		
	Technical Writing	.ISS -weekly writing circles .SEF-academic writing sessions	U S	.ELC - English support in writing	U	.GRS -writing retreats and special workshops on scientific publishing	U	■	■	■	■	
	Computer Support	.HPC Research support .IT Services - face to face and online training	U U	.HPC support	U	.HPC support .School based courses providing stats consulting, CMC for electron microscopy .iVec supercomputer centre provides support, also numerous specific course on software packages such as MATLAB, LabVIEW, Mathematica	S		■	■	■	
	Preparation for meeting milestones	.SEF_Preparation for stage 2 .IGR .QRSnet run workshops for stage prep	F U	.No formal process, but help through faculty for 6 mnths and confirmation of candidature	F	.School and research group seminars, Note 1)	S		■	■		
	Research Commercialisation	e-Grad Australia modules	U	ORD	U	.OIRS provides comprehensive support including, when appropriate, negotiation and drafting of confidentiality agreements, patent applications, licensing agreements, etc.	U	■	■		■	

International Student Services (ISS) Research Student Centre (RSC) Centre for Advanced Teaching and Learning (CATL) Office of Director of International Graduate Research (IGR) e-Grad School Australia (e-Grad Aus)
High Performance Computing Support (HPC) Doorway to Research Website (DR Web) Office of Teaching and Learning (OTL)

6.4 Administrative Support

Administrative support was identified as guidance, information and skills support. Administrative support is offered to both students and supervisors at different levels at all the three universities.

Information Support

This support includes inductions, online support and specialised support through publications like the SEF survival guide at QUT. Access to facilities like laboratories is granted upon gaining necessary safety training which is offered to small groups quarterly. Web based forums like My Research Space are also present to aid the individuals in their academic research and connect them to other researchers.

Administrative skills support:

Administrative skills support is available to help supervisors manage their work load with QUT offering this service at faculty level. Administrative skills support is present for specialised supervisor training (QUT) and at faculty level along with some general help available, at Curtin (ORD) and UWA- GRS. Supervisor support is mainly given university level, with the exception of specialised skills training or library services which are offered at faculty or school level.

Language Support

Language support covered English language support through writing skills and other initiatives. English language support is offered in one of three ways; through a dedicated service to developing English language competency (ELC-Curtin, CELT-UWA), indirectly through writing skills workshops at faculty level or funding to help in thesis writing (QUT) or on a need basis through special funding available for supervisors (UWA).

Table 9 The different levels of administrative support available to HDR students at QUT, UWA and CU

Support Type	Description of Support	QUT Provider (U- University, F- Faculty, S- School)		Curtin Provider (U- University, F- Faculty, S- School)		UWA Provider (U- University, F- Faculty, S- School)		Accessible to				
								Int'nal students	All HDR students	Faculty Students	Supervisors	Other
Administrative Support	Information support	.DR Webpage .SEF Student induction -Small grp & quarterly Faculty level .SEF Survival Guide	U F F	.ORD .Student inductions at Faculty and Uni levels	U	.My Research Space forum .GRS Web site .Student inductions esp on safety: safety induction mandatory to gain access to laboratory equipment.	U U		■	■		
	Administration Skills support	.SEF- supervisor admin training	F	.ORD	U	.GRS	U			■	■	
Language Support	English Language support through writing skills and other initiatives	·FLDP-SEF	F	.ELC	U	.CELT .Supervisors have funding for specific language support when needed	U		■	■	■	

Graduate Research School (GRS) e-Grad School Australia (e-Grad Aus)
Curtin Uni PG Association webpage (CUPSA) Doorway to Research Website (DR Web) Centre for English Language Teaching (CELT)

Social and Settlement Support

Social and Settlement support covered issues pertaining to accommodation, spouse support, cultural and social support and counselling.

Accommodation Support

Online accommodation support is offered through the university via dedicated websites for international students (ISS webpage-QUT) or general HDR (GRS-UWA) or more informally through student clubs (CUPSA-Curtin).

Spouse Support

No dedicated service within the university is available at Curtin and UWA for spouse support, while QUT provides some organised activities which are initiated by ISS for wives of international HDR students.

Pastoral Care

Pastoral care covers general life matters that may or may not arise from academic research. The degree of pastoral care varies, and is available at the supervisor level (principal or associate) postgraduate coordinators (school level) and HDR directors (Curtin, QUT) post graduate coordinators (faculty level at Curtin). The director for International Graduate Research (IGR) is a specialised role created within QUT to offer assistance to international HDR students across the university. Pastoral care covers issues pertaining to social factors or those presented by cultural differences.

6.5 Cultural and Social Support

The level of cultural and social support available for CALD students differs in the nature and scope that reflects the current needs of CALD students as well as what the universities are equipped to provide. For instance Curtin offers social and cultural support for CALD students by providing health and recreation facilities, onsite child care facilities and a prayer hall/mosque catering to HDR students from an Islamic background with families. In UWA social support is provided to international students by giving incentives to tutor in residential colleges in exchange for free accommodation. In QUT the social support takes the form of activities organised by the ISS at university level and other social gatherings organised at the faculty or research centre level.

Counselling

Counselling services are provided at all three universities and offered at the university level. In addition to this, QUT runs special workshops on stress management, time management and other wellness programs for HDR students.

Table 10 Social and Settlement Support for international HDR students at QUT, UWA and CU

Support Type	Description of Support	QUT Provider U- University F- Faculty S- School		Curtin Provider U- University F- Faculty S- School		UWA Provider U- University F- Faculty S- School		Accessible to				
								Int'nal students	All HDR students	Faculty Students	Supervisors	Other
Settlement and Social	Accommodation	.ISS .DR Web	U U	.CUPSA web site .facebook page	U U	.My Research Space website .GRS Web site	U U	■	■			
	Spouse Support	.ISS run Women's Group- for spouses of Int'l HDR students	U	.No official Service- Individual groups on Campus	U	.No official Service_individual groups on campus. .Social functions organized by most if not all research groups and Postgraduate Students Association	U	■	■			
	Pastoral Care	.HDR directors .IGR	S U	.School or depatment specific PG coordinator .Faculty Grad	S F	.School level PG coordinator	S	■	■	■		
	Cultural & Social Support	.ISS- supported programs and activities .Faculty level cultural and social activities for internationald and local students	U F	.Health & recreation, on-site child care, direct bus to campus, prayer hall/mosque on campus, food services on campus	U	.GRS-Assitance in finding housing .Help with tutoring in residential colleges in return for accomodation	U	■	■	■		
	Counselling	.C&C run specific workshops on time,stress management	U	.For all students	U	.For all students	U		■			
Other	Supervisor Support Other Support	.SEF info Hub .RSC- Workshops on Supervisory Solutions .E-Grad School Australia - virtual training for postgrad students, their supervisors, post doc fellows	F U	.ORD	U	.GRS by phone .Research Services for supervisory support-Ethics	U				■ ■	

International Student Services (ISS) Office of Research Development (ORD) Graduate Research School (GRS)
Faculty Language Development Program (FLDP-SEF) Centre for English Language Teaching (CELT)
Doorway to Research Website (DR Web) Careers and Counselling (C&C)

6.6 Miscellaneous Support

Miscellaneous support covered support services available to supervisors such as training programs. These were offered formally at QUT and included specialised workshops offered on supervisory as well as online through e-Grad and SEF info HUB (faculty level), No formal in UWA or Curtin but can receive help by contacting respective post graduate research offices. Curtin and QUT which are members of ATN universities offer e-Grad school which is a virtual school, operating locally and internationally. It supports HDR students as well as early researchers and is career oriented. This service is not available at UWA.

Service Delivery

The availability, location and awareness of the presence of support services are important to their delivery. This analysis revealed the following distinctions in the way services are organised from a service delivery point of view: formal versus formal, centralised versus specialist, general versus specific, stand-alone versus integrated services and current needs versus anticipated needs. These results of this analysis are conveyed in Table 4.

Table 11 Different support services as viewed from a delivery point of view.

Service Distinction	Service Description	Examples
Formal versus informal services	**Formal services**- those directly funded by the university within the university location **Informal services**- those not funded by the university, yet offered through a body affiliated with the university	- social support services are offered formally in QUT social services informally through social clubs in Curtin and UWA - Language support is offered formally in all 3 universities - UWA formally provides special funding to supervisors when there is need for language support - Milestone preparation is offered formally at QUT and candidates are supposed to submit a progress report (which is formally assessed).
Centralised versus specialist services	confined to one level/specialised providers catering for specific needs.	- UWA: specialised computer support is available at school level - QUT: High performance centre (HPC) is centrally located, but have personnel specialising in different areas and also software programs.
General versus specific services	specially dedicated and non-dedicated support services	- Curtin: Language support offered as a specialised service in Curtin, while at - QUT: offered as part of generalised writing skills workshops. - UWA: Accommodation support is offered for HDR students for free in exchange of tutoring as a (general non dedicated service) - dedicated service providers like ISS for accommodation at UWA.
Stand-alone versus integrated services	Integration facilitates effectiveness as services work towards achieving a common goal and avoiding duplication of efforts	- Pastoral care is offered by supervisors who are part of the university staff, members of faculty and schools. This helps integrate the different levels in supporting the HDR student and supervisor - Integration of computer services at QUT ensures that all the computer needs are solved and dealt by HPC without duplicating services. - Counselling often is a stand-alone, located in a different building due to the nature of the services as privacy is important.
Current needs versus anticipated needs	Current needs are impending needs posed by students while anticipated needs cater for future needs that may arise students or graduates	- Curtin provides a mosque for the students - The 3 universities have a career centre and it provides help to students. Changes in trends in the job market need to be always addressed as this is dynamic. With a lot of services available on applications on mobile phones, there is an anticipated need to create mobile based platforms easily accessible to HDR students for support.

Discussion

Accessibility of a service affects its effectiveness. Accessibility in turn is influenced by its availability, location and the awareness of its existence.

Availability

Availability talks of whether a service exists or not. It directly conveys the importance of the service since it warrants its provision. On site accommodation, child care, chaplaincy/mosque ensures that these services are readily accessible and used as opposed to off-site services. Availability can be increased by offering the service at a different location if the campus is not big enough. This can be done by means of an inter campus bus shuttle.

The student's perception is that formalised services (i.e. those offered by the university) are important and thus are provided whereas those that are not formally provided are deemed unimportant. There is therefore need to revisit support services of great importance like accommodation services which are mainly offered by clubs and not the universities as they may be deemed unavailable. Formalising operations of these clubs can help improve their delivery.

To aid accessibility some services that are available at university level can be offered at school level. The survey showed that most of the academic support is available at university level, where resources are open to non HDR students, creating competition and a possible unavailability of the resources to specialised HDR student.

Location

Location also affects the effectiveness of a service. This does not essentially need to be a physical geographic location. The location of service is reflected under centralised versus specialist and general versus specific. The further away a service is, the more difficult it will be to access. If services are located away from the specialist student's area of engagement, he/she is most likely not to use the service. Since increased numbers of CALD HDR students are from an Asian background they may not be up front with service providers as domestic HDR students would. They might not be persistent and demand for the services as a right and not a privilege. Location of services like accommodation at a university location and at school level can help ensure effectiveness of service delivery. Location can be better addressed by arranging for an inter campus bus service in case of multiple campuses. Building of IT infrastructure at faculty level or research facilities at school level can aid in ensuring easy accessibility of services to HDR students. Availing support services via web or phone based applications can improve their delivery.

Awareness

A service may be available, located reasonably but awareness of its existence determines if it will be used or not. Generally, the survey showed that the supervisors were aware of the availability of the different services. This is important since they can direct students accordingly as supervisors also offer pastoral care. However since the survey was done only with a panel of supervisors, student perceptions here remain unknown. To increase awareness emails to students, advertising and phone or computer networks can best improve awareness.

Concluding remarks

Generally, supervisors were knowledgeable of the existence of the different support services to both the students and themselves. This is important as supervisors act as pastoral care givers and so can direct students to the different services available at the university. This however means that every service including those informally provided (through agents or clubs or outside the university campus) should be integrated into the university structure to increase awareness of their existence. Specialised services are important for HDR students to avoid competition from the undergraduate non research based students. This can ensure effective delivery of services to more specialised students. With campuses growing beyond a single campus, services located in different places should be made accessible by means of an inter campus shuttle bus. To achieve and maintain effectiveness, services like career services should be constantly reviewed to promote their effectiveness in light of changes in the job market.

This report serves to highlight the different support services available to students and supervisors. It serves as a forerunner for other researches into the effectiveness of service delivery and should be constantly reviewed to address changes as current needs will change and an increased population of foreign students.

7. Qualitative Analysis: Interview Data & Critical Incident

7.1 Introduction

This report summarises the qualitative analysis undertaken for the ALTC project: '*A holistic model for research supervision of international students in engineering and information technology disciplines*'. It is divided into two parts each detailing a separate analysis:

1. Part 1 is an examination of the qualitative data collected in the project that complements and details the findings of the supervisor and student surveys.

2. Part 2 is an analysis of the specific issues, interview data collected for the project. The findings of this analysis were used to draft an online version of a case studies' resource useful for supervisors, as well as informed part of a training workshop for supervisors and other stakeholders interested in improving the supervision of international, CALD students.

7.2 Part 1: The HDR learning environment

Four sets of data were analysed for this part:

3. Students' qualitative responses – these include notes made during an initial focus group workshop in June 2011 at Curtin University (in the first phase of the project) attended by 11 HDR students and comments made on the online student survey (completed June 2011) with 228 HDR student respondents;

- Supervisors' qualitative responses – these include responses to an email survey sent to QUT supervisors also in the early stages of the study that 14 supervisors responded to, and a workshop held at UWA in April 2011 attended by 9 supervisors, as well as the comments made on the final supervisor survey (closed January 2012) that 69 participants completed;

- Specific issues interviews – 12 interviews were conducted across the three participating universities in the last phase of data collection completed in June 2012. While the aim of these interviews was to provide information on critical incidents that supervisors may face in their supervisory roles, the robust content also provided details of the complexity and context of the supervisory relationship.; and

- The institutional data collected for the three participating universities.

The analytical process used NVivo 10 software coding to organise unstructured data. In qualitative methods, a code 'is most often a word or short phrase that symbolically assigns a summative, salient, essence-capturing, and/or evocative attribute for a portion of language-based or visual data' (Saldana, 2009, p 3). Several forms of data, for example interview transcripts, field notes, documents, audio and video materials, can be coded for analysis. In the initial stages, codes can vary in range from single words to entire texts, or images. Further distillation helps to condense the material and may involve reconfiguration of the codes developed to capture the essence of the content (Saldana, 2009).

The approach was 'interpretive' (Welsh, 2002) analysis; in that, it deduced from the data presented what elements compose the learning environment and used these to construct the schematic illustration of the HDR teaching and learning environment. The raw data was loaded onto the software as sources, and nodes were created from the themes emerging in an initial examination. In NVivo, nodes are collections of references about specific themes, places, persons or other areas of interest. References are collected by 'coding' sources such as interviews, focus groups, articles or survey results (QSR, International, 2011) at these nodes.

Thirty-six general themes relating to the supervisory relationship and the HDR learning environment surfaced from the preliminary analysis. Narratives from the source material were coded at these descriptive nodes.

No ordinal ranking was sought, but the nodes were categorised under four nominal sets: 'student', 'supervisor', 'university/faculty' and 'other' as dimensions of the supervisory relationship. Nominal data is discrete data that can be represented by some notation or symbolism without any ranking differences to be established (see for example, the Mayo Clinic CTSA BERD Resource by Hoskin, nd). In this case, each category, while different from the others, is part of and relevant in the overall learning environment. Under each set, the themes were collated to produce condensed embracing descriptive nodes pertaining to the relationship and its context. The process of the NVivo coding leading to the schematic model is shown in Table 7-1 below.

Table 12 The coding process

Sources created	•Qualitative responses and interviews are loaded onto the NVivo software as sources and put into three folders - student responeses, supervisor responses and specific issues responses
First cycle coding	•Emerging themes are given descriptive node names and source material coded at these nodes
Categorisation	•Emerging nodes are categorised into four sets - 'student', supervisor', 'university/faculty' and 'other'
Second cycle coding	•In the second cycle, the first cycle nodes are condensed to produce embracing descriptor second level nodes
Schematic illustration	•A schematic framework is drawn using the second level nodes and the categories

As mentioned before, the thirty-six themes were coded at descriptor nodes in the first cycle of coding. In the second cycle, the first cycle nodes were condensed to produce twenty-six embracing descriptor, second cycle nodes. Table 1 below shows the categories and the second cycle coding nodes as elements pertaining to the teaching and learning environment. These are discussed in more detail in the subsequent section.

Table 13 Categories pertaining to the teaching and learning environment

Category	Second cycle nodes
Student	Attributes, Language and communication skills, Discipline-specific skills and knowledge, Project development, Academic and cultural mores, Academic and professional development, Relocation and settlement
Supervisor	Attributes, Supervision style, Expertise, Industry contacts, Workloads, Cross-cultural awareness, Feedback and advice Knowledge of student support services, Professional development
University/Faculty	Policies, procedures and protocols, Funding support, Discipline pedagogy, Support services for students and supervisors, Research culture
Other	Global competition for HDR students, Global research community, Scholarship funding, Industry funding, Employment opportunities

7.1.1 Second cycle nodes for the 'Student' category

*Attributes***:** As noted by supervisors, desirable attributes of successful HDR students are: the desire and pleasure to discover new things, an enquiring mind, flexibility, good attitudes towards study, working long hours, working independently, resourcefulness, resilience, persistence, motivation and passion about research. Comments from supervisors describing a successful HDR student included:

> *"…is smart, hardworking, resourceful, resilient and persistent".*
> *(Source: Supervisor comments on online survey);*

> *"…is technically skilled, independent and well-motivated".*
> *(Source: Supervisor comments on online survey).*

Language and communication skills: Both supervisors' and students' comments revealed that English language proficiency both for oral and written communication is essential for higher degree research and that international/CALD students' lack of proficiency is often an impediment that affects both the student and supervisor. Even though admission at the HDR level is tied to IELT scores, many supervisors thought that the scores do not guarantee the required level of English for HDR training:

> *"In spite of obtaining the required scores for the IELTS examination, they do spend a lot of time during the initial months struggling to understand and learn language skills to survive after their arrival in Australia. Some of them sought help from university-run special classes (workshops) to supplement their language-learning skills. Students were of the opinion that they would like to have more involvement by way of participation in teaching and tutoring classes, and seminars, so that they have more opportunities for interaction with native (English-speaking) students".*
> ***(Source: Student focus groups discussion transcript. June 2011);***

> *"With some of my other international students, I think writing is the big issue, and I would like more assistance with writing workshops for them".*
> ***(Source: Specific issues transcript. Interview 11)***

Supervisors expressed the expectation that students should be able to retrieve information, synthesise it in English and present it succinctly and clearly to a range of audiences in a variety of formats. As noted below, they would be expected to communicate and deal effectively with a wide variety of stakeholders including administrative entities and bureaucracies:

> *"(They should) know to retrieve information, synthesise same; present succinct, clear verbal and written presentation to a variety of audiences and in a variety of formats. (They should know) how to deal effectively with a broad variety of stakeholders, including administrative entities and bureaucracies (and) to provide potential solutions/mitigations with each critique or identified risk."*
> ***(Source: Supervisor email responses).***

The importance of this was validated in the supervisor survey findings, where nearly 85 percent of supervisors indicated that it was relevant to advise CALD, HDR students on how to improve their linguistic skills. A further 55 percent indicated that recommending language development programs was relevant or highly relevant.

