Work Integrated Learning in STEM in Australian Universities

FINAL REPORT

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Executive Summary

Overview

The Australian Council for Educational Research (ACER) undertook this study for the Office of the Chief Scientist (OCS). It explores the practice and application of Work Integrated Learning (WIL) in Science, Technology, Engineering and Mathematics (STEM) with a particular focus on natural and physical sciences, information technology, and agriculture departments in Australian universities. The project involved a detailed 'stocktake' of WIL in practice in these disciplines, with collection of information by interview, survey instruments, consultation with stakeholders and literature reviews. Every university in Australia was visited as part of this project, with interviews and consultation sessions gathering insight from more than 120 academics and support staff. This study contributes new knowledge relating to WIL in Australia especially in the STEM disciplines. It is hoped that the results of this work will offer a foundation for enhancing collaboration between education institutions and industry in preparing university students for the wider workforce.

In addition to the collection of primary data, this project draws on existing research and practice in WIL to inform the findings and develop a context for the study. WIL is a well researched field, with a number of high quality national pieces of research undertaken over the past five years placing Australia at the forefront of knowledge and practice in this area. However, within the STEM disciplines, and especially in the non-engineering areas, less information is known. The background research available highlights that exploration of WIL practice and policy needs to carefully consider the context in which it is being implemented – at the discipline level (i.e. within STEM fields), at the institution level, and at the system (national or state) level. While bearing in mind the contextual differences across these levels, the literature exploration in this report highlights some core themes relating to good practice in WIL. These findings are incorporated into the reflections and suggestions in the conclusion of this report.

Defining WIL and contextualising WIL activities

Strictly defining the term WIL is difficult and various terms other than 'WIL' were identified in this project as being used to describe the same kinds of activities. As such, this report takes a broad approach to defining WIL. In discussing and describing activities in this report, and in collecting information from universities during fieldwork, the considered advice of two international leaders in this area of research is followed. Coll and Zegwaard argue 'that the diversity and proliferation of terms has become so wide that it may perhaps be better to focus on defining features of co-op/WIL programs (or whatever term one chooses to use), allowing these programs to be known under a variety of guises and be identified by their defining features' (2012, p. 2). Consequently, this report focuses on describing key features of the practice and programs that were articulated and highlighted by the academics and support staff involved in the work.

The definitions developed by universities for describing WIL are relatively similar across Australia, although there are differences in terminology used to label such activities. Common features of WIL definitions include: *Integrating theory with the practice of work*; *Engagement with industry and community partners*; *Planned, authentic activities*; and *Purposeful links to curriculum and specifically designed assessment*. These definitions are informed closely by some of the key literature on this topic, such as the work undertaken by Patrick, Peach, Pocknee, Webb, Flectcher & Pretto (2008), Ferns, Russell, Smith & Cretchley (2014), and

Orrell (2011). WIL programs in Australian universities include, but are not limited to: industry based projects; internships; job shadowing; career development learning; clinical placements; fieldwork; project based learning; teaching practicum; virtual projects and simulations; volunteering; and work placements.

There is widespread support for WIL activities in STEM and many Australian universities are currently in the process of increasing WIL-related activities and redesigning policies to support expansion across all disciplines. Through the examination of WIL in practice in this project, a number of different 'models' for applying WIL were identified. These ranged from WIL as an 'add-on' to a traditional science curriculum, to having an institutionally embedded approach to WIL that leads to industry interaction permeating the whole course structure.

Student Participation in WIL

This project collected detailed information about the types of activities being offered to students and the extent to which students participate in them. Many factors motivate students to participate in WIL activities. Academics identify the opportunity for students to link learning with the real world and to gain a head start in the job market as the biggest motivations for students participating in WIL.

Exploration of WIL activities was undertaken across the STEM areas. Engineering has vast coverage in WIL activities that involve specific industry placements – traditionally a core facet of these courses used to satisfy accreditation with the peak body, Engineers Australia. In the other STEM disciplines, which are the main focus in this project, ICT tends to have the greatest extent of WIL activities embedded as 'for credit'. ICT is especially strong for industry projects. Agriculture and environmental sciences have a range of project and placement based activities, with comparatively large numbers of placements compared to other disciplines, although these placements tend to be of less than six weeks. Within the traditional sciences a number of placement and project based WIL activities exist, but in most cases they are situated in elective units and their coverage of the student population is relatively small.

The indicative data collected in this study suggest that almost three of every four ICT bachelor students in Australia experience an industry based project during their degree, compared with about one in four agriculture and environmental studies students and about one in seven science students.

Figures on participation in placements or internships are substantially lower in the ICT field, and almost negligible in the natural and physical sciences. Agriculture and environmental sciences are slightly higher with indicative data suggesting shorter term placements covering almost one in every five students, with lower participation in longer term placements.

Engagement with industry in WIL partnerships

Universities in Australia have connections with industry for WIL in STEM fields that span a vast range of industries and business sizes, and cover all sectors. Academics perceive that employers are involved in WIL activities to identify potential employees, to tap into knowledge and innovation that universities can offer, and to contribute more broadly to the education of students in their fields, and in some cases within their regions.

The vital role individual academics play in establishing industry connections within their disciplines for WIL activities was highlighted throughout discussions with universities. The importance of these relationships for academics in terms of personal research and professional opportunities was also emphasised. Reliance

on individual academics to develop and maintain relationships with industry is particularly prominent in the science disciplines, while organisation at the institutional or departmental level for establishing connections is more apparent in ICT and engineering.

In expanding WIL activities and connection with industry, universities are faced with identifying a sustainable balance between centralised administration of relationships and the personalised approach by individual academics.

Administration and funding of WIL

Arrangements and policies relating to coordinating, administering, and funding WIL activities are currently being developed or revised in many institutions across the higher education sector. Existing administration and coordination of WIL activities in STEM disciplines varies significantly across universities in Australia. Some universities have a highly centralised approach, while others are simply run by individual academics with a passion for WIL activities. Many models lie somewhere between. In general, the engineering and ICT disciplines tend to be more organised, and have specific faculty-wide processes and support for WIL activities, when compared with the science and agriculture disciplines.

The full costs of WIL based units are generally unknown. Usually WIL units are funded in the same way as any other academic subject – with funding allocated according to student enrolment numbers. Most participants in the study indicated that 'WIL costs more', but it was difficult to generalise about how much more. Issues with identifying and articulating costs for WIL have been shown to be difficult between faculties within institutions (Smigiel & Harris, 2008), let alone across universities and disciplines. The main reason given for the higher costs tended to be the time and effort that WIL activities require in developing and maintaining industry contacts, and supervision and allocating students to placements or projects.

Impediments to the expansion of WIL in STEM

Difficulty in attracting enough employers to participate in WIL activities was by far the most significant impediment to expanding WIL mentioned by academics and support staff who participated in this project. Under-resourcing of WIL, in particular funding of support staff, was also highlighted as a hurdle to expansion.

In science in particular, the lack of existing processes and infrastructure for developing WIL activities was identified as a potential impediment to expansion in the immediate term – without first establishing processes, it is anticipated that expansion might not result in success.

The general lack of value placed on WIL, and resistance to committing to WIL activities, was also identified as a substantial inhibiting factor in expanding WIL in many institutions. It was highlighted that simply relying on the commitment of a small number of academics is not a sustainable way to expand WIL activities in science, ICT, and agriculture.

In exploring the possibilities of overcoming these impediments, the report offers examples in the form of cases identified through this research. These examples can be found in chapter 9, they cover the science, ICT, and agriculture/environmental sciences areas and present different types of WIL activities. The chapter includes some specific programs being implemented, and briefly offers some insight into some institution-wide approaches to WIL.

Key aspects of 'Good WIL'

Based on fieldwork and background research conducted during this project a number of key elements were identified which are important in developing successful and sustainable WIL units.

Good WIL:

- is clearly linked to theoretical aspects of courses, *ideally* providing an 'ah-ha' moment to the student when the practical and theoretical merge;
- has strong engagement with industry;
- has well articulated expectations of both students and industry partners;
- has clear induction processes at the beginning and facilitated opportunities for reflection on experiences at the end - for both students and industry;
- has well established processes for logistics and support of students and industry; and
- has support from leadership and dedication from academic staff.

This report identifies specific factors that are needed in order to achieve the 'Good WIL' described here. These include increasing the value placed on WIL activities within the academy, working more closely to embed interaction with industry across all facets of the curriculum, developing processes for sustainable practice for expansion of WIL activities and recognising the need for flexibility in the application of these activities within different disciplines and across institutional contexts.

Approaches for the future

The conclusion to the report also explores a number of key issues and approaches that need to be considered if WIL activities in science, information technology, and agriculture departments are to be expanded in the future. Approaches considered here take into account the elements required for achieving 'Good WIL'.

The report suggests a greater focus in STEM areas on industry projects as a key tool for expanding participation in WIL. When designed and implemented well, industry projects were seen in this study as efficient in terms of the quantum of employers required as well as educationally useful in developing the skills and experiences that WIL activities offer. Other suggestions flowing from this research include the development of an employer/university STEM hub for projects and placements, and the integration of data collection on participation in WIL activities in order to better quantify participation and objectively explore the potential benefits that involvement in WIL offers students.

1 Introduction

1.1 Overview

The Australian Council for Educational Research (ACER) undertook this study for the Office of the Chief Scientist (OCS). It explores the practice and application of Work Integrated Learning (WIL) in STEM, with a particular focus on natural and physical sciences, information technology, and agriculture departments in Australian universities. The project involved a detailed 'stocktake' of WIL in practice in these disciplines, with collection of information by interview, survey instruments, consultation with stakeholders and literature reviews. Every university in Australia was visited as part of this project, with interviews and consultation sessions gathering insight from more than 120 academics and support staff. This study contributes new knowledge relating to WIL in Australia especially in the STEM disciplines. It is hoped that the results of this work will offer a foundation for enhancing collaboration between education institutions and industry in preparing university students for the wider workforce.

This document offers detailed insight into the context, approach and findings of this project. This first chapter provides a background to the work. In the second chapter the approach and methodology applied during the project are discussed, followed in chapter 3 by reviews of the WIL literature for further insight and background. The main findings of the project are then presented in the chapters 4-8. These cover:

- Context, definitions and types of WIL activities;
- WIL activities and student participation;
- Engagement of industry in WIL;
- Administration and funding of WIL; and
- Impediments to expanding WIL.

In chapter 9 a range of case studies is presented which help to highlight innovative practice and interesting approaches to WIL. The conclusion of the report highlights the key elements of 'Good WIL' identified through this project, re-explores some important issues that need to be addressed for expansion to be sustainable, and offers some suggestions to encourage further development of WIL activities in STEM.

1.2 Background and context

Gathering new insight into the activities of universities that link students to the work environment is important – especially in the sciences, where comprehensive national studies are uncommon. Over the past decade, research has shown that WIL is an important and effective means for preparing university students for active participation in the workforce on completion of their studies. The recently launched National WIL Strategy (ACEN, 2015), a joint undertaking between university and business groups, further highlights the growing recognition of the importance of WIL. Ensuring that universities equip graduates with capabilities that not only meet the expectations of employers, but also facilitate a smooth and effective entrance for these people into the workforce is of immense importance for the productivity of the Australian workforce. In the case of STEM – an area at the forefront of innovation – this need is arguably even more profound if the future workforce is to maintain and grow the reputation of Australia at the forefront of scientific knowledge and expertise.

STEM skills and STEM graduates contribute significantly to the Australian economy. As demonstrated through an ABS study for the Office of the Chief Scientist (ABS, 2014), STEM related occupations grew at one and a half times the rate of other occupations between 2006 and 2011. Furthermore, the demand for these occupations is expected to continue growing in coming decades (Deloitte Access Economics, 2014). As Australia increasingly develops its knowledge based economy, the contribution of the scientific workforce towards this end becomes increasingly prominent.

An employer survey conducted for the Office of the Chief Scientist (OCS) in 2014 clearly highlighted that for STEM employers, the key difficulties encountered when recruiting graduates related to deficiencies in interpersonal skills, understanding of business and workplace experience. Active learning and critical thinking were identified in this survey as the two most important attributes a graduate should be equipped with on entry to the workplace (Deloitte Access Economics, 2014).

This finding matches closely with other work undertaken in this area, including a substantial study and consultation into the views of employers in relation to science and mathematics graduates in Australia (Edwards & Smith, 2008, 2010). In the work from this 2008 study, expectations of employers in relation to 'hard' and 'soft' skills were articulated. 'Hard' skills include technical, analytical and appreciative skills. Technical skills relate to the specific ability to apply learned expertise to a task, analytical skills relate to problem identification and problem solving, and appreciative skills relate to the ability to evaluate and make appropriate judgements about complex situations. 'Soft' skills are a combination of personal, interpersonal and organisational skills. As found in the Employer Survey for OCS and in the Edwards and Smith work, these skills are highly sought after by employers, and have been reported to be lacking in many graduates in the science and mathematics fields.

It is therefore important that teaching in STEM related fields is sufficiently robust, relevant and appealing so that it both attracts high calibre students and prepares them as best as possible for a career in the workforce. Approaches that are often grouped under the heading of 'Work Integrated Learning' or 'WIL' are increasingly recognised as important tools in developing high quality and work ready graduates.

Strictly defining the term WIL is difficult. In this study, various definitions for the specific term were found (and are discussed in the chapters that follow). In addition, various terms other than 'WIL' were identified as being used to describe the same kinds of activities. This report takes a broad approach to defining WIL. In discussing and describing activities in this report, and in the collecting information from universities during this research, the considered advice of two international leaders in this area of research is followed. Coll and Zegwaard argue 'that the diversity and proliferation of terms has become so wide that it may perhaps be better to focus on defining features of co-op/WIL programs (or whatever term one chooses to use), allowing these programs to be known under a variety of guises and be identified by their defining features' (2012, p. 2). Consequently, this report focuses on describing key features of the practice and programs that were articulated and highlighted by the academics and support staff involved in the work.

In practice, WIL is a broad term for a range of different approaches to teaching and learning employed in a range of educational settings. In the case of universities, and more specifically the STEM fields, WIL is one of the terms used to describe activities and programs that integrate academic learning with its application in the workplace. Besides facilitating the development of greater contextual understanding, some WIL approaches also provide opportunities for students to develop the non-technical skills and attributes valued by employers.

WIL is important for developing graduate attributes that appeal to employers and equip graduates with workforce skills. These activities also help engage students while at university. Research using the Australasian Survey of Student Engagement (AUSSE) has shown that students involved in WIL are less likely to consider dropping out of university than those who are not involved in WIL. The AUSSE data also show that students who have participated in WIL are more likely than others to indicate that they have been learning things in their course that 'improved knowledge and skills that contribute to employability' (Coates, 2009; Radloff & Coates, 2010). Importantly for this project, students in natural and physical sciences have the lowest scale score, on average, for the WIL scale in the AUSSE (Radloff & Coates, 2010), suggesting they are least likely of the broad fields of education to be engaged in WIL activities during their degrees.

WIL approaches may be real or simulated and can occur in the workplace, at the university, online, face-to-face, or any combination of these. Although WIL is often seen as synonymous with work placement, paid or voluntary student placements in industry are an important but not mandatory component of WIL. Other WIL opportunities include industry relevant projects and simulated work experiences. WIL activities, particularly those involving work placements, may attract study credit for students, or they may be optional and not attract credit. Some are built into university courses. Others are driven by the initiative of the student rather than required by the university as part of a course.

There is limited evidence about the extent to which WIL programs and activities are deployed by STEM disciplines within Australian universities, the costs associated with them, and their effectiveness in the eyes of employers. The evidence is particularly limited at the national level and in the traditional sciences. This study, alongside a parallel project exploring employers' perspectives about WIL, offers a unique and more complete picture of these practices in STEM.

Given that WIL in Australia is uneven, and recognising that the engineering discipline is significantly ahead of other STEM disciplines, engineering was not investigated as intensively during this project as were other disciplines.

This project builds on the earlier work conducted for the Office of the Chief Scientist which identified the non-technical higher order skills of STEM graduates most valued by employers (Deloitte Access Economics, 2014). This project provided an opportunity to further explore academics' understandings of these skills and the ways in which their development is fostered within all parts of the curriculum, including WIL activities. Detail in relation to this particular facet was collected during this project and is detailed in a subsequent forthcoming report by the Office of Chief Scientist, also drawing on further work with employers undertaken by the National Centre for Vocational Education Research (NCVER).

1.3 Objectives

The objectives of this project, as specified by the Office of the Chief Scientist are outlined below:

1. To describe the level and type of Work Integrated Learning (WIL) for both credit and non-credit in science, technology (ICT), engineering, mathematics and agricultural science (STEM) related faculties in universities, with an emphasis on the non-engineering disciplines.
2. In the case of 'for credit' WIL, to describe how the WIL programs in STEM faculties are funded.
3. In the case of 'for credit' WIL, to describe the ways in which WIL is administered in STEM faculties in universities – the organisational structures, strategies, and the scalability of initiatives.
4. In the case of 'for credit' WIL, to describe the integration of STEM Work Integrated Learning into the STEM curriculum.
5. In the case of 'for credit' WIL, to describe and assess the quality and impact of existing WIL in STEM faculties.
6. To describe and analyse international best practice in STEM WIL and how it relates to the Australian context.

2 Approach and methodology

Key Points

- The project involved widespread consultation.
- Development of interview questions and templates for data collection was based on findings from background research and feedback from academics.
- Fieldwork took place in a three month period between late August and late November 2014.
- Every public university in Australia was involved in the research and visited by project team members.
- Overall, more than 120 academics and relevant support staff were interviewed about WIL activities in STEM areas.

2.1 Overview

This project commenced in June 2014. The main fieldwork period for the project was from late August to late November 2014. This final report was submitted in February 2015. This chapter describes the approach taken by the ACER research team in undertaking this project. It covers stakeholder engagement, background research, development of questionnaire instruments, engagement of universities, interviews and data collection.

For the purpose of this project, the emphasis on discussion and collection of results draws on definitions and categories detailed in the Australian Standard Classification of Education (ASCED). Included in the scope of this project are the fields of Natural and Physical Sciences (also termed 'traditional sciences' in some parts of this report and broadly encompassing chemistry, biology, earth sciences, geology, physics and mathematics), Information Communication Technology (ICT), and Agriculture and Environmental Science. Engineering is included in the discussion where relevant programs have been identified as offering course credit for WIL activities (i.e. 'for credit' WIL). The Health Sciences are out of the project scope.

2.2 Approach to 'defining' WIL

As noted in chapter 1, a purposefully wide 'definition' of WIL was used by the research team in developing interview questions, shaping discussions with stakeholders, collecting data and preparing the project report. Later in this report the discussion of outcomes highlights the different terms used to describe activities termed 'WIL' here and the benefit of focusing on describing programs and activities for what they are rather than omitting them for not fitting a strict definition or terminology. The researchers followed the pragmatic advice of Coll and Zegwaard: rather than 'focussing on defining features of co-op/WIL programs (or whatever term one chooses to use)' the research team has allowed 'these programs to be known under a variety of guises and be identified by their defining features' (2012, p.2).

As a broad guide for participants in this project, three definitions were provided as background to the interviews. Rather than being strict boundaries, these definitions provided a loose framework for helping focus discussions and the research team's expectations relating to interviews. The definitions were:

> *WIL is the term given to an activity or program that integrates academic learning with its application in the workplace. The practice may be real or simulated and can occur in the workplace, at the university, online, face-to-face or any combination of these.*

WIL provides the means to 'do in context' rather than developing practical skills alone.

WIL involves developing students' work readiness skills to industry standards and enhancing employability.

2.3 Stakeholder engagement

Every university in Australia is active in at least one of the fields of education that are the focus of this study: Natural and Physical Science, ICT, Mathematics, Agricultural Science, and Engineering. Consequently, the project required engaging and including every Australian university in interviews about WIL activities. In most cases, engagement occurred across multiple faculties and involved numerous academics and/or coordinators.

Due to the large number of faculties that the study needed to engage, the project team's work initially began at a national level through key stakeholder groups for disciplines relevant to the study. In the early phase of the project, support was gained from the relevant Deans' bodies – the Australian Council of Deans of Science (ACDS), the Australian Council of Deans of Information and Communications Technology (ACDICT), the Australian Council of Deans of Agriculture (ACDA), and the Australian Council of Engineering Deans (ACED).

Initial engagement with these groups involved discussions with executive members about the objectives and logistical issues of the project. All Deans' councils offered to help promote the project and to ask their members to assist the project team in gathering data.

Project engagement was further elicited through presentations to relevant groups. In the early phase of the project, the project leader presented at events held by two councils:

- ACDS Teaching and Learning Conference, June 30 2014, Deakin University; and
- ACDICT Annual Council Meeting, July 7 2014, UNSW.

The project team also conducted two well attended workshop sessions at the national Australian Conference on Science and Mathematics Education in Sydney in September 2014. These sessions attracted about 40 participants – primarily academics in science and mathematics fields. During the workshops participants worked in groups to answer questions about key themes that were emerging during the project fieldwork. The data collected in these sessions was used to help validate and contextualise the data collected through interviews with academics in individual universities.

The ACER research team also coordinated closely with the OCS throughout the project, providing the Office with information and relevant 'indicative findings' that were used to promote the project and engage universities and other stakeholders.

2.4 Background research

A substantial amount of background research was undertaken during the project. Three specific literature reviews were conducted:

- A general review of WIL in Australia – conducted in the early phase of the project;
- A review of international models of WIL – conducted later in the fieldwork phase; and
- A review relating to WIL in engineering – also conducted later in the fieldwork phase.

The background research for this study included scoping academic journals, policy documents, government and stakeholder reports, and university curricula documentation. The reviews contributed to the development of the interview questionnaire designed for the large fieldwork component of this research project. They also provided valuable insight into existing practice and knowledge from other regions in relation to formulating recommendations and ideas for improved practice in WIL for the STEM disciplines in Australia.

2.5 Instrument development

In the initial stages of the project the research team began to build a framework for developing the instrumentation for the interviews and data collection from universities. The core frame for this instrumentation drew heavily on the project's terms of reference and the first literature review undertaken in the project.

The project team drafted an interview questionnaire schedule and a number of tables for compiling specific data. The draft versions were distributed to the OCS, and to five academics in Australian universities who have expertise in the disciplines of focus and who have an interest in WIL practices.

Feedback from the academic reviewers and the OCS was incorporated into a final set of questions and tables that were used as the basis for the fieldwork component of the project. Broadly, the interview questions covered a range of areas relevant to WIL, including:

- WIL policies and institutional definitions;
- Specific WIL activities;
- Student participation;
- Industry participation;
- WIL costs;
- WIL evaluation and outcomes; and
- STEM higher order skills.

The questionnaire was designed to be completed during a 90 minute interview, the interview questions are included in Appendix A of this report..

2.6 Fieldwork – visiting each university

A core component of this project was to undertake face-to-face interviews with relevant personnel from all Australian universities. Given project timelines, all interviews needed to take place during Semester Two 2014. On a logistical level alone, this was a significant task. Utilising highly-qualified research staff, and significant administrative support, the project team visited every public university in Australia to interview academics and WIL coordinators in relevant disciplines. The section below describes the process followed.

In early July 2014, the project team contacted all universities in Australia which teach into the disciplines of focus. Personal emails inviting participation were sent to the Deans of all the disciplines covered in this project. For some universities, this meant contacting one Dean, but for most the initial contact involved emails to several Deans. Initial invitations provided an overview of the project objectives, insight into the interview content, and requested that the Dean nominate a person (or persons) who could speak to the researchers about the disciplines of focus.

The ACER project team then contacted the individuals nominated the Deans to identify appropriate times for visiting their institution. In cases where there was no response to initial email requests, subsequent emails and phone calls were made. In some cases other staff at the institution were contacted to make appropriate links.

In general those involved in the interviews tended to be in position of Associate Dean (Teaching and Learning) or equivalent. However, many interviews also included discipline-specific academics, and faculty or university WIL/placement coordinators. In some institutions a number of separate interviews were undertaken (usually one discipline at a time). In others, all relevant personnel met at the same time for the interview session. Some universities with distributed campuses set up video-links so that academics at various locations could participate in the interview.

Prior to interviews, participants were emailed the interview questions, incorporating a number of tables which they were asked to 'pre-fill' prior to the session. These tables were designed to enable some standardisation across the collection of information in the project to offer accurate comparisons of activity across the sector and within the disciplines of focus.

Six ACER researchers undertook the interviews across all states and territories of Australia. All 37 public universities in Australia were visited as part of the project. In total more than 120 university staff were involved in the interviews.

Interviews were conducted face-to-face. Some follow up telephone calls were initiated with participants to clarify information collected during the visits. Most universities provided broad data. In some cases the research team followed up with universities to complete some of the data tables. In other cases this was not possible due to factors like lack of data, the significant time required to collate data, and commercial concerns.

Following interview sessions, responses were transcribed by researchers into a standardised form for analysis. Project team meetings were convened to collect further insights from the interviewers and discuss emerging issues. The draft report for the project was reviewed by the OCS and an Industry Working Group comprising of representatives from the Business Council of Australia (BCA), Australian Industry Group (AIG), the Australian Collaborative Education Network (ACEN), Australian Chamber of Commerce and Industry (ACCI), Universities Australia (UA), the Australian Technology Network (ATN), the Group of Eight (Go8) and the Regional Universities Network (RUN).

2.7 Caveats

As detailed above, all universities were involved in the interviews and the academic leaders of the relevant disciplines were contacted to identify appropriate interviewees for the project. Based on this information, significant efforts were made to organise interviews with the people identified as most relevant to the needs of the project. Interviewees volunteered their time to participate in the research and in many cases devoted substantial amounts of time towards collating data relevant to the project. Concerted attempts were made to interview the most relevant person from all disciplines in all universities. Inevitably there will be instances in which additional interviewees may have offered different institutional perspectives on certain issues and practices.

In some cases, representatives from institutions were unable to provide some information relevant to the project. In most of these cases this related to compiling broad overview data about the extent to which STEM students participated in WIL related activities. The main reasons for not providing this information

were a lack of time on behalf of the interviewee, a lack of resources within the department for compiling the information for the project, and that the requested information was not recorded in an easily accessible way. This means the project team was unable to gather comprehensive data from every university about some quantitative aspects of the project discussed below. Nonetheless, the data that was collected spans a significant component of the sector. It provides sufficient quantitative data to offer strong overall insight into participation in WIL and the breadth of activity occurring across Australian universities at present.

Certain selection bias is likely to result from the interviews for this project. Given that the interview sessions were about WIL and required the voluntary time of academics and support staff, it is likely that those involved in the interviews were those with a passion for and commitment to WIL already. This inevitably leads to the likelihood of more positive views relating to the value of WIL activities than might be the case among the wider faculty. The researchers involved in the interpretation of data and development of this report acknowledge the potential for this selection bias and emphasise that readers of the results should consider this when interpreting the outcomes described.

It is important to highlight that most of the following discussion provides detail on WIL activities, processes and policies across Australian universities. There are instances in the discussion where the generalisations highlighted are not necessarily indicative of practice in every university in Australia. While caveats are added to general statements, there may be instances where there are differences from the 'norm'. Given the scale of the project such instances are likely to be inevitable; however, the researchers have made efforts to avoid such issues as far as possible.

3 Literature Review: Work Integrated Learning

Key Points

- WIL is a well researched field, with a number of high quality national pieces of research undertaken over the past five years.
- However, within the STEM disciplines – and specifically in the non-engineering areas – less information is available.
- Other gaps in our knowledge of WIL include the way in which it is assessed, equity and access, and participation by international students.
- WIL practice in engineering is significant in Australia WIL and generally involves internship placements with employers during university vacation periods. There are a range of innovative practices being implemented by engineering schools in facilitating these programs – with a number beginning to move from a 'not for credit' to a 'for credit' model of provision.
- Internationally, WIL (often termed differently) is gaining prominence as an effective method of teaching and learning in higher education. Recently a number of countries, including the UK, Canada and New Zealand, have completed significant studies into WIL's role in higher education.
- Contextual differences between countries and education systems mean that making directly applicable comparisons with Australia can be difficult – however, there are still programs and ideas that Australia can learn from in implementing WIL activities and policies.

3.1 Overview

This chapter comprises three literature reviews relating to WIL. The first (section 3.2) examines the broad application and integration of WIL in Australian universities, highlighting issues relating to definition, integration in STEM, funding, curriculum and assessment and the impact of WIL. The second (section 3.3) specifically explores literature relating to WIL in engineering in Australia – it synthesises findings from a number of significant studies and offers examples of best practice identified in the literature. The third (section 3.4) offers insight into WIL from the international perspective, collating findings from the international literature relating to core essentials for good practice and combining this with examples found in prior research.

The aim of this chapter is to provide insight into the current literature relating to industry-oriented academic activities in universities, with a focus on identifying best practice elements of WIL in practice. The elements identified in this chapter are used alongside the finding from the fieldwork in this study to develop the conclusions for this report.

3.2 A broad overview of Work Integrated Learning in Australia

3.2.1 What is Work Integrated Learning?

Work Integrated Learning (WIL) is most frequently described as the purposeful integration of theory and practice knowledge whereby academic learning is aligned with its application in the workplace (Patrick, Peach, Pocknee, Webb, Flectcher & Pretto, 2008; Orrell, 2011; Choy & Delahaye, 2011). WIL programs in Australian universities include, but are not limited to: industry based projects; internships; job shadowing;

project based learning; career development learning; clinical placements; fieldwork; teaching practicum; virtual projects and simulations; volunteering; and work placements (Gamble, Patrick, Stewart & Lemckert, 2008; Li & Randhawa, 2009; Orrell, 2011; Rowe, Winchester-Seeto & Mackaway, 2012; Jackson, 2013; Jackson, 2014).

