International Journal of Engineering Education Vol. 37, No. 6, pp. 1743–1767, 2021
Printed in Great Britain

0949-149X/91 $3.00+0.00

A Review of Work Integrated Learning in Australian Engineering Education*

PRADEEP VAILASSERI, JOHN LONG and MATTHEW JOORDENS
School of Engineering, Deakin University, Waurn Ponds VIC 3216, Melbourne, Australia. E-mail: pvailas@deakin.edu.au

Work integrated learning (WIL) has increasingly been becoming an important part of engineering higher education. This paper analyses the major research that has occurred primarily in the last decade in the area of engineering WIL. Research studies have identified industry and community needs and revealed the shortage of skilled graduate engineers in the Australian industry owing to the scarcity of industry-ready graduate engineers. This situation has resulted from a mismatch between the requirements and the number of skilled engineering graduates from Australian universities. The authors identify that the duration of WIL available for Bachelor of Engineering programs is very short. Thus, engineering students are not receiving adequate workplace learning opportunities to develop industry-readiness. Current WIL for engineering students is not effectively coordinated due to the absence of an effective framework. Students often need to organise their placements because many universities provide minimal support to individual students. The authors explore the research on WIL and its impact on engineering education quality, industrial productivity and graduate employability. There is a substantial need to increase the weightage of WIL and improve the outcomes of engineering education via a more effective work integrated approach. This paper emphasises the necessity of appropriately structuring WIL in empirical learning practice and propose an enhanced WIL (EWIL) framework to address the gaps in the effectiveness and quality outcomes of engineering education.

Keywords: engineering education; bachelor of engineering; work integrated learning; WIL; workplace learning; industry engagement

1. Introduction

Ever since the budding phase of industry integrated learning, efforts to improve different aspects of WIL have been undertaken through research. Gaining theoretical engineering knowledge without creating any link to its industrial application has become an outdated learning method in many countries, including Australia. WIL has become a critical pedagogical practice integrating theory and practice through the academic and workplace environments of students' learning. 'Exposure to professional engineering practice', which is a requirement of accreditation by Engineers Australia, can be achieved through WIL in the relevant field. To produce work-ready graduates and maintain the relevance of engineering education, an effective partnership between industry and universities is vital. The knowledge, skills and attitudes gained through a well-developed link between theory and practice improve graduate employability. Due to the advancement in technology, universities and industries can collaborate through different modes, such as on-site workplace engagement, off-site workplace simulations and online distance engagement. This paper examines major research studies of engineering WIL around the last decade and major contributions have been highlighted.

The review includes:

- WIL for engineering students, especially in Australia
- WIL expectations, benefits and barriers
- Relationship between WIL and employability
- WIL research focussing on universities, industries/workplaces and students
- Curriculum and assessment frameworks
- Existing Australian WIL frameworks
- Key global WIL frameworks

The existing research findings are categorised, and the possible research areas are identified. Scope for possible further studies is also discussed in the sub-sections. All the sections investigate the interesting question that whether the current WIL framework and practices are truly effective in preparing future engineers for the workplace, especially in Australia. The discussion section includes a summary of the research, suggestions from the authors and a recommended WIL framework that needs to be developed via further research.

2. Engineering WIL and Expectations

WIL integrates academic education with workplace practical application and has become a mandatory requirement for Bachelor of Engineering degree programs in many countries including Australia. Combining academic and work-related activities, WIL equips students with the ability to apply the knowledge gained on campus and provide oppor-

* Accepted 31 July 2021.

tunities of experiencing discipline-specific workplace issues. This will empower students by recognising their contribution to the workplace and help them in developing problem identification, problem-solving and decision-making skills. Students earn credit points by participating in WIL because it is a formal component.

To prepare students to be industry-ready, universities need to establish partnerships with industries and maintain collaboration to implement WIL. On-site work placements are the traditional WIL method [1]. Project works and workplace simulations are employed currently on-campus or in remote facilities [2]. Students receive the opportunity to gain real-world experience by completing WIL, including work placement, internship or a project, which provide a plethora of transferable skills. WIL is intended to help graduates to become industry-ready professionals [3]. WIL is an education arrangement that is delivered out of the classroom and campus and provides improved practical outcomes regardless of the mode utilised.

Universities are increasingly adopting WIL as an important element of academic education based on the concept that authentic work-based participation will have a positive impact. Graduate employability needs to be developed by university education via strong partnerships between universities and industry. When universities adopt a highly deliberate and enterprising approach to WIL, all stakeholders receive benefits through the mature reciprocal partnerships with industries and risks are mitigated [4]. To transform their learning experiences into practical knowledge, universities also need to provide students with the opportunities to share and review their workplace experiences. This factor has not gained due attention and curriculum space. To succeed in competitive job markets, WIL needs to equip students with the skills and knowledge required, which is enabled by fostering relationships among students, universities, employers and non-government organisations. In this research, the aim was to address some significant questions concerning the effectiveness of current WIL methods.

Some of the main expected outcomes of WIL for the three major stakeholders are listed below:

Students: Opportunities for hands-on work experience, increased employability skills, improved industry-readiness, smooth campus-to-industry transition, higher chances for employment in the area of study.

Universities: Increased quality of education, improved industry collaborations, higher research funding from industries, opportunities to stay up to date with technology and process advancements, higher possibilities for developing and maintaining academics' industry-currency, increased attraction for students and innovative industrial organisations, higher reputation.

Workplaces/Industries: Availability of industry-ready graduate engineers, opportunities for active collaboration with universities, possibilities for more innovative research participations, cost-savings in recruitments, possibilities for increasing functional outputs due to the extra support from the students undertaking WIL, increased popularity via students and universities.

Do the existing WIL frameworks help produce industry-ready engineering graduates resulting in optimum benefits to universities, workplaces and graduating engineers simultaneously? Is there a need for further research to develop a WIL framework that can effectively address the requirements to achieve the expected WIL outcomes for all the three major stakeholders? The following sections attempt to answer these questions.

3. Studies on WIL Frameworks

This section will discuss the major WIL and assessment frameworks, focussing on their effectiveness in providing the expected benefits to key stakeholders. The studies analysed here include skill expectations in industry, gaps in the skills required in the labour market and the effectiveness of current WIL to achieve competencies to meet these expectations. This section will explore the efforts to build systemic graduate confidence in higher education in a competency-based work-integrated system via learning, teamwork and co-operation and multidisciplinary initiatives. The WIL assessment framework with an employability focus and validity and reliability issues will also be discussed in this section.