In terms of discipline-specifics students in engineering and IT, there is a need for technical language, visual communication and graphic skills, in order to enable students to present highly abbreviated concepts where simple terminology specific to these disciplines is used to present complex concepts. This however, was not highlighted in the responses even though the literature shows this as a point in case (see for example, Bechky, 2003 and Bucciarelli, 1988). Finkelstein (2000) also explains the importance of technical writing as a fundamental tool for science and engineering: 'It is designed to be objective, direct and precisely defined in an empirical manner…, it avoids the use of rich metaphors and figures of speech, substituting instead precise, empirical data' (p2). The component skills emphasised by Finkelstein, are

technical definition, mechanism description and process description; and common applications are producing technical documents, visuals, technical briefings, electronic publishing and reports, which are the ways in which science research is communicated to various stakeholders.

Discipline- specific skills and knowledge: There was an expectation from supervisors that students come to higher degree study with generic skills for research such as conducting literature reviews; research skills; discussing and analysing reports, data and images; computing,; academic writing; ability to understand the complexity of issues; preparing reports; reading and synthesizing information; time-management; practical laboratory safety, book keeping, use of technology; risk assessment; formulating research questions; writing scientific papers; relating the outcomes of research in the context of a study; breaking problems down into manageable bits; the ability to design experiments; thinking critically and creatively for theoretical formulation and experiment with different options to solve the problem.

As well, supervisors in these disciplines expected students to have discipline-specific, conceptual knowledge and competencies that can be built upon, ranging from basics in general subjects such as high-level mathematics, physics, material Science, Chemistry, engineering, industrial design and computer programming, to theory and specifics in chosen topics such as statistical training, electromagnetic field theories, electronics, electricity, thermofluids, human-computer interaction and information security. Comments from supervisors on their expectations in discipline-specific academic knowledge and technical skills included:

> *"Maths (good knowledge of advanced math), physics, material science, quantum mechanics, solid state and molecular physics, chemistry. Also he (the student) needs to know at least one programming language (including MATLAB or similar programs)";*
> *(Source: Supervisor comments on online survey).*

> *"The fundamentals of the discipline of human-computer Interaction, which they need to learn through post graduate coursework, as undergraduate subjects do not cover in enough detail and incoming students have very variable knowledge. They also need to know how to design and to have a basic design practice based in IT, engineering or industrial design/landscape/architecture etc".*
> *(Source: Supervisor comments on online survey).*

> *"Practical laboratory analytical and field improvisational skills and a key appreciation of the central role of (realistic) logistics and how to generate experimental programs in light of same".*
> *(Source: Supervisor comments on online survey).*

Some supervisors expected students to have interdisciplinary knowledge across other science subjects including biochemical, geological, biological, microbiology, toxicology, environmental management. Additionally, as some students adopt qualitative methods in their research, it was expected that both students and supervisors have knowledge about these. Approaches to social research methods are distinct from those of other sciences. For instance, in contrast to social sciences and the humanities that are 'expansive', physical and natural science research tends to be of a specific focus involving linear processes around technical projects. A PhD in the

natural and physical sciences makes a contribution to the existing stock of knowledge whereas contribution in the social sciences and the humanities can be more extensive and may push the boundaries of existing paradigms (Sinclair, 2004).

Project development: The above discipline-specific skills and knowledge are foundations for project conceptualisation. Other identified qualities for successful project development noted by supervisors were identifying relevant literature, ensuring rigour in research processes including ethical conduct, health and safety of both the students themselves and others in the laboratory, interpreting and building up on results, being involved in wider research activities and engaging effectively with any industry partners. As they progress in their study, building up on their prior knowledge as well as what is gained in the process of research, it was expected that students identify and explain key technical challenges independently in order to progress. A lack of this was noted in the specific issues interviews as:

> *"There wasn't any concept of interpreting the results or what does it tell you, what does it tell about the physics of the situation you are studying and what further tests need to be done as a result of that and what questions does it ask, what new questions the results pose".*
> ***(Source: Specific issues transcript. Interview 10).***

Academic and cultural mores: Related to their HDR work, academic and cultural mores pertaining to students' CALD backgrounds were highlighted by many supervisors. These included: perceptions of hierarchy and formality in the student-supervisor relationship (the relationship in some countries may be deferential and formal address used in communication), pedagogical differences (for instance how to structure arguments, the aptitude to brainstorm, dependence on the supervisor for instructions, the difficulty in understanding the Australian study scheme), reticence in voicing needs such as for resources, open communication. Issues of deference, open communication, being used to having supervisor 'doing things' for you, a text-oriented learning mode, critical ways of thinking as opposed to acceptance of 'expertise' can all influence learning experiences and the quality of the research produced. These emerged in the analysis as:

> *"All participants agreed that culture is a problem. The authority of academics is different here from other countries. Here, discussion is expected between the supervisor and the students. This is difficult for students to accept. They want to be told what to do".*
> ***(Source: Supervisor responses. Workshop April 2011)***

> *"One thing that I found with international students is the logical reasoning is the same but it can be structured quite differently. And they'll come to different points than what we normally [expect them to be structured]. I don't know if that is specific to the international students, it is about learning academic writing. But it does seems to be an issue that comes about quite regularly with international students – the structure of their writing".*
> ***(Source: Supervisor responses. Workshop April 2011).***

Other responses on academic cultural differences, from supervisors included:

> *"Different way of thinking. Different way of writing reports. Difficulty in understanding Australian-English study schemes... A better understanding of the different cultures could be an advantage and an enrichment rather than a disadvantage for the Australian society. Also the way of presenting/discussing the PhD thesis could be reviewed, taking example from other countries".*
> ***(Source: Supervisor email responses).***

Many of these particulars have also been identified in the literature on CALD/international students (see for example, Okorocha, 2000; Taylor and Nigel, 2011).

> *Academic and professional development: Supervisors expected their students to progressively engage in academic and professional development by attending conferences, writing journal papers, attending workshops, and generally be a part of the broader scholarly community. These can be achieved through engagement in activities such as "organizing seminars".*
> ***(Source: Supervisor comments on online survey).***

Relocation and settlement: In the early stages of relocation, international students need some time to get used to not only geographical bearings, but also to a different cultural setting. Additionally for those relocating temporarily with families, looking for suitable amenities such as schools can be time-consuming. Being distanced from family and familiar social circles and often not having the time to interact with others on a social basis can be isolating for international students. Also noted by some supervisors, there may be financial issues that international students are faced with. For instance, students may have to pay fees or supplement their sponsorship stipends with accommodation and other living costs in Australia which may affect their study times. Some comments indicating the isolation felt by international students are:

> *"Students said that they had only a limited social life while in Australia. They had their own country-specific groups, but they hardly mingle with the rest of the community in Australia. They rarely went for a movie, a theatrical performance, or dined in restaurants in Perth. They said that the biggest problem they had was to begin life in Australia, when they first arrived. Some students stayed with their friends; others who had no friends found it very difficult to find an affordable place of stay for the first few days or to move around in the city or find how to commute to the university";*
> ***(Source: Student responses. Focus groups June 2011);***

> *"I think non English speaking students need to interact with native speaking colleagues or*
> *attend some lectures. Research is very lonely job and easily makes people isolated";*
> ***(Source: Student responses. Focus groups June 2011).***

7.1.2 Second cycle nodes for the 'Supervisor' category

Attributes: As identified by both students and supervisors, desirable supervisor attributes are: encouraging, giving guidance, understanding, social, proactive in monitoring progress, responsible, trusting, supporting, receptive to student views, engaging, sustaining interest in student's project and acting as intermediaries between student and other university and faculty staff. This role of the supervisor can be an important aspect of settling in, in the experience of CALD, international students who may have communication issues:

> *"I hope supervisors can play a better role between the research students and the technicians as students are sometimes hard to communicate with technicians."*
> ***(Source: Student comments on online survey).***

Supervision style: A range of styles identified in the literature (see the literature review) from 'hands-on', 'laissez-faire' and 'management' in-between, supervisory styles were presented in the narratives. As noted by students, the supervisory style can affect the teaching and learning outcome of the HDR project. For instance, a 'laissez-faire' approach may make a student independent, but may not necessarily help finish the HDR project in the required timeframe. On the other hand, planning each element of research and asking the student to write brief descriptions of each was seen as time-consuming. On an interpersonal level, students appreciated supervisors who take on a mentoring and pastoral role and make the effort to engage with them outside of the academic relationship:

> *"Understanding and interacting between supervisors and students could be the most important aspect and also these two factors help to build the good relationship which can affect on the quality of research".*
> ***(Source: Student comments on online survey).***

Expertise: Both student and supervisor narratives revealed that knowledge and experience helps in building up expertise, which in turn helps in attracting overseas students as well as supervising students in new research areas. Supervisors that do not have expertise in the particular field may be restricted to contributing more towards the process of developing, rather than the content of the PhD project. In some areas, Australia is leading in research and this attracts students from abroad who have an expectation of benefiting from the expertise. Some comments include:

> *"Strong industry experience - helps with much of the new research area; past experience in student supervision…".*
> ***(Source: Supervisor comments on online survey).***

> *"I am willing to take on students on the periphery of my expertise (e.g. when the original supervisor leaves or other circumstances); this means I am NOT expert in the topic of some of my students, so my contribution is more on the process than on the content in those cases".*
> ***(Source: Supervisor comments on online survey).***

"I have a reputation (mostly from context expertise) that attracts international students".
(Source: Supervisor comments on online survey).

Industry contacts: Supervisors' industry contacts provide funding opportunities for research. These can benefit students who can be given opportunities for developing projects in particular areas:

"As a CI (chief investigator) on large grants, PhD students are an important part of the overall team working on the research".
(Source: Supervisor comments on online survey).

While this can benefit some students, there was some evidence that it may cause a level of 'disadvantage' (*supervisor response*) for others and also that students can be 'exploited' through the use of student skills and knowledge to advance the supervisor's career for instance in this case:

"… and what this Professor did was he wanted the student to work on his PhD and the industrial project at the same time…You can do that, but if you keep on working for the industry more and more you distract from the PhD and this was a big conflict and it dragged on and on and on".
(Source: Specific issues transcript. Interview 2).

Workloads: While in general, workloads of supervisors have increased due to allocation of administrative duties over time, attending to the particular needs of CALD/international students in aspects of assisting with research training and writing as well as providing other assistance can increase the workload of supervisors. The narratives in the specific incident interviews revealed that critical incidents regarding CALD/international students especially impact a lot on the workloads of supervisors and can detract from their completion of other work. The following comments revealed some of the impacts on both the student and the supervisors:

"… if you have a few of those students they slow you down dramatically. You put a lot of effort you can't really see much that's the trouble. You spend a lot of time explaining the concepts, teaching the fundamentals, helping to plan the research, even down to the very detail of the steps you know you do this one two three. You need to produce this figure. It's even worse that I am doing the job, but even then you have all those things and after a few weeks and the time spent and the outcome is still not what you want…".
(Source: Specific issues transcript. Interview 12).

"Sometimes I'm very busy on other issues so it takes time for them to gain my attention when they need it".
(Source: Supervisor comments on online survey).

> *"Much of HDR supervision appears to be one way - we do the work to support increasing numbers of HDR administrators: eg formerly single page (paper) research form is now 9 page on-line form which autopopulates requisite databases and only needs to be printed for permanent record. The former administration overhead (coding, etc) is now performed by me!".*
> *(Source: Supervisor comments on online survey).*

Cross-cultural awareness. Apart from those noted as academic and cultural differences under the 'student' category, many supervisors pointed to social cultural differences that may require cultural awareness and levels of cross-cultural competency in how to deal with such issues. Some of the issues identified in the narratives were: deference for those who are in a 'superior' position or older in age. In especially Asian cultures there is regard for superiors or those older in age; thus students may be reluctant to address supervisors by their first name or accord deference to supervisors. Other aspects of cross-cultural awareness included dietary needs. For example, in the case of Muslims, students may want *halal* food or prayer facilities, or be fasting in *Ramadhan* and need time off to break the fast. Furthermore, gender cultural differences can also be an issue. In some countries there are gender-specific roles for men and women and also rules about male/female interactions. As pointed out in the following narrative, some female students may not be comfortable in communicating freely with a supervisor:

> *"I think particularly Middle Eastern students, and particularly female Middle Eastern students have real issues with gender, questioning. And [equally?] female students and male supervisors … trying to work out the subtle distinctions between suggestions or asking the students to move to some sort of independence – questioning versus what is a directive. I found students have lots of problems distinguishing between those two and taking everything as a directive. But once they take everything as a directive … then inability to question anything. [They honestly feel that] they are not in a position to question anything. But those were students in very early days".*
> *(Source: Supervisor comments on online survey).*

While some of these issues have been highlighted in the literature on CALD/international students as seen in the literature review, the study also brought forth others. such gender relations pertaining to particular regions, that can be of help in better understanding the particular needs of students from different regions.

Feedback and advice. As part of the supervisory obligation to further the study project, as well as to ensure that the student is making adequate progress, some students emphasise the need for regular and constructive precise feedback.

> *"Supervisors should regularly be cross checking the progress made by the student'.*
> *(Source: Student comments on online survey).*

> *"Supervisors should provide very constructive feedback and give very specific advices".*
> *(Source: Student comments on online survey).*

Knowledge of student support services. In response to the changing student demographics, there are many support services available for students. This project has identified support for students in the areas of administration, academic resources, language and social for students and supervision for supervisors. An awareness of these can help supervisors provide the support needed for issues common to all HDR students and those particular to international CALD students. The importance of this was highlighted in the supervisor responses as:

> *"When my student is facing serious personal issue which directly affects his/her PhD progress, where can my student seek for advice (other than counselling)? Also, what help can I offer (other than advising student to take Leave of Absence and who can I discuss the student matter with?"*
> ***(Source: Supervisor comments on online survey).***

Specific issues and the types of support sought by supervisors in the particular circumstances are discussed in the specific issues analysis following this section.

Professional development: As mentioned previously, there are supervisor support services available at the three institutions and training workshops are conducted at intervals. Web-based resources giving guidelines as to the role of the supervisor are easily accessible to both supervisors and students. The courses and guidelines provide supervisors with the skills needed in their own disciplines for example, running research laboratories and health and safety in the workplace. As well, they provide them with different insights into supervision.

7.1.3 Second cycle nodes for the 'University/Faculty'

Nodes in this category relate to the broader learning and teaching environment in which the supervisory relationship is situated.

Policies, procedures and protocols. Various policies, procedures and protocols emerged in the approaches in how international students may gain entry into an Australian university and how they are supervised. In the case of UWA, there are three ways in which HDR international students are recruited for admission into the university[13] (including Curtin and QUT)

- Research based candidates - potential candidates are generally found in universities and other institutions. They may contact potential supervisors or the Graduate Research Office requesting for supervision or research opportunities.
- Students may be recruited through the research linkages established by research centres and individual staff particularly through study leave and other visits to universities overseas.
- Recruitment is also closely tied to the availability of scholarships. Ranking of scholarships may be institution specific, but is usually based on publications, academic achievement, research environment and English proficiency.

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[13] Personal communication with various stakeholders at UWA

These direct and indirect approaches were also evident in the narratives:

> *"…they have to satisfy the entry requirements and that is the International School's responsibility. So there is a direct approach also, the direct approach also happens but sometimes a prospective student just emails the school, say they are interested in coming here or the faculty and that is my area and are there any opportunities and they often get passed on to heads of school and the head of school then see who is interested".*
> *(Source: Specific issues transcript. Interview 10).*

Funding support. Another aspect highlighted in the learning environment was funding support for the research. Economic imperatives that may lead to restructuring of departments can impact on the availability of funds for research in particular disciplines. This may mean that there are limited funds for support of HDR student project-related expenses and a competition for resources may mean that some students lose out. In some cases it appears that supervisors may have to fund aspects of the research and that puts a pressure on the supervisors

> *"Appropriate funding is important to support students plus supervisors. It is not realistic to expect supervisors to fund their own research and students and do teaching with increasing number of students".*
> *(Source: Supervisor comments on online survey).*

Discipline pedagogy: As noted at the 'student' discipline-specific skills and knowledge node, HDR research in the discipline requires skills and knowledge that are a part of the discipline pedagogy. These are endorsed and supported by the university and faculty. The expectation of supervisors was that their students come to study with the preliminary knowledge in the particular subjects and that the process of teaching and learning is built upon these. It was noted in the analysis of the specific incidents that some students do not have the foundational knowledge upon which to build their projects. A suggestion by a supervisor to improve discipline pedagogy was to include a component of coursework in the PhD tenure:

> *"If we could include a component of course work in that particular subject that is related to the project, the students can leverage on what is learnt in the unit to benefit their project. It is not only about the process of getting the basic knowledge, it's also about the process of submitting assignments, how to write assignments that can be of good use. This can be part of the candidature milestones that we set at the beginning of the candidature".*
> *(Source: Specific issues transcript. Interview 9).*

Support services for students and supervisors: Also noted in the discussion of nodes on support services for both students and supervisors, there are various services provided by the university for HDR research training. These are an integral part of the academic and social provisions made to both students and supervisors.

Research culture: An overall research culture is created through the abovementioned areas. For example, policies, procedures and protocols, determine how international students gain entry into the university, the allocation of work to supervisors in addition to other duties establishes the amount of time available for research training and feedback, opportunities for academic and professional development for both students and supervisor help develop the skills needed for successful outcomes in research. The research culture can also be affected by administrative procedures that can help or hinder the research progress for example:

> *"Extensive bureaucracy in university administration (student-related) was highlighted as a discouraging feature inherent in the existing university system. This was also pointed out as the issue when dealing with technicians and the workshop manager in laboratories for hardware fabrication involved with setting up of experiments, computer repair, renewal of software licenses, other IT-related support staff work, and when obtaining safety/ethics clearances. However, they were very happy with the research support services provided by the library."*
> *(Source: Student responses transcript. Focus groups June 2011).*

7.2.1 Second cycle nodes for 'Other' category

The nodes discussed in this section are the elements that are outside of the immediate learning environment. As the coding continued these also emerged as an essential part of the HDR learning and teaching environment.