The number and variety of manifestations of WIL foreshadow its adaptability across different disciplines and organisational contexts (Jackson, 2013). Professor Janice Orrell (2011) describes WIL as a 'chameleon term' with a definition problem in that different terms are used to describe a similar process, and others use the same term to describe a dissimilar process (Orrell, 2011, p. 1). While there is much debate about what activities constitute WIL (Rowe, Winchester-Seeto & Mackaway, 2012), it may be more helpful to consider the *purpose* of such activities (Coll and Zegwaard, 2012). There is considerable consistency across the literature, with agreement that the intention of WIL is to develop graduates' work readiness skills to industry standards and to enhance their employability (Ferns & Moore, 2012; Jackson, 2013). The potential benefits and outcomes of WIL are also consistently described as resulting in graduates who are appropriately skilled, work ready, and employable (Mahalinga-Iyer et al., 2004).

3.2.2 WIL in STEM in Australian universities

Recent increased demand for WIL in Australian universities comes from three distinct stakeholder groups: government, industry, and students. WIL has gained in popularity as a means to address the national skills shortage (Universities Australia, 2008), and the demand for STEM graduates with personal, interpersonal, and organisational skills (Edwards & Smith, 2008). Students are also seeking ways to differentiate themselves in the job market and gain a higher return on their education investment; obtaining industry experience while at university is one such way (Smith, 2012).

WIL programs are structured in a variety of ways. Approaches range from minimalist engagement to degrees fully awarded based upon Work Integrated Learning (McIlveen, Brooks, Lichtenburg, Smith, Torjul & Tyler, 2008). Most WIL programs are offered at the upper years of an undergraduate degree or at the postgraduate level, and industry placements can vary from two weeks to one year (Papakonstantinou, Charlton-Robb, Reina & Rayner, 2013). Some programs require a ceiling academic achievement level or application; others are open to all (McIlveen et al., 2008; Papakonstantinou et al., 2013). Some WIL programs have a capstone element aimed to consolidate the student's academic learning experience which can enrich the opportunity for students and industry partners (Papakonstantinou et al., 2013).

While there are different ways of achieving the purpose of any WIL activity – that is, assisting students to develop their work readiness skills and thus enhance their employability – much of the literature focuses on the WIL model that places large numbers of students from single disciplines into one-on-one placements (Orrell, 2011). To be effective, this model relies upon adequate student preparation pre-placement, support systems and mentoring during placement, and effective reflection and review processes to integrate practical and theoretical learning (Orrell, 2011). It is a costly and labour intensive model requiring significant time to establish and develop industry relationships so as to secure numerous single placements (AWPA, 2014a; Poppins & Singh, 2005).

In ICT, WIL programs are promoted and practiced in numerous Australian universities, and WIL is increasing in popularity in ICT courses. For example, at RMIT a year-long program exists in ICT (Poppins & Singh, 2005). In this program WIL is placed at the latter part of the degree to ensure that the students are sufficiently skilled to undertake work in industry. A compulsory preparation subject is required to undertake the WIL program and it is accredited as one unit of study (Poppins & Singh, 2005). The ICT industry strongly supports

industry based learning and internships to address skill deficiencies such as interpersonal and professional communications, business awareness, and problem solving abilities (Pilgrim, 2011). However, the ICT industry acknowledges that developing these skills takes time and 12 week placements are considered too brief to achieve intended outcomes (Koppi, Edwards, Sheard, Naghdy and Brookes, 2010). In addition, Koppi et al. (2010) assert that WIL for the ICT sector should be co-created by industry experts and updated at least every two years to reflect the continually changing nature of the industry.

All Australian university engineering undergraduates are 'required' to complete 12 weeks of work experience before the degree is conferred (Mahalinga-Iyer et al., 2004).[1] The work experience can be undertaken during vacation periods with verification provided by the employer as a pass or fail. In most instances this activity does not attract course credit points and is disconnected from the curriculum (Mahalinga-Iyer et al., 2004). Another model practiced at QUT involves project based learning with an industry partner underpinned by a formal contract and set of deliverables. This project might be supervised by both an academic and industry partner supervisor and can be accredited as completion of between 2-4 academic units (Mahalinga-Iyer et al., 2004). It is shown that the latter approach of integrating academic and workplace learning is more effective in achieving critical outcomes such as work readiness skills and enhanced employability (Orrell, 2011).

In pure science disciplines, Fraser and Deane (2002) found that WIL can promote interest in the face of declining enrolment. In the UK, all science students are advised to undertake some form of WIL placement prior to graduation (Rees, Forbes & Kubler, 2006). This is a logical approach to address the lack of opportunities for interaction and discussion in highly structured and lecturer directed science courses (Fraser & Deane, 2002). Science courses generally provide fewer opportunities than other disciplines for learners to reflect on their learning needs, skills development, and for self directed learning projects (Fraser & Deane, 2002). The most prominent WIL model in the science disciplines is the research related placement at a particular workplace (Papakonstantinou et al., 2013). The most important issue in this type of placement is the strength of the placement-student match, indicating that the placement coordinator plays a critical role (Papakonstantinou et al., 2013).

Monash University's Science Student Industry Research Placement Program (SSIRPP) aims to develop industry related research experience for high achieving undergraduate science students and to foster collaboration between Monash University and industry organisations (Papakonstantinou et al., 2013). The program's success is derived from the appropriate combination of industry engagement, project development, marketing, student recruitment and evaluation (Papakonstantinou et al., 2013). Deakin University's Science and Technology Industry-based Learning Program (IBL) is a 3-12 month elective which includes a variety of career development activities that scaffold full or part time industry placements (McIlveen et al., 2008).

The program is selective and available to high achieving students who receive tax-free scholarships to undertake the program. Other programs, such as Griffith University's Industrial Affiliates Program (Gamble, Patrick & Peach, 2010) and Victoria University's Problem Based Learning program (O'Brien, Venkatesan, Fragomeni & Moore, 2012) have also been cited as best practice WIL for the STEM disciplines. Additional case studies collected through this OCS research project are provided in chapter 9.

1 Further discussion relating to this practice is found in subsequent chapters.

3.2.3 Costs, funding and sustainability

Since 2005, for WIL programs to be funded at the same level as other academic courses, specific criteria and directives had to be met (Bates, 2008). These include ongoing contact between the university and students while on placement, provision of oversight and direction by staff, defined objectives and assessment of the program, and university management of performance levels (DEST, 2005 in Bates, 2008). These policy changes reduced the capacity of universities to provide a range of WIL opportunities (Patrick et al., 2008).

It is acknowledged that WIL activities involving work placements constitute a relatively expensive teaching and learning methodology compared with standard lecture plus tutorial designs (Smith, 2012), and that this approach requires careful consideration of many factors (Jackson, 2014). Large numbers of student participants create significant administrative burden on providers (Poppins & Singh, 2005). WIL is dependent on gaining the industry partner's support (Mahalinga-Iyer et al., 2004). This requires a high degree of often underestimated skill by WIL leadership within universities to network, consult with, and place participants (Smiegel & Harris, 2008; Patrick, Fallon, Campbell, Devenish, Kay, Lawson, Russell, Tayebjee & Cretchley, 2014). The workload created by placing, monitoring, supporting and assessment has been cited as impacting on WIL coordinators' ability to enhance, improve or expand programs, and in some cases this is not considered 'real work' (Patrick et al., 2008, p. 34) Employers also feel that the time/cost of WIL, incurred through providing induction, learning support and supervision (Smith 2012), is an investment that universities do not fully recognise (Patrick et al., 2008).

The major challenge for WIL programs involving work placements is finding sufficient placements for students (Orrell, 2011). In addition, the remuneration available for students undertaking WIL influences their decision to participate (Papakonstantinou et al., 2013). The argument being that if there is a desire to increase placement opportunities for students, additional resources must be invested.

3.2.4 Curricula and assessment

WIL programs aim to enable students to make the transition from study to work by developing discipline specific, general and career skills (Patrick et al., 2008). This may occur organically through unaccredited compulsory work placements, or through a structured WIL program where close attention is paid to intended learning outcomes. In the lead up to placement, goal setting and role playing is described as a useful way to prepare students to maximise placement learning opportunities (Jackson, 2014). This is echoed by Poppins and Singh (2005) who assert that curricula should be based upon formal learning objectives which result in more meaningful work placements. During placements, reflection is considered vital and can be practiced through creating journals, e-portfolios, learning circles and critical incident analysis (Williams et al., 2010; Jackson, 2014). Reflective practice has a pivotal role in WIL curricula (Harvey at al., 2012).

Numerous programs integrate career development learning into WIL to maximise students' employment potential (Reddan & Rauchle, 2012). Career development learning provides the student with the opportunity to critically appraise a chosen career (Careers Council of Australia, 2006, in Reddan & Rauchle, 2012). A study of science students participating in a career development learning program found that all agreed the program was valuable in teaching professional conduct, career planning, job application skills, and in developing an understanding of the perspectives of a variety of potential employers (Reddan & Rauchle, 2012).

Assessment of WIL involving work placement is complex as employability skills are difficult to measure (Jackson, 2014). In addition, assessment of industry placements and incorporating supervisor feedback is difficult to standardise beyond pass or fail assessments which do not capture the detail required by formal education (Jackson, 2014).

3.2.5 The impact of WIL in STEM disciplines

The impact of WIL involving work placement is often measured by program outcomes rather than what, how and from whom students learns skills during placements (Jackson, 2014). Participation in such programs can build students' confidence in their workplace abilities, provide them with a better understanding of the nature and standard of skills required by industry and the world of work, and develop skills that enhance their employability skills and understandings (Jackson, 2014). These skills include problem solving, communication, information literacy, digital literacy, and professionalism (Starcic, 2011; Jackson, 2014).

An often cited, direct impact of WIL program participation is job attainment (Papakonstantinou, 2013; Jackson, 2014). However, this outcome is dependent on labour market conditions (Jackson, 2014). The impact of WIL is apparent to those employers who have provided student placements, with reports of improvements in the skills of students between starting and completion (Mahalinga-Iyer et al., 2004). However, the proportion of employers using programs including work placements, internships and vacation work to recruit graduate jobs varies considerably. For example, in 2013, employer involvement ranged from 26% (Communication, Technology and Utilities) to 65% (Construction, Mining and Engineering) (AWPA, 2014a).

Identified benefits of WIL related programs for industry and universities include developing strong relationships with relevant industries which is perceived by universities as very advantageous despite the costs and clerical burden imposed by WIL participation (Mahalinga-Iyer et al., 2004). Institutions market their industry links and WIL programs to attract students, and to obtain national and international grants for collaborative research projects and sponsorship from different industries (Smith, 2012). Through participation in WIL, industry has the opportunity to inform curricula and contribute to developing work ready graduates (Smith, 2012).

3.3 WIL in engineering in practice in Australia

This section examines the literature relating to WIL practices in engineering. It is worth noting that entry to the engineering profession is overseen by the accreditation body Engineers Australia (EA). EA accreditation requires 'exposure to professional engineering practice' for all programs of study (EA, 2006, p.4). This almost always involves some form of engineering placement program – here referred to interchangeably with 'internships' (Mahalinga-Iyer et al., 2004, AWPA, 2014a). Most WIL activities in other areas of STEM (such as the pure sciences, ICT, and agriculture) are not structured in this way. Nevertheless, other STEM disciplines can learn much from the well travelled path of WIL in engineering and potentially find transferable good practice.

The situation for engineering graduates needs to be contrasted with that of science graduates, for whom there are typically no profession-related requirements to have been involved in WIL. A bachelor of science program is now much more likely to be used as 'generic' degree than in the past, as was typical for many humanities and social sciences graduates who completed a bachelor of arts. Rice et al. (2009, p. 8) note that '…the vast majority of first year [science] students will not go on to any traditional science career'.

Later Rice et al. (2009, p. 114) state that '…given that many of our science graduates will not be employed as pure scientists, it is important the other types of skills that our undergraduate students might need in preparation for a range of scientific careers. Employers had noted the need for science graduates to be adaptive, adaptable and to have good problem-solving and interpersonal skills' (Rice et al., 2009).

3.3.1 WIL and the engineering context

At present, engineers in Australia are generally considered to be in short supply. According to the Australian Workforce and Productivity Agency (AWPA) (2014b, p. 27), 'A lack of appropriately qualified engineers can have severe impacts on the economy'. This follows up the concerns expressed in 2010 in the Australian National Engineering Taskforce (ANET) report on engineering shortages:

> *There is widespread understanding that Australian industry faces an engineering skills shortage…. There is an identified supply mismatch between the number and specialisations of engineering graduates produced by Australian universities and the VET sector, and the identified needs of industry and the community. Graduations from university engineering courses are limited primarily by the number of enrolments from qualified and motivated school leavers (ANET, 2010, p. 5).*

ANET (2010, p. 21) examined the situation in engineering with internships, and it suggested that:

> *… a greater role for internships and other structured employer interventions would better support a student demand driven system … However, industry supply of [internships] can be variable, and programmes for matching employers with candidates remain dependent on individual universities … The role of the private sector in both pre- and post-graduate work-based learning, and its interaction with the immigration system, should be examined with an eye to any potential to boost engineering graduate numbers and reducing attrition rates … Policy makers should also examine the use of funding models and other mechanisms, such as university funding compacts, to ensure ongoing support for industry to increase internships and mentor relationships with universities.*

Highly relevant to this topic is AWPA's *Work Integrated Learning: AWPA Scoping Paper*, which '…aims to canvass the current academic literature and wider issues associated with work integrated learning' (AWPA, 2014a, p. 4). Its coverage is not restricted to WIL in engineering, but many of its observations are relevant to 'the big picture'. Among other things, this report notes that '…work integrated learning in generalist degrees and in degrees that do not have a traditional vocational focus … is regarded as still being in its infancy' (AWPA, 2014a, p. 8). The report also noted that 'the role of universities has undergone a radical change – from being powerhouses of knowledge and research, their role has become an increasingly utilitarian one; that is, preparing students for the world of work' (AWPA, 2014a, p. 5). The *Scoping Paper* goes through the 'barriers and concerns' in introducing WIL, which predominantly relate to costs, time and resource intensiveness. It states that small and medium sized enterprises '… often have the least resources and flexibility to accommodate WIL students (p. 22). The *Scoping Paper* also considers '… concern and legal uncertainty regarding work integrated learning … and the Commonwealth's *Fair Work Act, 2009*' (p. 20).

Related to this, an AWPA *Engineering Workforce Study* (June 2014) has a broader focus than university qualified engineering personnel, but it does refer to WIL:

> *The partnership between industry and education providers is vital to ensuring that engineering degrees and other qualifications remain relevant, meet the current information provision*

> *preferences of students and produce work-ready graduates. Work-integrated learning (WIL) programs (i.e. education and training courses that include a work-related component) are central to this partnership; however, we find that they are not co-ordinated effectively and largely rely on individual students to find placements. A more integrated approach is required to provide good quality work experience for university students (AWPA, 2014b, p. 9).*

The report follows up on this matter with its sixth recommendation: 'That industry and universities build on the findings of the Australian Council of Engineering Deans' pilot project on WIL and use these programs to create pathways into sustainable employment for graduates.'

Engineering therefore provides a potential source of 'inspiration' in finding workplace models that are applicable beyond engineering or other vocationally oriented university programs.

3.3.2 Key features of good practice in work oriented learning activities

Key features identified here are drawn from examining academic and policy documents on WIL in engineering. In particular, these features have been extracted and adapted from some key documents, including Orrell's 2011 study, and King and Male's 2014 report.

The Australian Learning and Teaching Council (ALTC) has funded a number of studies into WIL and Orrell has summarised many of them, concluding that the evidence:

> *…illustrates the growth of robust scholarship and educational development in this field of practice in Australia over the past fifteen years; growth that raises questions about the role of universities and their relationships with business, industries, professions and communities, and the value and place of theoretical knowledge in relation to practice knowledge (Orrell, 2011, p. 24).*

Orrell (2011) goes on to specify ten 'good practice principles' for universities when implementing WIL programs. These include: ensuring student preparedness; providing sufficient funding to ensure duty of care; equality of access and availability of appropriate support to all students; and ensuring that WIL programs meet professional registration requirements, are mutually beneficial to all, are integrated into the curriculum, and are evaluated to improve their effectiveness.

Of the 28 ALTC projects completed at the time of Orrell's study, half were in the health disciplines. Of the others: six were non- or multi-disciplinary; there was one in each of creative arts and education; and two in each of humanities and social sciences, management, architecture and building, and engineering. One of the multi-disciplinary studies was the *WIL Report: A National Scoping Study* by Patrick et al (2008). The two engineering studies examined the 'theory-practice landscape' and finding '... a way of bringing the workplace to the student…' (Orrell, 2011, p. 23).

One exposition is to be found in Male and King's (2014) *Best Practice Guidelines for Effective Industry Engagement in Australian Engineering Degrees.* The Guidelines were drawn up as an outcome from the Australian Council of Engineering Deans' 2013 project, 'Enhancing Industry Engagement in Engineering Degrees'. Male and King recommend that engineering faculties build industry engagement into their culture, and ensure that such engagement is supported by the allocation of resources for appropriate staffing and processes and resources, including support for academics to make effective contributions to WIL programs. They also suggest that students have the opportunity to work in industry, undertake industry

based projects, and be encouraged to learn about engineering practice. Male and King's report identifies a range of resources and provides links to their locations, and outlines examples of effective practice for each of its recommendations for engineering faculties, for industry, and for professional and industry bodies.

In the discussion below, six of these key features of good practice necessary for work oriented learning activities adapted from Male and King are described. Discussed in turn below, these features are:

- Faculty brochures;
- Company involvement in developing academic units;
- Mock projects;
- Industry design projects;
- Internship programs; and
- Combined degrees

Faculty brochures

Brochures developed by engineering faculties that are targeted at industry help identify potential partners for engagement. Faculty brochures offer 'a way in' for potential industry partners, as well as providing a succinct, but sufficiently detailed summary of the mutual benefits of WIL partnerships between universities and industry. Brochures can establish new links with industry partners, and help identify organisations that may not have considered engaging with students in work oriented learning activities.

By way of example, consider a brochure by the Faculty of Engineering, Architecture and Information Technology at The University of Queensland. It is simply entitled 'Engage with us' (University of Queensland, 2012). The brochure outlines the WIL program 'at a glance', before covering themes such as: 'build your organisation's profile'; 'engage with the leaders of tomorrow'; 'build a pipeline of talent'; 'enhance your organisation's capabilities'; and 'engage with global experts'.

Industry developing or delivering academic units

A good way identified to maximise the potential for industry considerations, expectations and expertise to be transferred to students is to involve organisations in both developing and possibly teaching academic units. Establishing these relationships may be aided by linking in with alumni who now hold influential positions in organisations. Developing a strong relationship between the university and the industry partner is essential in such arrangements.

Male and King (2014) note three ways this relationship is expressed in engineering in Australian universities at present. They are:

- Organisations taking responsibility for developing and delivering entire units of study. In these cases, an academic remains the unit coordinator, and the industry partner undertakes course design and deployment. It is recommended that the university pay the organisation or at least reimburse them in some way. The university is also normally required to pay for marking student work.
- Different partners teach a unit over a two year period. For example, in a model adopted at the University of Western Australia, a government utility teaches a unit in one year, and in the following year the unit is jointly taught by several engineering consulting companies. This model makes it more feasible for senior engineers to participate.
- Industry partners teach a unit for no financial reimbursement. In these cases, the industry partner would usually recruit graduates through the WIL program. The other benefit to the industry partner is that they have a direct influence on what graduates are taught and the competencies they acquire.

Mock projects

Delivering mock projects in a unit of study allows students to work 'as if' they were working on a real engineering project in an authentic, simulated context. Students can work in teams, and multiple teams can work on the same project at any one time. Projects are designed to simulate the environment of a real engineering workplace as much as possible.

At Swinburne University of Technology, two experienced engineers who are employed as teaching staff design and deliver units in which students must work in teams on a mock project. The engineers develop the units to mirror real projects as much as possible: they prepare calls for tender with requirements and detailed specifications and the teams must 'bid' for the job. Students are given new pieces of information throughout the project, they deliver cost control reports for the client, and they recommend how to realign schedules to meet deadlines. Students prepare reports along the way and receive feedback on their performance. Aspects of professional practice are well disseminated through these learning activities. The engineers enjoyed strong philosophical support from the Dean, as well as support in the form of learning spaces and office spaces. Their vast industry experience was noted as an essential element in making mock projects successful.

Industry design projects

The difference between industry design projects and mock projects is that an industry partner plays the role of a client. In some models, an organisation may come to the university requesting solutions to an engineering problem as they arise. Ongoing relationships can be established whereby organisations learn of the timelines required to implement a particular project through the unit of study. The solutions presented by teams of students may influence the implementation of an actual project in the industry partner.

From the student perspective, a major benefit of this model is that they have the opportunity to work on real world problems in authentic contexts, and get to see engineering analysis, design and practice in action. From the university perspective, multiple teams of students can each work on the same project. This reduces the pressure to find individual projects for each student. Finally, the employers can link in with academic experts and students as they look for cost-effective and innovative solutions.

At the University of South Australia, project work is based on a real project which is in the early design phase. Students are given real data and must complete a budget, tender, and feasibility study. Students

organise themselves into a company with positions such as project manager, deputy project manager, team leaders, and so on. They schedule meetings and determine project stages. Nominated students meet with the client and kept them abreast of their development. All students present to the client at completion, and they all receive feedback.

Internship programs

Male and King (2014) identify several types of internship programs in engineering in Australian universities. For internships to be successful, strong relationships between industry partners and the university are essential. However, finding employers for the large number of students looking for placements can be difficult and time consuming. The following two models constitute types of internship models identified by Male and King.

- Some research intensive institutions offer programs in which students spend up to six months on internship for credit. These internships are often elective units in the program of study. At the Australian National University (ANU), this occurred in second semester of third year or first semester of fourth year, and did not necessarily increase the duration of their degree. ANU approved each internship and guided the employer organisation as to suitable projects for the internship program. The university employed a chartered engineer to mentor students throughout the internship.
- Universities of technology also offer internship programs. One university provided students the opportunity to spend 6-12 months on an internship as part of their program of study. The requirement was that a student achieved an average grade of 'Credit'. However, if students with a lower grade could secure an internship, they would receive credit for it. Student who did not undertake an internship were required to enrol in a 12 week unit focusing on professional practice in engineering. These internships often occurred around second semester of third year or first semester of fourth year, and did not necessarily increase the duration of their degree. At this institution, approximately 250 students were on internships at any one time (around 45% of each cohort). Academics were nominated to maintain relationships with the students while they were on placement.

Combined degrees

One way of incorporating more WIL in engineering degrees has been to develop 'combined' degrees or higher level programs of study, where a specific qualification in engineering practice is awarded alongside a standard degree. A range of other papers report on specific initiatives undertaken by certain universities, where students undertake 'combined degrees' in engineering practice. Dowling (2009) describes a Master of Engineering Practice degree for experienced engineering technologists to become professional engineers, as offered at the University of Southern Queensland. Some universities offer similarly named programs.

Similar to the combined degree model, dual awards are a common theme in producing a technically competent workforce in Germany, and are being examined by other countries in Europe (Vairaktaris & Mallwitz, 2014). Howard (2008) describes the evolution of a dual award at the Central Queensland University, by which students are awarded a Diploma of Professional Practice in addition to an engineering bachelor's degree. The dual award program has a strong problem based learning emphasis.

3.3.3 Examples of innovative WIL practice in engineering

Student guide for chemical engineering design projects – Curtin University

The Curtin University Design Project allowed students from the chemical engineering stream to work on design projects devised and supervised in part by practising engineers from major engineering companies. The 'Guide for students' (Curtin University, 2014) is an excellent example of the way that industry design projects have been incorporated into the course.

The Guide explains (p. 1) that:

> *Design is arguably the defining activity of the professional engineer. Design for mass production is one of the things that makes engineering different from science. Chemical engineers design both products and processes. In this unit, you'll perform design work on a large-scale process plant. The aim is to design a plant that is technically feasible, safe, environmentally acceptable and as economical as possible within the given project constraints. The Design Project is the 'capstone unit' of the chemical engineering course, meaning that it is meant to draw upon and consolidate knowledge gained in the previous years of the course. It is meant to challenge you to apply chemical engineering fundamentals and your growing engineering judgement to a large and complex project.*

It can help you to:

- *revise and bring together skills developed in different units through the course,*
- *build confidence,*
- *enter a particular industry,*
- *strengthen your teamwork and time management skills to a level that other units usually do not, and*
- *generate evidence of quality of work for potential employers.*

This document would be useful for other STEM disciplines in thinking about how to set up a course with a focus on projects. It clearly outlines what a team project based unit of study looks like, and how it could be implemented.

Employer handbook – University of Tasmania

The University of Tasmania has produced an employer handbook for the Co-operative Education Degree Program at the Australian Maritime College (AMC), an institute of the university. AMC students work on design projects developed and supervised in part by practising engineers from major organisations.

The explicit purpose of the handbook is: *To provide guidance to employers who will be supervising students participating in the Co-operative Education Degree Program (Engineering) with the National Centre for Maritime Engineering and Hydrodynamics (NCMEH) at the Australian Maritime College (AMC).* (UTAS, 2012, p. 3)

The Co-operative Education Degree Program (Engineering) provides a unique opportunity in Australia for the successful integration of work and study. It is an educational program that links three major groups: students, employers and the National Centre for Maritime Engineering and Hydrodynamics. The diversity of work term positions and the training and experience received prepare Co-op students for the workplace demands they

will encounter after graduation. Naval Architecture, Ocean Engineering and Marine and Offshore Engineering Co-op students gain a broad range of technical skills on work terms and in conjunction with their academic knowledge, analytical and research skills they are valuable in any workplace. (UTAS, 2012, p. 4)

The handbook outlines the benefits to employers in detail and gives students significant exposure to industry. But more importantly, it gives to industry reference points for understanding the specifics of the program – what is expected of them, and of the students, throughout the program.

Combined degree in engineering and a diploma of engineering practice – University of Technology, Sydney

The University of Technology, Sydney offers a combined degree in engineering and a diploma of engineering practice – the 'BE, Dip Eng Prac'. The following overview of the combined degree/diploma program is adapted from Male & King (2014, p. 31). The program includes two internships of at least 22 weeks each. The UTS handbook summarises the program in this way:

> *This program is a comprehensive preparation for careers in the professional practice of engineering. Students learn to deal with complex systems and manage large-scale projects using the most appropriate emerging technologies. The course offers an authentic, professionally focused and practice-based education program with two semesters of internship (normally paid) in a real workplace setting... The course aims to equip graduates with the skills and attributes needed for professional practice and leadership. It is based on the themes of academic development, personal development and professional formation. It provides sound foundations in engineering theory, technical expertise and knowledge of professional practice, while also developing academic literacy, advocacy skills and social awareness so that graduates become lifelong learners and effective citizens in many different capacities. (UTS, 2014).*

Internships in the combined program are divided into 'junior' and 'senior' internships. Junior internships comprise the first two years of the program which involve both theory and experience in engineering practice. Students then study theory for 18 months before taking a senior internship with another practical experience. The final stage of the program combines theory and application. All internships and their associated project work are approved by the university. The most important aspect, however, is that students perform tasks in an authentic engineering work environment, which encourages professional and personal development. The double internship model offers many opportunities for students to learn and reflect on aspects of engineering practice.

3.3.4 Conclusion: Transferability to the sciences?

The six key features of good practice provide a succinct summary of the aspects identified as exemplary WIL in the engineering discipline. These six aspects are not unique or specific to the engineering sector – they may be conceived as key features of good practice for work-oriented learning activities in general.

Other STEM fields, such as the pure sciences, ICT and agriculture can learn much from the experiences of WIL in engineering. Given engineering's vocational focus it is perhaps unsurprising the field has developed some particular sophistication in vocational pathways.

The practicalities and realities of graduate engineering work, along with the history of the sector, mean that some aspects of good practice identified here are perhaps more suited to the engineering discipline.

Despite this, there are good lessons to be learned. Outlined below are elements of each of Male and King's six key features of good practice that seem immediately transferable to the other STEM fields. These themes are further discussed in the following chapters of the report.

Faculty brochures. Science faculties can adopt this feature immediately to outline the strengths of their programs. Brochures can assist in informing potential partners about the mutual benefits of university-industry collaboration. There is considerable benefit in WIL programs because industry has a direct role in graduate preparation and universities benefit from industry feedback about how well their academic programs are oriented to work in STEM. A further considerable benefit for industry partners is that through partnerships they have access to a wide network of academics who are adept at crafting innovative solutions to the challenges that industry confronts. Developing and disseminating such brochures relies on a communications strategy that is clear sighted both about what attracts industry to form partnerships with any given science faculty, and about the specific benefits that accrue to the faculty, the university, students and industry partners from participation in the kind of WIL program that is proposed.

Company involvement in developing academic units. Involving industry partners in developing and delivering academic units is possible in all STEM fields. However, strong links between academic staff and industry partners is essential. Support from science Deans will be paramount in ensuring this type of WIL can be integrated into the pure sciences. Perhaps, the most natural place to incorporate these types of activities is at the late second or third year level, aligning with a practical part of the science curriculum that focuses on solving real world problems.

Mock projects. Providing simulated work environments with authentic project based learning is clearly one of the most transferable aspects of good practice for all STEM fields. Further, this type of WIL activity can be undertaken even if there are no direct links to members of industry in particular disciplines at particular times. The essential ingredient needed to make these projects successful is knowledgeable and dedicated academic staff.

Industry design projects. Once strong industry partnerships are established in the pure sciences, they provide a foundation for industry design projects which incorporate good WIL into the curriculum. Multiple teams of students can work on finding solutions to the same problem, ensuring the efficient allocation of industry and university resources is maximised.

Internship programs. In a perfect scenario, internship programs in all STEM fields would be desirable (at least in the eyes of many WIL champions) and best of all possible worlds everyone would have an internship. However, adequate resourcing in terms of funding and more importantly employers with placements may be beyond universities at present and a good return on investment can be generated from the other five of Male and King's six factors.

Combined degrees. In academic programs in the pure sciences, an overhaul of degree structures to include awards focused on science practice or applications of theory would increase work-oriented learning activity. However, university leadership would presumably be required.