3.1 Male and King's Engineering Practice Model

Students need to be exposed to engineering practice for the accreditation of engineering programs by Engineers Australia. This is usually met by short-term engineering related placements. Students find it difficult to secure placements due to increasing student numbers, employment downturns and changes in engineering employment practices. To develop WIL modules via the virtual environment, module requirements were identified via the reviews of hypothetical modules and consultation with other stakeholders. Currently, most engineering students complete their job placements after the third year of their studies. Male and King [5] suggested that to improve their transition into

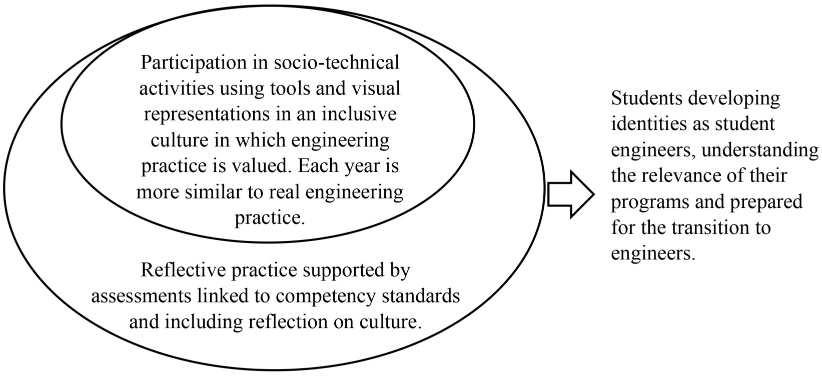

Fig. 1. Model of effective exposure to practice in an engineering degree [5].

professional engineering, students need exposure to practical engineering from earlier stages in their studies, which can be achieved by exposing students to the virtual work environment from the first year. Students are unlikely to be aware of engineering roles, which has been identified as a threshold for the readiness of students to study engineering [6]. Fig. 1 shows this model for effective exposure to engineering practice.

This model introduces the requirements and learning outcomes for the modules providing the vision, theoretical framework and planning phase. The developing suite of modules, student transitions and future research supported by the modules are outlined. The module will bring the intended student outcomes such as understanding engineering roles and the value of engineering, development contributing to the achievement of Stage 1 competencies, self-efficacy required for engineering profession, identity development as a student engineer and motivation towards engineering studies. It will also develop an improved capability to secure or create engineering work, understand the employment market in the student's discipline, and provide the capability to plan the navigation of the employment market and an expanded engineering network and ownership of responsibility for learning. The model in Fig. 1 outlines the motivational experiences without actual engineering work placement, which may develop more realistic perceptions of practice [6].

As they progress through their studies, engineering students develop a less realistic perception of engineering practice due to the immense emphasis on engineering science [7]. When graduates enter the workplace, the misperception that engineering is purely technical can lead to identity crises [8]. Students can be motivated by recognising the relevance of their education to future engineering roles [9]. Engineering work experience will motivate students by helping them to recognise the relevance of engineering practice during engineering education and the application of workplace learning, receiving affirmation from their co-workers including peers, colleagues and supervisors and recognising that they have experienced professional growth [10].

3.2 Competency-based WIL Frameworks

In the South-African framework (Fig. 2), modular WIL programs with compulsory and optional practical combined subjects have been introduced [11]. The processes of monitoring, evaluation and progression of students are focussed within the modular WIL program, which aims to give room to adjustments between compulsory courses and full-time or part-time placements. The system permits follow up on the students' progress on the job related to the logbook requirement. The WIL coordinators from the universities and the mentors from the company are expected to work together to assess the technical development of the students.

In WIL training, the grouping of students and rotation regardless of their engineering disciplines will be performed for exposure to various manual skills (Fig. 3).

In WIL training, students need to complete compulsory and other short courses with varying weight credits in different field backgrounds. The framework has a flexible design in the respective paths and field backgrounds, enabling the students to move from one modular course to the next. The flexibility regarding the time is the innovation of this framework. The students can undertake short courses in a part-time format. In this framework, the courses are aligned to logbooks and the performance of the students is measured via formal assessments and moderations. This generic framework is expected to be applied to any engineering course [11]. The limitation of this framework is that it was developed for small-scale applications and has not yet been tested or validated. The framework does not provide a guideline stating at what stage of the engineering program the WIL will commence and the duration of the WIL.

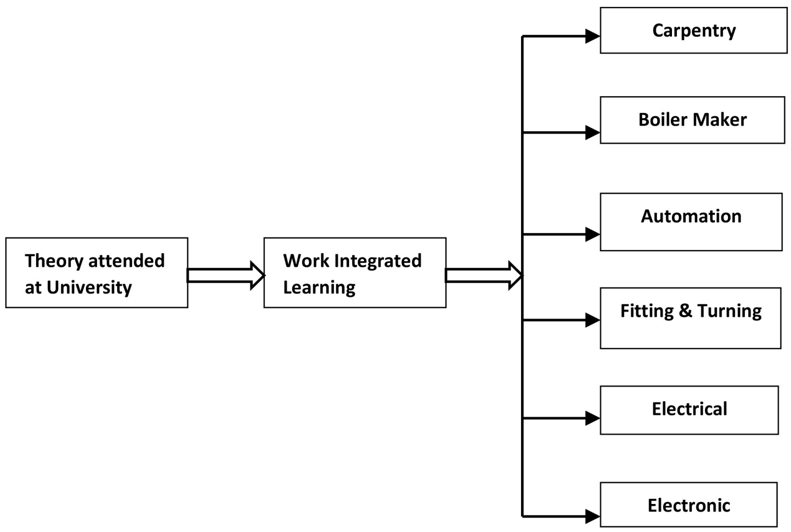

Fig. 2. Layout of the WIL training at resolution circle in South Africa [11].

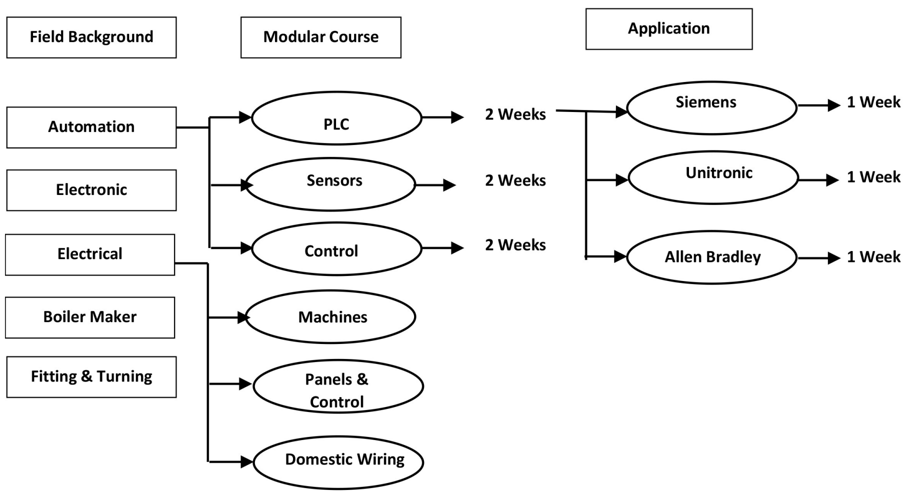

Fig. 3. Modular short course for WIL [11].