Global competition for HDR students. The preference for an Australian higher education is evidenced in the growing number of students coming to the three participating universities. Some of the reasons identified by students for choosing Australia as a destination for study included:

> *"*
> - *to carry out study and research in an advanced university that can provide higher academic standards and resources;*
> - *better value for their time and effort;*
> - *geographical proximity to their homeland; and*
> - *a better quality of life. Those who had plans to return to their homeland expressed confidence in their enhanced 'status' on their return to homeland because of an Australian higher degree".*
> *(Source: Student responses. Focus groups June 2011).*

However, supervisors were concerned about the global competition for HDR students, identifying the need for more funding and support to attract more students. To be competitive in the sector, Australian universities need to have established amenities to facilitate a smooth and enjoyable experience of HDR studies:

> *"It is not possible to attract more HDR students without funding and support. The student experience depends on good facilities and we do have these".*
> *(Source: Supervisor comments on online survey).*

There is evidence in the narratives that local students may not be interested in pursuing HDR studies and that there may not be enough scholarships to maintain the numbers of international students. Also many CALD/international students' bids for enrolment may be turned down because of a lack of English proficiency. Other countries that have less stringent rules on English language pre-requisites may benefit from this. Some suggestions from supervisors are to relax English proficiency rules and include English language studies as a part of the HDR tenure:

> *"Take on students who have less proficiency in English and work towards …to increase the numbers of high performing HDR students we would be better to take more students with weak English and teach them English skills".*
> *(Source: Supervisor comments on online survey).*

Global research community. One of potential advantages of supervising international students is that it presents a good opportunity to be a part of the global research community and make breakthroughs in areas that may not be accessed otherwise. As indicated by supervisors, supervision of international students assists in "*increasing scope of research, publications and dissemination",* extending the supervisor's reputation and helping broaden the base of research possibilities. While it may demanding in the extra time required, it is also rewarding in connecting the university to the broader global research community:

> *"The extra time involved in supervision makes it hard for me to complete a number of draft journal articles, and to apply for and work on grants and tenders. On the plus side, I have been able to publish in areas I was finding it hard to break into through my CALD students".*
> *(Source: Supervisor comments on online survey).*

> *Accepting international CALD students may indicate willingness to "to carry out collaborative research with other countries".*
> *(Source: Supervisor comments on online survey).*

It also increases the number of overseas students applying for postgraduate scholarships to study at Australian universities. Research relationships established through supervision may continue after the studies are completed and the ties become a part of the global research community.

Scholarship funding. As mentioned before, recruitment of HDR students is also closely tied to the availability of scholarships. At UWA, QUT and Curtin there are a range of scholarships, Aid, International Postgraduate Scholarship and other specialist programs such as Fulbright, help enlist students. Students are also recruited through international government scholarships that are managed by education attaches and embassies, for example, DIKTI (Indonesia) and the Ministry of Education Public Service for Malaysia, Saudi Arabian Cultural Mission (SACM),

Brunei Dar us Salam, Chilean scholarships, New Iraqi government Ecuador scholarships. Another source is private sector scholarships which are driven by the faculties. Scholarships are fully funded by the government or private business, such as Petronas[14]. In some cases however, it is found that scholarships may not be adequate in providing for students' needs financially, as well as in the time limitations stipulated for stay in Australia. The following comments indicated that it takes longer than three years to complete a PhD (which is also demonstrated in the empirical data on mean time to completions at the three universities) and more financial support is needed for a 'quality' PhD:

> *"more scholarships for international students; particularly support for them to complete in longer than 3 years which is insufficient for a quality PhD".*
> *(Source: Supervisor comments on online survey).*

> *"The financial support such as scholarships/fellowships to HDR students also needs to increase".*
> *(Source: Supervisor comments on online survey).*

> *"Students also need to live and thus need appropriate scholarship funding especially from the poorer nations".*
> *(Source: Supervisor comments on online survey).*

As some scholarships do not cover living expenses, supervisors may need to find living allowances for their students.

Industry funding. Funding opportunities are often provided by industry for collaborative projects resulting in industry backed technological advances. The narratives show supervisors' views on some of these, as supporting the research work at their universities:

> *"The level of research is not high in my area as compared to US and Europe mainly due to current existing environmental regulations differing. In Europe environmental issues receive more funding than in Australia".*
> *(Source: Supervisor comments on online survey).*

> *"Research in engineering in Australia needs a lot of improvement. For example, industries and Government must provide more funding opportunities for research";*
> *(Source: Supervisor comments on online survey).*

> *"In my area the local context is leading the global one - Australians are ahead of the curve".*
> *(Source: Supervisor comments on online survey).*

> *"Road safety in the global context - the main problem is a lack of funding opportunities which then results in a lack of research into road safety in developing countries".*
> *(Source: Supervisor comments on online survey).*

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[14] Personal communication with various international student support stakeholders

Employment opportunities. While it may be assumed that investments in higher education would be to further economic and financial prospects, some supervisors did not necessarily see this as the case for doing a PhD:

> *"…the first thing I asked was why you want to do a PhD. You understand that it is not going to help you get a job. A lot of people who want to do a higher degree like Masters or PhD because they think that it's going to get them a better job and it doesn't, not in this country. It makes no difference whatsoever. Thing is if you want to work in industry that is the worst thing you can do. So I was concerned that this fellow thought if he did a PhD that it would help him get a job straight away…I have said to a lot of people that all sorts of career ambitions you have, a PhD will not help you".*

On the other hand, others were concerned over the fact that there is an expectation from them in managing the student's job prospects once the degree is completed; that the topics of research should be of relevance to the economic situations in home countries to be effectively utilised:

> *"Managing the uncertainty as to the student's job prospects once the degree is completed".*

> *"securing an academic job for good students (the ratio students-available jobs is in great disarray".*
> ***(Source: Supervisor comments on online survey).***

> *"Relevance of topics and findings to situations in home societies".*
> ***(Source: Supervisor comments on online survey).***

The above sections have documented the coding at the four categories identified in the qualitative examination of the data. The factors that influence the HDR learning environment have been discussed to understand some of the nuances and features of these factors. Based on the categorisation and second cycle coding as shown in the above, the illustration below in Figure 7-1 shows the learning and teaching environment as an interaction of the student and supervisor relationship, situated in the broader context of the university/faculty and affected by elements exogenous to this relationship.
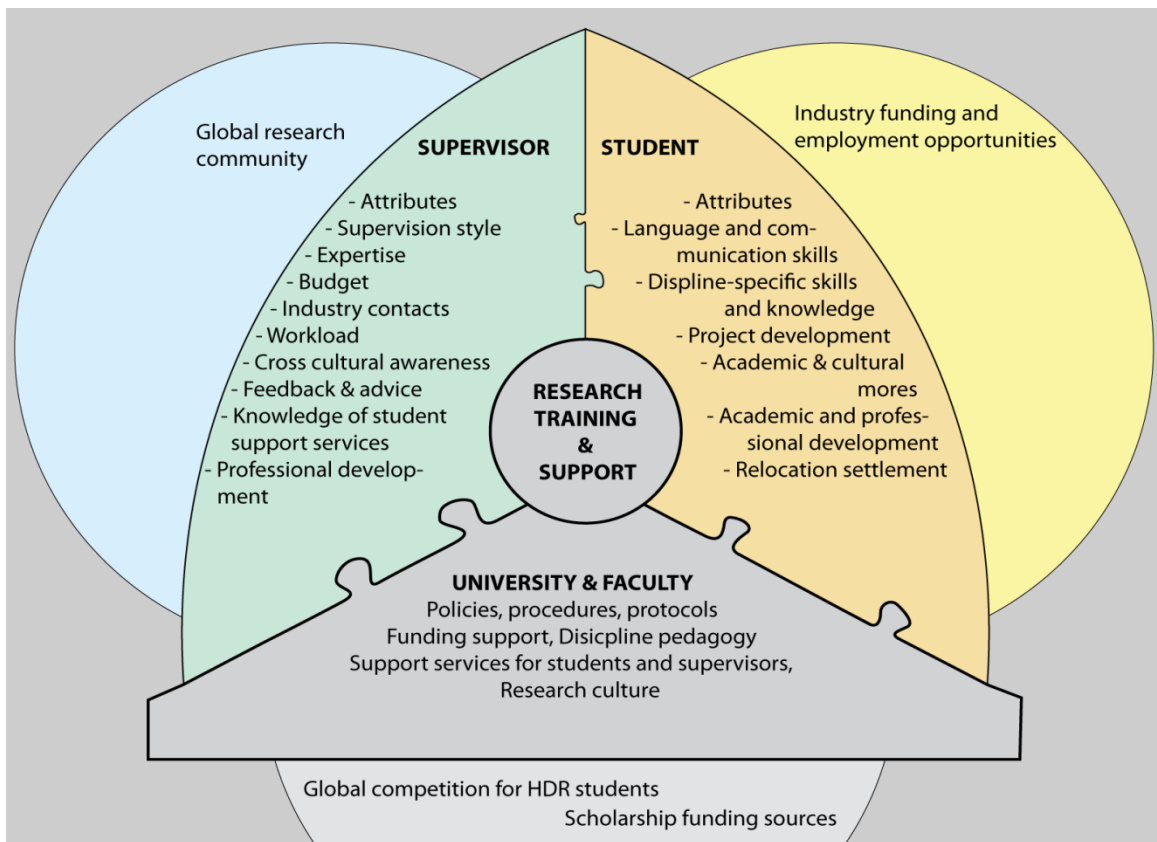
Figure 28 Engineering and Information Technology HDR learning environment

7.2.2 Illustration of engineering and information technology HDR learning environment

The qualitative data analysis above complemented the findings of the survey data. Additionally, it provided support for the suggestion that that the factors that influence HDR studies can be categorised into four areas; that of the 'student', the 'supervisor', the 'faculty/university' and 'other' which is external to the immediate learning environment.

With regard to the student, it was found that attributes, in addition to discipline-specific skills and knowledge, project development, academic and cultural mores and academic professional development, emerged as key factors influencing the performance of the students. However, issues related to relocating to Australia were also presented. For instance, HDR students are often accompanied by their families and may have to be well-informed about housing and schools for their children. In addition, they may have religious or cultural dietary needs that would have to be catered for.

Factors relating to the supervisor also included attributes, however the supervisory style, expertise in the research area, the budget, industry contacts, workloads, feedback and advice, professional development, knowledge of student support services and cross-cultural awareness also presented as relevant in the supervisory relationship. Supervisor attributes and styles are

different and whereas some may feel that that their role is limited to academic issues, other supervisors may be willing to go further to support their students by providing pastoral care needed during the candidature tenure. Besides academic issues such as feedback, advice, workloads of the supervisors, the knowledge of support services is a vital part of propping up the relationship when academic or social issues arise. Besides that cross-cultural awareness helps to bridge the differences that may exist in academic and socials conventions between the cultures of CALD students' countries/regions of origin and that within Australian universities.

The framework situates the supervisory relationship within the institutional arrangement of the faculty/university and is maintained by it. Policies, procedures and protocols, funding support, discipline pedagogy, support services for students and supervisors and research culture are highlighted as influencing the supervisory relationship. These elements shore up the supervisory relationship in defining its institutional structure and giving it financial and other support. Outside of these, the 'other' dimension revealed exogenous elements that have a bearing on the supervisory relationship. For instance, international research networks as well as the development of industries abroad attract students from abroad; industry funding is seen as crucial to sustaining research work; scholarships provide a stream of sponsored students and global competition for HDR students ensures focus on quality.

While many of the above factors have been highlighted in the literature on HDR studies, some of these are specific to CALD/international students, and their influence on the overall performance of these students needs to be studied further to get a better understanding of how to improve support for these students.

7.2.3 Project Limitations

Limitations of the qualitative analysis includes the use of unstructured data from a number of different sources which makes it difficult to run specific queries to establish an ordinal or numeric order in what is significant in the supervisor-student relationship and the learning environment. Also, multiple references are coded from one source in the case of focus groups and workshop contents, as the data sources cannot be broken into consistent bits to give responses of particular students or supervisors.

Limitations of the surveys included a smaller number of participants for the supervisor survey, which limited the statistical comparisons with the student surveys (and limited the statistical analysis). The lack of demographic information in the student survey limited the ability to identify the home institutions of participants to assess possible impacts of discipline, institutions or program on responses. There were no inherent links between the students who completed the surveys and the supervisors who completed the surveys. There are no inherent links between the cited completion data and the student or supervisor participants in the survey. Not all supervisors were necessarily from engineering or IT, and participation varied by institution.

7.3 Part 2: Specific Issues

7.3.1 Method

In the last phase of the project, twelve interviews with supervisors across the three universities were conducted to uncover what kinds of critical issues or incidents supervisors have to deal with, with respect to international/CALD HDR students. The interviews used a semi-structured questionnaire to examine the sorts of issues supervisors come across, what stages these incidents may occur at, whether they are related to the cultural and linguistic backgrounds of these students, what solutions are sought, and how these issues may affect the supervisor. The questionnaire was also designed to investigate what support was sought by the supervisors and how satisfactory this was; as well, it asked about what suggestions the supervisors have to offer to help mitigate such issues. While the purpose of this data collection is to supplement the data generated in the supervisor and student surveys, it also complements the other phases of the project; it will be used to create an activity resource that will help potential supervisors learn about issues encountered by supervisors and what strategies are used to skilfully assist international/ CALD students.

The analytical process also involved using NVivo software where the transcripts of the interviews were loaded as sources. Nodes were then created for each area of enquiry and the transcribed responses coded at the nodes. The coded material was then examined to see the pattern of responses.

7.3.2 Findings of specific issues analysis

All but one, were principal supervisors having a major role in the supervision process. The areas of supervision presented were in a variety of fields including heat transfer, material sciences, civil engineering, structural engineering, mechanical engineering and network security. Nine supervisors mentioned that the student/s they had experienced a critical incident with, came to study on a scholarship. The varied countries that the students came from included Bangladesh, India, Sri Lanka, China, Indonesia, Taiwan, Iran, Philippines and Malaysia.

The majority of the incidents were reported to be around mid to late candidacy. Four supervisors related having to deal with English language proficiency issues; however this was also compounded by students not having good background knowledge in the topics they had chosen for their PhD projects, as well as poor research skills. Other critical incidents were around matters concerning a complaint about hygiene, student dissatisfaction with the principal supervisor, relationship issues, ill-health, and family financial responsibilities.
The responses to whether the issues were language and culture related were regular and presented as a hierarchy in the supervisor-student relationship, international students losing out because they are not vocal enough in asking for resources, different learning styles, and the need for assistance in English language. However, the supervisors also pointed out the shortcomings of the 'vetting' systems that allow students to gain entry into an Australian university. These related mostly to scholarship-awarded students. For instance, one narrated

that '…*some students get government (foreign) stipends and they are not really selected according to merit exactly and this was not picked up in the vetting process… The student just did not have the background knowledge in the field of study. At that level you do not have the time to start with the basics*' (interviewee, 9). Various types of support were sought including peer support, counselling, language, technical, administrative, the International and Graduate Centres.

As to whether the support was satisfactory, the responses generally positively indicated that most supervisors were satisfied with the outcome. In cases where the outcome was not satisfactory for the student, according to the supervisors, if the matter had been resolved in favour of the students (by allowing them to continue doing their PhD), it may have been lowering academic standards, which would compromise on quality HDR education. In one case, the student, because of the lack of foundational knowledge in the area, was asked to convert the project to a Master's study, in another the student was asked to discontinue. Because of the financial investment and the prestige that a foreign education is valued for, this can be detrimental to an international student's social status, but on the other hand, allowing the student to continue may be negotiating Australian standards and downplaying the value of the HDR degree. Several suggestions were made to help moderate the issues including introducing compulsory units on research skills within the candidature tenure, more funding for assistance in academic writing and technical drawing, better coordination of support services, supervisors keeping informed about support services available to students and a strong vetting system at entry level for HDR students.

Regarding whether the incidents affected the supervisors in any way, all the responses reveal that such incidents add to the workload of supervisors, they can be stressful, time-consuming and can slow other work down and most of the participant supervisors would be wary of taking on international/CALD students. On the positive side though, the responses also reveal that the efforts are rewarding, as international/CALD students are hardworking and diligent – '... *In general, compared to domestic students, international students work harder to reach their goals or complete their studies…it is very rewarding to work with diligent international students*' (Interviewee 5).

7.3.3 Conclusion

The specific incident analysis finds that in some cases there are particular challenges that supervisors in engineering and IT face in supervising international/CALD students. Some are related to cultural and language differences, others are due to a lack of foundational knowledge in these disciplines, including practical abilities needed for experimental work. Yet others related to the processes through which HDR international students gain entry into the university. This rich source of data was used to develop the following learning resources – the Online Critical Incident Case Studies Resources and, incorporated with the institutional data obtained on support services, a Training Workshop template to help supervisors to improve their supervision knowledge base.

7.4 Online Critical Incident Case Studies Resources

This document sketches the format and describes the content of what a specimen online resource for HDR supervisors in engineering and IT at Australian universities can be presented as. It is developed from the findings of the ALTC/OLT research study PP10-1771, '*A holistic model for research supervision of international students in engineering and information technology disciplines*'.

7.4.1 Purpose

The purpose of the online resource is to link supervisors to information that they would find useful in case of critical issues arising, during supervision of CALD/ international students. However, it is likely to have an extended target audience.

7.4.2 Target audience

The target audience would be:
- supervisors who need assistance in addressing specific issues;
- trainers working with novice supervisors;
- graduate research coordinators; and
- other interested stakeholders.

7.4.3 Intended Outcomes

The resource aims to assist the audience to:
- develop an insight into what sorts of critical issues can arise in the process of supervision in engineering and IT;
- discuss practical suggestions on how to handle the difficulties that can arise in the supervisor-student relationship;
- encourage supervisors to reflect upon how to handle such situations; and
- encourage participants to reflect upon how their universities are equipped to handle similar situations and what they need to explore in terms of support initiatives for both supervisors and students.

7.4.4 Key activities

The key activities in the resource are:

- active learning exercises through case studies scenarios,
- questions to prompt discussion and test existing awareness, and
- self-reflective exercises to generate further insight.

7.4.5 Content source

The content is sourced from the qualitative research findings of the project. Twelve interviews were conducted with mostly principal supervisors of CALD/international students who shared their experiences of dealing with specific critical issues during supervision.

7.4.6 Contents described

To ensure the anonymity of both the participant supervisors and their universities, the contents of this resource are sketched by modifying the actual narratives of the supervisors who were interviewed to create hypothetical scenarios. To maintain anonymity, the students and supervisors have both been given pseudonyms and the countries of origin have been changed. The contents are three case studies where supervisors came across 'critical' issue/s regarding an international/CALD student/s during supervision. The case studies showcase how the particular supervisor dealt with the issue and what sort of support was sought and availed to the supervisor.

Case study 1: Ahmed, a very competent HDR student from Sri Lanka comes on an Australian Commonwealth scholarship to do his PhD under Professor Maan, a prominent academic in Heat Transfer. He is asked to work on an industrial project on which Professor Maan (the principal supervisor) is a lead investigator. Professor Maan makes tacit arrangements with him regarding doing research on the project and publishing a number of papers from the work and Ahmed does not think he is in a position to question these arrangements. No remuneration for the work done or the time allocated outside the PhD project on the industry project is discussed. Six months later, the amount of time Ahmed spends working on the immediate needs of the industry project starts to significantly affect his progress on his PhD studies. Ahmed begins to confide in Dr Aryasiri, the associate external supervisor (who is affiliated with another university) about these troubles and as things worsen with the principal supervisor, Dr Aryasiri is asked to assist more and more:

> *"And this boy used to call me every time saying that it's become extremely difficult to work…"*

Ahmed's frustrations are exacerbated by the lack of attention to his written work; any written work submitted to the Professor Maan is not returned on time as promised, and when returned there are a lot of corrections Ahmed is asked to make. Unhappy about the situation, Ahmed asks Dr Aryasiri if he can transfer to his (Dr Aryasiri's) university and continue the scholarship there. This is can only happen if Professor Maan, as the principal supervisor authorises the transfer. Ahmed does not think Professor Maan will support the transfer. Believing that things may worsen if he asks for the transfer and is refused, Ahmed does not approach Professor Maan for a transfer.