3.4 Work Integrated Learning: International Practice

3.4.1 Overview

This section summarises WIL practice in a range of countries. As articulated in this project's terms of reference, the main aim of this review of existing practice is to identify 'broad directions and trends in WIL, and those aspects which are transferrable into WIL practice in Australia.' This section considers accessible material from elsewhere in the world, looking mainly at the past five years. Material highlighted in this section has been drawn from policy and/or scoping exercises undertaken and/or reported by: government departments or other agencies; industry/interest groups (sometimes in concert with governmental agencies); and professional groups, such as the World Association for Cooperative Education (WACE). Notable involvement of WIL in higher education is highlighted for New Zealand, South Africa, Canada, the United Kingdom, and Europe.

Australia should be considered a world leader in WIL, especially in terms of practice specifically within universities. A number of comprehensive and high quality reports described earlier (for example Orell, 2011; Patrick et al., 2008; and Male & King, 2014) place Australia highly in WIL practice. These Australian reports also best suit the contexts of the Australian system in terms of developing future practice and exploring avenues for expanding WIL in the STEM disciplines.

In acknowledging Australia's high quality policy analysis and practice, it remains useful to explore the practices of other systems to identify potential avenues for approaching WIL. This section particularly explores policy-related documentation. It begins with a brief overview of the 'international WIL community', and then highlights some important caveats and contexts that are essential for interpreting the discussion that follows. The next section summarises issues and ideas that could be considered 'key features' of good practice internationally, followed by individual examples of approaches to WIL in higher education. The final section reflects on how some of these findings might relate to the Australian context.

3.4.2 Defining WIL in the international 'WIL community'

The broad review of literature about Australian practice highlights the idea that there should be an *integration of theory and practice knowledge whereby academic learning is aligned with its application in the workplace*. This is common ground around the world. However, there is considerable overlap in terminology and coverage. Bennett (2009, p. 1) notes that, in line with the increasing global interest in WIL, there has been '… increased inconsistency in definition and interpretation in practice, structure and especially typology.'

The literature examined for this section uses a range of terms that can cause confusion and inconsistencies. For example, 'Work Based Learning', tends to be used commonly in the UK, Europe and in New Zealand. 'WIL' is also used widely in New Zealand, as it is in South Africa. In Canada and the United States, 'Cooperative Education' is the term used in most research into university academic programs linked with industry.

The international WIL community is diverse. Practitioners, policymakers and academics are brought together by the World Association for Cooperative Education (WACE).[2]

2 WACE describes itself as '…the only international professional organization dedicated to developing, expanding, branding and advocating for cooperative & work-integrated education programs within industry and educational institutions' (WACE, 2014). WACE reports a membership of 4000, holds a biennial conference, and is a partner in publishing a scholarly journal. ACEN (the Australian Collaborative Education Network) is a 'national association' member of WACE, and is a partner in publishing a scholarly journal.

WACE uses the term *cooperative and work-integrated education* (CWIE), the justification being that 'the term "education" is more holistic', and using this terminology 'may present a useful umbrella term, overcoming the challenges presented by the diversification' of terminology used across the world (Coll & Zegwaard, 2012, p. 2).

Coll and Zegwaard (2012) suggest that rather than being overly focused on nuances of terminology and definition, for international comparative purposes it is best to focus on the features of these programs than the terminology used for them by the institutions or governments that created them.

Even within the Australian context, this pragmatic approach to 'defining' WIL is seen as significant if comparisons are to be made, and if the practice of some institutions is advanced as an example for others to follow. The approach to discussing international practice used in this report follows this general approach of exploring the features of programs aimed at producing work ready graduates rather that the way in which programs are defined or labelled.

3.4.3 The critical importance of context

The existence of a strong international organisation of WIL practitioners is of great benefit in identifying a range of practical and policy based issues that potentially can be aligned across different countries to build best practice. However, even with such a community of practice internationally, it is important to highlight the significant issues that can be encountered in attempting to identify 'best practice', and to suggest ways of applying this practice in educational settings other than the ones from which they are derived.

This particular point was recently emphasised in Europe, with a broad study highlighting that as a result of the significantly different educational structures across countries, '… baselines and benchmarks are difficult to establish at the European level' (WBLIC, 2012a, pp. 22-23).

An exercise that aims to specify best practice in one area or another must make it clear that what works in one country or jurisdiction will not necessarily work in another. In particular, care must be taken not simply to 'borrow' examples of good practice unless the terminology has a commonly accepted meaning and the education systems are sufficiently similar. When comparing approaches taken by institutions in different countries, some organisational 'variables' must be considered as they can impact on the generalisability of programs. These variables include national governance, higher education governance and structure, disciplinary differences, and the structure of national or state economies.

Some issues that can make a difference in the transferability of programs from one context to another include whether countries have federal systems of government. For example, within Europe there are variations of approach between unitary states (the Nordic countries, for example) and federal states (Germany and Switzerland, for example). Even within federated nations there can be specific organisational differences. For instance, Australia and Canada are both federally organised nations, but Australian higher education is effectively centralised in nature, whereas Canada has no federal education ministry coordinating the activities of the provinces and territories. Higher education governance also varies between the countries of the UK. These differences can have a significant impact on the way funding of education is arranged, and how the policy that governs the operation of institutions is overseen. Such variations may result in differences in the way WIL policies and programs can be implemented and funded.

The structure of education sectors is arguably even more fundamental in evaluating which elements of best practice to apply across countries and jurisdictions. In the case of higher education and vocational or professional fields such as engineering and ICT, it is complex to making cross-country comparisons. Most countries explored in this section have binary higher education systems – Australia does not. Many European

countries have two higher education sectors, with higher degrees offered by universities and polytechnics – in Australia, for the most part, universities cover many of the vocational or professional areas provided for by polytechnics elsewhere (particularly at the degree-level), while Registered Training Organisations provide the rest. In many nations, polytechnics are differentiated from universities because of the link to 'working life' (as described in the Finish context). However, within Australia the lines between vocational and generalist education, especially at the degree level and above, are more blurred.

Economic structures also have an impact on the applicability of programs from one country to another. This is notable in some recent research in Australia showing that from the Australian industry perspective, small and medium-sized enterprises make up a higher proportion of workplaces than in countries such as the US and Canada. These smaller companies '… often have the least resources and flexibility to accommodate WIL students' (AWPA, 2014, p. 12).

These differences between countries and their educational contexts could mean that good practice might be less transferable than it might at first appear.

3.4.4 Key features of WIL – a combined international perspective

Based on analysis of a wide range of academic and policy documents relating to WIL in practice, a number of key features are apparent, and are discussed here with reference to core sources, particularly Coll and Zegwaard's *International Handbook for Cooperative and Work-Integrated Education* (2011), an important WACE document. Key themes in this handbook are used here as a framework for concentrating the international literature.

The aim of this summary is to highlight important points that in many ways transcend the contextual and definitional issues appropriate to individual countries. The purpose is to provide an opportunity to identify important elements of WIL-related activity for consideration in this report's conclusion.

Based on the literature, the key features necessary for successful WIL identified are:

- Educational endeavour;
- Focussed assessments;
- Recognition of diversity across disciplines;
- Strong organisational support in development, implementation and promotion; and
- A clear value proposition.

Educational endeavour

A consistent message in the international literature is that without specific 'educational endeavour' built into WIL activities, the chances of actually deriving benefit from WIL are at best random or accidental (Coll & Zegwaard, 2012). The message here is clear – 'work experience' tacked onto an academic program is not beneficial.

The Association for Sandwich Education & Training (ASET), a UK professional body for placements, has developed guidelines for work placement best practice that highlight this fundamental point very well. In the ASET good practice guide, they suggest that a university should build academic and procedural requirements into the course, communicate these to the students, and provide students with academic and administrative support. Students 'should take every action necessary to get the most out of the learning experience…' and

use the opportunity to consolidate career planning (Wilson, 2009, p.2). The employer should think through the reasons for taking a work based learning student and ensure that the student recruited is appropriate to the post being filled, and will be progressively developed rather than overwhelmed (Wilson, 2009).

Important work undertaken for New Zealand's Ako Aotearoa also helps in highlighting the need to focus on educational endeavour in WIL activities. In Martin, Rees and Edwards' *Template for Good Practice* (2011), the authors emphasise the importance of student preparation for WIL activities. They suggest that students must be equipped with the necessary 'tools' for successfully negotiating the demands of WIL if there is to be an educational benefit. They highlight preparation activities such as relevant theoretical knowledge, and 'learning related to ethics, confidentiality, conflict management, stress management, time management, etc.' (2011, p.6) as well as an introduction to careers services such as interview skills and CV preparation. These are seen as important components of WIL.

The UK based, European funded, international project *Work Based Learning as Integrated Curriculum (WBLIC)* found that WIL programs explicitly focused on educational endeavour tend to be 'most prevalent in applied universities where the mediation of academic and professional or employer interests plays a key role in curriculum development' (WBLIC, 2012b, p. 9). Further, the researchers involved in WBLIC argue that 'the main differentiating factor associated with WBLIC is the extent to which the [higher education institution] or employer (labour market) influences the development and delivery of provision. This can challenge the traditional approach of [higher education institutions] as purveyors of knowledge…' (2012b, p. 9).

South Africa's *Work integrated learning: Good practice guide* (South African Council on Higher Education, 2011) also emphasises the critical importance of a focus on educational outcomes. It prompts academics to consider the educational purpose and role of WIL in teaching and learning, with a focus on ensuring that students graduating from university programs 'are prepared for the world in which they will live and work' (p. 65).

Focussed assessments

Assessment of WIL activities that focuses explicitly on the ways in which students integrate theory with practice and develop and demonstrate work-related generic skills plays a key role in shaping the expectations of all involved, and in influencing learning outcomes.

In their *Template for good practice*, Martin et al. (2011) highlight the identification of competencies and the use of assessment to 'follow' these learning outcomes as critical features of high quality and effective WIL. Approaches such as reflective journals, competency checks, oral presentations, and final written reports are seen as potential points for focussed assessment. In the case of the latter, they emphasise: 'We assess the student's report which states the skills they took to their placement, what new skills they've learnt, what they've learnt about the place where they were working, and also the broader context' (2011, p.15).

Importantly, a number of discussions in the international literature highlight the need to involve the employer in understanding the role of assessment in WIL activities. Developing a 'learning contract' signed by the student, employer and university is one common example of this (South African Council on Higher Education, 2011; Martin et al. 2011; Martin & Hughes, 2009; Medhat, 2008).

Recognise diversity across disciplines

Another important element noted in some international explorations of WIL is that structured work opportunities often differ between fields of education. This finding is clear, in particular, from the work of

Kramer and Usher in Canada, which used the CanEd Student Research Panel comprising 8,000 university undergraduates. The authors found that more than half of the students in education, mathematics, computer science, engineering, and architecture could take advantage of 'structured work opportunities', compared to only about a quarter of those in the visual and performing arts, social sciences, and humanities. Ferguson and Wang used Canadian Graduate Outcomes statistics to identify similar findings (2014). Kramer and Usher point out that the more vocationally oriented the higher education program, the more structured work opportunities seem to be available (2011). Similar points are made in most international contexts (UK Commission for Employment and Skills, 2014; Stirling et al., 2014; Sattler, 2011; South African Council on Higher Education, 2011; Medhat, 2008).

Strong organisational support in development, implementation and promotion of WIL

The need for an effective 'organisation set-up' (Martin et al., 2011) is highlighted throughout the international literature. Medhat suggests that '…research show[s] those universities who have a good WBL [Work-Based Learning] record were the ones who tended to have a more dedicated and structured administrative function to manage their interactions with companies' (2008, p.48). The UK Commission for Employment and Skills notes: 'A key message is that collaboration works best when it becomes part of the cultural norm for the organisations involved' (2014, p. 7). While recognising the burden this can place on universities, Sattler (2011) still emphasises the need for a formally structured, collaborative approach, as does the UK's Confederation of British Industry (UK CBI, 2009).

In the study *Learning through work,* Medhat found that while a dedicated approach to 'Work Based Learning' (WBL) was most desirable, a large proportion of UK universities were 'not interested in this approach due to the following: time it takes to develop programmes; assessment costs; lack of appropriate funding; lack of appropriate level of employers or participation; lack of academic frameworks that will enable WBL programmes to be developed more easily but maintaining rigour and quality assurance' (Medhat, p. 68).

However, in those universities that were involved, '…The Learning through Work programme builds on [students'] existing learning, takes account of work context, and provides a structure to plan for new learning that is specific to the student as an individual.'

Helping universities to identify the link between commitment of resources and leadership and the overall success of WIL programs for students is one of the most important factors to achieving successful outcomes from such activities. In this regard, institutional leadership and government and regulator involvement are seen to be critical. For example, key themes that emerged from a report by the UK's Confederation of British Industry were: a need for leadership at a senior level of universities; co-ordination across the university; working closely with student organisations and university careers services; investing in expanded student participation; efforts to engage local and regional employers; and student and employer feedback. In addition, the role of government and other regulators was also highlighted, with the report arguing for the need to ensure that they are supportive, both directly and indirectly. To achieve this, the report called for adequate funding of student places and research, and promotion of the idea of university-employer coordination (UK CBI, 2009).

Sattler's *Work-integrated learning in Ontario's postsecondary sector* (2011) identifies challenges for institutions and workplaces, including: the levels of administration and paperwork; aligning supply and demand; economic and financial pressures; and ensuring clarity in the expectations of all parties (including students). While acknowledging the challenges, Sattler's work suggests the gains can be great if the challenges can be met.

A clear value proposition for WIL

Linked closely with the above discussion is the need for the *value* of WIL activities to be emphasised in a transparent, effective and convincing way. This 'big picture' issue was prevalent throughout the international literature on WIL good practice. According to Coll and Zegwaard, 'the onus is on practitioners to market these substantive benefits to all key stakeholders; students, colleagues, and managers in their institutions, and external stakeholders such as officials and governments' (2012, p. 3).

Martin et al, note that 'increasingly, the Work Integrated Learning (WIL) experience is providing a point of difference for students in enhancing their employability after tertiary education' (2011, p.16). Universities with strong and well resourced WIL programs are now actively promoting these to potential students. This is particularly evident in the UK and New Zealand – contexts with strong parallels to the Australian situation. In the UK, for example, the CBI report, *Future Fit*, highlighted the importance placed on WIL-type activities by the universities with strong structures in place, stating that, 'they felt their particular approach gave them a distinctiveness, or unique selling point' (2009, p.17).

If WIL programs are to be expanded, the benefits of WIL need to be articulated and supported by objective research and data. However, setting up systems to collect, analyse and report on appropriate data requires resources that may not be readily available. Two strong examples regarding the application of strong datasets to measure and monitor the effectiveness of WIL programs, and to explore the extent to which they are reaching the student population, can be found in Canada. Statistics Canada has a small but significant collection of data on WIL placement activities (known as 'co-operative education' in Canada). The information is gathered through the country's National Graduates Survey (Ferguson & Wang, 2014) and reported alongside a range of other graduate destination-related variables. The collection allows for a relatively accurate quantification of the number of graduates who had been involved in co-operative education (12 per cent of bachelor graduates), and breaks down the data by field of education. In this regard, the authors found that graduates most likely to have been 'co-op students' were in the fields of engineering and architecture (35 per cent), ICT (28 per cent) and business management (18 per cent).

Importantly, these Statistics Canada findings also highlight the link between having undertaken a cooperative education placement and graduate employability. The authors note: 'The difference between co-op and non-co-op graduates was the largest for bachelor graduates in full-time employment, where 90% of co-op graduates were employed full-time compared with 83% of those who had not completed a co-op program during their bachelor degree studies' (Ferguson & Wang, 2014, p.23).

Canada has other interesting data for 'proving' the impact of integration of co-op programs in the curricula. Kramer and Usher (2011) analysed the CanEd Student Research Panel, comprising 8,000 university undergraduates enrolled at some point in 2010-2011. They found that for structured work opportunities, of their sample of 2,148 panellists, 16 per cent reported having been involved in a co-operative program, 18 per cent in an internship, 17 per cent in a research assistantship, and 9 per cent in a teaching assistantship. Panellists reported agreement or strong agreement with propositions such as the work having a positive impact on critical and analytical thinking, a better appreciation of concepts learned in the classroom, and improvement of knowledge.

The nuanced findings of these studies may not necessarily be generalisable to the situation in Australia. It is important to note that data can be collected (and, in the case of the National Graduate Survey, incorporated

in existing collections) to develop significant levels of evidence about the merits of wider investment in work placement programs. This importance is seen in the potential for using this information to articulate the value proposition of WIL on the basis of empirical, objective evidence.

3.4.5 Summary and suggested solutions

The key issues discussed in the section above help to frame the 'flavour' of the suggestions for best practice highlighted in the international literature from countries and institutions where WIL activities are successful.

A summary of some issues and solutions is captured in the table below. Adapted from the work of Martin et al. (2011, p.16), it provides indicative advice on the considerations suggested by these authors regarding the development of WIL programs.

ITEM	ISSUE	IMPLICATION	SOLUTION
A focus on educational endeavour and learning outcomes	Awareness of the fundamental importance of this. Academics may not have background knowledge and skills to support development of employability skills.	The work experience aspect of WIL is only one component of an effective WIL program. Design of effective WIL activities requires consideration of other facets.	Consider the educational purpose and role of WIL in teaching and learning. Build academic and procedural requirements into course. Provide students with tools, plus academic and administrative support. Facilitate reflective practice throughout the academic program. Assist employers to articulate their expectations and requirements. Match students to positions.
SCALABILITY	Elective or core unit?	Increasing the scale of WIL programs has resourcing implications.	Group/team learning is one approach to incorporating WIL as a core unit. On-campus simulations is another.
ASSESSMENT	Quality control.	Balance/triangulation of assessments is desirable.	Use both formative and summative assessment Involve employers.
ASSESSMENT	Moderation of Assessment.	It is easy to over-assess WIL. The key aspects of WIL can be challenging to assess/may require new approaches to assessment, particularly of non-technical skills, and involvement of employers.	Only learning outcomes should be assessed – these need to be clearly articulated and include both the application of theory to practice, and the use of technical and non-technical skills in context.
WORKLOAD	WIL is time consuming for staff.	Workload management.	Resources, administrative support.
INDUSTRY CONNECTIONS	Credibility of students, academics and industry staff.	Complex industry relationships.	Formal agreement and assessment.
RESOURCING	Priority of WIL.	Coordination of effort.	Administrative and liaison staff to assist.

Adapted from Martin, Rees & Edwards, 2011

3.4.6 Examples of international practice

As noted earlier in this section, the contextual difficulties in replicating WIL activities across systems are significant. As such, the focus of this review of international literature has been on emphasising the *elements* of practice which are most important to developing high quality WIL activities. The synthesis above provide this evidence and play a strong part in influencing the findings and conclusions of the wider study within which this review sits. Nonetheless, this final section of the international literature review points to some specific examples of WIL activities, focussed on STEM disciplines, that are highlighted in the international research.

Enhancing employability of Mathematics Graduates – University of Leeds

This case study is an exemplar highlighted in the UK by the National HE STEM Programme (http://www.hestem.ac.uk/). The text below is adapted from a summary of the program by Messmer and Pugh (2012).

> *This project has focussed on graduate skills development in Mathematics, by forming partnerships with those employers who regularly recruit Maths students from the University of Leeds. The first phase of the project focused on gathering opinion via surveys on skills development in Mathematics degrees from employers, alumni and current students. This intelligence was then used to inform curriculum development to address any skills deficits and augment current provision. The project has involved working with employers to develop case studies, activities/assessments and mini-projects that encompass these skills. Experience/research has shown that the development of skills is much more effective when they are integral and include employer input. Another successful outcome of the project has been establishing an external advisory board for the school, taking the impact of the project beyond teaching activities and into the research activities of the school.*

The academics involved in developing this course adopted a phased approach. First, they focused on working with employers to identify graduates' skills attributes and gaps based on liaison with industry. Second, they formed 'strategic partnerships with key employers to develop a range of learning activities that gave students experience of "real world" examples which were embedded into the curriculum.' An External Advisory Board (comprising industry, professional bodies and other universities) was also created to oversee the overall course development for the Faculty of Mathematics and Physical Sciences and advise on areas for greater inclusion of work based learning.

Among a range of employer-student-university activities that the program has inspired is a specific module called 'Maths at Work'.

> *This module will incorporate career development activities, with employer input, and the major component will be a team project, with topics being mostly developed in collaboration with industry. An initial set of project briefs has been developed but it is envisaged that this list will be added to in subsequent years. One of the key features of the projects is that the questions are open-ended and encourage students to use their creativity while drawing on their maths knowledge. This is an important skill employers have identified as lacking in typical maths graduates, and which is not represented prominently in a traditional maths curriculum. All level two Mathematics students will have the option to take the module.*

Overall the development project has been seen as a success both in creating WIL activities for students, and because it has embedded relationships with industry in the mathematics area.

Scientist-Educator partnership in Ocean Sciences – UC Berkeley

Halversen and Tran (2010) describe an innovative program at the Lawrence Hall of Science, University of California at Berkeley, which aims to link educators, scientists, university science students and school students.[3]

> *Communicating Ocean Sciences to Informal Audiences (COSIA) is a college course that creates and develops partnerships between science educators in informal science education institutions, such as museums, science centers and aquariums, and ocean scientists in colleges and universities...*

In the partnership between Lawrence Hall of Science and UC Berkeley, scientists and informal educators go beyond their typical roles, as both contribute their expertise to the content material of the course. COSIA uses ocean and climate sciences as the subject matter to introduce undergraduate and graduate student scientists to inquiry-based science pedagogy; it is co-taught by an ocean scientist from a university or college and a science educator from an informal environment. The students learn about teaching ocean sciences in informal environments and apply their understanding in a six-week practicum (approximately two-three hours per week) where they facilitate hands-on activities in the informal setting. For scientists, teaching the course not only draws on their expert knowledge of ocean and climate sciences, but also encourages them to think about how they communicate and teach this content in relation to their beliefs about how people learn. It builds their capacity to use current research-based pedagogy to better communicate science to the public and to apply the pedagogy embedded in the course broadly to all of their teaching. For informal educators, teaching the course not only uses their expert knowledge of learning and teaching in informal environments, but also requires them to articulate their pedagogical content knowledge. In addition, it builds their capacity to observe and assess effective science pedagogy and to apply the knowledge to their practice...'

For students, they experience being placed 'in a substantive outreach practicum where they are introduced to the importance of education, outreach, and the broader impact of ocean sciences research, as well as to possible careers in science education.'

Applied Informatics – Cracow University of Economics

The field of Computer Sciences at Cracow University of Economics (CUE) has a program that was highlighted as a case study in the WBLIC project, 2012. The overview below is adapted from the project's Case Study Summaries report (2012c, pp. 11-13).

> *The programme was developed by CUE in response to the shortage of qualified IT specialists in the Polish labour market, specifically the deficit of individuals with combined informatics and business competencies. It is supported by ESF funding via Education for Entrepreneurship Association (EdP). The rapid development of the IT market over the last decade led to an unexpected demand for IT professionals. The need for IT experts is particularly pronounced in the Malopolska region, where a large proportion of Polish IT companies are located.*

The program was developed through a collaboration of regional authorities, the university and Ministry of Science and Higher Education. In addition, representatives from employers (mostly IT companies) were involved in panel discussions to provide input into the development throughout 2008, with accreditation

3 Details can be found in a paper written by Halversen and Tran (2010). Further detail about this and other related programs can be found at the following link: http://www.coseeca.net/programs/communicatingoceansciences/

granted in 2009. The curriculum to cover three years of study was developed specifically to cover identified gaps in knowledge and skills, in particular 'modern computer science tools, techniques and business processes'.

Program delivery is a

> *'combination of lectures, practical classes, group and individual activities, discussions, workshops, case study analyses, and the use of guest speakers and industry experts. In addition, there are mandatory work placements and optional 'periods of probation' for students within companies. The work placement must comprise 120 hours, with the focus topic negotiated individually for every student at the beginning of the placement. The 'periods of probation' within companies comprise 192 hours and are available only to the best 20 per cent of third-year students. The final two semesters are dedicated to the dissertation which includes a work-based project. For students who have insufficient mathematical skills, the programme offers additional compensatory training in mathematics.'*

Evaluation of the course is both

> *'formative and summative evaluation to collect the feedback of students and employers. Student feedback relates to the quality of the modules (lecturers, teaching methods, etc.) and is obtained through anonymous surveys. Potential employers from the Malopolska region are invited to participate in panel discussions where the curriculum is discussed and their views solicited. Feedback from both groups is used to further the development of the curriculum. The programme is assessed by an external partner.'*

WBLIC saw this case study as important in terms of the involvement of enterprises in the full development of the course. WBLIC also saw the program as 'distinguishing itself from other IT programmes in the way it combines the delivery of IT skills with business skills and the fact that it adopts a very practical approach' (2012c).

Using WIL for recruitment – an employer perspective example in agriculture and ICT

Drawn from Ako Aoteroa's website, this case study summarises the application of WIL from an industry perspective. The text below is quoted and adapted from:

https://akoaotearoa.ac.nz/community/cooperative-education-work-integrated-learning/resources/pages/key-player-nz-agriculture-u.

Gallagher is a large company based in Hamilton which employs over 700 staff in New Zealand and a further 300 internationally in two major divisions – Animal Management Systems, and Security Management Systems. Animal Management Systems specialises in electric fence systems, electronic animal identification, animal weighing systems, gates, automatic gate openers, and electric fence systems for pets.

The company draws on employees from a range of backgrounds to help develop and manufacture their products. The company states: *'Among the many Gallagher strengths… is the ability to recruit loyal and capable staff.'* In recent years the company has involved its local university in helping to develop and identify new talent in the region. Each year, three University of Waikato students from ICT and/or agriculture are involved in a placement program in the Technical Development area of the company. These students work closely with mechanical and electronics staff and a team of software developers.

In a typical year, these three students will work the time over the summer holidays. After the summer holidays, if Gallagher has found the student helpful, productive and a good investment, coupled with if the work is available and the student keen then they may work part time, typically 8 – 10 hours a week over the term time. This may occur in the final year of studies, thus giving a year's worth of work at Gallagher's before graduation and potential full time permanent employment. Or the student may be employed first over the summer of their second year, thus giving potentially two years of work part time, or full time over summer before graduation.

The case study on Ako Aotearoa's website highlights the following areas as key benefits to students and the employer from this relationship: technical skills, soft skills, quick and easy integration, staff retention, identifying the best roles for the student, being identified as a good employer, flexibility of the program.

4 Findings: Context, definitions and types of WIL activities

Key Findings

- WIL definitions are relatively similar across Australian universities, although there are differences in terminology used to label such activities.
- Common features of WIL definitions include: *Integrating theory with the practice of work*; *Engagement with industry and community partners*; *Planned, authentic activities*; and *Purposeful links to curriculum and specifically designed assessment*.
- There is widespread support for WIL activities in STEM.
- Many universities are currently in the process of increasing WIL-related activities and redesigning policies to support expansion.
- To assist in better understanding the breadth of WIL, a Typology of WIL Activities is used. This typology differentiates between a range of 'on campus' activities, and the length of 'off campus' placements.
- Many WIL activities in STEM are applied to existing traditional curriculum as 'add-ons'. However in some institutions the approach to WIL is more embedded and permeates the whole course structure

4.1 Overview

The research team undertaking this project visited every public university in Australia during a three month period in second semester, 2014. A vast array of information about activities, experiences, opinions, and ambitions was collected in this time and is synthesised in this chapter. The discussion begins by providing some context to the project and to the teaching of STEM in Australian universities. The next section explores the ways in which WIL is formally defined by universities and defined and/or perceived by academics who implement the curriculum in science, ICT and agriculture in particular – some discussion of engineering is also included, but confined to instances where placements are undertaken specifically 'for credit'. A typology of WIL is presented that incorporates these definitions with that undertaken in practice in the disciplines of focus. The chapter then explores specific objectives of WIL and the activities that are put in practice to meet these objectives. It concludes with a section examining the range of models by which WIL is linked to the curriculum.

4.1.1 Context

Teaching in science, technology, engineering, and mathematics is an important component of the work undertaken by public universities in Australia. Overall, based on 2013 enrolment figures, STEM subjects account for nearly 23 per cent of all bachelor-level enrolments in public universities (DOE, 2014). All 37 public universities are involved in teaching at least one STEM discipline, and most have undergraduate degrees in all STEM areas.

In the natural and physical sciences (the largest of the broad STEM disciplines), 86,539 students were enrolled in a bachelor degree in Australian universities in 2013, comprising close to 10 per cent of all university

enrolments (Table 1). Thirty-six public universities enrolled bachelor students in this discipline, with the size of the enrolments ranging from 400 to 8500 enrolments. Of those with science enrolments, 11 universities had fewer than 1000 bachelor-level enrolments, 19 had between 1000 and 5000 enrolments, and six universities had in excess of 5000 enrolments.

In information and communication technology (ICT), there were a total of 33,587 bachelor level enrolments in Australian universities in 2013. These enrolments account for about 4 per cent of all enrolments in Australian universities at the bachelor level (Table 1). Every public Australian university has students enrolled in bachelor level ICT degrees, with a range from about 100 students in a few universities to 2800 in another. Most universities had somewhere between 500 and 1500 ICT enrolments at this level in 2013.

In agriculture and environmental studies 12,280 enrolments at the bachelor level were recorded in 2013 in Australia, making up 1.4 per cent of all bachelor enrolments in Australia (Table 1). Thirty-three public universities had enrolments in this field, and while some recorded only a few students (five have enrolments of less than 100 students), one university had an enrolment of 2500 students and two other institutions had enrolments in excess of 1000 students.

Like science, engineering is a large STEM discipline, with 69,372 enrolments comprising 7.9 per cent of all bachelor-level enrolments in Australia (Table 1). In total, there were 35 public universities with engineering enrolments in 2013, with cohorts ranging in size from 25 to 7300. Twenty-one of the universities with engineering enrolments had enrolments of above 1000 students, with the average size across all those with engineering students being nearly 2000.