There are some unique features in the competency-based work-integrated system [12]. The pre-approved registration system needs to be agreed upon by all parties in the tri-party system and the competencies developed in the industry by the trainees. The WIL trainees undertake industrial training and complete an academic portfolio consisting of reports of their developed competencies. To produce equitable outcomes, training reports are assessed academically as per academic standards, proportional to a one-year industrial project. The program facilitates a permanent cognitive mindset, which is perceptive to ingenuity and innovation, in the trainee into a professional engineer. To facilitate the establishment of a portfolio of learning, the program facilitates appropriate reporting structures for future professional registration. The program is dynamic to support logical updates based on industrial changes and the professional education literature. The correlation and effectiveness of the developed competencies in aligning with workplace expectations in the industry may be gauged via data analysis. Engineering competence may be developed locally via innovative competency-based engineering education programs.

Because of the absence in the adequate structures for WIL learning and assessment, the gap between the required skills in the industry and those being developed in young graduates is difficult to measure. A need exists to verify the skill expectations from employers and whether the achieved competencies of graduates meet those expectations. In competitive economic environments, contemporary workplace specifications require knowledge, skills and attitudes that can respond to the need addressed by the educational institutes. In collaboration between the training institution and industry, WIL and other placement programs may meet this requirement. Further focussed research is needed to explore the issues surrounding the assessment of the developed competencies of engineering students. To facilitate measurable competency-based outcomes against a known standard, an innovative WIL framework needs to be developed to suit most engineering academic programs.

3.3 WIL Assessment Models

For the successful delivery of WIL programs, some common concerns include maintaining academic standards, consistently meeting relevance and assessment processes, and identifying the responsibility for assessment. The student portfolio approach by Dunn, Schier and Fonseca in 2012 for assessing student learning in a WIL placement attempts to address these issues for multi-disciplinary workplace settings. In the portfolio approach to WIL assessments, a combination of performance-based measures is part of the assessment practices involved. In this approach, the student prepares the portfolio and the employer, or mentor, authenticates it. The first application of this approach was trialled in 2010 and documented greater evidence of graduate attribute development. A SWOT analysis identifying the strengths, weakness, opportunities and threats of this approach is given in Table 1 [13].

An assessment of soft skills for the practical application of theoretical principles and the behavioural development of the student mapped the competencies and reflective written reports [14]. Student portfolio assessment activities involve representing the professional discipline area, based on a range of activities or topic areas, writing a series of structured reports concerning these activities, developing learning objectives, showing evidence of involvement and then reporting on whether the students met the learning objectives and providing experience reflective summaries. To provide evidence of the completion of observed discipline-specific tasks, the student develops an experience record sheet and, in consultation with the academic and workplace supervisor, maps the graduate attribute development by completing pre- and post-learning benchmarks. On completion, the student submits the portfolio containing the cumulative collection of their work. The portfolio gets authenticated by the employer or mentor to increase the authenticity of this approach [15]. This model is an attempt to develop the graduate attributes and employability of students by providing greater workplace assessment evidence and establishing more consistency and clarity among industry partners and academics. For application in multi-disciplinary workplace settings, this assessment model requires further evaluation and refinement [13].

Table 1. SWOT analysis of changing the student industry-based learning report to a portfolio structure [13]

Strengths	Single document. De facto portfolio status. Some use of reflective statements.
Weaknesses	Unfocussed document. Inconsistent standard. Learning outcomes unclear. Lack of skill and experience documentation. Lack of consistent reflective process. Lack of coherence (covers 1 year). Variable quality in assessment.
Opportunities	Expansion of reflective processes. Smaller manageable sections. Redirect effort to portfolio. Clearly tabulated experience and skills.
Threats	Poor student and academic engagement. Potential loss of employment opportunities.

WIL assessment has been a difficult task because although the authenticity in learning relates to real-world experience, according to the contemporary perspectives of higher education, it is a challenge to link strategically and differentiate WIL provision, assessment task facilitation and authentic student evidence collation. Assessment is authentic if the evidence shows that the knowledge and skills gained by the student are realistic, exhibit judgement and innovation and tested in real-life or under simulated contexts. The maximal or minimal authenticity of an assessment needs to be better understood, regardless of whether the authentic learning tasks are performed in education or workplace settings. Curtin University was concerned about the comprehensive course review of higher degree courses as these did not use a structured framework to analyse WIL assessments in the curriculum. The parameters for assessments are not clearly described in the literature. To assist this gap in comprehensive course review and enable a consistent approach across programs and disciplines, Curtin University designed the Authentic Assessment Framework (AAF) and tested it. To enable a critical and constructive interrogation of how and where work-readiness skills are developed and the authenticity and relevance of the course experience, the assessment framework promotes staff engagement and decision-making [16]. The AAF provides the opportunity to solve the WIL in curricula issues creatively, demonstrates the range of completed WIL assessments in academic and professional settings and demonstrates the depth and breadth of the authentic assessments of a program.

Universities are accountable for the quality and proficiency of their outgoing graduates. Ideally, graduates should have acquired the necessary skills to contribute to the Australian economy as expected by the government, industry and students. To address this requirement, a quality curriculum that integrates WIL experiences across a program is mandatory. An evidence-based approach where the staff engage and analyse the authenticity of an assessment profile and the effectiveness of graduate employability capabilities can achieve this to some extent. AAF supports comprehensive course review and helps to evidence student learning and developing skills. This framework is flexible and can be applied to diverse disciplines and contexts after further refinement. During the comprehensive course review process, the framework can address the WIL agenda and staff are exposed to authentic assessment opportunities. A flexible approach to embedding WIL in the curriculum is essential owing to the dynamic global change in higher education [17].

The scope for a WIL framework can be identified that outlines WIL delivery and assessments from the commencement to the completion of the Bachelor of Engineering program. A EWIL framework needs to be designed to provide more weight to workplace learning in engineering education, so there is ample scope for incorporating a broad range of WIL assessments. Such a framework would ensure more effective benefits to the universities, workplaces and graduating engineers.

3.4 WIL Assessment Validity and Reliability

Integrative learning must be designed into curriculum activities and assessments to achieve and certify the learning objectives. According to Dewey [18], "We never educate directly, but indirectly by means of the environment. Whether we permit chance environments to do the work, or whether we design environments for the purpose makes a great difference. Any environment is a chance environment so far as its educative influence is concerned unless it has been deliberately regulated with reference to its educative effect". Assessing the development and refinement of workplace skills and experience has better validity and reliability than campus-based assessments. Three factors (predictions about possible future action scenarios and the impacts, setting interpretations and action choices) can develop the application element of disciplinary knowledge in a work context. The generic rubric developed for WIL curriculum designers and assessors justified by these three factors ensures that students have successfully integrated theory and practice [19].

The learning outcomes of WIL assessment integration need to focus attention on interpretation, prediction and action. Most assessment methods evaluate the domains in isolation, although curricular design increasingly integrates core knowledge and skills [20]. The turning-point is in two respects in the current state of play. First, in some disciplines, success implies aligning the goals of integrative learning with the workplace experience. Second, where integrative learning outcomes are to be incorporated, assessment needs to follow valid and reliable assessments. Clarity in articulating the learning goals of the WIL curriculum is the first step in assessing the outcomes of WIL. Work-world experience, professional ability development and canonical knowledge application are the three classes of WIL curricula learning outcomes that require different assessment strategies. The ability of students to interpret a situation, the possible range of actions and consequences and the ultimate decision made are ways to integrate canonical knowledge with practice in the work context. Validity depends on the assessment protocol and pedagogical outcome. Varying degrees of validity and reliability have been exhibited by protocols developed for work-world experience and practice skill development [19].