Meanwhile, Dr Aryasiri finds out that Ahmed got divorced just before coming to Australia and he is emotionally quite vulnerable. This emerges over the conversations he has with Ahmed as he assists him with his work:

> *"He used to cry over the phone to me and say please help me. I was giving him technical advice, so I used to (go to his university) to talk to him while I set up his design and apparatus, check the drawing, supervise workshop fabrication workshop… I used to spend a lot of time to see these things are being done properly… I knew this guy is emotionally very weak …the student had a lot of issues since his wife divorced him because he came to Australia to do a PhD."*

Around eighteen months into the candidature, things come to a head when during an altercation, Professor Maan asks Ahmed to '*get out of the room*'! On hearing about this, Dr Aryasiri sends a strong email to the principal supervisor cautioning him on Ahmed's emotional status and the need for counselling. Ahmed is sent for counselling and receives a lot of support from the counsellors and other university student support staff. Things stabilise as Dr Aryasiri helps Ahmed with his project work and they aim for joint publications together with Professor Maan. As Ahmed draws towards the end of his candidature, Professor Maan accepts a position at an overseas university without informing Dr Aryasiri. The university also does not inform Dr Aryasiri about the Professor's resignation:

> *"He didn't even have the courtesy to send me an email or call me and say look I have got a position. About a week or so before he left, he called me and said you know from the student that I am leaving… and the university never informed me".*

Ahmed finishes his PhD and the thesis is sent for examination and the examiners' reports are approving, with minor corrections asked for. However, as he is still the principal supervisor, Professor Maan does not allow Ahmed to submit the final version until a few publications are sent out. This continues until Ahmed makes an official complaint as his visa is running out. It is at this point that a change in the principal supervisor is made at the university. Dr Aryasiri is then asked whether he is happy with the corrections and the final submission is made and Ahmed is allowed to graduate.

Questions:

- What is the role of an external supervisor and how clearly are supervisory roles in the engineering and IT disciplines defined at your university?
- Can you identify any cultural specifics that may play a role in this story? Do you think that this could happen in the case of any student, not just an international/CALD student?
- Can you suggest issues not mentioned in this case study that could have made the situation even more difficult to resolve?
- Identify guidelines or policies at your institution that would help with these other issues. (for example, a dispute over the ownership of intellectual property emerging from the industry work, such as commercial rights coming from patents).
- Explain what if any action you would take if you were in the place of the external supervisor at the first stage (within six months); at the second stage (eighteen months) and at the last stage. Why would you take that action?

Case study 2: As a student needs to run some tests and would like to use equipment in the Material Sciences' laboratory, Dr Diana Foster, an expert in the field is asked to get involved in an HDR project in the Faculty of Science. As the supervisor from the Science Faculty 'drops the ball', although playing a minor role as an associate supervisor in the arrangement, Dr Foster soon finds herself as the principal supervisor to Chen, an international student from Vietnam. Dr Foster discovers that Chen has been in Australia working towards his degree for nearly 18 months. His initial project was in Dental Microbiology where he was looking at dental bacteria

that cause cavities. His new project is focused on additives to filling materials that can help resist bacterial action. Unsatisfied with two supervisors at the Dental School, Chen went to the School of Science to establish the new project. As the focus of the project has changed so has the discipline; the project is now situated in the material sciences area rather than the life sciences discipline.

Chen has little foundational knowledge in material sciences and Dr Foster has to frequently coach him in the basics of the discipline. She also acts as a laboratory assistant to get him to understand what he is supposed to be doing during experiments. What concerns Dr Foster is that Chen is treating the PhD project like a student laboratory session; he expects to always be told exactly what to do and just writes the results of what he observes. Chen does not seem to be capable of interpreting the results independently or appreciating what the results tell about the physics of the situation that he is studying; what further tests need to be done; and yet what new questions the results pose. He does not seem to be aware of the need to assess the repeatability of results.

She also realises that Chen may be doing the PhD for the wrong reasons. She feels that Chen thinks that getting a PhD from a foreign country like Australia will help his reputation. She describes her impression of this as:

> *"since he has the scholarship from his home country, he is basically paying for a degree and so why can't he come and do the work, write a quick report and get the degree qualification…"*

When she looks at the scores in his academic transcripts, she feels that he should not have been accepted as a PhD candidate. She suspects that his problems were not noted in the past annual reports and that is why the issues were not raised. This could be because supervisors may be reluctant to write something negative about a student:

> *"I suspect that many supervisors do not put anything in the annual report because the report has to be read by the student too. Whatever the supervisor writes the student can see. People are reluctant to write something negative , but they should, it can become a big problem in the end…I have been a mediator and problems can arise and the standard defence of a student is well, why wasn't it picked up earlier or why wasn't I told earlier and why didn't the supervisor mention it earlier. So the supervisor has to be proactive in identifying things and not be accused of not taking action".*

While she knows she has to take action, Dr Foster finds she is faced with a quandary of balancing the student's interests with those of the university. Her understanding is that if a student from Vietnam gets a government scholarship to study overseas, but does not manage to complete the degree, he may be in serious trouble. The student may lose face and status as well as have to repay the scholarship money and that could be a really difficult situation. The trade- off, on the other hand, would be to lower academic standards and allow a student to continue and graduate because he is going to be in social and financial difficulty. Unsure of how to fully handle the situation, she approaches the manager of the HDR office, Dr Tan, who is very supportive and works closely to resolve the issue.

Together they have an initial discussion with Chen to explain the situation and talk through options such as continuing at a Masters level or terminating the candidature. Chen is very defensive as well as upset at this suggestion and says he will think about the next steps. A week later, Dr Foster gets a call from Dr Tan that Chen has involved the Vietnamese Embassy and that she is required to attend a meeting with an attaché to explain the situation. While Dr Foster is apprehensive about the level which this matter has reached, she is also firm in her resolve that the options given to Chen are reasonable given the circumstances. The meeting with the attaché is quite tense and though she feels uncomfortable in the situation, Dr Foster puts her case to the attaché based on the records available to her. Together with Dr Tan who is Chinese and uses Asian cultural protocols to convey the message appropriately, she is able to carefully persuade Chen and the attaché that continuing on with the degree would be a time-consuming affair. She explains that Chen simply does not have the knowledge on which to build up a PhD project in material sciences as he is even struggling to evaluate information and data from the literature and the experiments. After a lengthy defence, Chen decides he is not going to continue with the project and settles on terminating his candidature.

Questions
- At your university what processes facilitate variations in candidature and what is involved in transferring from one discipline to another or an interdisciplinary project?
- How would you deal with the student's lack of preparatory knowledge in the area of research?
- How are issues that involve termination of candidature for a scholarship recipient handled at your university?
- Could Dr Foster have acted differently to avoid the difficulties involving the Vietnamese Embassy?
- How would you deal with the situation if you were in the place of Dr Foster?

Case study 3: Professor Ho is working with Selina, an HDR student originally from Columbia who got her permanent residency in Australia last year. Selina is hard-working and an eager student; however she is challenged with the lack of proficiency in English language, as well as a sound knowledge in her chosen field of research which is Vibration Control. Her technical background is far behind what Professor Ho would expect of a PhD student. On checking her background, Dr Ho learns that since she obtained her Masters' degree from an Australian university, Selina was awarded a scholarship largely because of the quality of her thesis. He also finds out that her Masters' supervisor put in a lot of effort in helping her write up the thesis:

> "I think what happened is once the student gets into our system, supervisors are very kind. They will do their best to help the student including try to polish their theses so that they can help them to go through. Once they go through, it looks like a high quality thing, but in fact whether the student learnt the skill, only the people who work with them would know that. So that's something you never know. We do have high quality students. In the meantime the weaker students do get through the system… if a student fails it's not good for the student, not good for the university".

While Professor Ho has to spend a lot of time explaining concepts, teaching the fundamentals of the topic, helping her plan the research to the extent of going through the process of detailing the steps to take in setting up an experiment, he is not willing to give up on Selina as he reckons that when you have a large number of PhD candidates, you will always have the "two ends" and "so you need to deal with both ends". He would also like to see a range of options in higher research education like in the European countries where if students are halfway then they are offered something between a Masters and PhD like an MPhil which some Australian universities do not offer.

As Selina is still in early candidature, at this stage Professor Ho thinks it is a good idea to suspend the candidature and recommends two units that Selina should take to bring her up to speed in the subject. She is enrolled on two postgraduate (Advanced Control engineering and Vibration and Signal Processing) and one undergraduate (in research methods) units to help leverage her studies. Despite this, and other additional support, he finds that she is still struggling to do things in a "professional manner" in terms of thinking critically and applying the knowledge learnt, independently.

> "I would reckon it's her background and knowledge and also to learn how to do all those things in a professional way… you cannot pick them up in a short term especially for those who lack this kind of training starting from the undergraduate level. But somehow they managed to get into our system so then if we really want to let them become one of the PhD students and successful then that needs time".

However, Dr Ho feels that his efforts have not been wasted as Selina is now preparing a conference paper.

Dr Ho shares that he is usually very careful about the vetting process of future students, especially those who approach him directly. In addition to asking for a CV and publications, when a student contacts him for supervision, Dr Ho usually does the following:

- Asks questions such as: Why do you want to do a PhD? Do you understand what is expected of you?
- If he thinks the student is capable, he directs the student to his website and asks what project the student would like to work on, and
- Sends a few papers on the subject and asks the student to write a summary, to identify what the papers are telling the student and what can be built into the project.

He also recommends that prospective supervisors be more involved and perhaps be a part of a committee that evaluates students' capabilities to embark on PhD studies. He cautions that some students who have difficulties writing in English may be adept at copying the style of an academic journal paper and substituting appropriate, but different words and references in order to construct their research proposal and literature review. He gives the example of a research proposal that he has come across where working from this original:

> "Object categorization is also related to our work as objects in the same category often share similar placing patterns. Categorization in 2D images is a well-studied computer vision problem. Early work (e.g. Winner et al 2005; Seren et al 2004; Fergus at al 2003;

Burke et al 2005) tried to resolve shape and orientation variability, limited by a single viewpoint. Motivated by this limitation, multi-view images were considered categorizing 3D generic objects by connecting 2D features (Thomas et al 2006; Murray et al 2007)",

the student, constructed a new paragraph for his (student's own) literature review:

"Object symmetry marking is also related to previous work as objects in the same category often share similar symmetry patterns. Symmetry marking in 2D images is a well-studied computer vision problem. Early work (e.g. Winograd et al 2001; Kovesi et al 2004; Brady at al 1983; Paul et al 1999) tried to resolve symmetry axis orientation variability, limited by a single viewpoint. Motivated by this limitation, multi-view images were considered for symmetry marking of 3D generic objects by connecting 2D symmetry axis orientations (Chen & Xao al 2000; Weibao 2010).

Impressed with the quality of the academic writing by the student, the research proposal was accepted and the student candidature was confirmed. It was only 18 months later that as the student started to prepare draft chapters for the final thesis that the true writing ability emerged. The student was unable to prepare adequate descriptions of his own work and the resulting thesis required numerous changes by Dr Ho even before it reached the stage where an English proof-reader could correct grammatical, punctuation, consistency and other errors. Thus, Dr Ho strongly advises that it is better to thoroughly identify the capabilities of the student as early as possible as it can impact on the time the supervisor needs to spend with a student and the outcome may not be favourable for the student:

"the easiest way for the supervisor is to identify the problem as soon as possible and or identify the problem through a committee… the longer it lasts the harder it will be. However that is the best for the supervisor, but it may not be the best for the student. Some students can be slow. I know of an Australian student – he took sixteen years to finish his PhD, then that would be a very good thesis! I would reckon for the international student…this (Selina) student was an international student, and then became an Australian student, and then in a way that's the solution. But if she/he is still an international student, the student would not be so lucky".

Questions:
- What processes are in place at your university with regard to the pre-enrolment, vetting of HDR students?
- What are the potential benefits of the action Dr Ho has taken in recommending Selina take the post/undergraduate units?
- How would you respond to an international student who requests to be enrolled under your supervision? How would you make sure that the work a potential student sends you is his or her own?
- In your opinion how do IELTS scores relate to HDR students' English academic proficiency? How would you assess the ability of a student to write at an appropriate standard in the first six months of candidature?
- What support is available in your institution for a student experience in the kind of difficulties and challenges described in this case study?

7.5 Training workshop template

This training workshop template is developed to present the results of this research through hands-on activities. By attending the workshop, participants will learn about the different success factors that have emerged from this research, through a series of activities based on the findings of the research. In our investigation, we have found that personal factors as well as institutional support structures play an important role in international students' academic and social acculturation in Australia. We have encountered several myths relating to international higher degree research students; it is important that stakeholders have access to empirical data to help dispel these myths. Through the activities based on the research, we anticipate that participants will learn about successful supervision strategies and other ways in which supervisor- student relationship can be supported.

7.5.1 Activities

There will be three components to the workshop:

1. A PowerPoint presentation that gives an overview of the project and outlines the results of data analysis on the two surveys conducted to uncover student and supervisor perceptions of the student-supervisor relationship.
2. The next activity will be working with a comparative table of student services made available to the participants. In this activity, the participants will be asked to work in groups. For the first five minutes, they will be asked to peruse the table and identify which services are particularly relevant to international, CALD HDR students and whether these services are provided at their own universities; the next ten minutes will be allocated to group discussion over which services the groups agree on as being most relevant, and if there are any gaps; the rest of the time will be spent on bringing the results to the whole group as to what are priority services for international CALD HDR students.
3. After this, the participants will do an activity on specific issues. Here the participants will be provided with three hypothetical scenarios based on the real narratives shared by supervisors in interviews in the research. For each scenario, the participants will be asked to identify how they would handle the situation if they were to encounter it. (The hypothetical scenarios have been presented in the preceding section). Again, the participants will be divided into groups on tables and each table will work on one scenario and share their views on the possible avenues for addressing a specific critical issue that can come up during supervision. For this activity, participants will have been provided a copy of hypothetical scenarios beforehand, to work on individually. They will be expected to have done some work prior to the workshop to determine a course of action which will be shared with the group at the table and then as a whole with the rest of the participants. Below is the breakdown of the time limits for the activities.

Table 14 Timetable for the different components of the workshop

First 5 minutes	Introductions
Next 5 minutes	PowerPoint presentation: overview of project and outline of results
Next 35 minutes	Comparative table of student services activity
Next 35 minutes	Specific issues activity
Next 10 minutes	Sum up and close.

7.5.2 Target audience

The workshop is aimed at graduate research coordinators to learn about the different success factors that have emerged in the study. We have encountered several misconceptions relating to international higher degree research students which can be dispelled through engagement with empirical data. The participants will also learn about successful supervision strategies and ways in which they can support graduate research student supervisors.

7.5.3 Outcomes

By attending the workshop, graduate student coordinators will learn about different success factors that have emerged from this investigation; it is expected that the coordinators will relay this information to other stakeholders at their respective universities. This will have the potential to moderate many issues currently impacting the supervision of international CALD HDR students in the Australian context.

8. Project outcomes and dissemination

The main outcomes for this project were identified in line with the aim(s) of the project to be;

- To identify factors that provide effective support to CALD/international students in the Engineering and IT disciplines to help them do well in their studies,
- To identify factors that will help improve and provide effective support for HDR supervisors in the supervision of CALD/international students in engineering and IT disciplines,
- To help improve the supervision of CALD/International HDR students through encouraging a more open, accepting, and supportive attitude towards students from diverse socio-ethnic backgrounds, as well as greater recognition of their potential contributions to the research agenda of universities.

8.1 Deliverables

In relation to these outcomes, 7 separate deliverables were identified;

Literature Review

The literature review contains the background that forms the basis for this project and is an important resource in providing valuable information into HDR Student-Supervisor interactions and a summary of the important findings in this area of research in Higher degree supervision.(Literature review is included in chapter 2 of this document)

A repository of articles was created and available on wiki that complements this literature review.

A classified table of HDR support services across the 3 institutions

Support Services Data gathered from the 3 institutions were under academic, administrative, social and settlement, language and miscellaneous (supervisor) support. These services were classified further according to the level of accessibility (International HDR, General HDR, Faculty level HDR), availability (Service available or not) and location within the university (university level, faculty level, school level).

This table of support services is a useful template for students, supervisors and university administrators alike in relation to achieving HDR student and supervision success.

 Chapter 6 "Institutional data and Support services" contains the classified table sectioned under different services. A further analysis carried out on the delivery of these services is also included.

These findings have been prepared for publication under the title:

"Support Services for Higher Degree Research: *A survey across 3 Australian universities*"

Quantitative Report and Findings

The survey data from both student and supervisor surveys provided the main basis for addressing the project outcomes (PO), especially 1) and 2) in a quantifiable way.

The data was analysed in a number of ways, including descriptive statistics, Principal components analysis (PCA), linear regression, and Bayesian Network analysis.

The student survey gave preliminary insight into the factors that influence supervision from a CALD HDR student perspective and is presented in chapter 4.1.4 Student Survey Results

These findings have also appeared in the following publications:

Woodman, K., Trevelyan, J., Sahama, T., Gudimetla, P., Sharda, H., Lucy, T., Taji, A., Narayanaswamy, R., and Yarlagadda, P. (2011). *Chaos or complex systems? Identifying factors influencing the success of international and NESB graduate research students in Engineering and Information Technology Fields*. ICERI2011 Proceedings, pp. 5359-5366. [ISBN: 978-84-615-3324-4]

Gudimetla, Prasad, Yarlagadda, Prasad K., Sahama, Tony R., & Woodman, Karen (2010) Assessment of the influence of cultural barriers to HDR supervision of non-English speaking background (NESD) students in engineering and information technology (IT) disciplines. In Butdee, Suthep, Sapsaman, Temsiri, & Yarlagadda, Prasad K. (Eds.) Proceedings of the 10th Global Congress on Manufacturing and Management - *Innovative Design for Sustainability In Manufacturing and Management,* King Mongkut's University of Technology North Bangkok, Thailand, Century Park Hotel, Bangkok, pp. 51-56.

The Bayesian network model and regression analysis on the different supervisor related factors helped to further prioritise these factors and identify critical factors that affect student perception of supervisors, an important factor determining the success of supervision (PO 2). These results are presented in Chapter 5.1 Student Survey of this report.