Table 1: Enrolments at the bachelor level in STEM fields in Australia

STEM field	Total bachelor degree enrolments	% share of all bachelor enrolments	Number of public universities* with:		
			Any enrolments in this field	More than 1000 enrolments in this field	More than 5000 enrolments in this field
Natural and Physical Sciences	86,539	9.8%	36	25	6
Information Technology	33,587	3.8%	37	12	0
Agriculture Environmental and Related Studies	12,280	1.4%	33	3	0
Engineering and Related Technologies	69,372	7.9%	35	21	2

* There are 37 public universities in Australia
Source: Department of Education, 2014

As the statistics above suggest, STEM disciplines stretch far and wide in Australian higher education. However, while STEM exists across all universities there are vast differences across the country in the delivery of each individual STEM discipline, the contexts in which universities operate, the locations in which their campuses are based, the types of students enrolled, and the extent to which WIL is a recognised element of the ongoing curricular. It is with this context in mind that the main discussions in this report need to be interpreted.

Nonetheless, there was certainly one theme that was consistent across the interviews conducted in this project, regardless of context. It is clear that there was strong agreement with the premise of this project – that WIL activities are useful in developing learning outcomes and improving the work readiness of university students. There is also substantial aspiration among the academics involved in this project for integrating more WIL into the curriculum.

4.2 Defining WIL

4.2.1 Institutional conceptions of WIL

As part of the fieldwork for this project, university WIL definitions were examined and discussed with participants. Overall most universities do have a definition of WIL, although in some cases the terminology used is slightly different or the concept is embedded within other policies. A number of examples serve to illustrate these variations. Macquarie University has an overall policy of Professional and Community Engagement (known as PACE) – the fundamental ideas articulated in the WIL definitions of other institutions are included in PACE but the specific term is not used. At Swinburne, the term 'Industry Engaged Learning' is preferred. At Deakin, the Faculty of Science and Technology uses the term 'Professional Practice'. At Charles Sturt University 'Workplace Learning' is a common term. The range of different terms is not considered a significant barrier to undertaking the WIL stocktake project. The researchers follow the 'advice' of influential academics in the WIL field, Coll and Zegwaard, who argued in 2012 that rather than focus arguments on aligning the proliferation of terms for WIL, 'it may perhaps be better to focus on defining the features of WIL programs (or whatever term one chooses to use), allowing these programs to be known under a variety of guises and be identified by their defining features' (2012, p.2).

In a minority of cases, an institution-level definition of WIL (or similar concept) simply does not exist. Academics in institutions where this was the case did not necessarily see this as a particular concern. Many of the institutions without a recognised definition were still involved in WIL activities, at least in some disciplines. In other cases the lack of definition was currently being addressed through various working groups.

When it came to discussing WIL definitions with academics, a common theme was the general uncertainty as to whether an institution-level definition existed. Apart from those in a few institutions that are highly engaged in these kinds of activities (that is, where these policies define most teaching activities across the institution), most academics involved in the study were unaware of the specifics of the definition, or had only become aware of it during their preparation for the interview for this project.

While this may seem problematic for creating a consistent approach to developing and promoting WIL activities, in a large number of cases the academics involved did not see the specifics of a WIL definition as being particularly influential on the actual design and undertaking of WIL related activities within their faculty or department. Some felt the definition was so broad that most of the activities they considered 'WIL' fitted within the definition anyway.

A consistent finding was that currently many universities seem to be in a process of redefining and redesigning the organisation of WIL activities. This is discussed further later in this chapter, but it is important to note that at a significant number of Australian universities there appears to be a renewed push to formalise WIL activities, definitions, and policies at the institution level.

4.2.2 WIL definitions in use

As discussed earlier in this report, WIL is a term that is used to fit a variety of definitions. When it comes to the exact language used in defining WIL, there is some difference across universities. However, through exploring the institution-level definitions of WIL across Australia, there are clear and consistent themes which help in articulating the overall aspirations of such activities and the broad parameters within which these

activities sit. In general, the term WIL was recognised by those involved in the interviews, except in a few isolated cases where academics admitted things like 'I hadn't come across the term until being told of your project.' Such conversations tended to occur in the more 'research intensive' universities.

A meta-analysis of the range of institutional definitions for WIL was undertaken for this report. In general, definitions tend to draw on the significant amount of academic work undertaken in this area over the past decade, with particular emphasis on ALTC/OLT work by Patrick et al. (2008) and Orrell (2011).

Four important themes are emphasised relatively consistently. Listed in order of their likelihood of being included in institutional definitions, according to Australian universities Work Integrated Learning involves:

- **Integrating theory with the practice of work**
- **Engagement with industry and community partners**
- **Planned, authentic activities**
- **Purposeful links to curriculum and specifically designed assessment.**

Not every institutional definition encompasses all four of these elements, but most allude to at least three of the four. The quotes below provide selected extracts from definitions provided by universities as part of this project. This is a small snapshot, indicative of the kind of wording used currently in Australian higher education.

Work Integrated Learning…

(examples of university definitions)

… is an umbrella term for a range of approaches and strategies that integrate academic theory and knowledge with relevant work practice within a curriculum purposefully designed to achieve explicit educational outcomes in collaboration with workplace partners. (Murdoch University)

… is deliberate and intentional learning in work, supported by appropriate induction of students and supervisors, and imaginatively embedded assessment. (University of Canberra)

… is a purposeful, organised, supervised and assessed educational activity that integrates theoretical learning with its applications in the workplace. (University of Tasmania)

… is an intentional, organised, supervised and assessed educational activity that integrates theoretical learning with its applications in the workplace. (Flinders University)

… promotes learning through authentic engagement in a natural workplace setting. Students develop their knowledge and skills through lived experience in a professional, discipline-specific context of practice. (University of NSW)

… is an umbrella term used for a range of approaches and strategies that integrate theory with the practice of work within a purposefully designed curriculum; and through specifically designed co-curricular programs where students' graduate capabilities are enhanced through work experience opportunities. (Curtin University)

… occurs in the curriculum where students learn through engagement with industry and community partners in authentic activities that are planned for and assessed. (Queensland University of Technology)

For the academics and practitioners involved in this project, WIL was seen as spanning a range of different activities within the curriculum. The activities most commonly raised in discussions were understandably those that most obviously sit within the definitions used for WIL – industry placements and internships. Other activities that were seen to encompass the full spectrum of WIL definitions were industry inspired projects. These were most commonly implemented as projects put forward by businesses for a team of students to tackle and present findings or solutions, with the majority of the work undertaken on campus rather than in the workplace itself. However, the range of WIL activities highlighted in the interviews was vast, with elements of laboratory work and fieldwork excursions often being raised as examples of WIL, as well as an emphasis on 'simulated environments' for undertaking activities in context but still within the university.

In general, the vast majority of activities described as 'WIL' were offered as 'for credit' activities within a degree. The only activities within the science, ICT, and agriculture areas that *could* be seen as WIL, but did not attract credit within the degree, were voluntary, out of semester, 'work experience' activities. These were usually 'encouraged' by the university, but not supported specifically – essentially it was up to the students to organise and arrange the work for their own experience. In terms of fitting with the elements of the WIL definition about 'planned' and 'purposeful links to curriculum and assessment', these work experience activities do not really fit – hence they are not attracting credit and are not emphasised in this report. This judgement of the work experience activities was supported by many of the academics involved in the interviews who generally identified them as potentially useful, but outside WIL because of their general lack of structure and lack of specific links to curriculum.

4.3 A Typology of WIL activities

Based on the analysis of background literature and the discussions with each university in Australia about their WIL activities in the STEM fields, a basic typology of WIL activities was developed to help contextualise the later analyses of the volume of WIL being undertaken in Australia.

The typology below is also intended as a tool to help policy makers and stakeholders avoid over-generalisation of WIL, and to enhance recognition of the different types of activities that can constitute effective WIL. Essentially, the authors have seen through this project a significantly 'blinkered' approach to conceptualising WIL activities by many outside of the 'WIL practitioner community'. That 'blinkered' approach tends to orient the conceptualisation of successful WIL as being *only* those activities which involve a one-on-one, student-employer relationship in the form of some kind of placement. In fact, there are other forms of WIL that are very effective, far more efficient and widely used in Australian universities. There are also specific elements of placements, such as their length, which influence their effectiveness and are often missed in over-simplified discussions of WIL.

On campus simulations	• Activities integrated into courses/units that are specifically designed to simulate a work environment. Often designed in consultation with industry.
On campus projects	• Long (usually at least one semester) industry sponsored projects. Conducted on campus rather than in industry. The industry partner is presented with a 'solution', report, and/or presentation at the conclusion of the project. Usually undertaken by a team of students.
Short term placements or internships	• Planned experiences in industry, off campus for up to 5 weeks.
Medium term placements or internships	• Planned experiences in industry, off campus for between 6 and 11 weeks.
Long term placements or internships	• Planned experiences in industry, off campus for 12 weeks or more.

Figure 1: A Basic Typology of WIL Activities

4.3.1 WIL activities and WIL objectives

Many different activities can be grouped under the heading of 'Work Integrated Learning'. While STEM disciplines around Australia are using various combinations of these it is important to keep in mind that they are a means to an end.

The overriding aim of activity in this area is to produce 'work ready' graduates. There is some contention over how far universities should be geared towards the needs of employers. However, there is widespread recognition that employability is highly valued by students, and that employers' views of what makes someone an attractive, work ready employee must figure in university decisions regarding course content and emphasis.

Recent research into employer perceptions and expectations of new entrants, including university graduates, has identified five main elements of 'work readiness' (Ithaca Group, 2013). These are outlined in Figure 2 in combination with references to the Core Skills for Work Developmental Framework (Ithaca Group, 2013).

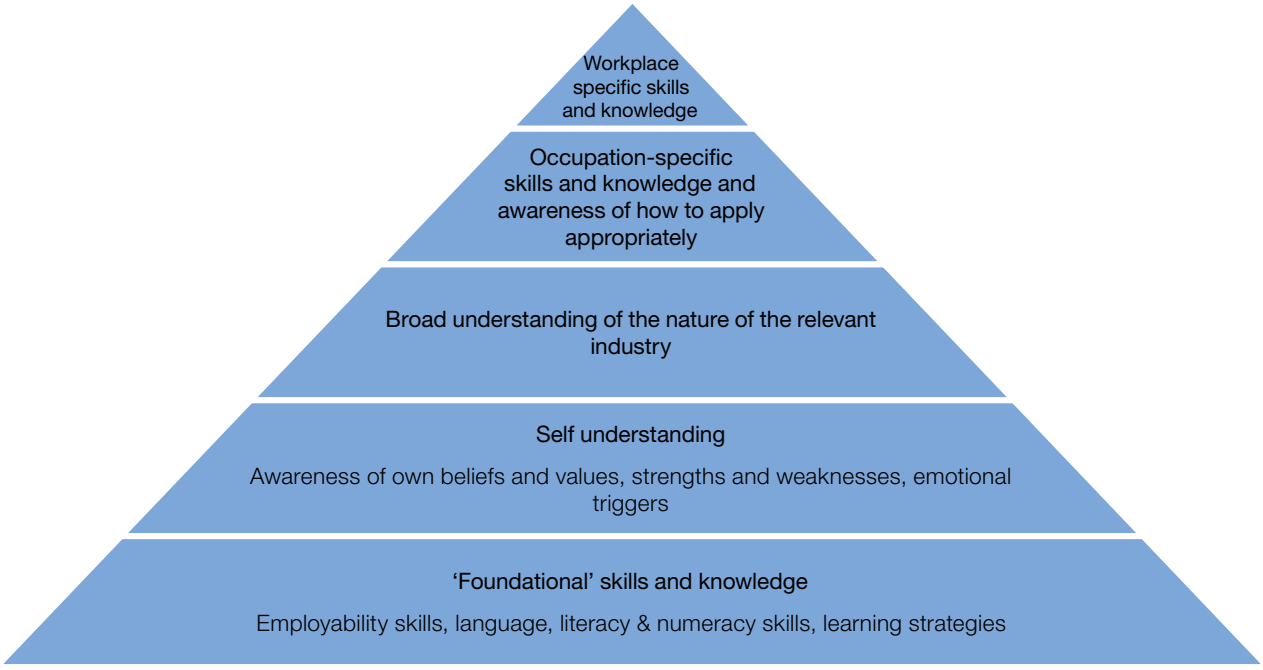


Figure 2: Work readiness: a conceptual framework (based on Ithaca Group, 2013)

This evidence based model captures the variety of aspects that come together to equip a new graduate to manage the first challenging months of their first professional job in their chosen field, and then continue to progress.

'Work ready' graduates have a broad understanding of the nature of the industry they are entering, and enough occupation-specific skills and knowledge to operate in a particular field. Importantly, they also have an awareness of how they might apply that knowledge in routine situations appropriate to a new entrant, and of the issues they may encounter as they seek to do so. They also have the contextualised literacy and numeracy skills, and the non-technical or 'employability' skills, required to work and communicate with others, follow workplace protocols, solve problems and make decisions within their level of responsibility. If they are to apply their theoretical knowledge, technical, and non-technical skills productively, new graduates also need an understanding of how workplaces in general operate, and of the values, priorities, and protocols of their specific workplace. To survive initially, and to progress, they need the self awareness to recognise their strengths, and an interest in learning and strategies to assist them to do so.

This model provides a useful way of considering some of the findings of the WIL stocktake project.

4.3.1.1 Developing workplace specific skills and knowledge

Much of the focus of WIL activity is on work placements because they are the most obvious way of helping STEM students develop a better understanding of the norms, expectations, and protocols of workplaces in general, and within a particular industry. However, as the model described above demonstrates, work placements alone are unlikely to be an effective strategy for producing work ready graduates if used in isolation from other approaches. Nor is it enough for students simply to do a work placement. There is now considerable research to suggest that the usefulness of the experience as a component of work readiness depends on a number of factors, including the way students prepare for the placement, the nature of the placement itself, the structures put in place to help them focus and reflect on their experience as it occurs, the quality of the feedback they receive, and the debriefing processes in which they are involved to help them reflect on, and learn from, their experiences.

Where work placements and internships were part of STEM courses, this project found examples that ranged from the ad hoc, 'the experience is enough' approach, to the carefully scaffolded program in which the placement itself was only one component. The most common approach was one in which the experience itself was *almost* enough. While the university might play a role in monitoring the appropriateness of the work, and manage the logistics of insurance and so on, lecturers had minimal involvement in preparing, mentoring, or debriefing individual students, or in interacting with employers. Students were likely to be asked to keep a journal and submit a formal report (often for a simple pass/fail assessment). The focus of the report was often on the technical aspects of the work they had undertaken rather than on matters like their observations on the way the industry/organisation functioned, or their interaction with others. Although they might receive formal and/or informal feedback from their employers, students were less likely to receive feedback from their lecturer or be involved in any form of interactive debriefing.

This approach was quite common in engineering and ICT. In undergraduate general science courses work placements of any kind were less likely to be a standard feature, though several examples of innovative and carefully scaffolded approaches involving a range of the aspects have been identified in research as good practice. This was also a feature of approaches used in environmental science.

4.3.1.2 Developing occupation-specific skills and knowledge

STEM undergraduate courses are designed to introduce students to the theoretical knowledge and skills of a particular field, but by their very nature not all can focus on a specific occupation. Whatever the course, it was once assumed that the learning associated with a degree would equip a graduate to continue with an academic career, or to gain employment in a relevant industry, and that those who went into industry would work out for themselves how to apply the learning from their degree. However, most academics interviewed for this project believed it was important to make explicit links between theory and real world practice.

The degree to which a course was oriented towards potential industries and workplaces varied considerably. At the very least, most courses utilised industry examples and case studies. There were one or two examples of courses with virtually no real world orientation at all. Some also used field trips, often quite strategically, to provide a context within which to anchor theory in reality and start to bring it to life. In agriculture and environmental science, field trips were often used to help students develop a big picture understanding of the issues facing organisations, industries, and communities. In one instance, a lecturer always scheduled a field trip to a working laboratory for first year clinical science students because she had found that many had little idea of what a job in this field would entail. Invariably the experience led some students to change courses.

While some disciplines lent themselves to simulated experiences on campus or online, others were more likely to incorporate industry based or industry generated projects. This usually occurred in the latter part of a degree, with the majority of academics interviewed reporting that they used an industry oriented capstone project in the final year to see how well students were able to apply their knowledge. Some industry projects were carefully constructed case studies with controlled variables, some were projects provided by one or more external organisations and completed by teams of students, and others were individual real world work based projects often identified by individual students themselves.

No matter what the activity, several academics interviewed drew attention to the importance of being explicit about *why* students were introduced to certain concepts and specific information. They observed that trying to sell this importance to students was not enough on its own, but that 'the penny usually dropped'

once students went on a field trip or undertook an industry project. Although these 'ah-ha' moments did not require a full work placement, unsurprisingly, they did appear more likely to occur when students were engaged in activities in a real world context.

Academics in agricultural and environmental sciences were mindful that their graduates were likely to be operating as consultants who would need to establish their credibility with clients who might be in diverse industries and contexts. Thus, 'occupation-specific' skills and knowledge needed to include non-technical skills such as one-on-one communication and presentation skills, and some efforts were being made to help students develop these skills. Several agricultural courses were also exploring the potential to incorporate nationally accredited vocational certificates and skill sets into their courses to give their students the practical skills and on-farm experience that would help them work alongside, and earn the respect of, the farmers with whom they would interact.

4.3.1.3 Develop a broad understanding of industry

Those disciplines with a limited range of identifiable career destinations were likely to incorporate activities that helped students build their understanding of the nature of the industries to which they might aspire. It was a common feature of courses in environmental and agricultural science and in engineering.

Engineering courses in particular actively provided opportunities for students to develop a broad understanding of the nature of the industries within which they might work and focused on occupation-specific skills and knowledge. They were likely to involve guest lectures, industry networking, and interactions with the professional association. Some faculties went further, involving industry members in course design and evaluation. At the same time, it is worth noting that there was considerable variation in approaches across universities. For example, engineering academics from universities with a strong research orientation reported that academic research remained the priority in their faculties, and that this was reflected in the design and emphasis of the curriculum, and in the allocation of resources to the industry oriented aspects of the course.

Undergraduate science is often considered to have too many possible destinations to make it feasible to cover industry characteristics and needs. In the majority of mathematics and science areas the curriculum was more likely to provide a student with some understanding of what it might be like to undertake an academic career, although this project identified several universities that were challenging this notion. However, while there were several outstanding examples of science activities explicitly designed to develop the broad range of skills required of a researcher, in the main, students were expected to develop their understanding of the nature of academic work through the traditional process of osmosis.

4.3.1.4 Understanding self

Self reflection is a critical component of self understanding, and of learning. All STEM courses that incorporated some form of industry based project used a student self reflection process – usually through journal writing and as part of a final report. This was usually a hurdle requirement, rather than a scored component of a final grade. However, most academics interviewed observed that this was a hit and miss approach. As one said, 'A lot of students just don't get it!' Only a small minority of those interviewed actively focused on helping students to develop their reflective skills, or conducted debriefings that might help a student move beyond a superficial response to a work placement. Those who did have formal strategies to encourage reflection saw it as one of the key aspects of the work placement process.

Another component of self understanding related to work readiness involves an awareness of one's own values and beliefs, and how well they align with those of an industry or community sector, or a workplace. A focus on values and belief is an inherent aspect of environmental science courses, and ethical considerations figure in a number of contexts. However, it was not possible to ascertain from this study the extent to which STEM courses encourage students to consider the implications of an alignment or non-alignment of their values and beliefs with those of a workplace.

4.3.1.5 Foundation skills and knowledge

This category encapsulates the knowledge, skills and understandings that are not specific to a particular industry, but which play a key role in how effectively graduates can adapt and apply what they have learned at university to a new context.

Non-technical 'employability' skills are commonly identified as graduate capabilities by most universities. Yet only a small number of STEM undergraduate courses actively focused on developing such skills. More often, the academics interviewed reported that students were given opportunities to develop these skills through experience – students could develop skills in working with others by working on group projects, skills in problem solving by working on problems, and communication skills by writing essays and reports and through giving formal presentations. There was a widespread expectation that students would learn how to apply their non-technical skills during work placements.

A further area that could be incorporated into the foundation skills aspect of work readiness concerns graduates' ability to gain initial employment and manage their careers. All universities have career support services from which students can get assistance with searching for jobs, preparing resumes, and presenting themselves effectively at interviews. STEM disciplines in some universities also provide more tailored assistance directly relevant to a particular industry or profession. In some cases, industry members are directly involved in conducting mock interviews. In others, students must submit formal applications for industry placements and projects and 'win' a place through an interview with the prospective employer. While some courses had highly structured and resource intensive approaches in place to identify potential work placements, academics in other courses believed that students should find their own placements as an integral and important part of the work placement experience. (Although it should also be noted that most also recognised the need to provide additional support and options for those who were unable to do so).

The discussion above informs the matrix format and content of Table 2 which recognises the broad range of activities used to develop aspects of a student's work readiness. This table lists some of the primary objectives of WIL and offers examples and ways that those objectives are achieved through activities undertaken by universities both in the 'classroom' itself and outside the classroom in industry or in actual research experiences. The matrix distinguishes between course based activities with a workplace orientation and those that involve or immerse students in real academic or industry contexts. Within those activities that have a workplace orientation further distinctions are made between course based activities that involve: telling students about how the curriculum (what is learned) relates to the workplace (labelled in the table as 'show and tell'); trying to convince students that what they are learning is valuable in workplaces ('sell'); engaging them in testing theories and reflecting on workplace implications ('engage'); and providing authentic practice fields in which they can explore and experiment ('practice').

There is no suggestion that one form is better than the other. Each may be appropriate in particular contexts. What is more important is how such activities are used in combination to assist graduates to develop all aspects of work readiness.

Table 2: What are WIL activities for? Objectives of WIL and activities used to achieve these objectives

Objectives of WIL		Ways in which WIL objectives are achieved					
		'In classroom' activities				Outside classroom activities	
		'Show and tell'	**'Sell'**	**'Engage'**	**'Practice'**	**Academia**	**Industry/community**
1	**To build workplace-specific skills and knowledge**	Workplace specific examples and guest lectures			Simulations	Students become active members of university based research teams	Industry based projects Work placements
2a	**To develop occupation-specific skills and knowledge, and skills to adapt and apply them**	Workplace examples in lectures and course notes Observational field trips	Explicit focus on *why* concepts and information are being covered, where and how they might be applied, why they are important	Field trips with searching questions to help develop 'big picture' understanding	Case studies and scenarios with problems to solve Simulations Industry provides real world issues that are used as basis for student projects and are managed, completed and assessed internally	Full lab experience where students manage all aspects of lab based research, reflect on the experience during the process, and debrief	Industry based projects Work placements
2b	**To train professionals to enter a specific industry**	Course design and lectures reflect industry input Lecturers share own (extensive) industry	Build sense of belonging to a profession	Explicit focus on the *whys* and *hows* of professional practice Work orientation/ applied focus throughout course with scaffolded opportunities to apply theory in real world situations, and consider issues and potential consequences of decisions	Simulations University based/ owned clinics	Skilled mentors/ supervisors in workplace and at university Ongoing feedback from employers Self reflection and skilled debriefing	Extensive work placement throughout course, with scaffolded opportunities to try new things, understand consequences of decisions Year long projects with high degree of student autonomy responsibility

Objectives of WIL		Ways in which WIL objectives are achieved					
		'In classroom' activities				Outside classroom activities	
		'Show and tell'	**'Sell'**	**'Engage'**	**'Practice'**	**Academia**	**Industry/community**
3	**To build understanding of the nature of industry/ occupations**	Industry guest speakers from industry, professional associations Academics talk about their work Discussion of professional expectations, ethics and protocols	Promote specific graduate destinations	Field trips with explicit reflection on employer expectations about professional practice Networking opportunities Reflection on what it means to work as a graduate in a particular industry, profession or academic field		Selected students take a short term placement with a university researcher	Work placements/ Internships
4	**To facilitate self understanding**	Demonstrate reflective practice in action	Explain why reflective practice is critical for developing personal and professional understanding, and is the basis of effective learning	Explicit strategies to promote deep reflection	Opportunities for reflective practice and debrief on process		
5a	**To develop employability and contextualised language, literacy and numeracy skills**	Explicit training in techniques and strategies		Case studies with explicit focus on non-technical skills	Simulated activities	Industry based placements with minimal preparation, support or feedback	Industry based placements with an explicit focus on technical AND employability skills with supports such as mentoring and client feedback
5b	**To develop career management skills**	Career advice and skills training – for example, how to write a resume Examples of job ads in relevant fields	Alumni speakers who focus on how their course has proved or who illustrate an unusual career pathway	Industry network events	Mock interviews involving industry members	Formal applications (with CV /interview) required for industry projects and placements	Competitive approaches to winning industry placements Student initiated work placements and projects

4.4 Linking WIL to curriculum

As part of the interview sessions with universities, academics were asked about the processes used to develop WIL activities for their courses. The main intentions of this discussion were to identify if these were different methods to those more traditionally used for creating academic subjects, and to find out if specific criteria were used to identify learning outcomes for the units involving WIL.

Uniformly across the country, academics were clear that the processes for developing WIL units were necessarily linked very closely with the processes for developing any kind of academic unit. The systems in place for undertaking development included close 'mapping' of unit objectives to the course objectives, ensuring graduate capabilities were covered, maintaining a balance with other units on offer in the degree and being able to justify that the course satisfied the Australian Qualifications Framework requirements for the qualification level at which it was pitched. In some cases (ICT and engineering in particular), the course development process also required adherence to external professional standards for accreditation, so alignment with these standards was built into the development process. These processes were viewed as being rigorous and fitting with standard practice across the sector.

Some institutions highlighted slight differences from the normal process of development in that they specifically included some industry representatives in the course design committees for these particular units – however, this was relatively rare. In the case of courses accredited externally by professional bodies, there was reference to the role of these bodies and the relevant industry in defining the types of activities and outcomes to be achieved. A small number of institutions specifically referred to following a 'constructive alignment' philosophy in their development of WIL units which could be seen as a break from the traditional mould – but this philosophy is not necessarily only used in WIL unit development and in these cases was applied more broadly to other units of study.

4.4.1 Approaches to including WIL

Essentially, in terms of linking WIL to the curriculum, the main difference found across universities was in the way in that WIL was built into the overall 'psyche' of the institution. This influenced whether WIL permeated most elements of course development, or whether WIL was seen as something that could be added onto a course if the impetus from individual academics existed.

The discussions revealed some patterns in the way that WIL is included in the general structure of undergraduate courses. Four typical models are shown in the diagrams which follow. They are designed to provide insight into the ways in which WIL is embedded in university programs.

4.4.1.1 'Trust transfer will happen'

Model 1 represents a traditional academic curriculum in which the focus of the undergraduate degree is on learning the theory and practical skills associated with the discipline in question (Figure 3). In its most extreme version, there is no direct focus on the ways in which graduates might apply this theory in a work/industry context. However, there may be an assumption that they will be able to do this because they have gained the knowledge, and developed the critical thinking skills, required to do so. In this model, there may be no activity with a real world orientation until the very end of an undergraduate degree. In effect graduates take full responsibility for working out how to adapt and apply what they have learned to whatever work context they find themselves in.

While this model may seem somewhat simplistic and stereotypical, this project specifically identified one example of this approach – in a mathematics faculty. In this context, curriculum design reflected the belief that undergraduates needed extensive exposure to theory before they knew enough to apply their learning to real word problems. This faculty saw no role for work placements for the majority of their undergraduates. Occasionally, however, one or two of their final year top performing students might be invited to participate in an industry based project, but only if an organisation approached the department with such a project.

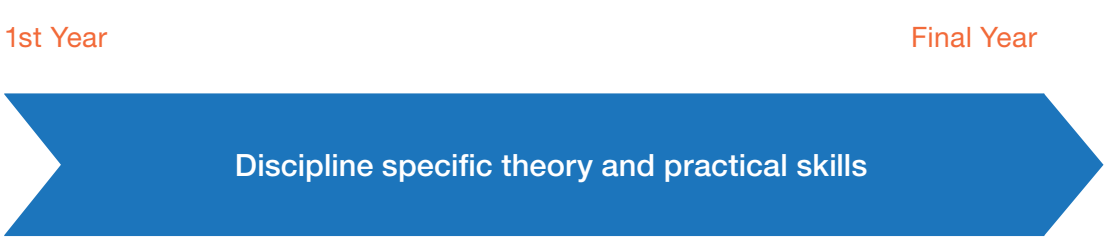


Figure 3: The 'Trust transfer will happen' model

4.4.1.2 The linear 'theory to practice' model

Model 2 describes the approach found to be typical of the way in which WIL is incorporated into the science, ICT, and agriculture curricula in most Australian universities (Figure 4). While difficult to quantify given the generalisations of these models, it is estimated that this 'theory to practice' model broadly fits the approach of about three quarters of the courses explored in this project which include WIL components. Courses are still predominantly centred on a traditional academic curriculum, but there is an attempt made to provide an industry orientation. This is done in various ways, but is likely to include the use of real world examples and case studies, guest lectures, and field trips. In their final year, students may work on industry generated projects and may have access to industry placements. These are often available as electives and in some cases are restricted to students with high grades.

In this model, the curriculum is designed as a logical step by step process in which students concentrate initially on theory, and are introduced gradually to real world applications, many of which are 'bolted on' to the existing curriculum. For example, industry illustrations might be used as part of lectures in first year. In second year, some assignments might involve simple, routine problems that might be encountered in specific real world contexts. As they master these, they may be introduced to case studies with controlled variables, then to more complex problems taken from industry. This approach usually culminates in a final year capstone project based on – or perhaps in – a real world context when students are expected to apply what they have learned throughout their degree to a complex, multi-faceted problem.

A common concern raised during interviews was that projects concerned with authentic real work issues were often 'messy' and difficult, and seldom had one right answer. Some of those interviewed believed that this was exactly what students needed to appreciate. Others had abandoned real world issues in favour of case studies that incorporated the kinds of problems a graduate might encounter and that were designed to allow them to demonstrate specific areas of knowledge covered during the course.