Thus, there has been major effort taken in specific areas to improve the competency-based WIL and WIL assessments. However, there are no enhanced WIL frameworks available for delivering and assessing WIL, which is embedded from the commencement to graduation of Bachelor of Engineering education. A EWIL needs to be designed to provide greater workplace assessment evidence and establish more consistency and clarity among industry partners and academics to develop the attributes and employability of student graduates.

4. WIL and Universities

The current WIL practices and studies focussing on WIL in the engineering curricula, and its benefits and barriers will be investigated in this section. Major academic curriculum developed for the success of WIL perceiving collaborative industry-university research and the re-engagement of teaching-focussed academics with industry is presented here. The effectiveness of the existing curricula related to WIL, WIL objectives, pedagogical aspects, curriculum change, and implication of WIL on academics, including the workload changes, faculty attitudes, possibility of industry exposure to academics, clarity of goals and pedagogical tools will also be discussed. The challenging barriers of the current WIL frameworks and the elimination of WIL by some educational institutes due to current complications in its implementation and possible aftereffects are discussed.

4.1 Engineering WIL Arrangements in Australian Universities

Universities in Australia have employed different models for WIL in an effort to improve the employability skills of their graduate engineers. This section provides a synopsis of the WIL arrangements in some Australian universities.

Queensland University of Technology (QUT) practices a project-based WIL model with an industry partner contracted for a set of deliverables. The project duration is one semester (half year) or two semesters (full year). Academic and industry supervisors oversee the project, which credits two to four academic units. QUT also offers short-term work placements of 30–60 days duration. Work-readiness skills and enhanced employability critical outcomes are achieved via integrating academic and workplace learning [21–23].

At Monash University, engineering students are expected to develop employability skills such as soft skills including teamwork, inter-personal skills and flexibility, interview techniques and professional communication for the workplace. The applicants are screened and matched to workplace opportunities by the WIL team. Before commencing their internships, student candidates are introduced to host organisations and need to pass face-to-face interviews. The project provided by the host organisations must be approved by the academic coordinator and the host will provide mentoring and supervision to the interns. The duration is around 80–100 hours of work placement [24].

The IBL program at Deakin University allows students to engage with one of the partnering organisations for a three-month paid full-time work placement. IBL is designed to help students utilise key skills and knowledge from their engineering degree by exploring the graduate environment and refining the attributes that will enhance future employment. IBL helps to explore the graduate environment and refine attributes such as self-management, effective communication skills, ethical behaviour and the ability to implement their knowledge in the discipline in a professional setting [25, 26].

To increase employability and provide key career development opportunities to their students, Griffith University's Industrial Affiliates Program offers the opportunity to participate in a range of WIL experiences such as a trimester-long industry-led capstone project, experiential learning, community-focussed workplace simulations, virtual internships, career development courses and study tours [27, 28].

Victoria University's WIL includes activities that engage students in authentic professional practice, such as practice integrated learning client-driven projects, placements, practicum, industry-focussed research, laboratories, fieldwork, cadetships and internships and simulations [29, 30].

RMIT University offers work placements such as industry placements, internships, vocational and professional practices, cooperative and field education, industry and community projects and offshore and online activities. Engineering students in some disciplines undertake Engineering Capstone Project Part A and Part B with 12 credit points each. This project may be industry based and focusses on discipline specific or cross-disciplinary engineering problems, producing well-managed practical and pertinent solutions via established engineering design processes [31].

At the Australian National University (ANU), the internship programs are often elective units in the program of study included in the second semester of the third year or the first semester of the fourth year of study. ANU guide the employer organisation in suitable internship projects and the duration of the degree remains unaffected by the internship. WIL students at ANU are mentored by a chartered engineer who is employed by the university [32, 33].

University of Southern Queensland (USQ) and Central Queensland University (CQU) incorporate more WIL in engineering degrees by offering 'combined' degrees or higher-level programs that award specific qualifications in engineering practice alongside a standard engineering degree. From this WIL program, students are awarded a Diploma of Professional Practice with a strong problem-based learning emphasis and an engineering bachelor's degree [34–37].

Engineering students at Curtin University can work at major engineering companies on part/s of design projects devised and supervised by practising engineers. Curtin University also provides opportunities for fieldwork, service learning, co-curricular work experience and placements [38].

The University of Tasmania offers a Co-operative Education Engineering Degree Program in collaboration with the National Centre for Maritime Engineering and Hydrodynamics at the Australian Maritime College. The program provides significant exposure for the students to industry. The university also offers a dedicated WIL unit in the College of Sciences and Engineering with 12.5 credit points [39].

The University of Technology based in Sydney, attempts to equip students for careers in the professional practice of engineering by offering a combined degree in engineering and a diploma of engineering practice. The program includes two authentic, professionally focussed and practice-based internships of at least 22 weeks, each in a real workplace setting. The course aims to equip graduates through themes of academic development, personal development and professional formation and develop the attributes and skills needed for professional practice and leadership. The course provides strong foundations in engineering theory, technical expertise, professional practice knowledge and development of advocacy skills, academic literacy and social awareness [33, 40].

All the above universities provide WIL opportunities to their engineering students. However, the durations of the current WIL opportunities are short and limited to the final semesters of the engineering bachelor program. Thus, there is good scope for restructuring WIL for better graduate employability outcomes.

4.2 WIL in the Engineering Curricula

WIL and related issues in engineering education have been an interesting area of study. Based on the available literature, academics generally have a positive approach to WIL-based curriculum. They welcome integrating more industry-based activities using their professional research contacts. Three important factors that increase work-related learning in engineering curricula are clear goals, pedagogical tools and the opportunity to work outside academia. Employability and the need to contextualise what is learned are required to prepare industry-ready graduates [41, 42]. Programs with extensive connections to industry offer more integrated activities and faculties favour work integrated activities. They stress the importance of keeping the professional focus of engineering education [41, 43]. To integrate more WIL activities, institutional strategies need to be developed that include objectives and pedagogical aspects. Another aspect to consider in the institutional strategies is the need for informing academics about implementation means [44]. Academics require clear goals and pedagogical tools to increase work-related learning in engineering curricula. Offering academics the opportunity to work outside academia is another option to increase work-related learning. The more connections to industry the programs have, the more integrated activities and professional contacts are established. Providing academics with the opportunity to work outside academia, the curriculum will increase work-related materials. Increasing the number of professional contacts will help identify more projects and cases and create opportunities for academics to draw on examples from their own industry experience.

One concern with this model is that academics may experience an increased workload. Navigating between academia and the workplace may risk an imbalance with becoming too instrumentally focussed, theoretical and disconnected. Academics need to be trained and developed to balance their academic and workplace workload. The question remains whether these suggested work-related activities are sufficient to entice academics to embrace WIL or more incentives related to academic careers and pathways are required. When there is little to no interaction between academia and industry, there is a risk of becoming too instrumentally focussed. When there is no collaboration, the interaction becomes disconnected [45].