These findings have been prepared for publication under the titles (or similar)

"Factors influencing CALD-HDR success in Engineering and Technology- *A Student Survey Perspective*"

"A Bayesian Network Analysis on factors influencing Supervision Success in Engineering and Technology- *A Student Survey Perspective*"

The supervisor survey was developed from the student survey insights and was a richer source of data for both supervisor and student success related factors as well as quantifying supervisor perceptions in relation to HDR and CALD HDR issues using descriptive statistics. These results are presented in Chapter 4.3.2 Results: Supervisor Survey

These findings have been prepared for publication under the title (or similar)

> "Factors influencing CALD-HDR success in Engineering and Technology- *A Supervisor Survey Perspective*"

The Bayesian network model and regression analysis on the different supervisor and HDR and CALD HDR student related factors helped identify and prioritise the critical factors affecting PO1 and PO2. These results are presented in chapter 5.2 Supervisor Survey of this report.

These findings have been prepared for publication under the title (or similar)

> "A Bayesian Network Analysis on factors influencing Student Success in Engineering and Technology- *A Supervisor Survey Perspective*"

> "A Bayesian Network Analysis on factors influencing Supervisor Success in Engineering and Technology- *A Supervisor Survey Perspective*"

A comparison of the student and supervisor responses to identical questions were carried out and analysed using linear regression analysis. These findings have been prepared for publication under the title (or similar)

> "A Comparison Study on Student and Supervisor Perceptions on factors influencing CALD-HDR success in Engineering and Technology"

Qualitative Report and Findings

This report was created to summary of the the qualitative analysis done for this project. It is divided into two parts each detailing a separate analysis:

1. Part 1 is an examination of the qualitative data collected in the project that complements and details the findings of the supervisor and student surveys.
2. Part 2 is an analysis of the specific issues interviews data collected for the project. The findings of this analysis were used to draft an online version of a case studies' resource useful for supervisors, as well as informed part of a training workshop for supervisors and other stakeholders interested in improving the supervision of international, CALD students.

Details of this report can be found in Chapter 7 *Qualitative Analysis: Interview Data and Critical Incident*

Critical incident Training Resource

This document sketches the format and describes the content of what a specimen online resource for HDR supervisors in engineering and IT at Australian universities can be presented as. It is developed from qualitative data gathered in this project and specifically from the critical incident interviews.

This resource is included in chapter 7.4 *Online Critical Incident Case Studies Resources* of this report.

Additionally the Qualitative data from 4) above and critical incident interviews were presented via the conference workshop; Trevelyan, Woodman and Samani. *Success factors in CALD, international HDR supervision.* Workshop presented at AAEE conference. (Melbourne, Vic) (December, 2012)

Final Report

This report is a compilation of all material and resources prepared under this project and is prepared to fulfil the requirements of the Office of Learning and Teaching (OLT) as the funding agency for this project. This report will be available on the OLT website.

Report to Deans of Engineering and Information Technology in Australia and New Zealand

This report is a summary of the Final Report prepared for the specific purpose of dissemination in printed version across universities in Australia and is expected to be a resource useful for Executive Deans, Heads of School, Faculty Supervisors and University Administrators involved in Higher Degree Research.

8.1 Dissemination of Project outcomes

The following have been identified as the deliverables:

Published:

- Woodman, K., Trevelyan, J., Sahama, T., Gudimetla, P., Sharda, H., Lucy, T., Taji, A., Narayanaswamy, R., and Yarlagadda, P. (2011). Chaos or complex systems? Identifying factors influencing the success of international and NESB graduate research students in Engineering and Information Technology Fields. *ICERI2011 Proceed*ings, pp. 5359-5366. [ISBN: 978-84-615-3324-4]
- Gudimetla, Prasad, Yarlagadda, Prasad K., Sahama, Tony R., & Woodman, Karen (2010) Assessment of the influence of cultural barriers to HDR supervision of non-English speaking background (NESD) students in engineering and information technology (IT) disciplines. In Butdee, Suthep, Sapsaman, Temsiri, & Yarlagadda, Prasad K. (Eds.) *Proceedings of the 10th Global Congress on Manufacturing and Management - Innovative Design for Sustainability In Manufacturing and Management,* King Mongkut's University of Technology North Bangkok, Thailand, Century Park Hotel, Bangkok, pp. 51-56.

Currently in Preparation:
- "Support Services for Higher Degree Research: *A survey across 3 Australian universities*"
- "Factors influencing CALD-HDR success in Engineering and Technology- *A Student Survey Perspective*
- "A Bayesian Network Analysis on factors influencing Supervision Success in Engineering and Technology- *A Student Survey Perspective*"
- "Factors influencing CALD-HDR success in Engineering and Technology- *A Supervisor Survey Perspective*"
- "A Bayesian Network Analysis on factors influencing Supervisor Success in Engineering and Technology- *A Supervisor Survey Perspective*"
- "A Bayesian Network Analysis on factors influencing Supervisor Success in Engineering and Technology- *A Supervisor Survey Perspective*"
- "A Comparison Study on Student and Supervisor Perceptions on factors influencing CALD-HDR success in Engineering and Technology"

National and international conference presentations:
- Woodman et al.*"Mythbusting International HDRs: How International HDRs are really perceived in Australian universities*". Presented at the 7th University of Sydney TESOL Research Network Colloquium (September 2012).
- Woodman .*"Mythbusting International HDRs: How International HDRs are really perceived in Australian universities*". Presented at QUT Research Degrees Committee meeting. (July, 2012)
- Trevelyan, Woodman and Samani. *Success factors in CALD, international HDR supervision.* Workshop presented at AAEE conference. (Melbourne, Vic) (December, 2012)
- Woodman, K. (for group). *ALTC Priority Grant Outcomes.* Presented as part of QUT Learning and Teaching Grants Showcase. (October 2012).
- Woodman et al*. Two sides of the coin: Supervisor and student perspectives on factors influencing the success of international graduate students in IT and Engineering*. Paper accepted for presentation. EDULEARN 2012. (Barcelona, Spain) (July, 2012) Woodman, K., Trevelyan, J., Sahama, T., Gudimetla, P., Sharda, H., Lucey, T., Tajii, A., Hargreaves, M., Narayanaswamy, R. and P. Yarlagadda. *Chaos or complex systems? Identifying factors influencing the success of international and NESB graduate research students in Engineering and Information Technology Fields*, ICERI 2011 (Madrid) (November)
- Woodman, K., Trevelyan, J., Sahama, T., Gudimetla, P., Sharda, H., Lucey, T., Tajii, A., Hargreaves, M., Narayanaswamy, R. and P. Yarlagadda . *Assessment of the influence of cultural barriers to HDR Supervision of Non-English speaking background (NESB) Students in Engineering & Information Technology (IT) Disciplines.* Sydney TESOL Network Colloquium 2011 (Sydney, Australia) (September)

- Gudimetla, Prasad, Yarlagadda, Prasad K., Sahama, Tony R., & Woodman, Karen (2010) Assessment of the influence of cultural barriers to HDR supervision of non-English speaking background (NESD) students in engineering and information technology (IT) disciplines. Presented at the 10th Global Congress on Manufacturing and Management - Innovative Design for Sustainability In Manufacturing and Management, King Mongkut's University of Technology North Bangkok, Thailand, Century Park Hotel, Bangkok, pp. 51-56.
- Samani, S., Woodman, K., Trevelyan, J. P., Taji, A., Narayanaswamy, R., Silva, P., & Yarlagadda, P. K. (2012, December 3-5). Higher Degree Research at Australian Universities: Responding to Diversity in Engineering and Information Technology. Paper presented at the Australasian Association for Engineering Education, Melbourne.

9. Summary of overall findings and limitations

9.1 Internationalisation at UWA, Curtin University and QUT

- **Increased number of Overseas HDR students**

  Reflecting the continued internationalisation of Australian education, there are increasing numbers of international HDR students studying at the three participating universities. Overall, UWA had a 35 percent growth in international enrolments, QUT, 51 percent and Curtin University 19 percent from 2008 to 2010.

- **Increasing percentage of International HDR students**

  The most recent data available show that out of 2185 HDR's 38 percent are international students in QUT (April 2012) and the percentage is higher at 46 percent within the newly formed Science and Engineering Faculty. For Curtin, 2011 data indicate 1400 full time equivalent HDR's and 38 percent are international students, and 42 percent of all science and engineering students are international. Currently (2012, April) there are around 2000 HDR students in UWA and the new enrolments for 2011 was 377 of which 33 percent are international students.

- **Diversity in geographical spread of international HDR students**

  The geographical spread of international students in science and engineering is very similar across the 3 universities and has remained consistent over the period data is available (2005-2010) with an overwhelming majority of students (75-80 percent) coming from Asia and the Middle East. Europe accounts to about 10 percent, while Americas (North and south) accounts to about 9 percent. Even so, within the Asian-Middle Eastern component there is a shift towards more students coming from China, India, Indonesia, Iran, Sri Lanka, Jordan, Saudi Arabia and Oman in preference to students from Malaysia and Singapore who have been traditionally the more dominant representatives within the Asian block. This increased diversity may be due to greater economic development among other Asian countries like China and India and possibly due to Australia being a preferred destination for post graduate studies among the Middle Eastern countries as an alternative to the United States of America or the United Kingdom.

- **Improved Performance amongst international HDR students**

  The total number of international HDR completions (broad areas of Engineering, Science and IT) between 2003-2008 was highest for Curtin University at 214 (from a total of 478), followed by QUT at 112 (total 535) and then UWA at 78.5 (total 295.5). However these numbers have increased substantially given the rapid increase of international HDR's in all three institutions. Between 2010 -2011, there were 207 overall HDR completions in science and engineering in Curtin alone (compared to 295.5 over 5 years from 2003-2008).

There is also an overall high percentage of completions compared to enrolments in the same period across all fields. In 2011, 377 commenced their studies in UWA compared to 304 who completed in 2010 indicating an 80 percent completion/enrolment ratio. In QUT that percentage is 117 percent with 252 HDR commencements and 295 completions across all fields.

Completion rates for international students in the broad areas of engineering, science and IT at the three universities are higher than for domestic students according to data from 2003-2008. The mean time to completion for international HDR students was lower for QUT 3.6 years (3.9 years for domestic), compared with 4.09 years for UWA (4.31 years for domestic); no data on completion times was available for Curtin University

Given that the number of international HDR's have been increasing at a higher percentage compared to domestic students (272 percent for QUT), it is possible that the overall completions may to a large extent reflect the performance of the international HDR's more so than domestic students.

9.2 Support Services

Support services available to students and supervisors were investigated and grouped under five main categories which are: academic, administrative; social and settlement; language and miscellaneous support. Factors that affect the accessibility of these support services were:

- Availability
- Location and
- Awareness

The level at which these services are available was looked at. This ranged from university level, school level and faculty level. This organisation had a direct bearing on the way the service was delivered. The analysis revealed the following categories in the way services are organised from a service delivery point of view: formal versus formal, centralised versus specialist, general versus specific, stand-alone versus integrated services and current needs versus anticipated needs.

Academic Support: Academic support was mainly used to describe issues pertaining to research support. The three universities have dedicated offices to support research students' needs. The library provides specialised courses on research and research-related skills. At a faculty level, specialised liaison librarians are available. The support at faculty level is thematic with universities with research centres (e.g. IHBI in QUT) having a more dedicated focus through workshops for students. Among the services given for academic support were technical writing skills. Dedicated workshops for technical writing for HDR students are available (QUT, UWA). Workshops for international students (ISS-QUT) or language support that covers technical writing (Curtin) was also available, along the same lines. High Performance Computer

(HPC) Support is available at the university level with schools providing specialised aid. Milestone Preparation is a formalised process at QUT, whereas in both Curtin and UWA it is an informal process, facilitated largely between the supervisor and the HDR student. Support for milestone preparation is done at regular specific research group forums where attendance of research seminars is considered important and compulsory in some cases. Peer support is encouraged, whereby more experienced students are expected to help the newer students (UWA) although no formal process exists. Commercialization of research is provided by all the universities.

Administrative Support: This was identified as information and skills support and is offered to both students and supervisors at different levels at all the three universities. Inductions (including laboratory ones), online support (e.g. My Research Space) and specialised support through publications like the SEF Survival Guide at QUT is available. Skills support to aid supervisors in better managing their workload is available. This service was offered as a specialised service at QUT and at faculty level at both UWA and Curtin. Language support is available as a dedicated service at Curtin and UWA and indirectly through writing skills workshops at faculty level at QUT, or is also available through funding for supervisors at UWA. Language support also covered English language support through writing skills and other initiatives. English language support is offered in one of three ways; through a dedicated service to developing English language competency (ELC-Curtin, CELT-UWA), indirectly through writing skills workshops at faculty level (QUT) or on a needs basis through special funding available for supervisors (UWA).

Social and Settlement Support: Support is available through the university via dedicated websites. UWA however informally offers the service through student clubs. QUT offers spousal support for wives of international HDR students. Pastoral care is available through supervisors, postgraduate coordinators, HDR directors (at Curtin, QUT) and post graduate coordinators (faculty level at Curtin). A specialised service through the Director for International Graduate Research (IGR) is available at QUT for international HDR students (at university level), is a specialised role created within QUT to offer assistance to international HDR students. Curtin provides social and cultural support for CALD students through provision of health and recreation facilities, onsite child care facilities and a prayer hall/mosque catering to HDR students from an Islamic background with families. At UWA accommodation support is offered as a general non dedicated service for HDR students with free accommodation provided in exchange of tutoring. QUT offers some activities at university level and other social gatherings at faculty level. All three universities offer counselling at the university level with QUT running special workshops on stress management, time management and other wellness programs for HDR students.

Miscellaneous Support: Miscellaneous support covered support services available to supervisors. This included trainings which are formally offered at QUT as specialised workshops. Online services are also available through e-Grad (QUT and Curtin only) and at faculty level, SEF info HUB. Service provision at both UWA and Curtin was informally provided and supervisors have help available by contacting the respective post graduate research offices.

9.3 Analysis of Quantitative Survey Data and Bayesian network (BN) analysis

Student Survey Results

The student survey was conducted among 229 CALD HDR students in engineering and Information Technology across three Australian Universities, UWA, Curtin and QUT. Students were from 33 countries with a majority of students coming from Asia and specifically from China (25 percent), while there were significant representations from countries such as Malaysia (10 percent), Iran (9 percent), Sri-Lanka (8 percent), India (8 percent) and Indonesia (8 percent).

The following general views of the supervisors were revealed through the survey:

- Students were very satisfied (80-90 percent) by their supervisor involvement in their academic research project through help given by their expertise, commitment and availability and in helping students understand their research environment, which includes research methods, the relevance of the research and how it fitted into a local and global context.

- A majority of the students felt that supervisors were considerate of their cultural or religious background, but had mixed views on the supervisor involvement in the support offered by the supervisor in the areas of work-life balance, economic and social needs. Over 30 percent never felt supported in these areas.

- Students felt their supervisors were considerate of their non-English speaking background (85 percent), but they did not feel their supervisors played an active role in developing their language and communication skills with very little or no help received to develop language skills (33 percent), being recommended reading material to help improve language skills (43 percent) or promoting interaction with other English speaking HDR students.

The following general views of the students were revealed through the survey:

- Students showed a high level of responsibility (70-90 percent) in their ownership of their research project that included taking initiative to organise meetings with their supervisors, to comply with university standards, and to explore research methodologies and to ensure that thesis was submitted on time.

- The majority of students (70-90 percent) agreed strongly that ownership of the research was their responsibility and saw similarities in their responsibilities to those of their supervisors in areas of complying with university reporting, planning their research and being aware of deadlines and key processes.

The following general views of HDR and CALD related issues were revealed:

- Qualitative comments identified issues that clearly indicated that there were differences in HDR and CALD HDR students arising from differences in language and culture that affected the student-supervisor relationships.

- There were also issues raised concerning knowledge gaps, supervisor attitude and supervisory style that may be more generic HDR issues, pertaining to engineering and technology disciplines.

Student Survey Bayesian Network Results

- A Bayesian network and linear regression was carried out on the supervisor survey responses. Bayesian network analysis was used to assess the degree to which different factors identified above would affect student perception of their supervisors.

- The B/N results showed that the two most important influences on CALD students' perception of their supervisors were the **supervisor attributes** and **student obligations**. A sensitivity analysis showed that the supervisor attributes was the most sensitive out of these two factors and can affect the overall perception of supervisors by as much as 46 percent, while the level of influence of student obligations was 39 percent, when all other factors were kept constant.

- Improving **social interaction** made the greatest positive change in supervisor attribute outcomes (4 percent).

- A decline in **supervisor obligations**, **help given in understanding the research environment** or **social interaction** was detrimental to the supervisor attributes by 17 percent, 16 percent and 15 percent respectively.

- These results indicate that improving social interaction by engaging supervisors to offer pastoral care and be sensitive to the needs of the students has the greatest positive benefit in improving supervisor attributes, but these extra efforts should not be made at the expense of supervisor obligations or supervisor help given in understanding research environment.

- **Personal profile** of the student had no significant impact on their perception of their supervisors. However a regression analysis of the individual categories showed that age had a negative impact on student perceptions on supervisor involvement in research and their social interactions, indicating that **as students mature in age, their expectations of supervisors** change in both these areas, of which supervisors need to be aware.

- **The course of study** and **previous qualifications** were also significantly associated with perceptions of **social interaction** and showed that PhD students and those with existing doctorates had different views to other students. Regression analysis showed that the country of birth influenced the comparative attitudes of students in the areas of social interaction, student obligations, supervisor involvement in research and supervisor investment in research. Compared to the attitudes of students from Malaysia, the attitudes of students from Iran and Western Europe were not significantly different, but the attitudes of students from the other countries were very different.

Supervisor Survey Results

The supervisor survey was conducted among 69 HDR students in engineering and information technology across three Australian Universities, UWA, Curtin and QUT. Of the supervisors, 60 percent were from QUT, 22 percent from UWA and 18 percent Curtin, with majority of them being male (81 percent). Forty eight percent of them were from Australia, while the rest were mainly from Asia and Europe. The following factors were prominently featured in relation to HDR and CALD HDR success:

Table 15 Summary of factors that influence HDR student success during different stages of the HDR program
Percentages shown are combined responses to *'agree'* and *'strongly agree'* or *'important'* and *'very important'* to the supervisor survey questions

	Pre-entry Factors	Post-entry Factors	Successful Completion Factors
Previous Experience	Problem solving skills 77% Foundational knowledge 68% Research methods 66%		
HDR Student Attributes	Motivation 99% Persistent 95% Positive Attitude 94% Resilient 94%		
HDR Student Obligations		Exploration of research methodologies 96% Comply with university reporting procedure 96% Organise periodic mtgs with supervisors 93%	
HDR Student Behaviour		Undertand research project 100% Ability to ask questions 96% Keeping uptodate with litreature 94%	
General Factors (HDR and CALD)			Ability to breakdown problems/ Complex issues 95% Discuss and analyse data 92% Maintain motivation 96% Time management 90%
HDR Competencies			Critical thinking 97% effective reading comprehension 97% Conducting litreature searches 93%
Supervision Factors		Stage 1 Start	Stage 2 Mid	Stage 3 End

Problem solving skills were the most valued trait for a successful HDR student to qualify for a HDR program (77 percent) and one of the strongest strengths that would ensure their academic success (95 percent) along with critical thinking (97 percent). In terms of competencies, research skills (66 to 92 percent) and problem solving abilities (from 77 percent to 95 percent) are two of the highest developed throughout the HDR experience.