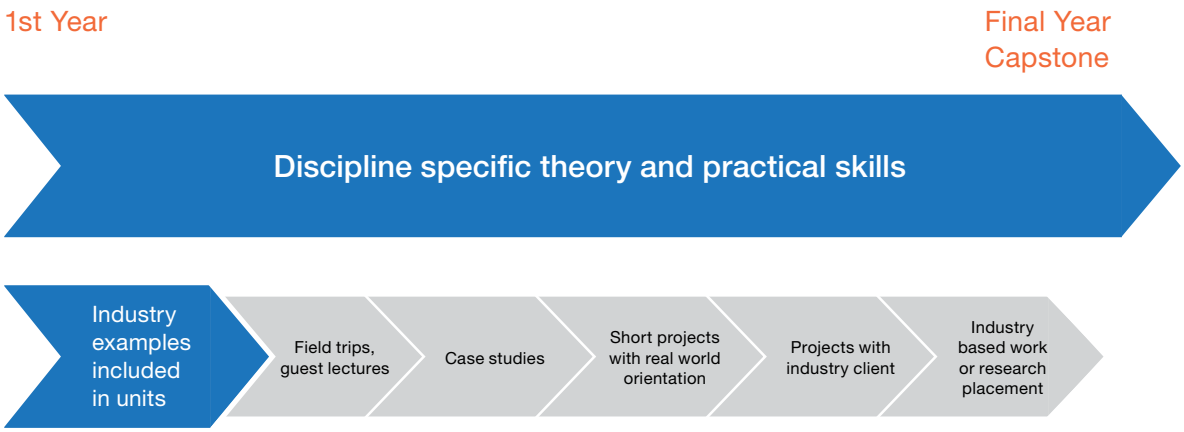


Figure 4: Linear 'theory to practice' model

4.4.1.3 The 'gradual immersion' model

Model 3 shows a variation on this theme in which students learn the traditional theory, but are also gradually immersed in the field (Figure 5). This might begin in first year with guest lectures and networking events, progress to field trips, then to practical application of theory in simulated contexts before a final extended period in an industry placement.



Figure 5: 'Gradual immersion' model

4.4.1.4 The Industry oriented course

Model 4 captures a different approach to WIL – and one not commonly encountered in this project (Figure 6). This approach typically involves embedding industry oriented approaches throughout the degree – in many cases beginning at 'day one'. It differs from the approaches described above in that it involves the orientation to direct industry involvement/ideas/problems from the beginning of the degree, rather than building up a theoretical base before industry exposure and immersion. Industry associations and members are often involved in developing and ongoing evaluation of these courses.

This approach contrasts with the 'bolted on' approaches described above, in which WIL activities remain less important than theoretical content and existing structures. In gradual immersion model, theory and real world issues, needs and applications are entwined – one cannot be taught without the other. Experiential learning plays a key role, and there is no assumption that students should have all the theory they need before they tackle a problem. Rather, the problem dictates the theory students need. They take increasing responsibility for identifying the questions they need to ask, and the sources they need to consult in order to understand the problem and develop workable solutions.

This model involves teaching technical skills specific to the degree (and usually to the particular industries or professions it leads to), and a focus on more general 'employability' skills contextualised for the industries or professions that are the focus of the degree.

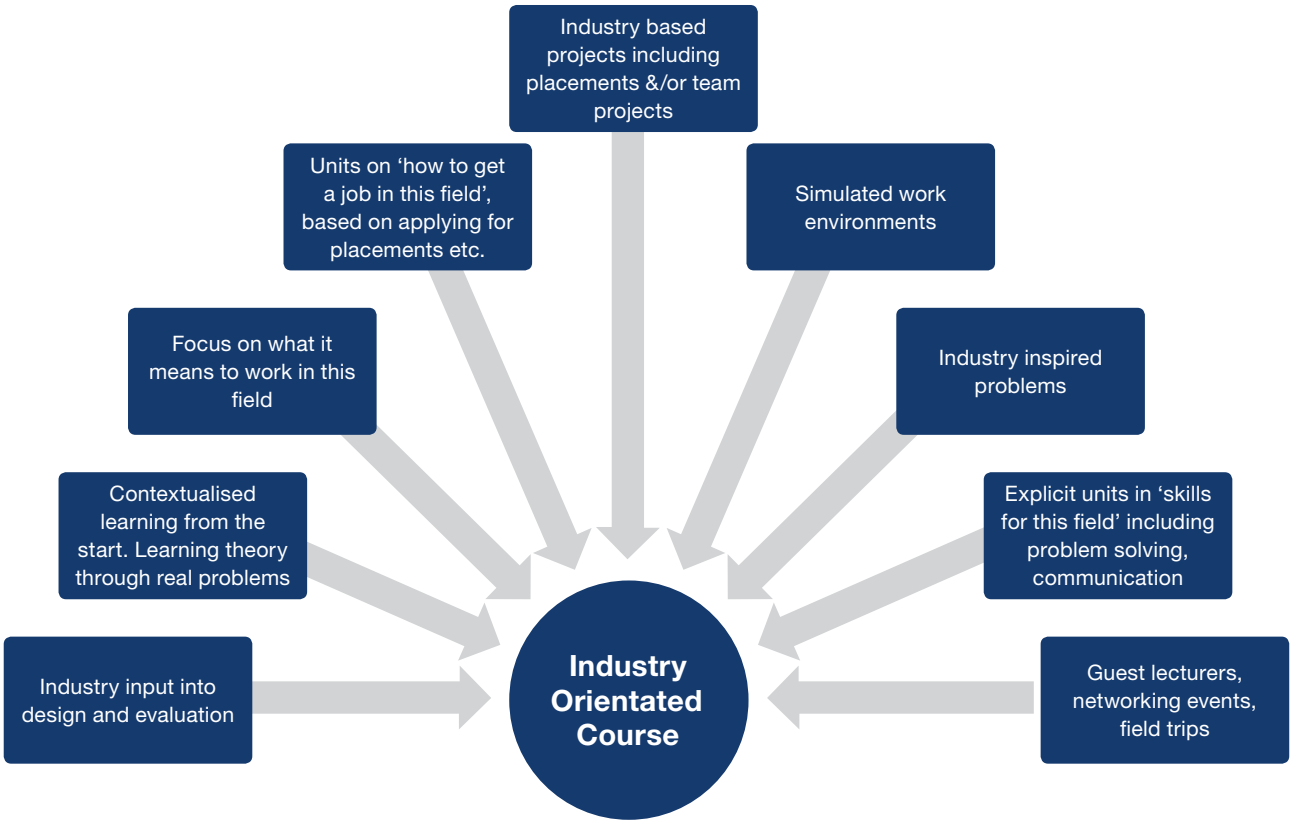


Figure 6: The industry oriented course

It is important to note that, while it may appear that the industry oriented model is the 'ideal' WIL model, it is acknowledged that in a range of current contexts it is not feasible. This model is intensive and requires an approach to undergraduate teaching and learning that does not fit easily into the practices and processes of most universities in Australia. It fits much more easily into vocationally oriented courses, such as engineering, than it does into general science courses. However, while rare, there are examples of this kind of model being implemented in science degrees in Australia (for more detail see case studies in chapter 9). Furthermore, the cost implications of these different models varies significantly. The 'Industry oriented' model necessarily requires broad structural changes, while the other models are arguably more easily incorporated due to their evolution from traditional practice. Specifically quantifying the relative costs of these different models is essentially impossible given the different circumstances within each university, within each discipline and even across subjects within the disciplines.

5 Findings: WIL activities and student participation

Key Points

- Many factors motivate students to participate in WIL activities. Academics identify the opportunity to link learning with the real world and to gain a head start in the job market as the biggest motivations for students participating in WIL.
- This project collected detailed information about the types of activities being offered to students and the extent to which students participate in them.
- In general, engineering has vast coverage in WIL activities that involve specific industry placements – traditionally a core facet of these courses used to satisfy accreditation with the peak body, Engineers Australia. It is relatively rare for engineering course placements to be 'for credit' activities, although there is change apparent in this practice.
- In the disciplines of main focus in this project, ICT tends to have the greatest extent of WIL activities embedded as 'for credit'. This is especially strong in industry inspired project activities. Agriculture and environmental sciences have a range of project and placement based activities, with comparatively large numbers of placements compared to other disciplines, although these placements tend to be of less than six weeks. Within the natural and physical sciences a number of placement and project based WIL activities exist, but in most cases they are situated in elective units and their coverage of the student population is relatively small.
- The indicative data suggest that almost three of every four ICT bachelor students in Australia experience an industry based project during their degree, compared with about one in four agriculture and environmental studies students and about one in seven science students.
- Figures on participation in placements and internships are substantially lower in the ICT field, and almost negligible in the natural and physical sciences. Agriculture and environmental sciences are slightly higher with indicative data suggesting shorter term placements covering almost two in every five students. In this field, medium-term placements (one in five students) and long-term placements (one in seven students) have lower participation than short term placements, but the rate is higher than for the other disciplines.

5.1 Overview

This chapter examines student involvement in WIL activities in Australian universities. The main focus of the discussion in this chapter is on the broad disciplines of science, ICT and agriculture. A section relating to engineering is also included to provide insight into this field from the perspective of this particular project.

The discussion here focuses on WIL activities that are 'for credit' in the degree. As noted earlier, in the vast majority of instances where WIL is included in the curriculum, it is in units which attract credit. The only clear exception to this is engineering in which most universities have long placements for students that are required but do not attract credit points towards the degree.

This chapter first examines interviewees' answers to questions about their perceptions of motivation of student's for participating in WIL activities. Some of these motivations map well with the matrix of objectives

and activities detailed in the previous chapter. This chapter also explores some issues raised by academics and support staff about the participation and engagement of particular groups of students in WIL activities. The chapter concludes with a quantitative overview of the extent to which STEM students are exposed to WIL activities, drawing on the typology presented earlier.

5.2 Student motivations

Those involved in the fieldwork for this project were keen to highlight that students were very eager to have elements in their degree which ensured that they interacted with industry and were gaining skills that would prepare them for future employment. The need for an element of relevance to the real world was felt strongly by academics involved in this research – particularly those in ICT, agriculture, and engineering, but not exclusively in these disciplines.

Some institutions with significant WIL offerings in their courses identified this element of their degrees as *the* factor which differentiated them from other universities and delivered strong student enrolments. Academics tended to highlight the employment outcomes that WIL activities can provide as being the key motivating factor for students.

It is important to highlight here that the WIL emphasis was on placements rather than other activities. Discussion around this included suggestions that students like these opportunities because they could be used to 'secure a job before graduating', or 'put themselves in front of desirable employers'.

As well as using WIL placements as direct avenues to a specific job, academics also believed that students saw these activities as building their 'employability' more generally. Placements offered students a chance to include something on their resumes with direct relevance to a future vocation that they may not have otherwise had an opportunity to represent, hence giving students a 'head-start' in the employment market on graduation.

Opportunities for interaction with industry – be they through placements, industry projects, or guest lecturers – also offered students an opportunity to gain a better understanding of the types of jobs, work environments, and real world problems that students might expect to encounter in these kinds of occupations. Academics indicated that they saw their students using these opportunities as a chance to 'test out their career path', and to compare their own perspectives on what they anticipated this work to be with the realities that a career in their field might involve.

Linked more closely to the course content of their degrees, students were seen to be motivated by WIL opportunities because they offered a chance to 'put theory learnt in lectures into practice'. Another take on this theme, predominantly seen in the sciences, was the opportunity to link course content with applied research and identify possibilities for future research careers.

There were some interesting differences noted in some institutions between types of WIL activities and student motivations. Involvement in project-type activities (usually involving a team of students) was seen as particularly desirable by students who were less confident in their ability to undertake an individual work placement. Such participation offered a potentially 'safer' opportunity to be involved in an industry related activity. While not the only desirable aspect of such project opportunities, it presents a different perspective on the placement option.

5.2.1 Demotivating factors

A number of issues highlighted in the interviews related to the problems with motivating students to participate in WIL activities. Importantly, most of these demotivating factors related specifically to placement/internship activities rather than other WIL activities. The main reason given was the additional time burden that placements often entail – specifics relating to this are discussed below.

A key theme highlighted by academics and support personnel throughout the project fieldwork was financial pressures on students involved in placements. In most cases, financial pressures arose as a result of having to forego income while undertaking a placement. The majority of placements tend to be non-remunerated. When employers do pay salaries, generally the rates are very low. But simply missing out on income is only one element of the financial pressure felt by some students. The precarious nature of employment conditions for many university students makes them vulnerable. A serious issue for many students is that they may have to give up their jobs entirely to take on a work placement as part of their university studies. Anecdotal evidence from academics in numerous universities attested to this as a relevant issue for many students, regardless of discipline.

Another demotivating factor for students arises when they are required to find their own work placements. In some universities where this policy applies, academics believed there were significantly fewer participants in elective WIL placements units because students had to do additional work to secure a placement rather than being 'handed it on a platter'.

Other factors impacting negatively on student motivations to participate in WIL placements included lack of time (also linked with other paid work) and low confidence (usually in a social sense) that their skills were strong enough to successfully undertake a workplace based activity. If a WIL activity was 'not for credit', the motivation to participate was also perceived to be lower among students, the argument being that students were less likely to give such activities prominence if the university did not give them prominence by offering credit.

5.2.2 Issues for certain groups of students

The purpose of this project is to present an overview of participation in WIL. In doing so it is important to recognise the considerable diversity of the student population, both within and across Australian universities. That recognition implies caution about applying generalisations to WIL, or proposing 'one-size-fits-all' solutions.

International students, students undertaking their study online, and mature age students were identified in a number of interviews as specific groups of students that needed additional consideration when developing and implementing WIL activities. Each of these groups posed different issues for universities and are addressed separately below.

5.2.2.1 International students

It was apparent from the background research for this project that the engagement of international students in WIL is under-researched. During the project fieldwork academics and coordinators were specifically asked about the extent to which international students can participate in WIL activities. A number of key themes emerged in the discussions. For context to this discussion, international students make up approximately 11 per cent of all science students, 39 per cent of IT students, 12 per cent of agriculture students and 27 per cent of engineering students (DOE, 2014). Across individual universities, the share of international students

in these disciplines varies considerably. For example, within science some universities have international student cohorts of less than 2 per cent, while others have up to 25 per cent. As such, the approaches taken by universities differ in relation to support for and recognition of the issues facing international students.

In the vast majority of cases universities indicated that legal/visa arrangements were no impediment to international students participating in WIL placements on the same basis as domestic students, provided the activity attracted credit in an award course. Some universities indicated slight variations to this if students are paid – however, there were inconsistencies in this message.

So while student visa issues were generally not an impediment to participation, some other issues influencing the participation of international students in WIL activities (placements in particular) were consistently raised across Australian universities. In general these fall into two categories – one relating to communication problems for international students, the other relating to employer perceptions of the 'value' in taking international students for placements.

Academics and WIL coordinators consistently highlighted communication problems as a significant barrier to the effective participation of international students in both placements and in group work on industry inspired projects. It was suggested that employers were concerned about verbal communication in particular. In cases where employers chose students for placements, it is not uncommon for international students to be left without an employer to sponsor because they were considered to lack basic verbal communication skills.

Even if communication was not a significant issue, many interviewees indicated that employers were much more likely to be interested in participating if they had domestic students as interns because they saw them as potential employees. Some employers were involved in the program out of an interest in 'growing local talent' for the Australian economy and saw that investing time for placements in international students did not contribute to growing a 'local talent pool'. On a more pragmatic level, some interviewees noted a perception among employers that it was too hard to hire international students following graduation due to visa requirements.

As such, there are challenges for universities in designing and developing WIL activities that meet the needs of both international students and employers.

5.2.2.2 Online enrolments

An issue raised in some institutions centred on the appropriate development and deployment of WIL activities for students who were enrolled in online courses. Again, the particular focus of discussions was on placements. Online course enrolments make up a relatively small proportion of enrolments overall in science (5 per cent of bachelor enrolments), ICT (7 per cent), and engineering (4 per cent). Agriculture and environmental sciences have a larger proportion at 17 per cent. There are also substantial variations in online enrolment cohorts across universities.

Online and distance learning is becoming more widely adopted in Australian universities. Incorporating authentic WIL experiences into online courses stands as a notable and growing challenge for institutions and fields of education with online student cohorts.

5.2.2.3 Mature age students

Many mature age students return to university to further their career opportunities or to change the direction of their employment. The issue for universities is how to design and deliver WIL activities to meet the needs of all participating students. As articulated by one university in the interview for this project, mature age

students often already have the 'employability skills' that some WIL programs are designed to improve and 'it is the content knowledge that they really want'. As with the other groups mentioned here, the share of mature age students in the disciplines examined ranges considerably across universities; in some institutions mature age students account for more than half the STEM student population, while in others it is less than 10 per cent. Overall, enrolments by students aged 25 and above account for 14 per cent of all science students, 20 per cent of ICT students, 26 per cent of agriculture students and 14 per cent of engineering students (DOE, 2014)

Some flexibility in WIL programs is required if universities are to best balance the needs of mature age students. An additional challenge articulated by some universities is that mature age students are less likely to have flexibility to take up placement opportunities. As one regional university noted, mature age students often have families and are established in a certain area meaning that moving (temporarily) for a placement is much more difficult than for younger students who have fewer constraining personal commitments.

5.3 Participation in WIL activities

5.3.1 Overview of collection of participation information

As part of the information collected from universities for this project, specific data was requested from universities relating to the details of the WIL activities included in their science, ICT, agriculture, and engineering courses. The collection involved completing two template tables. One table sought detailed information about activity type, participation levels, length of involvement, credit points allocated, and whether or not students were paid for the activity. The second table sought a general overview of student participation in WIL by broad activity type and discipline (see Appendix A for the survey questions and template tables).

This section summarises the information collected from these tables, and through interviews with academics and WIL coordinators. It is important to note that significant efforts were made to encourage each discipline at each university to provide the information requested. However, there were a number of circumstances where the specific data requested was not provided. The reasons for not providing data included: lack of time to collate information (given heavy academic workloads); lack of any underlying data to use as a basis for completing the tables; and not wanting to divulge information at the requested level of specificity. Estimates of the impact and scope of the non-responses to the data collection are discussed in the results sections. Despite the missing data, the research team believes that the interview sessions yielded sufficient information to be able to offer important new insights into the implementation of WIL activities in STEM in Australian universities, and student participation in these activities.

5.3.2 Engineering placements

In general, engineering as a discipline tends to have the most substantial student coverage of WIL related activities, reflecting the accreditation requirements of Engineers Australia (EA). One specific requirement by EA is that students have 'exposure to industry practice', which in most cases is translated into the placement program of at least 12 weeks duration (Male & King, 2014). Consequently, almost all universities facilitate placements for their engineering students – some in a more 'hands-on' way than others, but in general it is an expectation placed on students. It is estimated that about 12,000 engineering students per year undertake a placement program in Australia (King & Male, 2014, p. 2). On graduation the vast majority of engineering students in Australia have undertaken an internship or placement.

In terms of articulating the variety, types and quality of placements in engineering – and identifying exact participation rates and numbers – King and Male's extensive reporting for the Australian Council of Engineering Deans clearly points to the relative impossibility of such a task at this point in time. In their detailed examination of industry engagement in engineering curricula, they highlight the issues with collecting and aggregating this kind of information from universities: 'It was difficult for participants to report the extent of exposure of various kinds [of placements/internships] for the different levels of engineering programs because there was great diversity between engineering programs even within one university' (2014, p. 7).

The key issue in the engineering discipline at present is that most engineering students undertake placements during semester breaks, and while being a requirement for students to graduate, the placements do not attract 'credit'. Detail about the nuances of placement requirements and practices were highlighted recently by Male and King (Male & King, 2014; King & Male, 2014). Given the existence of significant prior research and commentary in this area the 'not for credit' engineering WIL activities programs are outside the terms of reference for this project.

An issue covered during this research is the existence of engineering courses in which the placement requirements do attract credit. Until recently, very few universities included the engineering placement program as a for credit activity (with the University of Technology, Sydney a notable exception). However, evidence gathered from engineering schools for this project identified a number of universities in the process of changing this policy and redirecting engineering placements into a 'for credit' unit (a finding also noted by Male and King, 2014).

The research team for this project conducted interviews with academics and coordinators in engineering faculties that had 'for credit' WIL placements or were developing policies along these lines. About 10 engineering faculties (about one third of all universities) were identified as moving in this direction, although it is possible the number may be higher given the number of non-responses, and that for some institutions this is currently a sensitive topic which they are not ready to discuss openly. It is important to note that a small number of institutions indicated a move away from industry placements in their engineering degrees, identifying project based and simulation activities as far more efficient, easier to 'quality-control', and potentially better for realistically engaging *all* students in the EA accreditation requirement of exposure to industry practice.

Those institutions moving towards 'for credit' placements in their engineering degrees had various nuanced and context specific reasons for the change in policy, but a core and universal reason given for this move was simply that for credit activities attract Commonwealth funding. In general, the discussions in relation to this issue followed this familiar path:

1. Current practice in supporting industry placements was underfunded, leading to problems in properly evaluating the experiences that students are exposed to in their industry placements. There was a feeling that many students were being let down by the firms they undertook their placements with, or (more commonly) that students were 'rigging the system' and not actually undertaking serious engineering work that would expose them to authentic experiences;
2. To better assure the quality of placement arrangements, converting a placement to a 'for credit' requirement would attract Commonwealth funding. Additional funding would mean support staff could be hired to facilitate the faculty's placement activities, including administrative, business development, and student support functions;
3. The move to a 'for credit' requirement would also result in developing assessment tasks focused on identified learning outcomes;
4. In sum, this scenario would lead to better student outcomes by ensuring students were supported (and monitored) in meaningful activities with genuine employers.[4]

When articulated in this way, an obvious question is to ask: 'why don't they all do it this way?' When posed to academics involved in the discussions during this project, three key reasons emerged to explain why this is not the preferred option for many engineering faculties.

The first reason is that offering credit for the placement raises the issue of how to fit the placement units into the course. If the time to complete the degree is lengthened it might become more difficult to attract students. If the time is not lengthened then the degree would need restructuring. This means removing one or more subjects to accommodate a 'for credit' WIL activity. However, it is difficult to remove subjects and still cover the material required by EA to maintain accreditation.

The second reason relates to HECS-HELP. If the credit points required for completing the course are increased, students' HECS-HELP liability also increases.

The third reason given was that 'for credit' must have structured assessment and outcomes that legitimate the level at which the unit is offered in the Australian Qualifications Framework. This often mean significant work is required to improve practices, develop assessments, document the 'new' unit and process it through university self accreditation procedures.

Some institutions suggested options for minimising these difficulties. One option would be to make the placement credit units part of a summer or winter 'semester' (generally the times that the bulk of students

4 These ideas appear to make sense and would go some way to alleviating some of the issues identified in the quality, consistency, and effectiveness of current practices identified by King and Male (2014). The following comment collected by these researchers in their study reflects 'the arguments for enhancing industry engagement in engineering degrees':

> *The only Industry engagement I have had through my studies is through my 12 week vacation placement. Industry exposure has been non-existent beyond that experience. Quite frankly, I feel that my studies have in no way prepared me for life as a professional engineer and have failed to even give me an appreciation for how engineering is actually carried out in the professional world. There needs to be more industry case studies, projects and assignments on real world scenarios at university. (Final survey comment from a student in King and Male's 2014 study, p.18).*

undertake current placements anyway), and keep the core units of the course operating in traditional semesters. A second option would be to 'waive' the HECS liability on students for the placement units, thus reducing the overall amount of funding these units attract but still maintaining some Commonwealth contribution.

The project team senses that these are currently sensitive issues within engineering education and hence there was limited willingness to speak openly about exact plans. As a result, quantifying the participation and numbers of students involved in 'for credit' engineering placements is virtually impossible (a finding also noted by King & Male, 2014), especially at present when a number of universities are literally in the middle of altering their programs and policies in this regard. However, the brief discussion above hints at trends that may be seen over the coming years in this discipline's approach to WIL activities.

5.3.3 WIL participation in Science, Agriculture and ICT

The discussion of policies and practice with engineering academics was significantly different to those within the main disciplines of focus in this research – generally because of the relatively entrenched nature of the engineering placement resulting from Engineers Australia's accreditation requirements. Like engineering, information technology courses generally have professional accreditation, with the Australian Computer Society (ACS) accrediting courses in all Australian universities. The ACS does not specifically require WIL placements or industry projects as part of accreditation, but does 'strongly encourage' these kinds of activities (ACS, 2014, p.13), thus making them a generally accepted part of the ICT curricular. The sciences traditionally have less structured or no external accreditation requirements and generally have far broader employment pathways. This section explores the quantitative information collected from universities in this project. The analysis offers an indicative overview of how different aspects of WIL are integrated into the curriculum in these disciplines.

Participants were asked to detail specific WIL activities in a template table, and to approximate overall coverage of student participation in WIL activities based broadly on the typology described in Chapter 0. As noted in the methodology section, despite considerable efforts there were a number of cases in which detailed information was not provided by institutions. Despite this, the information collected provides a significant insight into the nuances of WIL activities in the science, agriculture and ICT disciplines. The quantitative outcomes discussed here closely fit the themes emanating from the qualitative data collected through the interviews conducted.

5.3.3.1 On campus activities

Almost every degree program in the sciences and ICT incorporates to an extent some campus based work focused activities. Guest lectures were by far the most common element mentioned by academics (although there is general consensus that these are not strictly 'WIL' activities). Some interviewees argued that laboratory 'pracs' could be considered as work related learning. Actually measuring the extent to which these kinds of activities are covered in each institution and course is difficult, mainly because of the different ways, and the ad hoc nature in which they are undertaken. But it is estimated that the vast majority of students in science, agriculture, and ICT degrees are exposed to some basic on campus industry engagement at some time during their study.

Simulation based activities were not as common as the 'ad-hoc' implementations described above, but were found equally difficult to measure quantitatively. A key reason for this is the wide-ranging kinds of activities which might fit into this category and the specific information required to identify them in this way. For example, all universities with a science degree have practical laboratory sessions as part of the degree.

Sometimes these sessions are based around single experiments or introduce instruments that might aim at building specific technical or theoretical knowledge. Such sessions are not undertaken 'in the context' of a particular work-related issue or problem. Sometimes the sessions may involve a more complex series of experiments, or making choices of instrumentation to use for a particular scenario, that begin to draw on a specific work oriented problem or skill set. And sometimes a lab session in a unit may be integrated into a whole topic based on problem identification, definition, experimentation, application, and articulation of outcomes, with an emphasis on real world application. Overall, and recognising there are nuances between these three examples, it appears that the bulk of the work in the sciences is concentrated in the first two kinds of activities. More in depth simulations and work oriented applications certainly do occur, with one example at ANU given in the case studies presented in chapter 9.

5.3.3.2 Industry Projects

Industry oriented projects were easier to identify, and for academics and support staff to articulate during this project's fieldwork. Based on the quantitative evidence gathered, the figures below offer some new insights into these activities across the science, agriculture, and ICT disciplines. All information captured here is based on 'for credit' activities – the research team did not specifically identify any 'not for credit' industry project activities.

Industry projects are a key way of facilitating WIL across the disciplines of focus in this project. They appear to be increasingly recognised for their efficiency in terms of employer to student ratios, and for their abilities to draw out graduate capabilities in relation to teamwork.

Industry inspired projects typically involve creating a team based activity for students centred on solving a problem, creating something, undertaking applied research, monitoring an issue, or being engaged in a consultation process for a 'real world' industry client. The business or organisation involved will propose the project to the academic coordinator, and a team of students (most commonly four) will be engaged to undertake the task. In many cases, the task is predominantly completed on campus (but sometimes online), with specific hours built into the semester for students to congregate and work on the task. Some cases involve limited visits to the employer or a 'site' to gather information, but these projects rarely take place entirely at the employer's place of business. The majority of project units run for a whole semester, and usually culminate in a report and presentation to the employer based on the task undertaken. As discussed below, these units are sometimes a mandatory element of the course, and in other cases are electives.

Table 3 provides an overview of the number of universities identified in each discipline as having specific industry projects, and the proportion of students who participate in them. Each cell in the figure represents one university. The percentages in the box indicate the estimated proportion of undergraduate students in the discipline who have participated in an industry oriented project by the completion of their undergraduate degrees. The colouring of the boxes is based on deciles of participation and is included to provide a visual indicator of the participation levels. The table presents an overview of how embedded these kinds of activities are across the sector by discipline, and how embedded they are within universities. The notation 'NR' (non-response) in some cells indicates universities for which definitive data was unavailable.

The table illustrates key findings about the implementation of industry based projects for these disciplines. First, a large number of universities undertake these kinds of activities in their ICT disciplines – 25 specific programs were identified in this research. While the numbers for the other disciplines are lower, there is notable practice and precedent for these kinds of activities in agriculture and environmental sciences, and

in the natural and physical sciences. Seventeen programs in the sciences were identified as having industry based projects. Qualitative and quantitative data collected suggest that 11 institutions did not have any such projects in their science degrees.

Table 3 also illustrates the extent to which students participate in industry based projects within each institution. The colour coding emphasises a clear pattern, showing that, in the case of ICT participation is near universal in institutions where industry based project units are in place (indicating that the units are compulsory elements of the degree). In agriculture, and even more so in science, Table 3 shows a number of degree programs offer industry based project units. However, in only in a few cases are they mandatory elements of the degree. In many cases where the units are offered as elective, they attract a minority of students. For example, of the 17 programs in science identified, more than half attract 50 per cent or fewer of the science enrolment cohort, and 8 are participated in by no more than a quarter of students. This compares with 22 of 25 ICT industry project units which cover 100 per cent of the cohort, and 3 covering at least 80 per cent of ICT students enrolled.

Given the nature of the collection, it is difficult to estimate the number of institutions that have no industry projects as part of their curriculum. Table 3 attempts to quantify the number of universities without such programs, but this is indicative only. For the sciences, the research team estimate that about 11 universities have no industry inspired projects in their degrees. About nine universities did not have data on this item. For ICT, non-response accounted for about 12 universities, and for agriculture non-response on this item is estimated at 10 universities.