In a research study conducted at the University of New South Wales, it was observed that in its Cooperative Scholarship Program, engineering students completed up to 68 weeks of industry-based education, during their bachelor program, through industry collaboration. Students received training experience and were supported financially by their employers. The industrial training undertaken several years ago by the graduates was explored for its long-term value and compared with the current graduate engineers. As identified in the study, to enable WIL to develop the professional identity of the students, industry-based training requires workplace mentors. To help students develop a sense of professional identity, structured learning opportunities need to be included in the study program [46]. The gap in the industry-based education research is that it has been focussing only on immediate outcomes and graduate employability measures. When allocating resources to support student learning, the longer-term benefits must be considered.

Another study on Australian WIL identified that the curriculum revolves around a team-based project, which is supported by the delivery of lectures and small team meetings, with the students needing to develop a conceptual design [47]. Conventional engineering education focusses on the solution of constrained engineering problems. Students aim to achieve high grades by providing the correct answers. Engineers need to involve themselves in a broad range of engineering, environmental, social and economic issues [48]. An innovative approach to curriculum and assessment design is required to place more emphasis on these real-life issues. By developing the WIL approach, students can apply ideas, concepts and theory to a 'real-world' scenario and develop the gained knowledge. Within a traditional engineering program, an innovative approach for aligning the curriculum, assessment and resources uses milestones, a final project report, project file and seminar and a balance between summative and formative assessments. The students need to be motivated to learn about these complex issues and relate them to their proposed work environment, which will help them engage with complex issues. By undertaking a workplace-based project, engagement with the complex issues becomes more effective for the students. Engineering students receive the motivation to learn about complex issues related to their proposed work environment via project-based learning approaches such as developing a real-life conceptual design for water and sewerage services [49].

4.3 WIL and Academic Workload

Partnerships between universities and industry have traditionally focussed on the knowledge transfer of university research to industry and collaborative university-industry research. This type of collaboration introduces the concept of 'academic WIL', in which academics complete a sabbatical placement with an industry partner. It is a way to re-engage teaching-focussed academics with industry. Academics can experience current industry practice by collaborating with industry partners on research projects, which is a way for teaching-focussed to remain engaged with industry [49]. The academics can test their knowledge and skills in the 'real-world' via academic WIL placements. The academics can learn new techniques that would be challenging at that time. Through this methodology, the curriculum can be benchmarked with the requirements of the industry. Other significances are increased industry networks and opportunities for WIL placements for students.

There are some limitations of academic WIL, such as the possible bias towards industry-needs in developing the curricula. University graduate attributes also need to be met. Another concern is one specific industry sector may receive more focus in the curriculum and poor performing teaching-research academics may not have the incentive to participate in an industry placement. Department heads may give good teachers more teaching and research-focussed academics may continue their research job, which will not add the value of academic WIL [50]. Teaching-focussed academics may leave academia for a career in industry and casual academics may no longer be available for teaching as they find a career path in industry.

Due to the involvement of an external partner in the assessment process and the complexities of assessing the more holistic nature of WIL learning, WIL assessments are different from classroom-based course assessments. The academic workload implications of WIL assessments for Australian university academics must be investigated. The largest single contributor to the academic workload in WIL courses is the assessment of student learning. There are several contributing factors influencing staff workload. Many factors reflect the broader challenges of the WIL assessment, including the complexities of assessing holistic student learning and the individualised nature of WIL assessment [51, 52]. Possible factors associated with higher education assessment workloads are similarly influenced staff workloads in WIL. Examples are the time and effort involved in providing high-quality feedback to students and the complexities of assessing reflection. A study presented in two publications claimed that the involvement of external partners in WIL increased assessment workloads [53–54]. There is extra workload required to assess the professional competence of students owing to the need to equip and support industry partners [55] and chase them to ensure the timely return of industry-based assessments.

To sustainably manage the workload involved in assessing WIL, various 'balancing acts' need to be negotiated at individual, departmental and institutional levels. Pedagogy, policy, practice and research need to be addressed in a multi-dimensional fashion to ensure the scalability and sustainability of WIL courses. To reduce the amount of unrecognised academic workload that WIL assessments entail and enhance the quality of student learning it promotes, the different modes of assessment that are currently used need to be evaluated in-depth. The impact on workloads of all stakeholders due to the collaborative modes of assessing student learning through WIL is valuable to understand. To effectively recognise and reflect on the diversity of WIL and evaluate whether these adjustments achieve their desired ends, university faculties need to adjust their academic workload models [56]. Further research is required to find the total operating costs and benefits of supporting WIL and analysing methods to meet these costs.

4.4 WIL Leadership

There is a need to support WIL leadership capacity building and professional development of WIL staff and develop and test a WIL leadership framework. A study conducted with this aim was based on a distributed leadership approach through the distribution of power by the collegial sharing of knowledge, practice and reflection within the social context of the university and industry organisations [57]. The roles and settings for WIL are defined by several factors within the WIL context. These factors provide the perspectives of WIL context for consideration, including WIL balance in universities and industries; WIL delivery in small and large industries and partner organisations; WIL practice in universities, disciplines and organisations; the level of organisational focus on WIL and the role and responsibilities of WIL leaders and practitioners in university/industry settings.

Shaping the WIL vision domain is aligned to other leadership models [58]. It appears in the centre of the framework and links together the other four domains such as communicate and influence, create relationships, drive outcomes and foster engagement to shape the WIL vision. Shaping the domain gets feed from and feeds into the other domains. These authors identified that WIL leadership is distributed across tertiary institutions and industry, and benefits WIL from shared and collaborative relationships. Similar challenges are faced by WIL leaders in tertiary institutions, disciplines and industry. To build the WIL capabilities of staff and implement and maintain effective WIL activity, enhanced collaboration and support are required by industry and partner organisations. Important drivers of WIL practice are WIL vision and strategic intentions. A recognised need for WIL practitioners is resourcing and acknowledging the work of WIL leaders. The three intended outcomes achieved using the WIL leadership framework include a multi-dimensional framework of capabilities, characterisation of WIL leadership and nurturing a community of WIL leaders [59]. Further research is required to improve the effectiveness of WIL leadership capacity via EWIL by increasing the industry component in engineering education programs.

4.5 Industry Engagement

To determine the requirement of support and contribution to WIL, engagement with industry partners is essential. A study conducted by Curtin University in 2016 on improving WIL industry engagement developed user-friendly and accessible resources for industry. The study collected data from various sources and findings such as negotiating partnerships, resources on assessment, information on clarification of roles, and feedback and supervision of students. In Australia, the WIL agenda is widely engaged with universities, university corporations, government agencies, discipline-specific organisations and peak industry bodies [60]. According to the research findings, it is evident that to support industry engagement with WIL, a range of resources need to be developed. A key finding was that for industry, greater clarity is required around their roles and responsibilities for monitoring student progress through assessment, supervision and feedback. To facilitate a collaborative approach to learning, all parties may be involved as assessors as an empowering process, espoused a model of assessment. Deciding the nature of educational programs is difficult due to the uncertainty of attributes required for a productive and globally competitive workforce. Industry engagement and input into the curriculum are required by education that promotes skills development and entrepreneurial skills. To achieve this, two-way communication channels are required. To progress the WIL agenda as per the industry requirements, the Curtin University's study identified clear strategies and deliverables to develop resources in the format required by industry partners and developed a website and provided a store of resources for industry and provided future directions for the WIL domain [61]. This study was limited to the development of industry resources.