Motivation was seen as the highest personal attribute for student success from start (66 percent) to finish (96 percent). Overall attributes and behaviours that fell under "positive outlook" were considered more important than "Ethics" (or values) or "Skills".

Supervisory role is seen as helping maintain and develop these essential qualities for success during the different stages of the HDR experience

The results for general factors for HDR and CALD did not show any significant differences, except that supervisors preferred CALD students to have a prior postgraduate qualification 10 percent more than for general HDR students.

Supervisor Survey Bayesian Network Results

- The overall perception of success of a CALD student was most influenced by node (or category) HDR student success which was 58 percent likely to be positive, followed by node CALD student success which was 48 percent likely to be positive. **This meant that the supervisor perception of success of a CALD was more influenced by their perception of a successful HDR student than factors that were specific to CALD supervision**. The most negative influence on OSP was by node HDR student success which was 14 percent followed by supervisor demographic which was responsible for a 12 percent negative change.

- *HDR Student Success*-A sensitivity analysis on sub network HDR student success shows that the node **student experience has the highest positive change** in outcome of 13 percent indicating that a stronger vetting process and more stringent criteria can help improve the level of experience and competency students have when they start. Alternatively this is a call for more effective support services to help upgrade the level of skills for greater effectiveness from the start in areas of problem solving, research methods and foundational knowledge in subject. Making such requirements mandatory as part of the research degree may also ensure a greater effectiveness.

- Categories **student obligations and student attributes** overall contribute to the highest negative outcome by 15 percent and 12 percent respectively. These two categories are connected through student motivation and the combined negative effect of losing motivation attributes to a total of 28 percent drop in the HDR success according to model predictions. Hence **student motivation and enthusiasm** needs to be maintained at all costs.

- *CALD-Student Success*- OSP was positively influenced by the node CALD student success by up to 14 percent change. CALD student success can be largely improved through **supervisor involvement in helping CALD students develop communication and networking**, which has been shown to have only a 6 percent probability of being high.

- Currently CALD outcomes were very low for CALD supervision, meaning that **supervisors, despite being aware of their specific needs, made little or no impact through their input into CALD specific issues.** This should be addressed as a primary importance.

- The model predicts a change of CALD student success to have a 65 percent likelihood of being positive (up from 48 percent) as the maximum outcome scenario from improving supervisor involvement in communication and networking.

- *Supervisor Attributes*-According to the sensitivity analysis results on the sub network supervisor attributes, supervisor participation in training (13 percent) and supervision style (12 percent) were the two most influential nodes for a positive change in outcome, followed by node, university support to supervisors at 11 percent. The two most negative influences on Supervisor attributes were from nodes supervisor involvement (-10 percent) and supervisor obligations (-7 percent).

Recommendations for improving the Quality of Supervision according to findings of the study:

Improving supervisor support, supervisor style(time spent in supervision) and supervisor training lead to an overall improvement in supervisor attributes up to 37 percent (from 33 percent to 70 percent likelihood) according to the current model.

Supervisor Training

Participation in training should take an interpersonal approach with the supervisor that builds on their personal experience with opportunity for self-reflection, since the survey identified this to be the most effective learning style for supervisors. The emphasis in training should be expanded to include cross cultural communication issues, pastoral care emphasis and a coaching approach towards building motivation in students.

Supervisor Style (Time spent in Supervision)

This means getting supervisors to be engaged in the specific activities of supervision to a greater degree than at present by removing other constraints such as administrative activities that may be a hindrance to spending more time supervising.

University Support

University support can be improved by addressing the issue of supervision time by factoring in HDR supervision into the workload equation and adjusting for extra time devoted to CALD students and reducing administrative paper work, all useful means of helping engage supervisors more in supervision. Support can also be increased in the funding available for HDR scholarships and research facilities and improving on the type of training available for supervisors including personal development seminars and workshops.

Supervisor involvement

A drop in supervisor involvement can result between Stages 1 and 2 of the supervision process, due to differences in student and supervisor expectations as described in Chapter 4.3.2. Hence, increasing the supervisor involvement by opening up communication between students and supervisors and improving CALD student interaction socially and academically is recommended.

9.4 Qualitative analysis

- The interview data revealed four categories pertaining to the HDR learning environment – student, supervisor, university/faculty and other. There is reasonably close alignment between the results of analysis and the survey analysis reported above.
- Analysis revealed that the supervisory relationship is embedded in the institutional framework of the university and both are affected by exogenous factors such as the global research community, industry funding, the global competition for HDR students and scholarship funding sources.
- The qualitative data provides the context and content of the findings of the quantitative surveys and provides an opportunity to look at the factors in more depth and detail.
- Supporting the survey findings, the results of the qualitative analysis suggested that supervisor attributes, expertise, budget, industry contacts, workloads, feedback and advice, knowledge of student support services, professional development and cross-cultural awareness are relevant in the supervisory relationship.
- In terms of attributes, students preferred to have supervisors who were not dictatorial but willing to help even when discussing personal problems.
- The supervisory style can be crucial in sustaining a long supervisor-student relationship.
- In terms of cultural awareness, the analysis revealed that most supervisors are attentive to cultural differences and use that awareness in strengthening the student-supervisor relationship.
- On the part of the student too, personal attributes are important for success in HDR research. Supervisors identified a successful HDR student as one who is capable of independent thinking & analysis, self-motivated and has a genuine interest in research.
- Language and communication stand out as particularly essential in the initial stage of the candidature.
- Discipline-specific skills and knowledge emerged as highly relevant to what contributes to success. As many supervisors pointed out in both interviews and surveys, inadequate background knowledge and preparation for research work can delay completions. However this is not seen as a problem specific to International CALD students.
- Other factors include project development, academic and cultural mores and academic professional development. Additional factors outside of the academic relationship pertaining to relocating to Australia were also noted. For instance, students may have to be informed about housing, schools for their children and other family-related issues, as well as religious needs.
- Influential factors in the environment included policies, procedures and protocols, discipline-specific pedagogical resources, funding support and support services. Several supervisors commented on the need for adequate testing and technical facilities for research purposes. These types of factors strongly influence the supervisory relationship, defining its structure and giving financial support. The 'other' dimension revealed exogenous elements such as international research networks, industry and scholarship funding, and global competition for HDR students driving a quality agenda.

9.5 Critical incident interview analysis

- Analysis of data from critical incident interviews reveals that, in some cases, there are particular challenges that supervisors in engineering and IT face in supervising international/CALD students.
- Most of the incidents occurred in mid to late candidacy.
- These include challenges related to cultural and language differences, weaknesses in foundation discipline knowledge, and the admission processes.
- Narratives covered hygiene issues, disagreements with principal supervisors, relationship problems, ill health and family financial responsibilities.
- The findings revealed that such challenges affect supervisors and can add to their workloads, cause stress, are time-consuming and can slow other work down. Most significantly some supervisors would be wary of taking on international/CALD students.
- On the positive side though, the findings revealed that the additional efforts are rewarding for supervisors as international/CALD students are hardworking and diligent.
- While there are programs available at the universities to address challenging issues, some supervisors may not be fully aware of these, hence there is a need to create an awareness of the services as well as the issues presented and how to resolve them.
- Data from critical incident interviews has been used to create case study resources that can be used in courses to help develop better supervision skills for supervisors in engineering and IT disciplines.

9.6 Overall

- While there are certain factors that are specific to engineering and IT disciplines, most factors are common to all academic disciplines to a greater or lesser extent. Discipline-specific factors included graphical communication abilities, occupational health and safety issues in laboratory and field work, expertise with analysis software, intellectual property protection, working with industry organisations providing research funding and support, coordinating the work of technicians and other support staff, and confidence in operating equipment to obtain reliable and repeatable experimental results.
- The data reveals that HDR international/CALD students perform well in their studies. It also shows that there are existing services that can assist these students to support them in their studies. The study has identified a set of factors that influence the HDR learning environment from the perspective of students and supervisors who were part of the study.
- While overall the study finds that student and supervisor perceptions are generally positive and there is little difference between international and domestic HDR students, the critical incident interviews reveal that some supervisors face challenges that may make them hesitant to take on such students. The qualitative data has invited strategies for dealing with these concerns at an individual basis when they arise.

9.7 Limitations

With only limited resources, this study has identified factors that are believed to influence success for international/CALD HDR students in engineering and IT disciplines. Although the Bayesian Network likelihood scenarios make predictions of the most significant and sensitive factors that influence student and supervision success, further investigation and assessment of these factors is beyond the scope of this project.

In the particular case of this study there were some limitations due to the requirements of the method. Specifically, the survey used to quantify the supervisor model was written and completed before the construction of the BN model. The BN model was then derived using a Principle Components Analysis based on the supervisor's answers to questions on the survey. This is not the most desirable method of model construction and quantification, as it relies on the survey being constructed from random questions. For example, if the survey was written to measure levels of five constructs, it is likely that the PCA would produce five nodes. As such, modelling the answers in such a way may tell us little more than the survey alone about what supervisors think, however it does allow for some simulation of hypothetical scenarios based on survey results. In particular, there is little indication of whether unnecessary factors have been included, or necessary factors excluded when using this method.

Future research should look at developing a complete and parsimonious model at the outset, using a validation framework such as that proposed by Pitchforth and Mengersen (2013) to ensure its validity. One test used in this framework is the Principal Components Analysis, which is more enlightening to the researcher when applied in this fashion. Once a valid BN structure has been derived from expert opinion, published research and validity test results the survey can be constructed to allow for quantification of the model. An advantage of this approach is that it produces both a model capable of simulation, as well as clean and easily interpreted descriptive statistics.

Limitations of the qualitative analysis includes the use of unstructured data from a number of different sources which makes it difficult to run specific queries to establish an ordinal or numeric order in what is significant in the supervisor-student relationship and the learning environment. Also multiple references are coded from one source in the case of focus groups and workshop contents as the data sources cannot be broken into consistent bits to give responses of particular students or supervisors. Therefore references and sources in some cases are limited in number.

Limitations of the surveys included a smaller number of participants for the supervisor survey, which limited the statistical comparisons with the student surveys (and limited the statistical analysis). The lack of demographic information in the student survey limited the ability to identify the home institutions of participants to assess possible impacts of discipline, institutions or program on responses. There were no inherent links between the students who completed the surveys and the supervisors who completed the surveys. There are no inherent links between the cited completion data and the student or supervisor participants in the

survey. Not all supervisors were necessarily from engineering or IT, and participation varied by institution.

Even though the project was specific to assessing the factors that influence success in CALD student supervision, the scope of student survey could have been broader to include CALD as well as non-CALD HDR students. This would have helped verify perceptions of the two separate groups and enabled distinguishing of CALD specific perceptions from general HDR perceptions, which would have given a greater degree of certainty of CALD issues.

The design of the supervisor survey did not have a Bayesian Network model in mind and as a result there were questions that did not allow for a proper quantification. Questions could have been more specific clearly defining the differences between qualities and between different sets of questions, as it appeared there were regions of unintended overlap that caused confusion among participants. Consequently the survey appeared to be too lengthy and proved more challenging than it needed to be when it came to create the Bayesian model.

The scope of this research focussed was limited to a narrow definition of student success in that it considered only academic success. However a more broader definition of engineering success (Silva and Yarlagadda 2013) could have led to greater insight in understanding the aspirations of CALD students and the role of supervisors in relation to success beyond timely completions and quality publications.

10 Future Direction

Issues with CALD, international students who are seeking a higher education degree by research fall into five main categories:

1. Communication – The first of these is communication issues, both in the form of not being able to speak English well, but also because even when they do speak fluent English, they are unsure or unwilling to talk to their supervisors or superiors about any issues that are coming up because they feel that this is either inappropriate/rude or because they think the problem could be normal and expected even when it is not. This was featured heavily in the case studies by several researchers.

   Some solutions to this could be to ensure students go through a communications course when they first arrive. Another could be to continuously encourage them to speak up and voice any problems or suggestions. Senior student Mentor schemes are a useful tool in facilitating this. It is important to ensure that students get proper advice to deal with inadequacies in communication skills early in their candidature.

   Supervisors must:
   - Ensure students take an English course to aid in correcting any language issues
   - Explain to students that they should voice problems
   - Continuously encourage student to voice concerns during research.

2. Cultural Pressures - Another problem that requires a lot of research is how pressure from their native countries to perform well impacts their success as poor performance or failure to attain the degree may result in pressure we do not see. Students may face high repercussions, such as repaying scholarship money, losing local respect and many other problems if they don't succeed. Many students who are not genuinely interested in PhD or Master's degrees pursue it anyway, especially when given a scholarship and such students are often the ones who struggle.

3. Identifying a student as a genuine researcher prior to commencement is another key issue. A case study to determine how to screen students so that the above problems can be avoided or minimised would be useful. This may involve:

   - Improving the vetting process that allows student to enrol for a PhD
   - Looking at students' cultural pressures before enrolling
   - Talking about any cultural pressures with the student
   - Finding ways to assess whether the student is appropriate during the first months of work
   - Should the student not be a good candidate, they should be approached (possibly along with someone from their culture).

4. Input of Supervisors – There is an issue about how much a supervisor should support a student in their work, with the suggestion being that supervisors overseas should not help the student too much, so as to get an accurate picture of their skill and performance without the supervisor's help. It is advised that when the student is from overseas, the supervisor should take an active interest in helping the student passively by enrolling the student in units to help them gain the skills needed rather than just doing the work for the student. It has been found that students from certain countries get their research proposal prepared professionally by experts sometimes by paying them. How you can ensure that a student's submitted work is their own highly researched work, rather than getting help from their Professors or other superiors/peers?

   Some suggestions include:

   - Finding ways to ensure the student is capable of doing their own work
   - Improving the vetting process to see if a student's work, that is submitted before being approved for a PhD, is their own
   - Observe how much help should be given by supervisors to students and what type of help this should be (if any).

5. In America the majority of universities require that research students first complete a year or more of coursework related exercises. This, as you can see has many positive and negative effects:

   Positive:
   - Students produce work in a format that is acceptable for university standards
   - Students get at least a base knowledge in the field they wish to do future work on
   - Students get a feel for general research methods and protocol
   - Students can be observed for their suitability for a future PhD or Masters if their work in this preliminary year is not up to standard

   Negative:
   - May deter students from attending the university as extra work must be done
   - More expensive for both the university and student
   - Work done here may be a repeat of what the student has already done
   - Overseas students might choose to attend a school where this extra year is not needed

A future study is required to see whether, in case of international students, it is beneficial to have this requirement given that they study in diverse institutes and cultures and course work may be useful in aligning them to the home institute's requirements. There may also be many other benefits such as integration with other students and cultural interchange.

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Appendix A: Evaluation report

Final Evaluation Report

A holistic model for research supervision of international students in engineering and information technology disciplines (PP10-1771)

In this evaluation report I will focus on two main aspects of evaluation, the processes and the outputs of the project.

In general the procedures and activities of the project team were very successful in achieving the outcomes of the project. Processes were set in place early in the project and these included weekly informal meetings between the project manager and coordinator; fortnightly meetings with the project leader and manager, formal monthly meetings and status reports uploaded to Wiki, as well as quarterly Advisory Group meetings. The constant communication between team members ensured that collaboration was maximised across institutions. This has lead to a rich source of information and data collected for the project that has informed the outcomes. During the teleconferences that I was involved in, I witnessed the collaboration between partners involved in the project were working effectively and together and were drawing on a range of sources and ideas. This was also evident in the advice and guidance offered by the Advisory Group.

The resources that have been developed are excellent. They are accessible and will inform the enhancement of practices for supervision of international students in engineering and information technology. They have been developed from a sound evidence-based that was analytical in terms of identifying the factors that support research higher degree students, and the advice to academics involved in supervision. The project should emphasise that the resources they have developed, in particular the critical incident training resource, will be useful for all students, nit only international/CaLD students.

In terms of dissemination, there have been suggestions to broaden the dissemination beyond the conference presentations and journal articles, to include sending copies of the resources to Deans and Directors of Graduate Studies. The resources could then be used to inform Research Higher Degree training within Australian universities.

In summary, the processes incorporated into this project, including the collaboration across the team members and the effective communication throughout the duration of the project, have led to the production of resources that will enhance practices within the sector.

Yours sincerely,

Associate Professor Sophie Arkoudis
Deputy Director, Centre for the Study of Higher Education
University of Melbourne

Appendix B: Questionnaire coding

A1. Questionnaire coding

The components of the questionnaire were coded as follows:

- Supervisor details
  Gender: Female=1, Male=0
  Country of Birth: Australia=1, Other=0
  Cultural Background: Western Europe=1, Other=0
  Long Residence in Australia: >5 years = 1, <5 years=0
  English as First Language: Yes=1, No=0
  Number of Languages Spoken: >1=1, 0-1=0
  Previous Study in Australia: Yes=1, No=0
  Overseas University Experience: Yes=1, No=0
  Time in Current Position: >5 years=1, 0-5 years=0
  Current Appointment: >B=1, B=0
  Field of Research: Engineering=1, Other=0
  Time in Current Research Area: >3 years=1, 0-3 years=0

- Questions with 5 point scale
  4,5 coded as 1
  1-3 coded as 0

- Postgraduate students supervised, completed, discontinued
  Above average = 1, Less than average = 0

Appendix C: Student Survey

Non-English Speaking Background (NESB) Higher Degrees Research (HDR) Student Survey

Dear HDR Student,

Thank you for agreeing to be a participant in the survey of Higher Degrees Research (HDR) Students from Non-
English Speaking Background (NESB).

This survey is a joint venture between the Queensland University of Technology, Brisbane and the University of Western Australia, Perth. The information obtained through this survey will be used to develop better research supervisory frameworks for NESB HDR students in order to facilitate better...

Human Research Ethics clearance has been sought/has been obtained for this project. All information collected from this questionnaire is private and confidential and will be used for the purposes of this study and any research papers arising from it. No personally identifiable data will be published from this research.

Participation: Your participation in this project is voluntary. If you do agree to participate, you can withdraw from participation at any time during the project without comment or penalty. Your decision to participate will in no way impact upon your current or future relationship with QUT (for example your grades).

Your participation will involve an anonymous questionnaire which contains a series of multiple choice questions. Included in these are three introductory questions to determine your school and the stage you have reached in your studies. As the questionnaire is anonymous, it will not be possible to withdraw once you have submitted your response.

There are no risks beyond normal day-to-day living associated with your participation in this project. All comments and responses are anonymous and will be treated confidentially. The names of individual persons are not required in any of the responses. The return of the completed questionnaire is accepted as an indication of your consent to participate in the project.

Please contact the research team members named above to have any questions answered or if you require further information about the project.

QUT is committed to researcher integrity and the ethical conduct of research projects. However, if you do have any concerns or complaints about the ethical conduct of the project you may contact the QUT Research Ethics Officer on 3138 2340 or ethicsconact@qut.edu.au. The Research Ethics Officer is not connected with the research project and can facilitate a resolution to your concern in an impartial manner.

The research team greatly appreciates your time and patience in answering all the questions contained in this survey.

Please tell us about yourself.