Table 3: Industry projects identified in universities, by proportion of undergraduate students who participate and broad field

Nat & Phys Sciences	Agri/Enviro Sciences	ICT
100%	100%	100%
100%	100%	100%
100%	80%	100%
100%	75%	100%
100%	50%	100%
90%	50%	100%
75%	50%	100%
50%	50%	100%
50%	20%	100%
25%	5%	100%
20%	NR	100%
15%	NR	100%
10%	NR	100%
5%	NR	100%
5%	NR	100%
5%	NR	100%
2%	NR	100%
0%	NR	100%
0%	NR	100%
0%	NR	100%
0%		100%
0%		100%
0%		95%
0%		90%
0%		80%
0%		NR
0%		NR
0%		NR
NR		NR
NR		NR
NR		NR
NR		NR
NR		NR
NR		NR
NR		NR
NR		NR
NR		NR

(NR = Non-response – data unavailable)

5.3.3.3 Placements and internship programs

Placement programs specifically identified through the fieldwork in this project were spread relatively widely across Australian universities and throughout the disciplines of focus. There are some uncertainties about the extent to which science, ICT and agriculture disciplines participate in them. The main focus in this project was data collection from faculty level staff about faculty level information. However, almost all universities in Australia have some kind of WIL internship or placement program that potentially any student, from any degree, can apply for. These are often highly selective, sometimes include an overseas element, and also tend to focus less on discipline specific knowledge. Although many of these general WIL opportunities are 'not for credit', a range of 'for credit' programs do exist. Technically, then, almost every student in Australia has 'access' to a WIL placement program. The analysis and discussion below focuses on WIL placements and internships specifically coordinated by science and ICT faculties and targeted in some way on providing specific involvement in industries with direct relevance to the discipline being studied.

The findings are summarised in Table 4, the structure of which is the same as for Table 3 above. Table 4 presents a consolidated overview of the extent of placement programs identified, and the estimated levels of student participation in each of these. All placement programs identified are 'for credit' – there were no formal placement programs identified that were 'not for credit'. In total, 20 universities were identified as offering placement programs in the traditional sciences, 16 in agriculture and environmental science, and 23 in ICT. There were no instances in which a placement program in the sciences was a mandatory element of the curriculum, but examples of this did exist in ICT and agriculture and environmental science. For science and ICT, the majority of programs identified had low take up rates. All but four of the science placement programs had a participation rate of 20 per cent or below, with 9 programs having a participation rate of 5 per cent or less. The majority of placement progams in ICT reached a quarter or less of the student cohort. While being a smaller discipline than either science or ICT, the agriculture and environmental sciences discipline had a greater number of fully embedded placement programs.

It is difficult to identify universities and degrees which definitely have no WIL placement programs given the issues discussed earlier about data provision, identification of student numbers, and non-response. Some insight into non-participation and non-response is provided in the '0%' and 'NR' boxes in Table 4. It was difficult to identify the complete range of placement offerings available to students given the inclusion of general institution level placement programs at some universities. In many cases there may be no placement program within a specific STEM course yet students may have accessed the general placements at the institution level.

Table 4: 'For credit' placement programs identified in universities, by proportion of undergraduate students who participate and broad field

Nat & Phys Sciences	Agri/Enviro Sciences	ICT
80%	100%	100%
60%	100%	100%
50%	100%	100%
40%	100%	100%
20%	100%	100%
15%	100%	100%
15%	100%	80%
10%	50%	50%
10%	50%	50%
10%	33%	30%
10%	30%	25%
5%	30%	23%
5%	20%	20%
5%	15%	20%
5%	10%	15%
5%	5%	10%
5%	NR	10%
2%	NR	10%
2%	NR	10%
2%	NR	5%
0%	NR	5%
0%	NR	5%
0%	NR	2%
0%	NR	NR
0%		NR
0%		NR
0%		NR
0%		NR
0%		NR
NR		NR
NR		NR
NR		NR
NR		NR
NR		NR
NR		NR
NR		NR
NR		NR

(NR = Non-response – data unavailable)

As noted in the literature review and the earlier discussion about the 'typologies' used in this project for data collection, an important element in analysing WIL activities is the ability to differentiate by type.

Table 5 offers insight into the coverage of placement programs in a similar format to earlier tables, but this time disaggregated by the length of the placement.[5] It shows that a number of universities offered long term placements in the focus disciplines. However, much of the cohort-wide (or close to cohort-wide) coverage of placements is in short term placements lasting less than six weeks. It is useful to disaggregate this information. As an example, in agriculture and environmental sciences there are a number of 'for credit' programs operating in universities. However, the majority are concentrated in the short term placement category. Overall, the data collected for this project suggest that in the traditional sciences no degree programs require all students to undertake a placement, and there are none that are longer than six weeks and attract more than half the science cohort from the institution. In ICT, and agriculture and environmental science there are some programs with these characteristics, but the information gathered in this project suggests they are rare.

Table 5: Universities with identified 'for credit' placement programs, by proportion of undergraduate students who participate and duration of placement

Short Term Placements (less than 6 weeks)			Medium Term Placements (6 to 12 weeks)			Long Term Placements (more than 12 weeks)		
Nat & Phys Sciences	Agri/Env Sciences	ICT	Nat & Phys Sciences	Agri/Env Sciences	ICT	Nat & Phys Sciences	Agri/Env Sciences	ICT
80%	100%	100%	50%	100%	100%	40%	100%	100%
40%	100%	100%	20%	100%	100%	30%	100%	80%
20%	100%	50%	15%	50%	100%	30%	100%	50%
15%	100%	20%	10%	20%	100%	10%	15%	30%
10%	50%	20%	5%	10%	50%	10%	5%	23%
5%	33%		5%	10%	25%	5%	5%	20%
	30%		2%		25%	5%		15%
	30%		2%		15%	5%		10%
	20%				10%	5%		10%
	10%				5%	5%		10%
	5%				5%	2%		5%
	4%							5%
								5%
								5%
								5%
								5%
								5%
								2%

5 Note that the number of boxes in the three types of placements displayed in this table does not match the number of institutions represented in Table 4. This is because some universities have a number of placement programs of different length, and are thus 'counted' in each of the categories in Table 5, but aggregated in Table 4. In addition, the NR estimates at each of these placement lengths are not shown in this table.

5.3.3.4 Summary and participation rate estimates

Tables 3, 4 and 5 provide a visual overview of the number of, and participation rates in, WIL placement and project activities in Australian university science, agriculture, and ICT faculties. These tables help to show the extent to which WIL activities have been identified, allowing comparisons across the disciplines and comparisons of relative embeddedness within the disciplines. This section examines the data collected in a different way. It offers an aggregated perspective of WIL activities by student numbers across the country. The figures calculated for the table below are *indicative* rather than comprehensive. The use of creating nationally aggregated data in this way is questionable in itself, given the significantly different contexts in which degrees in these fields are taught across Australian institutions (an overview of the different models of application is provided in chapter 4).

The caveats previously articulated in this report about institutions providing data for this project are again relevant to the analysis below. The figures presented in this section are based on the WIL programs identified during the project. Where there was non-response (as detailed earlier), it is assumed that no students are participating in WIL. Therefore, it is likely that the data presented here underestimates true participation rates. As discussed in the conclusion, a more accurate picture of participation would be best accomplished through a coordinated national data collection, probably most efficiently accomplished if linked to an existing collection such as student or graduate surveys, as is the case in Canada for example.

Based on the data collected for this project as well as enrolment figures provided by the Commonwealth Department of Education, an indicative estimate of the proportion of students in science, agriculture and information technology bachelor courses who are exposed to WIL activities at sometime during their degree is provided in Table 6.[6] The table provides further confirmation of the findings presented above relating to the levels of participation in WIL activities by different disciplines.

Based on the indicative data, the figures suggest that almost three of every four ICT bachelor students in Australia undertakes an industry based project during their degree, compared with about one in four agriculture and environmental studies students, and about one in seven science students. Participation in placements and internships are substantially lower in ICT, and almost negligible in the natural and physical sciences. There are slightly higher participation rates in agriculture and environmental sciences with the indicative data suggesting short term placements cover almost two in every five students. There is lower participation in medium term placements (one in five students) and long term placements (one in six students), but participation is higher overall than for the other focus disciplines.

Using these participation rates and population numbers (and keeping in mind caveats about the data), it is estimated that in a given year approximately 7000 ICT students, 4000 science students, and 900 agriculture and environmental science students engage in some kind of industry linked project. In addition it is estimated that about 2500 students from each of the three disciplines (an estimated 7500 overall) are involved in industry placements or internships, with science and agriculture student numbers concentrated in short term placements and ICT student more likely to undertake long term placements.

6 Further analyses of the data were undertaken at the regional and university grouping level. However, given the indicative nature of this national-level data, the caveats noted above and the finer grain of detail required for these analyses, the output from these analyses was deemed unsuitable for publication.

Table 6: Estimated proportion of students involved in WIL activities during undergraduate degree, by broad discipline (%)

Type of WIL activity	Natural and Physical Sciences	Agriculture Environmental and Related Studies	Information Technology
Industry Projects	14.5	26.9	72.9
Short term placements and internships (less than 6 weeks duration)	5.5	37.4	7.0
Medium term placements and internships (6-12 weeks duration)	2.8	19.5	15.2
Long term placements and internships (more than 12 weeks duration)	2.6	17.5	12.2

Note: Estimates of student numbers for calculating participation rates are based on 2013 commencement data supplied by Commonwealth Department of Education.

Note: Table contains estimated enrolment proportions and numbers for WIL programs identified in the WIL ACER/OCS project – missing data and non-responses are not included. Outcomes are indicative only.

6 Findings: Engagement with industry in WIL

Key Points

- Universities in Australia have connections with industry for WIL in STEM fields that span a vast range of industries and business sizes, and cover all sectors.
- Academics perceive that employers are involved in WIL activities to identify potential employees, to tap into knowledge and innovation that universities can offer, and to contribute more broadly to the education of students in their fields, and in some cases within their regions.
- The vital role individual academics play in establishing industry connections within their disciplines for WIL activities was highlighted throughout discussions with universities.
- The importance of these relationships for academics in terms of personal research and professional opportunities was also emphasised.
- Reliance on individual academics to develop and maintain relationships with industry is particularly prominent in the science disciplines, while central organisation for establishing connections is more apparent in ICT and engineering.
- In expanding WIL activities and connection with industry, universities are faced with identifying a sustainable balance between centralised administration of relationships and the personalised approach by individual academics.

6.1 Overview

A necessary element of WIL is engagement with industry. All universities in Australia have links with industry within the STEM fields. The interviews conducted for this project indicated that these relationships cover a significant range of employers, industries and business types. Even in universities and disciplines where the scope of WIL activities was comparatively small, there was still a sense that connections with employers across a range of industries and sectors existed. Academics and WIL coordinators involved in the interviews were asked about their perceptions of the motivations for industry involvement in WIL activities, and about the practicalities of making industry connections.

6.2 Motivations for involvement

Academics' perceptions of the reasons employers become involved in WIL activities tended to follow two broad themes, summarised well by one academic in a large metropolitan university: 'For many, it's about recruitment. For others it's about being a good corporate citizen'. The only notable variation to these themes was heard in rural regions, where there seemed to be a strong sense that local businesses wanted to bond with the local university to contribute to the region as a whole.

A range of specific recruitment incentives were identified by academics. The most common was that placement programs offered employers a chance to 'try before you buy'; in other words, the programs offer a means of screening potential new recruits. Academics identified this motivation as significant for medium to large businesses which often had graduate programs, or hired staff on a regular basis. In the opinions of

the interviewees, small businesses were less likely to be motivated by recruitment because they were less likely to be recruiting new employees. For small businesses, a core motivation was to have an additional pair of hands to 'get things done'.

This idea of students helping to 'get things done' was also seen by academics and WIL coordinators as a common motivation for local government and not for profit organisations becoming involved in WIL activities. In the sciences and agriculture, these organisations used WIL programs to undertake small research projects or to explore a 'problem' they did not have time or resources to allocate to it. In the ICT discipline, engagement with these employers often occurred on the basis of providing a software or online 'solution' to an issue the organisation might have been unable to tackle.

Some academics reported that universities were sometimes seen as 'cheap' consultants for particular problems. But here the word 'cheap' was not used in a negative or 'low quality' sense. Industry was telling academics that industry based WIL projects were a means of securing input from the best, innovative students and academic researchers at virtually no cost.

A common theme among 'service' motivations identified was the interest of university alumni in hosting and mentoring students as a contribution to the university or to the discipline from which they gained their qualification. As noted above, many academics from regional universities reported that employers were motivated to participate in WIL activities as a means of strengthening the region by supporting local students. 'Service' motivation was also apparent in discussions with engineering academics who often noted that some alumni specifically helped them to find placements because they remembered their own difficulties as students.

Linked with this motivation was another mentioned by some of those involved in the research – the ability for employers to 'tap into' the knowledge and innovation that the university could offer. The benefits of partnering in WIL activities were seen as offering access to students, to academics, and to research and innovation opportunities. The 'branding' impact of being affiliated with a university was also mentioned as a core factor – typically mentioned by larger research intensive institutions, but also noted in some cases by academics at regional universities.

6.3 Making connections with industry

Universities establish connections with employers using a broad range of methods, from informal networking by individual academics, to formal centralised industry engagement activities undertaken by some chancelleries. Between these two extreme examples existed the practice of having an 'industry engagement coordinator' within some faculties who was tasked with making and maintaining industry connections, mainly for the purpose of securing placement and project opportunities.

Within this overall theme there were some discipline specific generalisations. The science fields tended to be more likely to have connections with industry established primarily by individual academics in a relatively informal process. ICT areas with industry engagement and larger WIL programs were more likely to have a formal faculty level coordinator for industry engagement. This was not as uniform as tends to be the case in engineering faculties where a coordinator for making and maintaining industry connections tends to be the norm.

Academics in some institutions placed an emphasis on students making the industry connections that produced their internships or placements. Some institutions argued that this was a good way of helping

students to learn the skills required for making industry connections, developing written job applications, and familiarising themselves with the professional interview processes in their fields. In many cases the process of applying for placements was supported by the university through faculty or (more commonly) institution level careers services, but the 'making connections' element was a student responsibility. This approach was seen as far more efficient in terms of time and costs. In many cases (and as discussed further in the next section) it was argued that without this approach the university would be unable to afford the placement programs, given the level of resources the institution would require to find placements for their students.

Often through the students' efforts in finding placements, the university was able to make ongoing industry connections, sometimes resulting in the placement opportunities for students in subsequent years. This kind of linkage often worked as a 'safety net', helping those students who simply could not find a placement independently.

Using intermediaries or centralised portals was mentioned by a few institutions as a key to engaging with industry. A noteworthy example of using intermediaries is Monash University's ICT projects unit (discussed as a case study in chapter 9). Here the university works with local councils who act as the conduit for small businesses in the area to propose projects for Monash ICT students to undertake. The Australian Collaborative Education Network (ACEN) helps to facilitate relationships with industry for universities across a spectrum of disciplines. Among other things, ACEN has a web based portal as a central location for universities and industry to engage and to identify projects and placements for students. This portal is discussed further in the conclusion.

Commercial intermediaries also exist within Australia. Their aim is to link universities and business. One notable example of this is Cooperative Education for Enterprise Development (CEED http://www.corptech.com.au), an organisation which has arranged partnerships with four universities – QUT, University of Queensland, University of Southern Queensland, and University of Sydney. The CEED program places students from these institutions with relevant businesses for internships and project based work. Arrangements have been negotiated with the universities whereby credit is given to students who undertake these programs. The CEED program is focussed on STEM and business disciplines.

Another placement program specifically for the sciences is the Undergraduate Research Opportunities Program (UROP), facilitated by Biomedical Research Victoria. This program links STEM students from a range of disciplines (not just biomedical science) into research laboratories for casual placement work during their undergraduate degrees. Discussed in more detail in chapter 9, UROP works as a conduit between students and potential employers. Victorian universities are linked with UROP, but the placement offerings do not attract course credits from universities as WIL activities.

Connection to industry through alumni was identified as especially important in two groups of universities. Rural and regional institutions often highlighted alumni working locally as key WIL partners, and their motivations for involvement were discussed earlier. Larger research intensive universities also underlined the role of high profile alumni in helping to build relationships with industry for WIL and research activities. These institutions often have well established alumni associations, and internal support for facilitating them is generally more sophisticated than in other universities.

An issue raised consistently in discussions with universities was the high value that academics contributed to developing and maintaining industry relationships. It was consistently observed that for academics with a passion for WIL, the process of making connections with industry was very important – the establishment of connections was as a positive 'trade-off' for the significant effort that this entailed. Often academics used

the connections they had established for undertaking research, and for accessing professional associations and networks that would otherwise be unavailable to them as academics. For many academics these outcomes were the key 'incentive' for being involved in WIL activities. Many academics involved in WIL held their industry connections as important assets for their careers.

The scenario just presented is clearly positive for individuals involved. However, in some discussions this approach was raised as an issue for the overall sustainability of WIL programs. In some interviews with faculty leaders and WIL coordinators it was clear that the 'ownership' of industry partners by individual academics was problematic in that if the academic were to leave the institution, the bonds with these partners would be lost. In some cases it was stated that if the one academic with the connections was to leave, the faculty would be unable to offer the WIL placement unit for at least a couple of semesters until new relationships were established.

In addition, some tensions were apparent in institutions that had begun to 'centralise' the coordination of industry relationships – with some academics closely 'guarding' the links that they had established and fostered. Some institutions identified the importance of finding a balance that allowed academics to maintain some personal control of their connections, and at the same time ensuring they were comfortable in receiving coordination assistance with industry relationships and WIL activities. This balance would make for WIL programs that supported both academics and students.

7 Findings: Administration and funding of WIL

Key Points

- Arrangements and policies relating to coordinating, administering, and funding WIL activities are currently being developed or revised in many institutions across the higher education sector.
- WIL activities are administered very differently in STEM disciplines across Australian universities. Some have a highly centralised approach, others are simply run by individual academics with a passion for WIL activities. Many models lie somewhere between.
- In general, the engineering and ICT disciplines tend to be more organised, and have specific faculty-wide processes and support for WIL activities, when compared with the science and agriculture disciplines.
- The full costs of WIL based units are generally unknown. Usually WIL units are funded in the same way as any other academic subject – with funding allocated according to student enrolment numbers.
- Most participants in the interviews indicated that 'WIL costs more', but it was difficult to generalise about how much more. In general, the main reason for higher costs tended to be the time and effort that WIL activities require in developing and maintaining industry contacts, and supervision and allocating students to placements or projects.
- Central support for administration is provided in some institutions. In the case of universities with centrally developed WIL policies and coordination, this support comes through formal channels. However, in most cases the central support is negotiated or identified by the individual academic coordinator responsible for the WIL unit.

7.1 Overview

As noted earlier, the development and redevelopment of policies and processes relating to WIL activities in universities appears to be occurring now in a large number of universities. There are currently working groups within universities working on redeveloping WIL definitions, migrating data into new systems, redeveloping courses to integrate more WIL, centralising administrative processes for coordinating placements, and establishing cross disciplinary communities of practice. In short, at present there are many people thinking about the administration, coordination, implementation, and funding of WIL in the Australian higher education sector.

Through discussions with universities this project gathered information from institutions on their ideas about, and practices in, administering and funding WIL. This section deals with each of these aspects separately, and notes significant themes which link them. Essentially, the project found that there are very different approaches to WIL in STEM disciplines across Australian universities. This chapter generalises these differences and discusses some of the key issues raised by participants in the project.

7.2 Administering WIL activities

A range of different models for administering and implementing WIL were apparent from the discussions with STEM faculty members. As was expected, the support for and administration of WIL differed, depending on the extent to which WIL was embedded in the university. The administration approach to WIL follows

a similar pattern to the approaches to including WIL in the curriculum that were described in chapter 0. In institutions where overall there is an 'industry oriented' approach to WIL across the university, centralised systems and administration of WIL was likely to exist. The more common approach, in which WIL is 'bolted-on' to the curriculum, is characterised by decentralised approaches with less formal structure.

A small number of universities have, or are finalising, highly developed processes for coordinating, administering, and supporting WIL activities. In the main, these structures relate to placements and internship programs within the institutions, but in some cases they also facilitate project based work. Typical of these highly evolved systems are:

- An institutional leader based within the Chancellery (usually DVC or PVC) tasked with overall coordination.
- An institution-wide WIL policy (sometimes using a different term), outlining the core aims of the university in integrating learning with the workplace, and in some cases stipulating expectations for embedding these activities in all courses.
- A centralised team of coordinators who either reside in the DVC/PVC office, or are seconded to each faculty. Often this team includes an 'academic lead', administrative support, and sometimes a 'business developer'. Between two and four personnel might be allocated to cover all STEM disciplines.
- Academics who are responsible for coordinating units, but have only a small role in administrative contact with employers.
- A centralised database of employers and for tracking students while on placement (for example, *In-Place* is a system mentioned by a number of institutions).
- An institution or faculty level placement/internship program for students as a broad elective that attracts credit towards a degree, often in addition to the discipline based WIL activities stipulated for their course.

Often the practices of these universities have built on experience gained in clinical placements in the health discipline, and/or through engineering placements programs. The core challenge for institutions undertaking this approach has been to make processes flexible enough to facilitate incorporation into disciplines that are not specifically linked to a certain profession, such as the broad sciences.

The other end of the spectrum from these highly centralised systems is the decentralised approach, probably better termed the 'unsupported' approach – although offering a specific term for this is potentially misleading due to the differing nature of implementation. These types of approaches are usually driven solely by a single academic, or at best a team of academics in a department. They are very much in the mould of 'bolted-on' WIL integration. They usually rely on significant efforts of a few people who have a passion about, and belief in the benefits of, including WIL activities in the curriculum. As mentioned above, this model is the norm in a large number of science department WIL placements and projects.

The academics involved in units involving WIL activities are generally highly motivated. Successfully implementing a WIL project or placement subject relies on significant efforts of individual academics to maintain relationships with employers and coordinate students and employers. A number of academics who run these programs themselves were keen to emphasis the '12 month effort' required to implement a WIL activity. A year round commitment is required primarily because of the constant need to develop and foster relationships with businesses in order to have projects or placements for their students. A typical comment by academics with this role was that while the efforts in terms of face-to-face teaching were reduced during semester time when students were out on placements or entrenched in projects, this was significantly offset by the additional responsibilities in coordination and relationship maintenance outside semester.

As a result of the model on which they operate, subjects with embedded WIL activities that use this model are generally small and selective. The prospect of scalability of these WIL programs was raised during the interviews with individual academics involved in the type of role described above. In general the academics only saw expansion of this model as possible if a number of equally motivated academics were to be added to a unit to attract a wider coverage of businesses. The option of having a business developer or administrative support to facilitate wider implementation was often dismissed by academics in these situations on the basis that such additional personnel would likely be unable to make the 'right' kind of connections, and that having to supervise or support someone else in the process would add more work rather than reduce the burden.

An administrative model that sits between the two models discussed here was witnessed in some ICT and many engineering schools. This model usually involved an academic in charge of placement coordination, with administrative support provided for some of the logistics of placements such as student and host contract arrangements, and day-to-day clerical duties. The difference between this and the first model described above is that it exists in some universities where there is no centralised coordination from the chancellery. In general, the existence of these positions in engineering schools has been commonplace for some time as a result of the large scale placement programs they operate. In ICT, in the universities where these arrangements existed, it was usually a model adopted to mirror the existing arrangements in engineering – and appeared to be an area where particular emphasis is now being placed.

Another approach identified as useful in assisting WIL administration in universities is using career advisory services as facilitators in helping equip students with the necessary skills and tools to apply for work placements. These services are almost universally a centralised university service – they are not specifically located in, funded by, or exclusively for science faculties. In a number of cases where placement programs were designed in a way that students themselves were responsible for finding employers, making approaches and securing a placement, the central careers service at the university has played a pivotal role in assisting with developing portfolios and CVs, and in some cases offering lectures and seminars to students about these issues (see, for example, the University of Melbourne case study in chapter 9). Academics who drew on the assistance of careers services tended to emphasise the usefulness of the expertise provided by the professionals in these areas.

The relationships between careers services and the academics coordinating WIL programs tended to be mostly informal and based on links established by the individuals involved rather than through specifically designed collaborative arrangements between faculties and the careers service. However, in the universities which incorporated more of the 'industry oriented' model across all facets of the institution, the links between faculties and careers services tended to be more formalised and less reliant on individuals establishing subject-specific relationships. In these cases, the careers services acted as more of a hub of information and tended to be significantly more closely involved in WIL policy development and overall WIL administration. For example, in some cases these services were the centralised location for institution-wide databases of industry partners, and often had people employed for their specific expertise in managing such databases.

7.3 Funding WIL

Discussions with universities explored the ways in which units of study which included WIL activities were funded. As with many of the discussions relating to these activities, the focus of the conversations tended to be on units and activities that involved either industry inspired projects or placements.

A key finding was that in the vast majority of cases the actual costs of WIL were unknown to institutions. This limited the detail that could be gathered on this topic during discussions. As discussed below, the units including WIL are funded, but whether they were 'fully' funded was a topic which did not result in any definitive answers during the interviews. In most, but not all, cases interviews participants tended to think that WIL units were underfunded in their institution, but when asked few could estimate the extent to which they were underfunded. Some universities indicated they were undertaking work to establish the 'true costs' of WIL, although nothing concrete was presented during the interviews. In many cases such explorations were more likely to be occurring in disciplines with large placement demands, such as health and education.

Overall, in most universities the funding of WIL units in STEM is no different to the funding of any other academic unit in the discipline. That is, faculty or central funding is allocated to the unit based on the Effective Full-Time Student Load (EFTSL) of the subject – in other words, the number of students enrolled. Based on this funding, teaching resources (that is, an academic coordinator and other teaching staff such as tutors, or in some cases administrative support) are allocated to the subject and the academic coordinator is then expected to run the subject based on this allocation.

As highlighted in an ACEN submission to the national Base Funding Review in 2011, this approach to funding the academic workforce involved in WIL is unrealistic, especially in relation to assessment and ensuring high quality outcomes for students:

> *While assessment and academic supervision are standard academic activities, they are far more complex and challenging in a WIL context (Cooper, Orrell & Bowden, 2010). It is critical to ensure assessment practices are rigorous, fair and equitable and comprehensive moderation processes are in place. Assessing WIL incorporates occupational health and safety risks, employer relationships and frequent off campus activities. Scrutinising assessment strategies across the higher education sector is presently high on the agenda for institutions. ACEN has noted an increasing focus by members in building professional skills in this area. Intensive professional development and capability building for WIL staff in these areas will require significant resource allocation. (ACEN, 2011, p.3).*

As noted above, in some institutions where coordination of WIL activities was driven centrally, faculty level administrative support was often available to subject coordinators to assist them in running their subjects. However, and especially outside engineering, this arrangement was not the norm in STEM subjects with WIL activities.

Some academic coordinators of WIL activities draw on central careers and counselling services to provide some support for helping students to find placements and equip them with resources for developing resumes and so on. In these cases, the service was provided to the students and the coordinator without cost to the faculty or subject. In one typical example, the academic coordinator indicated how grateful she was for this service, but also noted that the arrangement with her unit was relatively informal and manageable at the current level. However, the sustainability of this arrangement was tenuous if the unit were to grow, or the careers service was to ask for funding to maintain the support.

In a detailed audit of WIL costs and practice at Flinders University, the authors highlighted the difficulties in quantifying the administrative costs of WIL activities in one institution: 'Considerable variation and inconsistency occurs between faculties and schools regarding the description of duties for placement staff and subsequent classification' (Smigiel & Harris, 2008, p. 46). Specifying actual administrative costs at a subject, institution, or national level is very difficult.

It was almost unanimously noted that 'WIL costs more' than traditional academic units of study. When asked about the elements that make these units more costly, academics noted that establishing and maintaining relationships with industry was particularly time consuming, and that supporting and coordinating students into placements or projects was also a significant investment of time and effort.[7] One academic summed up the general sentiment about WIL coordination, noting that 'it's not particularly intellectually strenuous, but coordination and administration is a year round job'. There were some interviewees who argued that the costs ended up being relatively similar because during semester while students were on placement, academic coordinators had less face-to-face contact time with students than they would if they were conducting a traditional subject. However, in opposition to this comment it was sometimes noted that if placement programs were being run effectively, the academic who would otherwise have been lecturing would be out visiting students and employers.

In terms of further quantifying the costs or WIL activities in universities, the available evidence is limited and has been best summarised by ACEN for the Base Funding Review (ACEN, 2011). One unpublished report referred to in this ACEN submission describes the quantifying by Price Waterhouse Coopers in 2009 of the costs of designing, implementing and sustaining WIL for Victoria University. This work:

'identified that placements incurred approximately 21% additional costs to standard teaching activity with significant additional costs associated with building partnerships with host organisations, structuring learning activities and placing and supervising students. For project based learning in the workplace and community, the report identified 15% additional costs to standard teaching activity again associated with building partnerships, structuring learning and supervision of students' (ACEN, 2011, pp. 3-4).

7 A finding established in previous studies – see for example Bates, 2010.

8 Findings: Impediments to expanding WIL

Key Points

- Difficulty in attracting enough employers to participate in WIL activities was by far the most significant impediment to expanding WIL mentioned by academics and support staff who participated in this project.
- Under-resourcing of WIL, in particular funding of support staff, was also highlighted as a hurdle to expansion.
- In science in particular, the lack of existing processes and infrastructure for developing WIL activities was identified by the researchers as a potential impediment to expansion in the immediate term – without first establishing processes, it is anticipated that expansion might not result in success.
- The general lack of value placed on WIL, and resistance to committing to WIL activities, was also identified as a substantial inhibiting factor in expanding WIL in many institutions. It was highlighted that simply relying on the commitment of a small number of academics was not going to be a sustainable way to expand WIL activities in science, ICT, and agriculture.

8.1 Overview

A core focus of the Office of the Chief Scientist is expanding the sector wide embrace of WIL activities in STEM disciplines. A figure of 50 per cent participation in WIL activities was suggested by the OCS as a potential target in the terms of reference for this project, and while the specifics of what types of WIL this actually entails were not articulated, the broad idea was presented to universities as a reference point for discussions of expansion. This project provides a platform for understanding what is currently happening and how WIL activities are arranged. Interview participants were also asked about their faculty's plans for expanding WIL and asked about the impediments they saw to expansion of WIL.