Australian engineering education includes the industry exposure requirements and provides relevant experience for graduate employees' future practice. Currently, academic staff are focussing on engineering science research and challenges students' experiences of industry engagement coverage, quality and university assessments. A project by Male and King, based on the national project by the Australian Council of Engineering Deans completed in June 2014 that included 35 Australian universities and was supported by Engineers Australia, engineering employers and industry peak bodies, was aimed at increasing the employability of graduates, student retention and graduation rates through stronger industry engagement for all students during the early years of engineering degree programs. The two proposed approaches were (1) A research-based model for improved industry engagement in engineering degrees. The university participants explored and refined this in extensive sector-wide consultation processes. This approach developed model principles for an industry engaged curriculum, with best-practice guidelines. Practice improvements in their industry engagement methodologies were demonstrated by the participating universities through recommendations for action by industry and employers, academic providers and stakeholders. The outcome included a suite of resources and a reflection tool. (2) To implement and evaluate 'industry-inspired' content, in core curriculum areas of engineering science and practice, particularly in large enrolment subject units. The study included 1,000 students and involved approximately 30 engineering employers.

From Male and King's (2014) study findings and literature on engineering higher education, a curriculum model was developed progressively integrating the effective exposure of engineering degrees to engineering practice. The model encompassed learning, motivation and identity development, which are key elements of the student's entire education experience. In the curriculum, exposure of practice is aimed to develop: (1) an understanding of engineering practice comprehensively and accurately; (2) the faculty and the profession's sense of belonging; (3) the engineering program's recognition of relevance to motivate learning; and (4) understanding context and connections and thereby improving learning. Male and King's (2014) study aimed to systematically improve industry engagement and employability in reference to Engineers Australia's Stage 1 competencies [62]. To track their progress against Stage 1 competency standards, Engineers Australia launched EA Connect to help students who are looking for industry placements contact employers. Difficulties in securing student placements was reported in the industry-university forums and from student focus groups. Many universities prefer to provide WIL within the curriculum, but the engineering faculties favour the traditional casual employment arrangements. This project findings and guidelines highlighted the benefits of WIL in science, technology and mathematics degrees and demonstrated the outcome of small and focussed investment in university – industry partnerships towards bringing industry-inspired content into the curriculum. In all core course units in engineering science and practice, universities may contribute to industry-inspired and industry-referenced resource materials. There are opportunities for systematic improvement addressing the deficiencies and challenges to current practice. The limitations are the challenges in finding ways to be engaged and lack of any university support. The universities need to initiate successful engagement and contact employers about WIL opportunities. There is a research requirement in designing a EWIL framework to address this gap in a lack of industry engagement.

4.6 Benefits of WIL for Universities

WIL contributes to the university by helping students to graduate and transition into the workforce with employability skills. WIL provides universities with the venues for their students to manage diversity and ambiguity, recognise and mitigate potential risks and solve problems effectively. WIL facilitates the opportunities for students to transform their learning experiences into practice knowledge, by sharing and reviewing their workplace experiences [63]. WIL increases the quality of engineering education in universities by improving the employability of graduate engineers. The graduate engineers who undertake WIL may improve their chances of getting hired; therefore, a university that provides WIL for engineering students becomes a sought-after destination [64]. The university rating and ranking will become higher due to the increased employability outcomes and student satisfaction.

4.7 Barriers to Participating Universities

To build institutional capacity to enhance access participation and progression in WIL, a research project led by QUT, in partnership with four Australian universities, investigated WIL participation barriers [64]:

1. At the partner universities, it investigated the current practices in WIL management.
2. It translated the education principles into the WIL context in working with national and international colleagues to improve access, participation and progression for students.
3. It enabled improved support for students to participate in WIL from various backgrounds to change university policies, principles, guidelines and procedures.

Three main themes emerged from the survey administered to stakeholders from a range of undergraduate programs, which captured insights into the student experiences:

1. The success of WIL is influenced by the following main factors: WIL opportunity flexibility, WIL experience alignment to their career and workplace acceptance of diversity. Regardless of context, discipline or student circumstance, these factors appeared to be equally prevalent.
2. WIL preparedness and workplace conditions were the main factors enabling successful participation in WIL.
3. Six aspects of WIL were identified by the students that they would like to see changed, which were workplace preparedness, workload, alignment and supervision, attendance flexibility and mode options, organisation and support, WIL opportunities, communication and building confidence, and workplace culture.

According to the framework developed by the Impact Management Planning and Evaluation Ladder to review and consider the impact at different levels [65], in undertaking WIL experiences, issues regarding communication skills and lack of local contacts networks are barriers for students. Mental health issues associated with financial difficulties, caring for dependants, time management issues and disabilities are the academic staff being unaware or do not externally influence the student's function in the WIL experience. As more students start undertaking WIL, the current academic and other staff will have to handle larger numbers of WIL students and the challenges they face in accessing the benefits of WIL. This issue needs to be managed through program restructuring and employing non-placement WIL such as on-campus placements. This strategy might reduce the workload considerably over time.

Various key curriculum areas of WIL were mentioned in the above discussions. There is a clear gap in the academic engineering curricula regarding the industry-readiness via WIL that provides benefits to universities, workplaces and graduate engineers. Research is required to develop an effective WIL framework that can address and meet the expected requirements of the key stakeholders. The discussion also implies that there is a need for an innovative WIL learning framework that will address the academic workload in an optimum way without causing more work pressure on academics and engineers in the workplace and causing any compromise to the quality of WIL.

5. WIL and Industry-Readiness

This section will be focussing on the current literature in the expected industrial employability and work-readiness achieved through WIL. The major studies on employability skills required of graduate engineers, in addition to occupation-specific skills will be analysed. The issue of gaining professionalism through observation and interaction with others, the impact of WIL and graduate outcomes and the components of a quality WIL curriculum also will be discussed.

5.1 Engineering Industry-Practice

A study by O'Brien, Venkatesan, Fragomeni and Moore [30] proposed nine dimensions of engineering practice. Focussing on these nine dimensions, they conducted a study on final-year civil engineering students at Victoria University, Australia, investigating how well final-year engineering students prepared to enter the workforce. This study has implications for engineering education institutions with WIL and problem-based learning approaches, indicating understanding students' perceptions of preparing industry-ready graduates. The civil engineering students believed they were prepared to enter the workforce with communication, teamwork and leadership skills in nine dimensions of engineering practice. For successful engineering practice WIL, problem-based learning and learning in the workplace and community are essential. Early employment negotiations are the benefits of learning in the workplace and community experiences. The findings indicate the importance of industry in informing educators about the new graduates on their needs and expectations. Learning in the workplace and community provides opportunities to bring the educators and industry together to devise the learning outcome and future curricula. Problem-based learning and WIL experiences are the key aspects of a good engineering course [66]. This study has a limitation that it was focussed purely on the perceptions of final-year students on how well prepared they were to enter the workforce. Further research is required to investigate the preparedness for engineering practice in Australia, the experience of the actual transition after engineering graduation, as an engineer, and how well graduates are being prepared for the work-life.