1. Please enter your current age (years):

Please use the blank space to write your answers.

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2. Please indicate your sex:

Please pick one of the answers below.

- O   Male
- O   Female

3. What is your country of birth?

Please use the blank space to write your answers.

---

4. If you were born overseas, for how long have you been living in Australia? (please enter the number of years below)

Please use the blank space to write your answers.

---

5. Have you previously studied in an Australian University before enrolling in the current course?

Please pick one of the answers below.

- O   Yes
- O   No

6. What is the broad field in which you are doing your research?

Please pick one of the answers below.

- O   Engineering (Mechanical)
- O   Engineering (Medical)
- O   Engineering (Electrical/Electronics)
- O   Engineering (Aerospace, Avionics)
- O   Engineering (Urban Development)
- O   Engineering (Industrial Design)
- O   Information Technology

0

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7. What is the full title of your course of study?

Please pick one of the answers below.

○   Masters by Research (Full time)

○   Masters by Research (Part time)

○   Doctor of Philosophy (Full time)

○   Doctor of Philosophy (Part time)

8. What is the highest level of qualification you have attained before commencing the above course?

Please use the blank space to write your answers.

9. Which of the following best describes the mode of your supervision for the current course you are enrolled in?

Please pick one of the answers below.

○   Single Supervisor

○   Multiple Supervisors or Panel or Supervisors

The following set of questions relate to your supervisory satisfaction.

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10. Supervisor's guidance in my research project [Rating scale legend: 1 - Poor, 2 - Moderate, 3 - Average, 4 - Good, 5 - Very Good]

Please mark the corresponding circle - only one per line.

	1	2	3	4	5
My supervisor's expertise in my research field	O	O	O	O	O
Interest shown by my supervisor in my work	O	O	O	O	O
Extent to which I can comfortably raise issues of concern	O	O	O	O	O
Independence to plan my own project	O	O	O	O	O
Availability of supervisor(s) when needed	O	O	O	O	O
Effort made by my supervisor to discuss/comment on my work	O	O	O	O	O
Guidance on research design and analysis	O	O	O	O	O
Getting feedback in reasonable time	O	O	O	O	O
Guidance on thesis writing	O	O	O	O	O
Support to attend conferences/seminars	O	O	O	O	O

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11. My supervisor's role in helping me understand my research environment [Rating scale legend: 1 - Poor, 2 - Moderate, 3 - Average, 4 - Good, 5 - Very Good]					
Please mark the corresponding circle - only one per line.					
	1	2	3	4	5
Helps me understand the impact of my research at national and international level	O	O	O	O	O
Educates me on the standards of good research practice in my discipline	O	O	O	O	O
Educates me on the standards of good research practice at my university	O	O	O	O	O
Guides me to do my research responsibily and safely by helping me understand the workplace health and safety issues	O	O	O	O	O
Helps me understand the academic and commercial importance of my research	O	O	O	O	O
Shares information about the funding opportunities and processes in my school, faculty and university	O	O	O	O	O

12. Interaction with my supervisor at a social level. [Scale: 1 - Never, 2 Sometimes, 3 - Most times, 4 - Frequently, 5 - Very Frequently]					
Please mark the corresponding circle - only one per line.					
	1	2	3	4	5
My supervisor is considerate of my cultural background	O	O	O	O	O
My supervisor educates me about life in the university	O	O	O	O	O
My supervisor is considerate of my social needs	O	O	O	O	O
My supervisor is considerate of my economic needs	O	O	O	O	O

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13. Communication and Networking [Scale: 1 - Never, 2 Sometimes, 3 - Most times, 4 - Frequently, 5 - Always]					
Please mark the corresponding circle - only one per line.					
	1	**2**	**3**	**4**	**5**
My supervisor is considerate of my non-English speaking background	O	O	O	O	O
My supervisor directs me to useful resources to help improve my language skills	O	O	O	O	O
My supervisor promotes my interaction with other English speaking HDR students	O	O	O	O	O
My supervisor recommends readings to help me improve my English skills	O	O	O	O	O
My supervisor supports my initiative to participate in English learning workshops	O	O	O	O	O
My supervisor invites me to informal meetings with other HDR students within my research group	O	O	O	O	O
My supervisor invites me to his lectures/talks related to my research	O	O	O	O	O
My supervisor recommends my attendence at other HDR student seminars/presentations	O	O	O	O	O

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14. My obligations as an HDR student [Scale: 1 - Strongly Disagree, 2 Disagree, 3 - Neutral, 4 - Agree, 5 - Strongly Agree]					
Please mark the corresponding circle - only one per line.					
	1	2	3	4	5
Attend HDR student orientation program conducted by the Office of Research	O	O	O	O	O
Gather information and understand my duties as an HDR student	O	O	O	O	O
Take the initiative of organizing periodic meetings with my supervisor/supervisory team	O	O	O	O	O
Clearly present my research ideas to my supervisor and seek guidance for further action	O	O	O	O	O
Explore appropriate research methodologies that can be applied to my research	O	O	O	O	O
Understand and comply with the University reporting procedures	O	O	O	O	O
Discuss with my supervisor when I should submit my thesis	O	O	O	O	O
Ensure that my thesis complies with the university regulations	O	O	O	O	O

15. Obligations of the HDR Supervisor/Supervisory Team [Scale: 1 - Strongly Disagree, 2 Disagree, 3 - Neutral, 4 - Agree, 5 - Strongly Agree]

Please mark the corresponding circle - only one per line.

	1	2	3	4	5
My supervisor should ensure that I understand all the HDR university rules and regulations	O	O	O	O	O
Make him/herself available for regular meetings to discuss the research progress	O	O	O	O	O
Ensure that you are aware of how your research fits into any research groups or projects which you are part of	O	O	O	O	O
Provide regular information and guidance about your research literature and methods	O	O	O	O	O
Ensure that the research methods and design of experiments are robust	O	O	O	O	O
Help you collect data and analyse data using appropriate research tools	O	O	O	O	O
Advise on special courses that you may need to undertake to successfully complete your HDR program	O	O	O	O	O
Provide you with timely feedback on your written submissions	O	O	O	O	O
Liaise with the research portfolio/Office of Research to arrange for your seminars	O	O	O	O	O
Arrange for required examination panel members in time for your seminars	O	O	O	O	O

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Appendix D: Supervisor Survey

Survey of Supervisors of Culturally and Linguistically Diverse (CALD) Higher Degree Research (HDR) Students

Dear Supervisor of HDR Students,

Thank you for agreeing to be a participant in the survey of Higher Degree Research (HDR) Supervisors of Culturally and Linguistically Diverse HDR students.

This survey is a joint exercise among three universities: Queensland University of Technology, The University of Western Australia, and Curtin University. This survey is part of a research project supported by the Australian Learning and Teaching Council (ALTC). All information collected from this questionnaire is private and confidential, and will be used only for the purpose of this study, and any research publications arising out of this study. No personally identifiable data will be published from this research.

The information obtained through this survey will be used to develop research supervisory frameworks for CALD HDR Students designed to improve the research study experience and facilitate timely completions of HDR degrees. Your participation will be extremely useful to realise the project goal. Your participation in this project is voluntary. If you do agree to participate, you may withdraw at any time during the project without comment or penalty.

Your participation will involve completion of an anonymous questionnaire, which contains a series of multiple choice questions. This survey should take approximately 20 minutes to complete. There are no risks beyond normal day-to-day living associated with your participation in this project. All comments and responses are anonymous and will be treated confidentially. The names of the individuals are not required in any of the responses.

Requisite ethical clearance has been obtained from the Research Ethics Unit of QUT Approval Number: 1000000116, Clearance Until: 25/02/2013, Ethics Category: Human. QUT is committed to researcher integrity and the ethical conduct of research projects. However, if you do have any concerns or complaints about the ethical conduct of the project you may contact the QUT Research Ethics Officer on 3138 5123 or ethicscontact@qut.edu.au. The Research Ethics Officer is not connected with the research project and can facilitate a resolution to your concern in an impartial manner.

If you have any questions or concerns, or would like more information on the project, please contact:
Prof Prasad Yarlagadda, Project Leader, School of Engineering Systems, QUT
y.prasad@qut.edu.au, Ph: (07) 3138 5167, or
Mrs Christine Percy, Project Manager, QUT
ca.percy@qut.edu.au, Ph: (07) 3138 9116

The research team greatly appreciates your time and patience in answering all the questions contained in this survey.

PART 1: General Questions

1. Please indicate your gender:

Please pick one of the answers below.

O Male

O Female

2. What is your country of birth?

Please pick one of the answers below.

- ○ Afghanistan
- ○ Akrotiri
- ○ Albania
- ○ Algeria
- ○ American Samoa
- ○ Andorra
- ○ Angola
- ○ Anguilla
- ○ Antarctica
- ○ Antigua and Barbuda
- ○ Argentina
- ○ Armenia
- ○ Aruba
- ○ Ashmore and Cartier Islands
- ○ Australia
- ○ Austria
- ○ Azerbaijan
- ○ Bahamas, The
- ○ Bahrain
- ○ Bangladesh
- ○ Barbados
- ○ Bassas da India
- ○ Belarus
- ○ Belgium
- ○ Belize
- ○ Benin
- ○ Bermuda
- ○ Bhutan
- ○ Bolivia
- ○ Bosnia and Herzegovina

○	Botswana
○	Bouvet Island
○	Brazil
○	British Indian Ocean Territory
○	British Virgin Islands
○	Brunei
○	Bulgaria
○	Burkina Faso
○	Burma
○	Burundi
○	Cambodia
○	Cameroon
○	Canada
○	Cape Verde
○	Cayman Islands
○	Central African Republic
○	Chad
○	Chile
○	China
○	Christmas Island
○	Clipperton Island
○	Cocos (Keeling) Islands
○	Colombia
○	Comoros
○	Congo, Democratic Republic of the
○	Congo, Republic of the
○	Cook Islands
○	Coral Sea Islands
○	Costa Rica
○	Cote d'Ivoire
○	Croatia
○	Cuba

○	Cyprus
○	Czech Republic
○	Denmark
○	Dhekelia
○	Djibouti
○	Dominica
○	Dominican Republic
○	Ecuador
○	Egypt
○	El Salvador
○	Equatorial Guinea
○	Eritrea
○	Estonia
○	Ethiopia
○	Europa Island
○	Falkland Islands (Islas Malvinas)
○	Faroe Islands
○	Fiji
○	Finland
○	France
○	French Guiana
○	French Polynesia
○	French Southern and Antarctic Lands
○	Gabon
○	Gambia, The
○	Gaza Strip
○	Georgia
○	Germany
○	Ghana
○	Gibraltar
○	Glorioso Islands
○	Greece

○	Greenland
○	Grenada
○	Guadeloupe
○	Guam
○	Guatemala
○	Guernsey
○	Guinea
○	Guinea-Bissau
○	Guyana
○	Haiti
○	Heard Island and McDonald Islands
○	Holy See (Vatican City)
○	Honduras
○	Hong Kong
○	Hungary
○	Iceland
○	India
○	Indonesia
○	Iran
○	Iraq
○	Ireland
○	Isle of Man
○	Israel
○	Italy
○	Jamaica
○	Jan Mayen
○	Japan
○	Jersey
○	Jordan
○	Juan de Nova Island
○	Kazakhstan
○	Kenya

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○	Kiribati
○	Korea, North
○	Korea, South
○	Kuwait
○	Kyrgyzstan
○	Laos
○	Latvia
○	Lebanon
○	Lesotho
○	Liberia
○	Libya
○	Liechtenstein
○	Lithuania
○	Luxembourg
○	Macau
○	Macedonia
○	Madagascar
○	Malawi
○	Malaysia
○	Maldives
○	Mali
○	Malta
○	Marshall Islands
○	Martinique
○	Mauritania
○	Mauritius
○	Mayotte
○	Mexico
○	Micronesia, Federated States of
○	Moldova
○	Monaco
○	Mongolia

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○	Montserrat
○	Morocco
○	Mozambique
○	Namibia
○	Nauru
○	Navassa Island
○	Nepal
○	Netherlands
○	Netherlands Antilles
○	New Caledonia
○	New Zealand
○	Nicaragua
○	Niger
○	Nigeria
○	Niue
○	Norfolk Island
○	Northern Mariana Islands
○	Norway
○	Oman
○	Pakistan
○	Palau
○	Panama
○	Papua New Guinea
○	Paracel Islands
○	Paraguay
○	Peru
○	Philippines
○	Pitcairn Islands
○	Poland
○	Portugal
○	Puerto Rico
○	Qatar

○	Reunion
○	Romania
○	Russia
○	Rwanda
○	Saint Helena
○	Saint Kitts and Nevis
○	Saint Lucia
○	Saint Pierre and Miquelon
○	Saint Vincent and the Grenadines
○	Samoa
○	San Marino
○	Sao Tome and Principe
○	Saudi Arabia
○	Senegal
○	Serbia and Montenegro
○	Seychelles
○	Sierra Leone
○	Singapore
○	Slovakia
○	Slovenia
○	Solomon Islands
○	Somalia
○	South Africa
○	South Georgia and the South Sandwich Islands
○	Spain
○	Spratly Islands
○	Sri Lanka
○	Sudan
○	Suriname
○	Svalbard
○	Swaziland
○	Sweden

○	Switzerland
○	Syria
○	Taiwan
○	Tajikistan
○	Tanzania
○	Thailand
○	Timor-Leste
○	Togo
○	Tokelau
○	Tonga
○	Trinidad and Tobago
○	Tromelin Island
○	Tunisia
○	Turkey
○	Turkmenistan
○	Turks and Caicos Islands
○	Tuvalu
○	Uganda
○	Ukraine
○	United Arab Emirates
○	United Kingdom
○	United States
○	Uruguay
○	Uzbekistan
○	Vanuatu
○	Venezuela
○	Vietnam
○	Virgin Islands
○	Wake Island
○	Wallis and Futuna
○	West Bank
○	Western Sahara

○	Yemen
○	Zambia
○	Zimbabwe

3. What is your cultural background?

Please pick one of the answers below and add your comments.

○	Oceanian
○	North-West European
○	Southern and Eastern European
○	North African and Middle Eastern
○	South-East Asian
○	North-East Asian
○	Southern and Central Asian
○	People of the Americas
○	Sub-Saharan African
○	Other

If you selected Other please elaborate:

----

4. If you were born overseas, for how long have you been living in Australia?

Please pick one of the answers below.

○	<1 year
○	1-5 years
○	6-10 years
○	> 10 years

5. Is English your first language? If not, what is your mother tongue?

Please pick one of the answers below and add your comments.

| ○ | Yes |
| ○ | No |

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6. How many languages do you speak? What are they (please list)?

Please pick one of the answers below and add your comments.

○   1

○   2

○   3

○   4

○   5

----

7. In which languages do you consider yourself most proficient? (please list)

Please write your answer in the space below.

----

8. Have you previously studied in an Australian University?

Please pick one of the answers below.

○   Yes

○   No

9. Which university(s) did you attend?

Please pick one of the answers below.

○   QUT

○   UWA

○   etc

10. Did you complete your high school, undergraduate and graduate studies in the country of your birth?

Please pick one of the answers below or add your own.

- ○ Yes
- ○ No

If no, where did you complete your various qualifications?

----

11. Where did you do your graduate and post-graduate studies (university/country)?

Please use the blank space to write your answers.

----

12. Have you worked in universities and/or industry in countries other than Australia? Please list the countries you have worked in?

Please pick one of the answers below or add your own.

- ○ Yes
- ○ No

If yes, please list the countries in which you have worked:

----

13. If you have worked in universities and/or industry in countries other than Australia, for how long did you work overseas?

Please pick one of the answers below.

- ○ <1 year
- ○ 1-5 years
- ○ 6-10 years
- ○ >10 years

14. At which university are you currently employed?

Please pick one of the answers below.

- ○ QUT
- ○ UWA
- ○ Curtin

15. How long have you been employed at the current university?

Please pick one of the answers below.

- ○ <1 year
- ○ 1-5 years
- ○ 6-10 years
- ○ >10 years

16. What is your employment status?

Please pick one of the answers below and add your comments.

- ○ Lecturer A
- ○ Lecturer B
- ○ Lecturer C
- ○ Associate Professor
- ○ Professor

Comments

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17. What is the MAIN field in which you are supervising and doing research? Please make your selection from the following list taken from the Field of Research (FOR) code clasifications.

Please pick one of the answers below.

○ Built Environment & Design – Architecture

○ Built Environment & Design – Building

○ Built Environment & Design – Design Practice and Management

○ Built Environment & Design – Engineering

○ Built Environment & Design – Urban and Regional Planning

○ Built Environment & Design – OTHER (please list in comments box after this question)

○ Engineering – Aerospace

○ Engineering – Automotive

○ Engineering – Biomedical

○ Engineering – Chemical

○ Engineering – Civil

○ Engineering – Electrical and Electronic

○ Engineering – Environmental

○ Engineering – Food Sciences

○ Engineering – Manufacturing

○ Engineering – Maritime

○ Engineering – Materials

○ Engineering – Mechanical

○ Engineering – Resources and Extractive Metallurgy

○ Engineering – Interdisciplinary

○ Engineering – OTHER (please list in comments box after this question)

○ Information & Computing Sciences – Artificial Intelligence & Image Processing

○ Information & Computing Sciences – Computation Theory and Mathematics

○ Information & Computing Sciences – Computer Software

○ Information & Computing Sciences – Data Format

○ Information & Computing Sciences – Distributed Computing

○ Information & Computing Sciences – Information Systems

○ Information & Computing Sciences – Library and Information Studies

○ Information & Computing Sciences – OTHER (please list in comments box after this question)

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○	Technology – Communications Technologies
○	Technology – Computer Hardware
○	Technology – Nanotechnology

18. If your main field of research was not in the above list, please write it here:

Please write your answer in the space below.

---

19. How long have you been working in your current research discipline?

Please pick one of the answers below.

○   <5 years

○   5-10 years

○   10-15 years

○   15-20 years

○   >20 years

---

20. How many HDR students are you currently supervising?

Please mark the corresponding circle - only one per line.

	0	1	2	3	4	5 or more
PhD - Principal Supervision	○	○	○	○	○	○
PhD - Associate Supervision	○	○	○	○	○	○
Masters - Principal Supervision	○	○	○	○	○	○
Masters - Associate Supervision	○	○	○	○	○	○

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21. How many HDR candidates have you supervised to successful completion?

Please mark the corresponding circle - only one per line.

	0	1	2	3	4	5 or more
PhD - Principal Supervision	○	○	○	○	○	○
PhD - Associate Supervision	○	○	○	○	○	○
Masters - Principal Supervision	○	○	○	○	○	○
Masters - Associate Supervision	○	○	○	○	○	○

22. In your best recollection, how many HDR students who started under your supervision have discontinued?

Please pick one of the answers below.

○ 0

○ 1-3

○ 4-6

○ 7-10

○ >10

23. In your opinion, the main reasons for students discontinuing HDR studies are:

Please check all that apply and/or add your own variant.

☐ Financial reasons

☐ Academic reasons

☐ Family reasons

☐ Work reasons

☐ Supervisory reasons

☐ Cultural reasons

Other

----

24. Are you currently supervising any culturally and linguistically diverse (CALD) HDR students?

Please mark the corresponding circle - only one per line.