Overall, academics and coordination staff involved in this project were in favour of expanding participation in WIL activities among their students and supported any move to engage universities in the expansion effort.

This section provides a brief overview of the impediments identified by participants that are currently preventing them from expanding existing WIL activities. A number of themes emerged and these are the focus of this discussion. It is important to note that as with much of the discussion in previous chapters, the focus of most participants in the interviews was expansion of WIL placement and project activities and impediments to them rather than to other types of WIL such as simulations or other more campus-based activities.

8.2 Science and agriculture

By far the most consistent message relayed by universities when asked about the expansion of WIL was concern about the number of industry partners they could engage to participate in WIL activities. This was overwhelmingly the greatest concern expressed by academics in the science and agriculture fields.

For science academics in general, the concern was that if placement, or even project, units were introduced as mandatory elements of their degrees a significant number of students would likely miss out due to lack of engagement and interest from industry. For many science disciplines, the range of employment options and career choices made by graduates was vast and it was pointed out that this might suggest a plethora

of potential partners. However, it was argued that the dispersed nature of potential industries and employers made it very difficult to identify 'where to start' and how to do this efficiently so as to maximise student interest – a very difficult task given the broad interests of the cohort.

A consistent theme among science academics was the need to recognise that their disciplines were contextually different from the engineering and (to a lesser extent) ICT fields as they were not vocationally or professionally oriented. They did not have overarching accreditation bodies or professional recognition that encapsulated their disciplines in the way other fields do. Due to this difference, it was strongly argued that simply picking up practices in other disciplines and trying to apply them to the sciences was not realistic.

From a practical perspective, the large student cohorts in science made considering large scale expansion of WIL placements a seemingly impossible prospect for some academics. In the larger universities, it is not uncommon for science cohorts to have more than 1000 students in each year of study. A 50 per cent participation rate in WIL activities for the sciences was seen as daunting by many institutions, given their enrolment scale and (as established earlier) current low participation levels in existing WIL programs.

Among science academics, fewer concerns were expressed for universities in regional areas. As discussed earlier, ties with local industry were often already strong in some regional institutions. These institutions also tended to have smaller numbers of students for whom they would need to find placements. In addition, many regional institutions adopt a more applied approach to science curriculum, which places them closer to industry oriented learning than some large metropolitan universities where theory and research are heavily entrenched aspects of the curriculum.

Another impediment within the science and agriculture disciplines identified by the researchers in this project (and not necessarily by the interview subjects) is that most science faculties do not have a history of this kind of activity that could be relied on in any 'scaling up' exercise. As noted earlier in this report, most significant WIL activities in the sciences are run almost solely by individual academics who have a passion for the particular area and have worked very hard to establish personal relationships with industry. The infrastructure required for upscaling these activities, such as established processes, administrative support, and systems for vetting employers, either do not exist or are not well understood by anyone except the individual academic responsible. Increasing coverage of WIL in the sciences would need more systems and processes in place to make it sustainable, and developing such systems is a significant task.

8.3 ICT

Among the ICT academics and support staff, the theme of finding employers for students was again the biggest issue raised as an impediment to expanding WIL activities. One particular concern in this regard expressed by academics was the influences of the wider economy on the availability of placements. Academics highlighted that the university was unable to control these particular influences, but that they have potentially significant impacts on the availability of placements and internships in particular.

8.4 General

In addition to the theme of availability of employers discussed above in the context of ICT and the sciences, academics consistently raised other general issues they believed to be impediments to expanding WIL activities.

Resource issues were mentioned widely. In the context of significant recent growth in the higher education sector (Edwards & Van der Brugge, 2012), the issue of resourcing for the growing student base was a large enough challenge, let alone expanding the proportion of the cohort participating in WIL. Despite there being little knowledge of exactly how much it costs to implement WIL activities, as noted in the preceding chapter, interviewees were generally in agreement that WIL costs more. The areas most requiring increased resources were generally seen as support for academic coordinators through basic administration and management of industry relationships. As discussed above, the researchers in this project suggest that it would be important to establish processes that ensure such support was effective.

Another significant issue raised in the fieldwork for this project that the wider implementation of WIL activities is impeded by the lack of *value* placed on WIL in many institutions and across the academic community more generally. Apart from the few institutions where there is a centralised commitment to incorporating WIL across all disciplines, many academics involved in WIL believed it was only being implemented in their discipline as a result of the passion and commitment of a few people who genuinely believed in the value of the activities and had the energy to pursue them. A key impediment to more WIL being rolled out through institutions was the lack of recognition for, commitment to, or value placed on these activities. In most cases it was highlighted that there was not necessarily 'push back' against having WIL activities included in degree programs, but more that there was a general ambivalence towards their development. Some saw this as reflecting the lack of academics with any real world experience in their field, meaning that expansion into the real world was likely considered too risky. Others believe that the philosophy of the institution and many of the academics in their field was that their job was to teach undergraduate students theoretical fundamentals, undertake research with postgraduate students, and publish as much as possible – engaging with industry simply didn't fit in. This issue is explored further in the conclusion to this report.

A further impediment to wide-scale expansion that was raised in some universities was the fact that many students were not deemed to be 'ready' for exposure to the workplace in the way in which many placement and internship activities require. Some academics openly expressed their concerns about the maturity and emotional capacity of some student to cope with the potential rigours of a work placement, worried that bad experiences might be damaging for the student's progress and the university's reputation. It was suggested that mandating specific workplace experiences for all students in some cases might result in negative consequences for all involved. While not necessarily wanting to over emphasise this point, academics involved in the project did raise this as something to be aware of if any blanket policies were to be applied to specific types of WIL application. These concerns are genuine, but it is important to remember that all students in other disciplines (teaching and health for example) are required to enter the workplace during their degree. In addition, the majority of Australian students are already engaged in some kind of paid work while studying making the concern about 'readiness' perhaps slightly less pertinent. As such, the significance of this particular issue perhaps should not be used as a barrier to undertaking WIL, but rather as a reason for undertaking WIL. If done well, the key benefit of WIL can be to help enable students to develop the skills and confidence to be 'ready' for the workplace.

9 Case studies – Examples of WIL in Practice

9.1 Overview

Based on the detailed interviews across Australian universities, the researchers identified examples that highlight specific practices within science, ICT, agriculture, and environmental science. These examples help to illustrate the kinds of programs currently offered in Australia to facilitate WIL, and which provide opportunities to help students connect more closely with the industries in which they may find themselves following graduation.

It is important to note that the programs presented here offer just a small glimpse into the range of activities occurring in Australia. Information in the case studies is generally presented in a way that is specifically relevant to this project. For more insight into WIL in practice, a particularly rich source of far ranging practice in Australian universities is available in 'WIL vignettes' developed by the Australian Collaborative Education Network (ACEN) at the following website: http://acen.edu.au/wil-vignettes/.

The chapter offers examples in the form of cases that demonstrate ways in which institutions are overcoming some of the impediments identified in the research. The examples cover the science, ICT, and agriculture/ environmental sciences areas and present different types of WIL activities. The chapter includes some specific programs being implemented, and briefly offers some insight into some institution-wide approaches to WIL. The intention is to draw attention to a range of projects, offering interested readers a starting point from which to pursue more detailed examination of the programs.

9.2 Examples of WIL in Science

The analysis presented in this report demonstrates that the practice of WIL in the traditional sciences is, in general, the least developed of the STEM disciplines. Interesting WIL programs do exist and the discussion below describes a number of initiatives that include simulation activities, a project, an internship, and a placement program that sit outside a university but offers a model of success in science.

9.2.1 Biology Laboratory Simulations – The Australian National University (ANU)

Traditionally, science students are only likely to experience what one of the academics involved referred to as 'the edited highlights' of the laboratory experience. For example, they may arrive at a prac to find most aspects of an experiment already in place, with their role being to follow the instructions and observe what happens. To provide students with a more realistic experience of laboratory or field research, many universities offer undergraduate research experiences (URE). These involve a project under the direct supervision of an active researcher and differ from standard practical courses in that there is no standard procedure to be followed, no right or wrong answer to the research - and it is quite likely that things will not go according to plan. In other words, it is an authentic research experience.

Research led education incorporating UREs is not new, but one of the things that distinguishes ANU's approach is its focus on fostering students' reflective skills. An integral part of the process is that students keep an Online Learning logbook – in effect a blog - in which they reflect on what is happening. A series of simple prompts helps them to identify and reflect on their expectations of the project, recognise key decision points, make decisions about the value of their data, evaluate the validity of the approaches they have

adopted and capture observations on other aspects of the process that help or hinder them in their search for outcomes. This approach was developed in an OLT-funded project, Teaching Research: Evaluation and Assessment Strategies for Undergraduate Research Experiences (treasure.edu.au/project/).

As well as helping students to think more deeply about the whats, whys and hows of research in real time, their posts have also provided insights for lecturers. Analysis of responses is being used to evaluate and redesign the scaffolding and assessment of UREs within the course. A key finding to date is that:

> *formal assessment in most UREs assesses only a small part of the learning that occurs. Actual learning encompasses not just disciplinary knowledge, but also a sense of self as a researcher, an understanding of the nature of research, and the development and valuing of professional and generic skills* (Howitt & Wilson, 2014, p. 5-6).

This program demonstrates that students do not always have to undertake an industry placement in order to develop and demonstrate both the technical and non-technical skills that they need to be work-ready. While providing direct experience of what is involved in the logistics of operating within a university research laboratory, there is potential for students to learn much that will be relevant to other work contexts, laboratory based and otherwise. The blog focuses students' attention on different aspects of the experience, making it relatively easy to explore, capture and revisit the 'messiness' of the research process, as they record their thinking at different points in time, and reflect on other important elements of effective performance, such as communicating with others and negotiating for resources. However, analysis of the posts has shown that most students do not demonstrate the degree of sophistication of understanding about research desired or expected by their supervisors. One of the project's recommendations is that learning about research, and the development of research skills, become a whole of curriculum responsibility, beginning in first year.

9.2.2 University of Technology Sydney and Choice: Physics in the real world

UTS students taking the first year subject, Physical Modelling, are putting theory into practice as they conduct comparative testing of consumer goods for consumer advocacy organisation CHOICE. The School of Physics and Advanced Materials has launched a collaborative program in conjunction with CHOICE in order to challenge the traditional emphasis on theory and offer students an opportunity to undertake the kinds of testing and designing they might do as part of a career.

In a recent press release (http://newsroom.uts.edu.au/news/2015/uts-students-help-choice-choose-best-appliances), the co-ordinator of the program, Dr Jurgen Schulte, commented that, one of the main motivators in starting the collaboration was 'to give student an authentic workplace experience very early in their course and to provide opportunities to put theory into practice'.

To date, students have undertaken tests of domestic appliances such as vacuum cleaners, ceiling fans, LCD TVs and hairdryers. Before conducting tests of various models of each appliance against a series of testing criteria, they receive an initial briefing from

CHOICE representatives and UTS Science lecturers. CHOICE staff members also participate in lectures and question times throughout the program, and this gives students an opportunity to develop their understanding of an industry client's needs, priorities and expectations.

There are also other benefits.

‘Teamwork is a big focus of this program, where each student is responsible for certain tasks within the group. They work individually and then come together as a team to discuss their findings. There is also an element of self-guided learning’, Dr Shulte observed.

Students appear to be finding the approach useful and engaging. For example, one of those interviewed for the press release commented, ‘When I’m doing the practical I get to experience different situations and where and how I can apply theory to them. I love every single bit of it.’

Internships in a research-focussed institution – The University of Melbourne

At the University of Melbourne, an internship subject for students in the science and technology stream of the undergraduate program was initiated in 2013. The subject follows many principles that are applied in a range of internship and placement programs encountered during this project. This unit offers a clear example of an ambitious WIL activity in science and in a research focused environment. The internship unit emphasises recognition and development of workplace skills.

The internship unit is now offered within the Bachelor of Science, Bachelor of Environments and Bachelor of Biomedicine. The unit was developed in response to a widening acknowledgement among science academics that there was a disjunction between the career outcomes for their students and the science curriculum. There was growing recognition that among their thousands of science students ‘only a small proportion of them actually become scientific researchers’. Despite this, like most science courses in Australia, Melbourne’s curriculum was structured around relating theory and practice to scientific research (usually university based scientific research).

The course convenor has developed and introduced a third year unit that involves an internship of between 80 and 100 hours over the course of a semester. The placement is scaffolded by introductory sessions at the beginning of semester aimed at helping students prepare for the practicalities of finding a placement – such as resume writing, how to approach employers, framing students’ expectations about the placements, and assisting them to understand employers’ expectations. The university’s careers service facilitates these sessions and offers one-on-one assistance to students in preparing for their internships. After the placement, on campus time is allocated for students to present reflections of their placements and to debrief with academic staff.

Students are required to find their own placements – an aspect of the course seen as important for developing student understanding process for applying for work in their field. This requirement has led to low enrolment in the unit, despite high levels of interest expressed by students initially. Assistance is provided by the course convenor and the university’s careers service if students need help in securing a placement.

Employers to date span a range of STEM based organisations, including research institutes and hospitals, the CSIRO, large companies (e.g, mining companies, engineering firms), as well as smaller businesses (e.g., IT start up companies, pathology laboratories). Each student must complete an online form prior to having their enrolment approved by the subject coordinator, that acts as a risk assessment of the role and employer. The employer provides a ‘letter of willingness’ to the university, and a legal agreement (standard format drafted by university solicitors) is negotiated and signed by the employer and the university. Intellectual property is signed over to the business. Employers are contacted by the academic coordinator and provided with a document which details expectations, obligations, and the assessment tasks expected of students. The document is prepared and updated by the subject coordinator, and presented to host organisations by the student during the early stages of their discussions. It includes the contact details of the subject coordinator providing the opportunity for employers to seek further information from the University if required.

Assessment in this unit is carefully designed around a core focus of orienting the student's mind towards the employment market and the workplace. Students undertake three assessed pieces of work. In addition they prepare documentation for obtaining the internship which might include a resume and letters of introduction, and prepare for interviews. The three assessed tasks are:

- An information interview with someone at the workplace of the internship who holds a job the student thinks they would like to be doing in the future. The focus of the interview is maintained by ten well constructed questions designed to examine the pathways this person took to get to their current position, details regarding necessary qualifications and experience, the pros and cons of the role and ways of establishing important networks (e.g., professional societies to join, meetings to attend). This interview is incorporated into an essay on career possibilities, steps needed for this kind of work and a reflection by the student on how this information aligns with their perception of the role.
- A presentation (15 mins) at the end of semester – focus on discussing the 'workplace experience'. Here students highlight the areas they found most valuable, whether positive or negative, and often comment on whether their dream role is or is not what they wish to pursue into the future. While many students confirm their passion for a career, others find they learn a great deal about themselves, and recognise that what they thought they want to do is not for them after all.
- A final essay about linking university skills and knowledge into the workplace. This essay requires students to reflect on the new knowledge and skills their workplace experience helped build, and what knowledge and skills learnt at university were used during the internship. Students are asked to include comment on the two-way development of their soft skills as well as discipline-specific knowledge and skills.

This unit is relatively new. It was first offered in second semester 2013, and it ran once in 2014. About 50 undergraduate students have completed the unit so far. As a sign of support for the aims of the unit, and recognition of its potential to grow, the university will run the unit twice in 2015.

9.2.3 Undergraduate Research Opportunities Program – Biomedical Research Victoria

UROP sits outside the university degree structure and hence does not attract course credit for science degrees. UROP does offer a successful model for attracting science and technology students into research work in a range of organisations and research centres in Victoria. The model is an example of what is possible when groups of employers are coordinated with the aim of facilitating authentic experiences for the next generation of scientific researchers.

UROP has been run by Biomedical Research Victoria (BioMedVic) since 2004. It facilitates and administers the casual employment of Victorian students in research organisations in a structured and supported program. BioMedVic delivers all aspects of the UROP including the recruitment of students, sourcing projects, custom matching students and projects, monitoring placements, and providing ongoing administrative support. UROP has links with Victorian universities and students with an interest in applied research are encouraged to apply for the program through suggestions of individual lecturers. University websites also provide links to the program.

Entry to the UROP is highly competitive and students apply through an online application system. Intakes occur twice per year – Summer and Winter. Students begin their placements during a vacation period with 2-4 weeks of full time work. They then work about eight hours per week for between 6 and 24 months, depending on the arrangement with the employer. The majority of students remain in the program for

at least 12 months. The participating employers pay students at a casual rate. BioMedVic also provides professional development opportunities for UROP participants, including an annual UROP Conference Day and Presentation Skills Workshops.

Based on information collected from UROP, the main motivations for employer involvement are postgraduate recruitment, attracting students from cross-disciplinary areas to build their organisations' capacity in specific skills (such as mathematics, computing and engineering), and to mentor the best and the brightest students in their fields.

Over the 11 years, UROP has facilitated placements for more than 500 undergraduate students, with an annual intake of between 40 and 60 students. Students from a range of undergraduate degrees have participated in the program. The largest cohort has come from Bachelor of Science degrees, but participants also include biomedical, engineering and computer science students.

UROP is supported by a full time program manager and part time administrator. The potential for scalability of the program exists. Indications are that the main limit to significant expansion is the availability of stipend funds to enable employers to offer more projects.

9.3 An ICT project case study

9.3.1 Industry Experience Projects – Monash University

Monash University's Faculty of Information Technology has a strong emphasis on linking their students to employers. The faculty employs a Director of Industry and Community Engagement whose role is to engage students in work-oriented activities linked with industry.

One project based unit offered by the faculty is described here because of its innovative process for connecting with businesses, and the efficiencies that the approach has for administration and for developing core facets of WIL to serve a relatively large cohort of students.

Monash's ICT Industry Experience Project unit introduces teams of students to real world ICT problems proposed by employers. Students work in teams of four across two semesters to 'solve' a problem and present their solutions in a practical and applicable way to the project's business sponsor. The Industry Experience project is the equivalent of one subject per semester. Students are assessed on their project deliverables, project diary, feedback from the client, and feedback from their group peers.

About 200 students participate in this unit each year, drawn primarily from Bachelor of Information Technology and Systems, Bachelor of Business Information Systems, and Bachelor of Software Engineering.

The way in which projects are sourced for this unit is particularly innovative and efficient. It relies on building strong partnerships with a few core organisations that essentially act as 'brokers' to provide and facilitate the involvement of a range of businesses in offering projects for students to undertake. The 'brokers' used by the university are local councils and peak charity bodies.

In building the relationships, the university focused on local councils in municipalities in Melbourne in which their campuses are based. In general, the councils involved have a contact officer who liaises with the faculty's Director of Industry and Community Engagement to identify businesses in the local area which would benefit from the ICT projects. The council gathers the relevant projects and the university staff meet with the businesses to discuss the project and ascertain its appropriateness for the unit. With the peak

charity organisations involved, a similar process occurs, although with less administrative input from the peak body – usually the body uses its network to advertise for projects and further contact and specification of appropriate opportunities is facilitated by the university.

Employers, brokers, and the university all highlight the mutual benefits that these projects offer. For businesses, it often presents an opportunity to secure an IT solution to a problem they have grappled with but have not had the funding to hire an IT firm to fix. Successful projects in e-commerce are common. For the brokers, it is a way of supporting their partners or local businesses. For students, it is an opportunity to apply their learning in the real world, and an opportunity to experience the client contact element of ICT work which universities often highlight as a fundamental skill set ICT graduates need. For the university, it is an efficient way of facilitating a large number of students through an industry oriented experience.

9.4 Regional Approaches to Industry Engagement

9.4.1 Thinking bigger

In a group interview session at a regional university, it was reported that it was extremely difficult to find industry placements for ICT undergraduates because there were very few ICT consultancy firms operating in the area. During subsequent discussions, another interviewee suggested that, rather than chasing individual placements, it was time to 'think bigger', and tie approaches to work integrated learning into broader strategies aimed at regional development. She was a member of a newly established collaborative research and development program involving the university and government and non-government partners that was exploring ways of delivering high impact research that would lower investment barriers and enable a flow of capital to support regional development. Precision agriculture and aquaculture in particular offered enormous potential for long term, sustainable development, and as these industries were becoming increasingly reliant on digital technology to provide the information they needed to make decisions, there would be a growing need for technological knowledge and continuing innovation.

This interviewee suggested that the initiative could offer significant opportunities for undergraduates from a variety of STEM disciplines to be involved in research programs and to undertake work placements with industry partners. Her group was working on a broad strategy involving the development of an IT incubator/ Innovation hub in conjunction with industry partners. If successful, this would open up many new possibilities for ICT undergraduates, and provide a starting point within the region for new graduates from this university, almost all of whom currently seek, and gain, employment elsewhere.

Although this idea is in its infancy, it is of general interest because it challenges the widespread assumption that universities must somehow find work placements for individual students. It also suggests that it may be useful, and timely, to challenge assumptions about what constitutes an appropriate work placement and about how these might be offered to students.

9.4.2 Building a degree in consultation with local industry

Another regional university was doing this in a different way. For historical reasons this university does not offer an agricultural science degree, even though it is located in a highly productive agricultural area that is also the home to some of the country's major seed producers, a national agricultural centre of excellence and state government research facilities. Recognising the difficulty that many universities are experiencing in trying to attract undergraduates to agricultural science, this university is about to introduce a post graduate agribusiness degree. The program is being developed in consultation with potential regional employers – all

of whom are likely to be in a position to contribute in various ways to the program, including by offering work placements. In return, employers stand to benefit through access to work-ready graduates who will have a broad understanding of their industry sectors combined with enough occupation and workplace-specific skills and knowledge to get started in their new jobs and learn to operate productively in a relatively short space of time.

9.4.3 Environmental Science Industry Based Program – University of Wollongong

The University of Wollongong has a long history collaborating with local industry for research projects in the environmental sciences. This program is for students in 4th year, undertaking their honours program in the Bachelor of Environmental Science, coordinated through the School of Earth and Environmental Sciences. The program has been running for 22 years and the school is well-respected by local industry, and sees industry actively engaging with the program, providing project and applying for student placements each year.

Colloquially referred to as the 'Industry based program', this unit of study is officially a Research Report (ENVI403), worth 24 credit points. All enrolled students are required to undertake the unit, although it is selective in the sense that only the students who are academically eligible to enter the honours year of the program participate – up to 20 students per year. It is a requirement that every student enrolled in the program undertake a research project carried out with a non-university organisation, in order to gain professional work experience in the field of Environmental Science.

The research must be a collaboration between a host organisation, the University (both providing a supervisor for the project) and the student, running effectively for the whole year but representing half of the credit points for honours. Students are required to write a research report of approximately 15,000 words on the topic encapsulating the results of a piece of supervised research. An oral presentation is given on completion to staff, fellow students, host organisations, family and friends.

One of the striking aspects of the program is that there is a high level of demand for students from industry. Efficient coordination from within the School of Earth & Environmental Science sees an annual cycle, where local industry must submit potential projects each August. The local links are strong, and the industry partners are advised on the research expertise of the academics and academic background of the students (comprising Land Resources, Biological Sciences, Earth Sciences and Environmental Chemistry). The industry collaboration is managed by the Professional Officer and Coordinator for the Environmental Science Program. Project allocation and set-up is determined in consultation with industry partners, academic supervisors and students with an appropriate background for the project. This ensures that proposals for research projects are well-designed and targeted to the interests of all involved. Ongoing consultation and the long running collaboration with industry means that specificities are understood and the research projects are realistic and achievable over the 1-year timeframe.

The strong regional ties to the environmental industry in Wollongong are evident in this example. The bodies were typically arms of councils and state government, or private businesses: such as water catchment authorities, fisheries, OEH, CSIRO and DEPI. Industry finds the relationship extremely beneficial, noting that they see this program as a way of solving specific problems for very little cost. In some cases such collaboration results in peer-reviewed publications. When coupled with industry research, expertise and advancements in environmental science can be demonstrated with the outcome of a peer reviewed journal article. It's a type of 'academic consultancy' arrangement where university expertise is coupled with student engagement, resulting in positive outcomes for all involved.

9.5 Embedding university-wide WIL practice

9.5.1 WIL at Queensland University of Technology

QUT brands itself as 'a university for the real world'. Through centralised policies on WIL, QUT offers a good example of the type of university described earlier in this report that is embracing an industry oriented approach to course design and teaching. This short snapshot of the universities approach is presented through the lens of the STEM fields involved in this project. However, the approach described essentially encompasses all disciplines and degrees offered by then institution.

Defining features of QUT approach are:

- **A central policy.** QUT's 2014 Blueprint stresses the central importance it places on orienting teaching and learning in and for the workplace context. Key to this strategy is the statement that 'Real world learning is a defining feature of the QUT experience, and takes a number of different forms including simulation, practical experience, international and intercultural experiences and engagement of practitioners in teaching. These make education more authentic and engaging, and they need to be refined and embedded more effectively across QUT's courses.'

  The university has a specific target for 60 per cent of the 2016 graduating cohort to have had a WIL experience. It was predicted by those involved in the interviews for this research that introducing a new key performance indicator relating WIL, especially given how it is to be measured, will drive an increase in 'for credit' WIL at QUT.

  For STEM, QUT emphasises that it will increase and improve teaching in STEM disciplines, stating the ambition to 'Reposition and refresh STEM courses including the development of new learning approaches, which can be deployed across the University.'
- **A central online system to manage WIL placements.** This was viewed positively by those involved in this project.
- **Recognition of changes in the WIL landscape**, and a willingness to adapt in order to improve outcomes for students.

10 Conclusion

10.1 Overview

The conclusion presents some of the overall insights gained through the project as a means of offering potential guidance and pathways for future support of WIL activities in STEM in Australian universities. It begins by highlighting the key findings about identifying and developing 'Good WIL'. This section is followed by a review of issues and insights that emerged from feedback gathered during the project and which it is considered important to emphasise.

10.2 'Good WIL'

Based on discussions conducted during this project, a number of key elements were identified which are important in developing successful and sustainable WIL units.

Good WIL:

- is clearly linked to theoretical aspects of courses, *ideally* providing an 'ah-ha' moment to the student when the practical and theoretical merge;
- has strong engagement with industry;
- has well articulated expectations of both students and industry partners;
- has clear induction processes at the beginning and facilitated opportunities for reflection on experiences at the end - for both students and industry;
- has well established processes for logistics and support of students and industry;
- has support from leadership and dedication from academic staff.

This list is not long, but each point is important and requires attention to systems, processes, and human resources if each point is to be implemented effectively. Interesting patterns were present in the articulation or emphasis of these points. Interviewees from faculties with strong WIL programs tended to emphasise strongly the role of processes and logistics which they saw as essential to successfully implementing WIL programs. Interviewees in departments with little or no WIL were much more likely to highlight the need for strong engagement with industry. This observation is important – it is argued here that all five elements are crucial to successful WIL programs. However, different emphases point to the stage that institutions have reached in developing WIL activities. Those thinking more about the processes are perhaps at a stage where the programs are up and running and industry links are established. Those in the early stages of development are focused on the significant (and sometimes seemingly overwhelming) task of engaging with industry.

10.3 Important issues that need to be addressed

Within the context of the five elements above, this section highlights a number of crucial issues that need to be addressed if 'Good WIL' is to become a common standard. Within this section a number of 'barriers to WIL' are discussed. These include:

- A lack of value placed on WIL and resistance to commit to WIL activities
- A lack of processes/infrastructure to develop WIL activities
- Difficulty attracting enough employers to participate in WIL activities
- A need for restructuring of curriculum to encompass greater engagement of WIL.

10.3.1 Valuing WIL

This report underlines the critical importance of institutional leaders and peers across disciplines placing value on WIL. Valuing WIL is a precursor condition for enabling the expansion of WIL activities. The value of WIL in higher education needs to expression in centralised policies and targets, adequate funding for support and administrative staff, and recognising the contribution of those who commit to the year round task of building and maintaining industry connections.

An important element of valuing WIL is appreciating and accepting WIL development and coordination as a legitimate and important academic task. Placing value on WIL has occurred in some universities where centralised processes have been established, and policies either mandating or strongly encouraging WIL related activities. However, of concern through the discussions across institutions was the perception that there was a long way to go in valuing WIL and giving adequate recognition to it, especially in the traditional sciences.

Other work in this area supports this finding. For example, ACEN highlighted work conducted by Flinders University (Smiegel & Harris.; 2008) in its 2011 submission to the National Base Funding Review, noting that this work highlighted 'critical issues in relation to resourcing WIL including lack of recognition of the amount of work and skills required to run successful WIL programs, clerical and administrative assistance required, status of staff involved, staff professional development and career opportunities' (ACEN, 2011, p. 4).

Within some universities and disciplines, significant changes in culture are required for WIL to permeate deeply. The reality for many academics and support staff involved in this project is that their contributions are not necessarily appreciated by leadership and by peers across their disciplines in the way that their colleagues' research grant successes or even traditional teaching approaches are celebrated. To paraphrase one senior academic involved in the project, 'it is relatively well accepted that teaching is seen as the poor cousin to research among academics … well, I often feel that WIL teaching is the poor cousin of teaching!'

10.3.2 A value proposition for WIL

Closely linked to the discussion above is the need to be able to articulate the value proposition WIL offers. Without presenting a value proposition, it is unlikely that the value recognition called for above will eventuate. As discussed earlier in this report, the value of WIL needs to be emphasised in a transparent, effective and convincing way. This is recognised internationally as the key to building traction for WIL, in this sense 'the onus is on practitioners to market these substantive benefits to all key stakeholders; students, colleagues, and managers in their institutions, and external stakeholders such as officials and governments' (Coll & Zegwaard, 2012, p. 3).