Workplace-based or simulated learning opportunities develop students' employability capabilities. WIL enables practical settings for students to learn through experience and the higher education experience need to prepare graduates through WIL. The aim of the research funded by the Office of Learning and Teaching was to guide university leaders in curricula investment and best practice. It was also aimed to judge the impact of WIL on the readiness of graduates to commence work and provide an evidence base [67]. The project aimed to address the research questions on the essential characteristics of WIL and the valid measurements, methods to conceptualise and measure work readiness and the impact of WIL on work-readiness. The data collection involved five study types: "Cross-sectional study", "Proxy-longitudinal study", "Alumni interview study", "Employer interview study" and "Employer survey study". The impact on learning and gaining employability skills are integral to the authenticity of the WIL experience. Factors required for optimal WIL experience outcomes are preparation and induction, quality of supervision, aligned curriculum, debriefing and employer feedback. Productivity, sustainability and innovation of the worldwide economy are directly influenced by the employability capabilities of graduates. The need to support WIL initiatives requires increasing recognition from the government, industry, education providers and community. The research results provide a comprehensive evidence base supporting a commitment to resourcing WIL and highlighting the role of mutually beneficial collaborative partnerships between industry and community organisations and educational providers in culminating employable graduates by providing authentic student experiences.

Graduate attributes and skills have been the focus of most of the work-ready research. To conceptualise professionalism, the ways in which students gain professionalism and how it affects their professional identity construction are key issues. An exploration of students enrolled in WIL programs on how they think they learn to become a professional reveal the efforts to construct a "hoped-for-possible" professional self, continually renegotiating their sense of self [68]. The study emphasised the importance of self-management and self-censorship to look and sound like a professional. Defining professionalism is a difficult task for students who interacted with others, in the workplace or at school to become professionals. Self-regulation and imagining the hoped-for-possible professional self are mandatory to becoming a professional and require focus on managing personal information and controlling emotions. The limitation is that these research findings are based on limited samples and represent an exploration of only the thinking and attitude of the students. More research is required to focus on how professionalism is perceived by different genders, culturally diverse people, those already in the workforce and new graduates regarding which attributes are accepted and valued [68].

5.2 WIL and Graduate Employability

Relevant studies are questioning the nature of the relationship between student participation in WIL and the improvement of graduate employability and employment outcomes. Although universities may not reduce their WIL interest and efforts, evaluation of the contribution of WIL to graduate employability and employment is required due to the importance of quality assurance and improvement processes for institutions. The relationship between WIL and graduate outcomes is complex and context dependent. Studies have developed and presented evaluations of the contribution of WIL to graduate employability and employment proposals and offer a methodology in its own unique institutional context that others can adopt or use as per their requirement.

Existing graduate destination survey data was used in a study by Harris and James [69] and matched the student records to analyse the impact on graduate employment through the student participation in WIL activities outcomes in one discipline. The study also used the employability survey instrument for a longer term [70]. To incorporate WIL activities into university study programs, there is significant competitive pressure; therefore, universities are keen for involvement in WIL. For quality assurance, it is important for institutions to conduct their own evaluations regarding the impact of WIL and graduate outcomes, due to the effort and cost of participation in WIL for all stakeholders. The expected differential benefit or impact will likely diminish as WIL moves to a generally available option from a specialised student activity. In such situations, all stakeholders need to optimise the value of WIL for graduate outcomes [71]. A key strategy for promoting graduate employability is WIL. The diverse range of skills, attributes and criteria such as networks, professional identity and active social skills are included in the concept of graduate employability. In the study, emphasis was given to appropriate pedagogical strategies to effectively support the importance of embedding WIL experiences in the curriculum and employability outcomes, where quality assessment is provided. The study by Harris and James would have considered the resourcing implications and impacts of WIL on staff workload for higher education.

Many WIL employability studies are not based on employment data but student or industry self-reported perceptions [72, 73]. Before completion of their degree, employers prefer graduates to have two or more WIL completion experiences and a minimum of 6–12 months of full-time work experience [74]. Besides the discipline-specific knowledge and generic skills, it is important to identify and develop context-specific skills for dedicated professions. Employability can be developed through activities such as co-curricular WIL or using holistic approaches to more effectively embed employability within the academic curriculum. Employability is the potential to gain desired employment [75]. It emphasises how graduates need to behave and perform in employment. Employability has attracted considerable attention and scholarly debate in the literature. However, the evidence connecting the attainment of work-ready skills to the impact of graduate employability and employment has some important gaps. To enable the students, identifying and connecting the desirable graduate competencies to their learning activity and curriculum redesign with employability foundation to the curriculum must be considered. Employability will remain a focus of scholarly debate and a key research direction because to effectively prepare the post-secondary students for a lifelong career in their chosen field advancing the provided education is integral [76].

To meet the needs of labour markets, in addition to occupation-specific skills, employability skills of graduate engineers are mandatory. Employability skills are an additional set of skills and include attributes such as professionalism, creativity and initiative, emotional intelligence, flexibility and adaptability, self-awareness, willingness to learn, self-confidence, independence, stress tolerance, reflectiveness, and a commitment to lifelong learning. Personal qualities, core skills and process skills are included in the employability skills framework. Several aspects from each skill group are shown in Table 2.

A documentation study of job advertisements in newspapers and online is suggested to identify the critical employability skills enabling the transition from graduation to competitive workplace [78]. A summary of the results of previous studies is given in Table 3. As perceived by the employer or supervisor at the workplace, the results are focussed on

Table 2. List of Employability Aspects [77]

Personal Qualities	Malleable self-theory, Self-awareness, Self-confidence, Independence, Emotional Intelligence, Adaptability, Stress tolerance, Initiative, Willingness to learn, Reflectiveness.
Core Skills	Reading effectiveness, Numeracy, Information retrieval, Language skills, Self-management, Critical analysis, Creativity, Listening, Written communication, Oral presentations, Explaining, Global awareness.
Process Skills	Computer literacy, Commercial awareness, Political sensitivity, Ability to work cross-culturally, Ethical sensitivity, Prioritising, Planning, Applying subject understanding, Acting morally, Coping with complexity, Problem solving, Influencing, Arguing, Resolving conflict, Decision-making, Negotiating, Teamwork.

the attributes of employability skills for entering the world of work required by graduates.