	0	1	2	3	4	5 or more
PhD - Principal Supervision	○	○	○	○	○	○
PhD - Associate Supervision	○	○	○	○	○	○
Masters - Principal Supervision	○	○	○	○	○	○
Masters - Associate Supervision	○	○	○	○	○	○

25. How many CALD HDR candidates have you supervised to successful completion?

Please mark the corresponding circle - only one per line.

	0	1	2	3	4	5 or more
PhD - Principal Supervision	○	○	○	○	○	○
PhD - Associate Supervision	○	○	○	○	○	○
Masters - Principal Supervision	○	○	○	○	○	○
Masters - Associate Supervision	○	○	○	○	○	○

26. In your best recollection, how many CALD HDR students who started under your supervision have discontinued?

Please pick one of the answers below.

- ○ 0
- ○ 1-3
- ○ 4-6
- ○ 7-10
- ○ >10

27. In your opinion, the main reasons for CALD students discontinuing HDR studies are:

Please check all that apply and/or add your own variant.

☐ Financial reasons

☐ Academic reasons

☐ Family reasons

☐ Work reasons

☐ Supervisory reasons

☐ Cultural reasons

Other

Part 2: Supervisory Styles

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28. In your opinion, the obligations of the HDR Supervisor/Supervisory Team include:

Please mark the corresponding circle - only one per line.

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
Ensure that students understand all the HDR rules and regulations	O	O	O	O	O
Make themselves available for regular meetings to discuss the research progress	O	O	O	O	O
Ensure that students are aware of how their research fits into any research groups or projects which you are part of	O	O	O	O	O
Provide regular information and guidance about a student's research literature and methods	O	O	O	O	O
Ensure that the research methods and design of experiments are appropriate	O	O	O	O	O
Help students collect data and analyse data using appropriate research tools	O	O	O	O	O
Guide students on workplace health and safety issues	O	O	O	O	O
Guide students in undertaking accurate risk assessment for any experimental work that their research involves	O	O	O	O	O
Advise on special courses that students may need to undertake to successfully complete their HDR program	O	O	O	O	O
Provide students with timely feedback on their written submissions	O	O	O	O	O

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Liaise with the research portfolio/Office of Research to arrange their student seminars	O	O	O	O	O
Arrange for required examination panel members in time for student seminars	O	O	O	O	O

29. The following statements pertain to supervisory style. Please indicate how often you do the following:

Please mark the corresponding circle - only one per line.

	Never	Sometimes	Most times	Frequently	Always
Assist HDRs in formulating research topic	○	○	○	○	○
Help HDRs in refining and planning their projects	○	○	○	○	○
Introduce/share current literature with HDRs	○	○	○	○	○
Challenge HDRs intellectually	○	○	○	○	○
Encourage HDRs to write briefs of their research ideas, plans etc.	○	○	○	○	○
Provide advice on logistics for experimental plans	○	○	○	○	○
Question the validity of experimental plans and pre-empt outcomes	○	○	○	○	○
Direct HDRs to correct resources on campus (people and places)	○	○	○	○	○
Promote good scientific and social interaction amongst your HDRs	○	○	○	○	○
Approach supervision with flexibility depending on the stage of HDR	○	○	○	○	○
Drive your HDRs to work effectively and in a timely manner	○	○	○	○	○
Demonstrate a high interest in the overall development of HDRs	○	○	○	○	○
Encourage HDRs to network within the university and beyond	○	○	○	○	○
Allow your students to explore novel research approaches	○	○	○	○	○

Critically and openly discuss research practices	○	○	○	○	○
Encourage HDRs to participate in seminars, conferences etc.	○	○	○	○	○
Respect the knowledge and expertise your HDRs possess	○	○	○	○	○
Encourage HDRs to question their own ideas and concepts	○	○	○	○	○
Use language other than English for communication with your HDR students	○	○	○	○	○

30. Other practices or issues with supervisory style you wish to discuss:

Please write your answer in the space below.

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31. Do you believe your supervisory style has been influenced by:

Please mark the corresponding circle - only one per line.

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
How you were supervised as an HDR student	O	O	O	O	O
Observations you made while you were an associate supervisor	O	O	O	O	O
Literature on effective supervision	O	O	O	O	O
Discussions with your senior and more experienced colleagues	O	O	O	O	O
Participation in research supervision seminars and workshops	O	O	O	O	O
Feedback from your HDR students	O	O	O	O	O
Refinement based on your personal reflections of your supervisory experiences	O	O	O	O	O

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32. How do you think your HDR students rank your involvement in their research project?

Please mark the corresponding circle - only one per line.

	Poor	Moderate	Average	Good	Very Good
Expertise in research field	○	○	○	○	○
Interest shown in the student's work	○	○	○	○	○
Independence to plan their project	○	○	○	○	○
Availability of supervisor(s) when needed	○	○	○	○	○
Effort made by supervisor to discuss/comment on the student's work	○	○	○	○	○
Guidance on research design and analysis	○	○	○	○	○
Getting feedback in reasonable time	○	○	○	○	○
Guidance on thesis writing	○	○	○	○	○
Support to attend conferences/seminars	○	○	○	○	○
Extent to which students can comfortably raise issues of concern related to academic issues	○	○	○	○	○
Extent to which students can comfortably raise issues of concern related to personal issues	○	○	○	○	○

33. What are some other strengths or areas of challenge for you as a supervisor?

Please write your answer in the space below.

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34. In your opinion, the obligations of HDR students include:

Please mark the corresponding circle - only one per line.

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
Attend HDR student orientation program	O	O	O	O	O
Gather information and understand their duties as an HDR student	O	O	O	O	O
Understand and comply with the University reporting procedures	O	O	O	O	O
Take the initiative of organizing periodic meetings with their supervisor/supervisory team	O	O	O	O	O
Clearly present their research ideas to their supervisor and seek guidance for further action	O	O	O	O	O
Explore appropriate research methodologies that can be applied to their research	O	O	O	O	O
Be proactive in organizing laboratory spaces to conduct any experiments	O	O	O	O	O
Ensure that they are aware of all related workplace health and safety issues	O	O	O	O	O
Show initiative in planning the submission date of their thesis	O	O	O	O	O
Ensure that their thesis complies with the university regulations	O	O	O	O	O

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35. Are there any other obligations you wish to mention?

Please write your answer in the space below.

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36. In your opinion, to what extent do the following behaviours characterise a succesful HDR student?

Please mark the corresponding circle - only one per line.

	Not important		Moderately important		Very important
Asks questions	O	O	O	O	O
Works independently	O	O	O	O	O
Contributes to the research project	O	O	O	O	O
Publishes in peer reviewed journals	O	O	O	O	O
Completes on time	O	O	O	O	O
Understands the research project	O	O	O	O	O
Has good time management	O	O	O	O	O
Keeps up to date with literature	O	O	O	O	O
Mentors new students	O	O	O	O	O
Researches appropriate methodologies	O	O	O	O	O
Requires minimal supervision in lab	O	O	O	O	O
Can work collaboratively	O	O	O	O	O
Good risk assessment mitigation skills	O	O	O	O	O
Keeps accurate lab books	O	O	O	O	O

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37. In your opinion, how important are the following attributes in contributing to a successful HDR student:

Please mark the corresponding circle - only one per line.

	Not important		Moderately important		Very important
Positive attitude	O	O	O	O	O
Intelligence	O	O	O	O	O
Hardworking	O	O	O	O	O
Resourceful	O	O	O	O	O
Resilient	O	O	O	O	O
Persistent	O	O	O	O	O
Technically skilled	O	O	O	O	O
Independent	O	O	O	O	O
Motivated	O	O	O	O	O
Passionate about research	O	O	O	O	O
Excellent communication skills	O	O	O	O	O
Ethically responsible	O	O	O	O	O
Good analytical skills	O	O	O	O	O
Willingness to work in teams	O	O	O	O	O
Show respect for others and their work	O	O	O	O	O

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38. In your opinion, how important is it for HDR students to have experience in the following areas in order to be successful?

Please mark the corresponding circle - only one per line.

	Not important		Moderately important		Very important
Research methods	O	O	O	O	O
Problem solving	O	O	O	O	O
Industry experience	O	O	O	O	O
Lab safety	O	O	O	O	O
Quality assurance	O	O	O	O	O
Environmental management	O	O	O	O	O
Foundation subjects specific to the field (eg. physics, chemistry)	O	O	O	O	O

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39. In your opinion, how important is it for a HDR student to be competent in each of the following skills in order to be successful?

Please mark the corresponding circle - only one per line.

	Not important		Moderately important		Very important
Set up an experiment	O	O	O	O	O
Acquire data	O	O	O	O	O
Discuss and analyse data	O	O	O	O	O
Prepare a report	O	O	O	O	O
Read and synthesise basic information to be applied to their project	O	O	O	O	O
Do technical writing	O	O	O	O	O
Conduct a literature search	O	O	O	O	O
Effective reading comprehension	O	O	O	O	O
Engage in critical thinking	O	O	O	O	O
Use mathematics to solve engineering problems	O	O	O	O	O
Present solutions in an appropriate manner	O	O	O	O	O
Understand breadth and complexity of problems	O	O	O	O	O
Understand and build technology	O	O	O	O	O
Formulate a research question	O	O	O	O	O
Be able to interpret and relate the outcomes of the research in the context of the study as well as in a broader context	O	O	O	O	O
Keep an accurate lab book	O	O	O	O	O
Deal effectively with a wide variety of stakeholders	O	O	O	O	O
Be creative	O	O	O	O	O
Have a good knowledge of chemicals and materials	O	O	O	O	O

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Programming	O	O	O	O	O
Time management	O	O	O	O	O
Interpersonal skills	O	O	O	O	O

40. Other comments:

Please write your answer in the space below.

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41. In your opinion, please indicate to what extent you believe these factors influence success of any HDR student (e.g., all HDR students in the discipline, domestic and/or international)

Please mark the corresponding circle - only one per line.

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
Experience in experimental work	○	○	○	○	○
Experience in discussing and analysing data	○	○	○	○	○
Ability to break problems down to manageable bits	○	○	○	○	○
Ability to understand the complexity of issues	○	○	○	○	○
Effective time management	○	○	○	○	○
Confidence in themselves and their work	○	○	○	○	○
Adequate background and preparation for research work	○	○	○	○	○
Ability to recognise the amount of effort needed	○	○	○	○	○
Adequate technical knowledge	○	○	○	○	○
Experience in independent and analytical thinking	○	○	○	○	○
Ability to maintain motivation	○	○	○	○	○
Openness to different ways of thinking	○	○	○	○	○
Ability to write conference and journal articles	○	○	○	○	○
Ability to write different styles of reports (rhetorical styles)	○	○	○	○	○
Confidence when giving seminar presentations	○	○	○	○	○
Understanding Australian HDR expectations (educational norms)	○	○	○	○	○

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Adequate level of practical background	○	○	○	○	○
Completion of postgraduate coursework	○	○	○	○	○

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42. In your opinion, please indicate to what extent you believe these factors influence success of CALD HDR students (eg., factors which may be specific to students from culturally and/or linguistically diverse backgrounds):

Please mark the corresponding circle - only one per line.

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
Experience in experimental work	○	○	○	○	○
Experience in discussing and analysing data	○	○	○	○	○
Ability to break problems down to manageable bits	○	○	○	○	○
Ability to understand the complexity of issues	○	○	○	○	○
Effective time management	○	○	○	○	○
Confidence in themselves and their work	○	○	○	○	○
Adequate background and preparation for research work	○	○	○	○	○
Ability to recognise the amount of effort needed	○	○	○	○	○
Adequate technical knowledge	○	○	○	○	○
Experience in independent and analytical thinking	○	○	○	○	○
Ability to maintain motivation	○	○	○	○	○
Openness to different ways of thinking	○	○	○	○	○
Ability to write conference and journal articles	○	○	○	○	○
Ability to write different styles of reports (rhetorical styles)	○	○	○	○	○
Confidence when giving seminar presentations	○	○	○	○	○
Understanding Australian HDR expectations (educational norms)	○	○	○	○	○

Adequate level of practical background	O	O	O	O	O
Completion of postgraduate coursework	O	O	O	O	O

43. Other Comments:

Please write your answer in the space below.

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44. Are there any other aspects of HDR supervision or the student/supervisor relationship you want to highlight as part of this survey?

Please write your answer in the space below.

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Part 3: Research Supervision in the Multicultural Context

45. The following statements relate to your supervision of culturally and linguistically diverse (CALD) HDR students. Please indicate how relevant these issues are to the supervision of CALD HDR students:

Please mark the corresponding circle - only one per line.

	Not at all relevant		Neutral		Very relevant
Awareness of the cultural background of your HDRs	O	O	O	O	O
Awareness of the socio-economic background of your HDRs	O	O	O	O	O
Awareness of the religious background of your HDRs	O	O	O	O	O
Awareness of the level of social interaction you maintain in relation to the university's code of conduct	O	O	O	O	O
Need to advise HDRs on how to improve their linguistic skills	O	O	O	O	O
Need to support your HDRs in terms of scientific and social interaction	O	O	O	O	O
Need to recommend your HDRS to any language development programs	O	O	O	O	O

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46. The following statements relate to the involvement you have in developing the communication and networking skills of your CALD HDR students. Please indicate how often you try to do the following:

Please mark the corresponding circle - only one per line.

	Never	Sometimes	Most times	Frequently	Always
Consider how a student's non-English speaking background is impacting their study	O	O	O	O	O
Direct students to useful resources to help improve language skills	O	O	O	O	O
Promote interaction with other English speaking HDR students	O	O	O	O	O
Recommend readings to help students improve their English skills	O	O	O	O	O
Support students' initiative to participate in English learning workshops	O	O	O	O	O
Invite students to informal meetings with other HDR students within their research group	O	O	O	O	O
Invite students to your lectures/talks related to their research	O	O	O	O	O
Recommend students attend other HDR student seminars/presentations	O	O	O	O	O

47. How often do you experience the following with your culturally and linguistically diverse (CALD) HDR students:

Please mark the corresponding circle - only one per line.

	Never	Sometimes	Most times	Frequently	Always
They require more personal time to help them recognise and adopt the research culture than non-CALD HDRs	○	○	○	○	○
They find it more challenging to embrace state-of-art technology as potential research tools (such as software) than non-CALD HDRs	○	○	○	○	○
They experience a steeper learning curve in understanding research methods than other students than non-CALD HDRs	○	○	○	○	○
They request more help in critiquing literature than non-CALD HDRs	○	○	○	○	○
They need more guidance on norms of academic referencing than non-CALD HDRs	○	○	○	○	○
They need direction in goal setting than non-CALD HDR's	○	○	○	○	○
They need more encouragement to freely discuss their views	○	○	○	○	○

48. Other Comments:

Please write your answer in the space below.

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49. In your opinion, does research supervision of CALD HDR students impact your own research in any of the following ways:

Please mark the corresponding circle - only one per line.

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
Help me disseminate my research to a wider global audience	O	O	O	O	O
Educate me in identifying other research cultures	O	O	O	O	O
Improve the quality of my research	O	O	O	O	O
Extend my understanding of some theories to newer concepts	O	O	O	O	O
Enhance my personal outlook across more socio-cultural groups	O	O	O	O	O
Open more opportunities to further my career in the global context	O	O	O	O	O
Does not impact my workload	O	O	O	O	O
Does not impact my supervision time	O	O	O	O	O
Does not impact my research time	O	O	O	O	O
Does not require me to use skills outside my discipline (eg., pastoral care)	O	O	O	O	O

50. Are there any other aspects you wish to highlight in this section?

Please write your answer in the space below.

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Part 4: Support Structures for HDR Supervision

51. Are there any other aspects you wish to highlight in this section?

Please write your answer in the space below.

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Part 5: Research Supervision Seminars and Workshops

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52. Please answer the questions below that relate to your participation in any research supervision seminars and workshops that you may have attended at your university.

Please mark the corresponding circle - only one per line.

	Not at all useful	Somewhat useful	Very Useful	Extremely Useful	Have not attended a course of this type
Managing HDR Candidatures	O	O	O	O	O
Codes of Practice	O	O	O	O	O
Ethics	O	O	O	O	O
Dealing with HDR conflicts of interests	O	O	O	O	O
Examining HDR theses	O	O	O	O	O
HDR Thesis writing	O	O	O	O	O
Supervising International HDR students	O	O	O	O	O
IP & Commercialisation	O	O	O	O	O

53. Were these courses compulsory?

Please mark the corresponding circle - only one per line.

	Yes	No
Managing HDR Candidatures	O	O
Codes of Practice	O	O
Ethics	O	O
Managing HDR conflicts of interests	O	O
Examining HDR theses	O	O
Supervising International HDR students	O	O

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54. Are there any other courses you have attended that you found useful? (Please list)

Please write your answer in the space below.

Part 6: Faculty/University Sponsorship

55. Does your university or faculty provide support for you as an HDR Supervisor in the following ways:

Please mark the corresponding circle - only one per line.

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
HDR supervision workloads	O	O	O	O	O
Opportunities to be mentored by senior supervisors	O	O	O	O	O
Support for development as supervisor	O	O	O	O	O
Funding to support HDRs to conferences etc.	O	O	O	O	O
Adequate scholarships for HDRs	O	O	O	O	O
Support for HDR thesis development	O	O	O	O	O
Funding for your attendance to conferences	O	O	O	O	O
Access to laboratories and equipment	O	O	O	O	O
Access to High Performance Computing and related support	O	O	O	O	O

56. Are there any other aspects you wish to highlight in this section?

Please write your answer in the space below.

Part 7: Individual Research Perceptions

57. In your opinion, research in the multicultural context provides the following personal benefits:

Please mark the corresponding circle - only one per line.

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
Greater self-awareness of own conceptions of research and supervisory practice	O	O	O	O	O
Greater understanding of the literature on the scholarship of supervision	O	O	O	O	O
Enhanced competency in interactional and communications skills	O	O	O	O	O
Better understanding of institutional policy and procedural requirements	O	O	O	O	O
Recognition of specific needs of CALD HDR students at the University level	O	O	O	O	O

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58. Are there any other aspects you wish to highlight in this section?

Please write your answer in the space below.

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Part 8: Research in the Local and Global Contexts

59. In your opinion, what is the impact of supervising HDR students on your own research profile?

Please write your answer in the space below.

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60. Please identify any important gaps in the level and quality of research in your area in the local and global contexts?

Please write your answer in the space below.

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61. What do you perceive as the most important challenges that universities have to address in the future of research supervision, in light of the increasing international HDR student population?

Please write your answer in the space below.

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62. Please highlight any other aspects of HDR supervision that are impacting your own research profile.

Please write your answer in the space below.

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63. We would like to conduct a brief interview with supervisors who have had a specific issue with a CALD HDR student that was affected by cultural factors.

Student names will not be required and supervisor details will not be disclosed in any dissemination of findings.

If you agree to be contacted so we can discuss this issue with you in more detail, please provide a brief summary of the issue and your contact details (email, phone):

Please write your answer in the space below.