The value of WIL has been detailed in chapter 3 through the literature and has also been described during the project by academics and support staff involved. Put simply, WIL has been shown to:

- Improve student engagement, and reduce the likelihood of dropping out (Radloff & Coates, 2010);
- Improve student perception of their capabilities, knowledge and skills that contribute to employability (Radloff & Coates, 2010);
- Enable students to make the transition from study to work by developing discipline specific, general and career skills (Patrick et al., 2008);
- Teach professional conduct, career planning, job application skills, and in developing an understanding of the perspectives of a variety of potential employers (Reddan & Rauchle, 2012);
- Build students' confidence in their workplace abilities in areas such as problem solving, communication, information literacy, digital literacy, and professionalism (Statcic, 2011; Jackson, 2014);
- Offer universities stronger relationships with industry partners, providing the opportunity to inform curricula and contribute to developing work ready graduates (Smith, 2012); and
- Provide a university with a 'point of difference', that has the potential to attract a greater share of enrolments (Martin et. al., 2011; CBI, 2009).

Value propositions for universities	Value proposition for students	Value propositions for industry
Can be a source of significant competitive advantage. It enables universities to differentiate themselves, potentially attracting a greater share of student enrolments.	Facilitates transition from study to work by developing discipline specific, general and career skills.	Offers a means for identifying and recruiting new staff.
Leads to improved learning and employment outcomes for students.	Leads to improved student engagement, completion and retention.	Provides a resource to undertake business related projects, and offers fresh ideas.
Offers a means of preparing students for the real world, and equipping with some of the generic skills desired by employers.	Improves the student's confidence in the workplace.	Leads to opportunities to play a role in developing curriculum to develop workers for the future.
Leads to stronger industry-university partnerships – flow on to other benefits.	Leads to the formation of industry connections and networks.	Offers an avenue to engage with wider community as a means of contributing as a 'good corporate citizen'
	Leads to better employment outcomes	

The international literature reviewed in this report suggests that students who participate in WIL activities have higher rates of graduate employability and potentially stronger learning outcomes (Ferguson & Wang, 2014), and while the anecdotal evidence articulated by academics through the interviews in this project suggests similarly successful outcomes in Australia. However, emphasising the value proposition of WIL is made significantly easier if objective data is available to make the case, and while such endeavours have been successfully undertaken in Canada, where data is available (see Ferguson & Wang, 2014; and Kramer & Usher, 2011), Australia does not currently have collections which enable this level or analysis.

10.3.3 Embedding industry engagement

The dialogue about learning with and through industry needs to move towards a broader spectrum of interactions with industry rather than focusing on placements and projects alone. Becoming distracted by the semantics of 'WIL' definitions is unhelpful and can significantly blinker the discussions in this area (Coll & Zegwaard, 2012). To really help students in preparing for and better understanding the industries and

work places they may graduate into, courses need to have engagement with industry embedded across all facets. When viewed in isolation, guest lectures, small projects and site visits might appear trivial or a poor fit for the aims of a vibrant WIL program. However, if the focus is on overall engagement with industry, rather than narrowly concerned with specific forms of WIL, then likelihood of developing graduates with industry oriented skills will be enhanced. King and Male came to a similar conclusion in their recent detailed study in the field of engineering, arguing: 'As well as providing opportunities for students to undertake work placements, arguably there need to be more occasions for authentic engineering practice to be brought into the classroom' (2014, p. 2).

10.3.4 Processes to ensure sustainability

When the scalability of current WIL activities was discussed with academics and WIL support staff, it was commonly stated that a crucial limitation on expansion was the fact that many were run based on processes that were developed by an individual academic that were not necessarily transferable to other academics or administrative staff. As noted earlier in the report, academic leaders raised concerns that if certain colleagues decided to leave their institution, WIL activities would have to be 'written out' of the degree program – at least until another academic was able to establish a new group of industry contacts.

Academics who have run successful WIL programs observed that creating sustainable and scalable programs requires some sharing of industry contacts, and more centralised coordination of processes. However, changing practices and establishing more sustainable processes was highlighted as potentially difficult terrain. For many academics who have invested in developing industry relationships, the importance of this investment for their careers is often paramount. As one academic noted during the interviews, 'this is time-consuming work, but can be rewarding once you have established connections and start filtering students through because often it can lead to research opportunities.' Some interviewees from institutions which have established centralised systems for storing employer contact information noted that gathering information about industry relationships from academics could be very difficult, with many guarding the contacts for fear of them being misused (and thus lost), or simply because they saw these relationships as their 'advantage' in their field. Processes and procedures to enhance the sustainability of WIL must recognise the extent to which many academics have a sense of ownership. As was noted in one interview, 'without ownership from academics these programs wouldn't exist.'

10.3.5 Recognition that engaging industry is resource intensive and difficult

This research encountered a very real concern among many academics in Australian STEM fields about the difficulty they face in attracting industry engagement, especially on the scale suggested in the interviews (that is, a 50 per cent participation among students in WIL activities).

This was constantly highlighted in the science disciplines. It is difficult for them to focus WIL activities given relatively large cohorts of science students and the 'generalist' nature of science degrees which are not linked to a specific profession or concentrated in a particular industry or vocation. There is enthusiasm from these disciplines for embracing more WIL activities, but it is important to highlight that the enthusiasm with which suggestion of major expansion might be received in these disciplines may not be particularly loud.

Industry engagement is complicated by the competition among universities for employers willing to participate in WIL programs. In metropolitan areas, even though the population base is large, the number of universities located in relatively close proximity can be an issue in securing engagement from employers. For example, within 20 minutes of the Melbourne CBD there are seven large university campuses that

all have significant STEM enrolments. In discussions with these institutions and with stakeholder groups the issue of competition for WIL placements and projects was regarded as an impediment to expansion. Collaborative ventures between universities for industry engagement may be a possibility. However, the reality of competition for students (and possibly fees) between universities in a deregulated environment makes collaboration more complicated.

Another complicating factor in this regard is the necessity that WIL opportunities have an element of flexibility built into them so that employers can engage in different ways. Through the discussions in this project, it was clear that flexibility from universities and from employers is needed in order to ensure students have a fruitful WIL experience – a one size fits all approach often leads to disengagement of employers or significant restrictions on the value gained for students. Achieving such relationships and developing useful flexible approaches to WIL is time-consuming and difficult and needs to be recognised for this.

10.4 Suggestions for the future

10.4.1 Recognising the value of industry sponsored projects

As noted throughout this report, a key impediment to WIL is lack of employers/businesses to link students with. There is clear evidence that science graduates are employed widely across industries in Australia (and therefore there *should* be many businesses to link with). However, there remains in many cases an uncertainty about where to start, how to do it, and whether there is genuine industry interest. There is also a perception that to do 'real' WIL, each student needs to have an industry placement (a seemingly insurmountable task given the large numbers of students in science degree programs). These issues converge on the same overall problem – the need for more employer engagement.

Generally, internships and placements are seen as the ideal way of embedding WIL in a course. Yet there are logistical and practical considerations, especially in science, that prevent this from occurring widely. As noted above, there is a perceived lack of employers willing or able to participate in WIL activities and many science faculties feel the task of getting every student placed is unrealistic. This report is by no means the first to point to these difficulties. As highlighted in chapter 3, numerous others have noted the fact that placements can be a labour intensive model requiring significant time to establish and develop industry relationships, so as to secure numerous single placements (AWPA, 2014a; Poppins & Singh, 2005; Orrell, 2011).

Industry inspired projects are an efficient way of engaging larger number of students across a smaller number of employers. As reported earlier, industry inspired projects are available in ICT relatively commonly and at scale, are less common in environmental science, and relatively uncommon in other sciences. Industry inspired projects typically involve creating a team based activity for students centred on solving a problem, creating something, undertaking applied research, monitoring something, or engaging in a consultation process. The projects usually involve an organisation proposing the project to the university and the university involving a team of students to undertake the task. In many cases, the task is predominantly completed on campus or in the field. Rarely do these projects take place at the employer's place of business.

In many examples seen by the researchers during this project, about four students work with an employer on an allocated project. This means that rather than allocating one employer per student, the employer engages with a number of students, meaning fewer employers are required to support WIL activities that involve large numbers of students.

More than one university suggested the possibility of allocating more than one team of students to each industry inspired project so that more students can participate in a WIL activity. In cases where this happens, the employer has two, three, or more 'solutions' to their initial problem and can choose the one most pertinent to their needs.

Universities also pointed out that project learning of this kind can be 'safer' for the university and for individual students. As noted earlier, a number of academics questioned the suitability of some students for individual immersion in industry. Team projects can potentially avoid problems for individual students who are not ready, and can be part of a process that helps them gain confidence through exposure to industry that is mediated by a group of students and an academic advisor.

Keogh, Sterling and Venables (2007) provide further insight and details about industry inspired WIL activities in a number of institutions. Their work focuses on the ICT area, but the authors stress the generalisability of the approach they have developed.

10.4.2 A central hub for STEM employers

An idea that provides another avenue for generating industry sponsored projects is to develop an online hub for STEM employers. The hub serves as a tool for lodging placements, internships, and science projects. A hub would be accessible to universities who are developing WIL activities and potentially to students looking for placements, projects or internships. Universities could identify employers and/or projects that suit their students and then engage with the employers who propose them. Universities could also post 'calls for activities' that could be targeted to employers who can respond to the opportunity.

A number of institutions in Australia have well organised networks linked into hubs or similar resources. However, there are many institutions that are unsure where to start, or do not have integrated systems for maintaining relationships at the institution level, instead relying heavily on the individual academics who run the WIL activities. As such, a central hub could be a way of increasing the potential points of connection for science departments looking for ways to expand their WIL offerings.

Significant work has already been undertaken in Australia by ACEN which has a National WIL Portal (http://acen.edu.au/wilportal/?page_id=110). Discussion with ACEN during this project suggests that the Portal's infrastructure is well established and could undertake the kinds of tasks suggested above. ACEN points out but that the traction and momentum that initially inspired the development of the portal has been lost, meaning its reinvigoration is an option. To achieve this would require a review of the Portal's integration and engagement with universities, specific funding to promote the Portal to industry, educating industry about its benefits, and revising the Portal's user interface. Examining other portals, such as the project in Canada's British Colombia that inspired the ACEN project, would also help to reorient the Portal's operation, promotion, and engagement with users.

Another issue to be confronted in relation to the potential feasibility of a central hub for universities is that of competition between universities for placements. When the suggestion of a hub was raised with academics and WIL coordinators at some universities, the general reaction to the idea was positive, but often with a caveat implied in this question: 'how will this work if the university down the road is looking for the same sorts of placements as us?' This is an issue that could limit the success of a hub as a conduit for placements. However, competition for placements exists already, so while perhaps a hub might make the competition more visible, the idea is probably worth pursuing despite this.

10.4.3 Improving knowledge about WIL participation

As discussed in the section above, building a value proposition for WIL is an essential element for expanding the practice in STEM. At present there is evidence in literature that suggests the benefits derived for students, institutions, academics, employers and government through well developed WIL activities. However, in Australia there is limited objective data available to emphasise this point.

This project has offered some quantitative insight into the breadth of WIL activities in science, ICT and agriculture through collection of data from academics and support staff involved in the project. While this collection has been useful, it has also highlighted the significant difficulties with consistent and robust data collection at the national level in higher education. Establishing detailed systems from scratch to collect and analyse national level data can take time and significant costs. However, there may be other more efficient and timely ways of beginning to collect national level data on WIL participation and outcomes in Australia.

Utilising existing national survey collections of student data (for example the University Experience Survey) or graduate data (for example the Graduate Outcomes Survey) may offer an effective avenue to collecting more nuanced and objective information about WIL activities without having to establish a whole new data collection. By inserting some efficiently developed items into these surveys (in the case of the GOS, this is currently under development), it becomes possible to identify participation levels and then cross tabulate this information with other data collected in these surveys, such as graduate outcomes, student engagement, student characteristics and course of study. The work undertaken in Canada utilising data from the national graduate survey points to the relative simplicity of this approach, and the clear benefits that having this information can achieve for justifying the investment in WIL activities (Ferguson & Wang, 2014).

10.5 Mapping Objectives to Project Findings

The table below re-explores the objectives developed by the OCS for this project with some of the key outcomes and findings from the report.

Objective	Key outcomes from the project
To describe the level and type of Work Integrated Learning (WIL) for both credit and non-credit in science, technology (ICT), engineering, mathematics and agricultural science (STEM) related faculties in universities, with an emphasis on the non-engineering disciplines.	All universities in Australia involved in the study interviews. Data collected to show a different range of activities and engagement between disciplines and across universities. In general these include a myriad of on-campus activities, projects and placements in these disciplines. A typology of WIL activities was created to guide the collection of information from universities. Among focus disciplines, indicative data suggest that almost three of every four ICT bachelor students in Australia experience an industry based project during their degree, compared with about one in four agriculture and environmental studies students and about one in seven science students. Data relating to participation in placements and internships are substantially lower in the ICT field, and almost negligible in the natural and physical sciences. Agriculture and environmental sciences are slightly higher with indicative data suggesting shorter term placements covering almost two in every five students. In this field, medium-term placements (one in five students) and long-term placements (one in seven students) have lower participation than short term placements, but the rate is higher than for the other disciplines.

Objective	Key outcomes from the project
In the case of 'for credit' WIL, to describe how the WIL programs in STEM faculties are funded.	The full costs of WIL based units are generally unknown. Usually WIL units are funded in the same way as any other academic subject – with funding allocated according to student enrolment numbers. Teaching staff are then allocated based on these enrolments. Most participants in the interviews indicated that 'WIL costs more', but it was difficult to generalise about how much more. In general, the main reason for higher costs tended to be the time and effort that WIL activities require in developing and maintaining industry contacts, and supervision and allocating students to placements or projects. Some estimates from previous research suggest that WIL placement activities cost about 20 per cent more than a traditional subject, and project activities about 15 per cent more. However, there are significant caveats to this kind of estimate given the vastly different contexts across universities and within disciplines in terms of student characteristics, existing practices, size, location, etc.
In the case of 'for credit' WIL, to describe the ways in which WIL is administered in STEM faculties in universities – the organisational structures, strategies, and the scalability of initiatives.	Arrangements and policies relating to coordinating, administering, and funding WIL activities are currently being developed or revised in many institutions across the higher education sector. WIL activities are administered very differently in STEM disciplines across Australian universities. Some have a highly centralised approach, others are simply run by individual academics with a passion for WIL activities. Many models lie somewhere between. Central support for administration is provided in some institutions. In the case of universities with centrally developed WIL policies and coordination, this support comes through formal channels. However, in most cases the central support is negotiated or identified by the individual academic coordinator responsible for the WIL unit. In general, the engineering and ICT disciplines tend to be more organised, and have specific faculty-wide processes and support for WIL activities, when compared with the science and agriculture disciplines.
In the case of 'for credit' WIL, to describe the integration of STEM Work Integrated Learning into the STEM curriculum.	WIL definitions are relatively similar across Australian universities, although there are differences in terminology used to label such activities. Common features of WIL definitions include: Integrating theory with the practice of work; Engagement with industry and community partners; Planned, authentic activities; and Purposeful links to curriculum and specifically designed assessment. Many WIL activities in STEM are applied to existing traditional curriculum as 'add-ons'. However in some institutions the approach to WIL is more embedded and permeates the whole course structure.
In the case of 'for credit' WIL, to describe and assess the quality and impact of existing WIL in STEM faculties.	International literature suggests that some of the best practice in WIL in universities occurs in Australian universities. Through the case studies highlighted in this report, a number of exemplars of the level of quality and impact of WIL activities are demonstrated. There are impediments within many universities to developing higher quality WIL that has a more significant impact. In science in particular, the lack of existing processes and infrastructure for developing WIL activities was identified as a potential impediment. Without first establishing processes, it is anticipated that expansion might not result in success. Reliance on individual academics to develop and maintain relationships with industry is particularly prominent in the science disciplines, while central organisation for establishing connections is more apparent in ICT and engineering. This over-reliance on individual academics has potentially negative consequences for maintaining consistency, quality and impact of programs over time. The general lack of value placed on WIL, and resistance to committing to WIL activities, was also identified as factor inhibiting the potential for developing high quality WIL in many institutions.
To describe and analyse international best practice in STEM WIL and how it relates to the Australian context.	Material was drawn from policy and scoping exercises by: government departments or other agencies; industry/interest groups; and professional groups, such as the World Association for Cooperative Education (WACE). Notable involvement of WIL in higher education was highlighted for New Zealand, South Africa, Canada, the United Kingdom, and Europe. Australia was shown to be among the world leaders in WIL in higher education. A number of comprehensive and high quality reports (for example Orell, 2011; Patrick et al., 2008; and Male & King, 2014) place Australia highly in WIL practice. These Australian reports also best suit the contexts of the Australian system in terms of developing future practice and exploring avenues for expanding WIL in the STEM disciplines.

Appendix A: Questions that guided university interviews

The interview schedule below provides indication of the questions that were asked of university staff involved in the project. Each interviewee was emailed this schedule prior to interview.

Background provided to participants

Office of the Chief Scientist has asked ACER to conduct research into the use of different forms of Work Integrated Learning (WIL) at Australian Universities. It also includes some discussion about the skills of STEM graduates. The main focus is on the fields of science, mathematics, information technology and agriculture. The objective is to 'stocktake' current activity in WIL in these fields. The interview covers:

- WIL policies
- Specific WIL activities
- Student participation
- Industry participation
- WIL Costs (WIL for credit)
- WIL evaluation and outcomes
- STEM higher order skills

The information gathered from all the universities involved in this study will be used to highlight the practice of WIL in these specific fields. The Chief Scientist sees WIL as a valuable activity and will use this information to inform policy and assist universities in funding, facilitating and/or promoting WIL.

Defining WIL

The research team recognises the term WIL is broad and used differently in different settings. Some broad definitions which frame this study are provided below as an indication of our understanding of WIL. However, these definitions are not intended to be prescriptive in terms of the discussion in this interview. Essentially, the researchers are interested in collecting information about what the interviewee/s consider to be WIL.

> *WIL is the term given to an activity or program that integrates academic learning with its application in the workplace. The practice may be real or simulated and can occur in the workplace, at the university, online, face-to-face or any combination of these...*
>
> *WIL provides the means to 'do in context' rather than developing practical skills alone…*
>
> *WIL involves developing students' work-readiness skills to industry standards and enhancing employability…*

It is anticipated the interview will take about 90 minutes.

Your participation in this project is entirely voluntary. If you do agree to participate, you can withdraw from the project at any point before or during the interview.

WIL Policy and Definitions

Does your university have a specific Work Integrated Learning (WIL) policy?
[Yes / No] [If yes, briefly describe (e.g. it may be that x credit points per degree include internship or WIL activity)]

What is the formal definition of WIL used at your university?

Does this definition reflect what is actually practised in your faculty/department?
[Yes / No] [If not] In what ways is it different?

Does your faculty/department you have an official WIL coordinator? (if yes, who, how appointed, time fraction etc)

WIL Activities

UNIVERSITY PRE-INTERVIEW activity

Please list each of the different kinds of WIL activities undertaken in your department/faculty in the table below. Where possible, for each activity please include details relating to each of the column headings. The first row includes an example of what might be included. Please Add rows if needed.

WIL activities might include but are not limited to:

- *Industry-based projects*
- *Internships*
- *Job-shadowing*
- *Clinical placements*
- *Fieldwork*
- *Project-based learning*
- *Guest lectures from industry*
- *Teaching practicum*
- *Virtual projects and simulations*
- *Volunteering*
- *Work placements*
- *Research-related placements*

Activity (and name given to the activity by the university)	**Durat-ion (# weeks, and hours per week)**	**Discipline (i.e. chemistry, ICT, general science etc)**	**Year level**	**Offered to all? Or Selective? (All/ Selective)**	**% stud-ents partici-pate**	**For Credit? (Y / N) If Y, how much?**	**Paid? (Y/N) If Y, by who?**
[EXAMPLE] Internship – 'Interns for ICT project'	10 weeks 3 hours per week	ICT	Final year	Selective	10%	Y (6 points = one subject)	N

For the WIL activities listed above that are NOT FOR CREDIT, what are the main reasons that credit is not offered to participating students?

UNIVERSITY PRE-INTERVIEW activity

The research team has created five broad categories for WIL. They are defined below.

- On campus ad hoc: occasional activities conducted on campus. For example guest lectures from industry, or small projects that might aim to replicate industry practice;
- On campus industry projects: activities that involve longer (semester-long) industry influenced projects that are conducted on campus rather than through an industry placement.
- Short term placements or internships: experiences in industry, off campus for up to 5 weeks in length.
- Medium term placements or internships: experiences in industry, off campus for between 6 and 11 weeks in length.
- Long term placements or internships: experiences in industry, off campus for 12 weeks or more in length.

For each of these broad WIL types, use the table below to estimate the proportion of students who would have undertaken this WIL at your institution by the time they graduate (Only answer relevant to your discipline):

Discipline (only answer for relevant discipline)	WIL Category	% of students who have participated in this by the end of their degree	% of students who have participated in this FOR CREDIT by the end of their degree
SCIENCE/ MATHEMATICS	On campus ad hoc		
	On campus industry projects		
	Short term placements and internships (less than 6 weeks duration)		
	Medium term placements and internships (6-12 weeks duration)		
	Long term placements and internships (more than 12 weeks duration)		
ICT	On campus ad hoc		
	On campus industry projects		
	Short term placements and internships (less than 6 weeks duration)		
	Medium term placements and internships (6-12 weeks duration)		
	Long term placements and internships (more than 12 weeks duration)		
AGRICULTURE	On campus ad hoc		
	On campus industry projects		
	Short term placements and internships (less than 6 weeks duration)		
	Medium term placements and internships (6-12 weeks duration)		
	Long term placements and internships (more than 12 weeks duration)		

Students & WIL

What do you think are the main motivations of students to participate? Are there differences between activities that attract credit and those that don't?

What do you think are the main reasons students have for not participating in WIL activities? Are there differences between activities that attract credit and those that don't?

Do students bear any costs for participating in WIL?
[IF YES] What kind of costs? (For example, accommodation, travel, purchasing safety clothes)

Is any financial support provided to disadvantaged students to help them participate in WIL?
[IF YES] What kind of support?

Are there differences between activities that attract credit and those that don't?

Are international students able to participate in WIL activities in the same way as their domestic classmates? If not, what main reasons prevent this?

Is students' participation in WIL activities assessed? Broadly, are activities just 'pass/fail' based on participation, or are there more specific assessments of participation (with rubrics, criteria etc)?

Industry Participation

How does the faculty/department go about making connections with industry partners? What kinds of approaches do you find most effective?

Do potential industry partners approach the university themselves? If so, please provide an example.

What are the characteristics of employers you work with on WIL? [tick all that apply]

Sectors	**Industries (list up to five)**	**Organisation Size (approx.)**
☐ Government		☐ Large multi-national (200+ employees)
☐ Not-for-profit		☐ Large national (200+ employees)
☐ Private		☐ Medium (20-200 employees)
		☐ Small (fewer than 20 employees)

What do you think are the main motivations of industry partners for participating in WIL activities?

How (if at all) do these motivations differ from those of the university? (e.g. are industry partners focused on improving skills/capabilities of students? Do you think industry is involved for easy labour, while university is aiming for deeper learning...?)

Do industry partners bear any costs for participating in WIL?
[IF YES] What kind of costs?

Where WIL activities involve students working within an enterprise, how is this managed? (e.g. Whose responsibility is it for supervision of the students? Is there on-going liaison?)

When students interact with industry partners, who is responsible for the legal aspects such as insurance, legal liability, workplace occupational health and safety, employee assistance and so on?

What kind of training and support do industry partners receive in supervising students?

WIL 'FOR CREDIT'

The following sections relate only to the WIL activities in your faculty/department that attract credit points for students – i.e. they count as credit towards gaining a degree at your institution.

Development of WIL Activities

How does your faculty/department go about designing For Credit WIL activities?

Are these activities linked to your curriculum (through blueprinting etc)? And are they matched to graduate capabilities statements and/or professional standards or other reference points?

How much/what type of input do industry members have and how is these activities are designed?

Costs – Institution (WIL 'for credit')

Is the coordination of WIL for credit explicitly included in the budget of your department/faculty?
[IF YES] Approximately how much is allocated annually in relation to:

- Full-Time Equivalent Staffing:
- Other costs (travel, facilities, etc):

What other kinds of support does the university offer in coordinating WIL 'for credit' activities? (e.g. administrative, office space, links to alumni etc)

Are WIL 'for credit' activities funded by other sources (such as foundations, scholarships, industry grants, research projects etc)?

Are the full costs of WIL activities in your department/faculty known? Explain if necessary.
[Y/N]

UNIVERSITY PRE-INTERVIEW activity

Using the table below please indicate which university staff are involved in 'for credit' WIL activities. Using the column headings as guidance, please provide as much detail as possible.

INVOLVEMENT IN 'FOR CREDIT' WIL ACTIVITIES

Role (alter types where needed)	Approx. # weeks (FTE) spent per year on WIL	Basic description of Role in WIL program	Time funded specifically by WIL budget allocation? Y or N	Employed within the Department/faculty, or from a general university 'pool'
Deputy Dean				
Academic Lvl E				
Academic Lvl D				
Academic Lvl C				
Academic Lvl B				
Academic Lvl A				
Casual teaching staff				
Administrative staff				
Student support staff				
Careers Counsellors				
[Other]				
[Other]				
[Other]				

Are there other costs involved in coordinating WIL 'for credit' activities that are not covered in the above questions? If so, what are these?

Is there a gap between the funding of WIL 'for credit' activities and the real costs of undertaking these activities? If so, how substantial is it?

☐ No Gap (fully funded)

☐ Small gap, less than ¼ of total costs

☐ About ¼ of total costs is unfunded

☐ About ½ of total costs is unfunded

☐ About ¾ of total costs is unfunded

☐ None of the activity is funded

Comments/notes

WIL Reflections and Outcomes

(note: this section is for ALL WIL – both 'for' and 'not for' credit)

Which factors do you think are needed to make WIL successful?

Has your institution undertaken any formal evaluation of WIL-related activities in your department? [Y/N]

What other strategies do you use to evaluate WIL Outcomes? [For both Students and Industry]

Can you give any examples of ways in which WIL has changed over time in response to feedback from students or industry partners?

Do students involved in WIL placements then go on to be employed by the partner following graduation? If so about what proportion of students are employed by their industry partner? [one third? Half? Three quarters?...or 'don't know'..]

Do industry partners approach your students differently when recruiting graduates as a result of WIL activities?

Do industry partners indicate that they benefit from their involvement in WIL activities? If so, what are the main benefits they express?

Does your faculty/dept/institution have any plans to expand or change its current WIL activities?

Are your existing WIL 'for credit' programs scalable? i.e. can they easily be expanded to expose a greater number of students to WIL?

What are the key impediments to the further expansion of WIL in your faculty/department?

What could be done to reduce these impediments?

STEM Higher Order Skills

The final section explores some ideas about the desired skills of STEM graduates as articulated by industry through a survey undertaken by the Office of Chief Scientist in 2013. While these may/may not relate to WIL activities, for the purpose of the interview, this section is seen as completely separate to the WIL sections.

In 2013, the Office of Chief Scientist surveyed employers about the 'higher order skills of STEM graduates'. According to the survey, a number of skills were identified as 'very important' by employers.

The highest 'rated' skills were:

1. Active learning
2. Critical thinking
3. Quantitative skills
4. Complex problem-solving
5. Creative problem-solving

The Office of Chief Scientist is now interested in further exploring the nature and components of these skills. We are asking you to describe them from the perspective of a university academic. A parallel project is interviewing employers to gain their understanding of these concepts.

Going through each of these in turn, please articulate what you see as the key components of these skills:

- ACTIVE LEARNING
- CRITICAL THINKING
- QUANTITATIVE SKILLS
- COMPLEX PROBLEM SOLVING
- CREATIVE PROBLEM SOLVING

Please outline the way in which each of these skills are currently taught in your STEM curricula (with reference to discipline where relevant) :

- ACTIVE LEARNING
- CRITICAL THINKING
- QUANTITATIVE SKILLS
- COMPLEX PROBLEM SOLVING
- CREATIVE PROBLEM SOLVING

Appendix B: University interview schedule

University	Date/s visited	Disciplines of focus				University-wide 'WIL' coordinator/s	Number of staff involved in interviews
		Natural & Pyisical Sciences	Agricultural/ Environmental sciences	Information Communication Technology (ICT)	Engineering		
Australian Catholic University	11-Nov	x					1
Australian National University	3-Sep-14	x	x				7
Charles Darwin University	17-Sep-14	x			x		6
Charles Sturt University	25-Nov	x	x	x	x	x	7
CQUniversity	29-Sep	x	x	x	x		3
Curtin University of Technology	10-Sep	x				x	2
Deakin University	27-Nov-14	x		x	x		1
Edith Cowan University	9-Sep	x		x			2
Federation University Australia	15-Sep-14	x		x	x		1
Flinders University	19-Sep-14	x	x	x	x		3
Griffith University	11-Sep			x	x		4
James Cook University	24-Sep	x		x		x	2
La Trobe University	18-Sept/Oct	x	x				4
Macquarie University	24-Sep	x		x		x	3
Monash University	18-Aug/2-Sep	x		x			3
Murdoch University	1-Sep			x		x	2
Queensland University of Technology	16-Sep	x		x	x		2
RMIT University	16-Sep-14	x					6
Southern Cross University	27-Oct	x	x		x		2
Swinburne University of Technology	28-Aug	x		x	x	x	3
The University of Adelaide	26-Sep-14	x	x	x			2
The University of Melbourne	13-Oct/20-Oct	x	x	x	x		5
The University of New England	21-Oct	x	x	x	x		2
The University of New South Wales	25-Sep	x		x	x		3
The University of Newcastle	13-Oct	x	x	x	x		6
The University of Queensland	8-Sep	x	x	x			5
The University of Sydney	24-Sep	x	x				4
The University of Western Australia	9-Sep-14	x					3
University of Canberra	28-Aug/19-Sep	x		x		x	3
University of South Australia	22-Sep-14	x		x	x		2
University of Southern Queensland	25-Sep	x	x	x			3
University of Tasmania	20-Aug	x	x	x	x		4
University of Technology Sydney	23-Sep-14	x		x	x		3
University of the Sunshine Coast	21-Oct-14	x		x	x		3
University of Western Syd	20-Oct	x		x		x	4
University of Wollongong	14-Oct	x	x	x			4
Victoria University	18-Nov-14			x	x		1

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