The employability capabilities in students through WIL and the employability outcomes have been an interesting area of research. Qualitative and quantitative study on employers, graduates and current students helped to identify the components of a quality WIL curriculum. To enhance the acquisition of employability capabilities through contributing to quality learning outcomes, a study identified the key curriculum dimensions such as curriculum design, assessment methodologies and partnership models [79]. The essential elements of an experiential curriculum are the learning outcomes and assessment integration of theory and practice, activities of student preparation and debriefing, active supervision and constructive feedback, learning experience authenticity and robust partnerships with host organisations. Curriculum design factors result in student satisfaction, meeting student expectations and influencing employability. The main goal of a good WIL design is authenticity and that the enterprise of WIL design is complex. Curriculum elements are underpinned by assessments and activities in accordance with integrative learning with a foundation of good supervision, preparation and debriefing. The importance of any learning outcome depends on specific curricula. The overarching goal of WIL is employment readiness. Effective WIL curricula are complex pedagogical enterprises and different parts of a complex puzzle are integrated into it [79].

Different workplace-based approaches apply to develop employability in university graduates. Further research is needed to design a EWIL framework to develop industry-ready graduate engineers by addressing the three aspects of employability –

Table 3. Summary of Employability Skills Attributes [78]

Research Focus	Methods	Approach	Employability Skill Attributes
Employers' perspective	The questionnaire, the respondents consisted of 180 employees in various fields of engineering.	This study used the instruments adapted from the SCANS model.	The analysis showed that personal quality is the highest mean values followed by interpersonal skills, resources skills, basic skills, information skills, thinking skills, and system and technology skills.
Graduates and employers perception	The questionnaire to assess the information perceived by graduates and employers. There were 34 graduates and 29 employees who returned the questionnaire.	The instrument used in this study adapted from Survey of the Employability Skills Needed in the Workforce, originally designed by J. Shane Robinson.	Problem-solving and analytic, decision-making, organisation and time management, communication ability, interpersonal skills, leadership and influence, creativity, innovation, flexibility and ability to conceptualise, lifelong learning, professional behaviour, motivation-personal strength.
Examines employers and instructors' perspectives	The data was collected using a questionnaire which was analysed using descriptive and inferential analysis.	Focussing on seven core skills comprising communication skills; critical thinking and problem-solving skills; teamwork skills; lifelong learning and information management; integrity and professional ethics; entrepreneurship skills; and leadership skills.	The highest ranked perceived by employers and university instructors are communication skills, and integrity & professional ethics. The lowest ranked are leadership skills and entrepreneurship skills.
Investigates the importance of employability skills as perceived by employers	The data was collected using a questionnaire. Employers participating in this research was an operational manager, supervisor and chief executive.	The instruments used in this study were adapted from the SCANS model. Employability Skills 2000+ form Conference Board of Canada, and Malaysian Qualifications Framework.	The findings of the study showed that employers place great importance on communication skills, problem-solving skills, teamwork skills and personal qualities. Graduates also need to emphasise leadership skills, entrepreneur skill, technical skill and informational skills.

context-specific employability, individual human capital and the ability to articulate possession of the desired attributes. An appropriate EWIL framework can meet the increasing accountability measures and the demands of society for a dynamic global workforce by addressing the WIL factors such as preparation, induction, quality of supervision, aligned curriculum, debriefing and employer feedback for optimal WIL experience outcomes. EWIL can also increase the possibility of delivering expected industry-ready engineering graduates with a diverse range of skills, attributes, networks, professional identity and active social skills.

5.3 WIL and Professional Development

Continuing Professional Development (CPD) was introduced to update the outdated skills and knowledge of employees of an organisation [80]. CPD concerns practices aimed at employees' development beyond that derived from their initial training [81]. To build the skill sets in the organization, some companies adopt the strategy of utilising professional development to improved efficiency, increase retention, build confidence and credibility, re-energize staff and make easier succession planning [82]. Some organisations actively promote professional development activities to inspire loyalty in their employees by encouraging professional growth which is in turn a great way to retain staff [83]. There are many advantages of Professional Development programs which help engineers' and company's growth. The advantages include that the graduate engineers can stay ahead of competitors, keep up with industry changes, receive an opportunity to learn, grab in new talent, increase self-confidence, positive attitude, improve group effort, and develop customer care abilities [84].

When graduate engineers start working in an organisation, they might be required to undergo training and professional development. Graduate engineers take time out of their work-day resulting in reduced work and productivity in addition to their less output as compared to the experienced engineers. In-house PD's are usually free of cost, but advanced PD's come at a cost. Most of the external PD's are expensive although the PD worth the expense, companies, especially small enterprises, may not be able to accommodate it in their budget [85]. For in-house professional development, if the senior engineers deliver the PD graduate engineers, the operations would be down or less productive. This could lead to adverse impact to the company's productivity and budget. EWIL is expected to help in reducing the necessity of professional development for graduate engineers in the early stages of their career. This is because they would have already gained the technical and operational know-how of different kinds of workplaces.

5.4 Benefits of WIL to Industries

In industry, employers are looking for engineering graduates who can quickly become productive members of the organisation. The first-hand work readiness of future graduate engineers helps companies during recruitment processes. The employers are also more confident in recruiting graduate engineers who can make a smoother transition into paid employment. Industries can reduce costs and recruitment risks. For employers, the readiness to give back to the professional field and thereby meet their corporate responsibilities helps to improve their corporate image. Employers often desire to advance their business through facilitating WIL and recruiting graduates. With university collaboration, industries can gain access to innovative thinking and ideas by cooperating in emerging research.

5.5 Barriers to Workplace Participation

As the number of WIL students grows, the number of relevant workplaces also needs to grow to accommodate and facilitate the students [63]. Employers' understanding of the WIL experience may not align with the purpose and nature of the WIL expectations of universities [86]. Employers may not accurately understand the requirements of WIL and how they need to facilitate it. Employers also may not have sufficient resources and supervisors to coordinate WIL [87]. Identifying the suitable student or students to attend the workplace in the appropriate phase of their business cycle may be a challenge [61].

A previous study identified the reluctance of employers who might not want to provide WIL experiences [5]. Their concerns may result from an unclear understanding of WIL and the potential costs to productivity and return on investment, which may result in a general reluctance to take on students for WIL. However, sometimes there is a reluctance to offer WIL to international students, students from low socio-economic backgrounds or those with disabilities. Such an attitude creates difficulties for these students in gaining graduate employment, which universities need to consider due to the expected commitment to inclusiveness and equity. Some employers do not favour WIL because they fear that WIL may cause wastage of time, increase distraction, reduce the focus on productivity and impart more financial load on the company. Some employers do not want to participate in WIL because of the possible low organisational productivity, production defects and errors, extra business expenses, disturbance to the production process due to the students in the learning phase and the possibilities of increased workplace accidents [88].

No research studies were found that had investigated the possibility of enhancing WIL through embedding workplace learning components throughout engineering studies. To emphasise the real-time engineering, environmental, social and economic issues, an innovative approach to curriculum and assessment design embedding EWIL is necessary. EWIL needs to enable the engagement of engineering students with complex issues, and they need to be motivated to learn and relate the problems to their proposed work scenario. The study program must include structured learning opportunities and WIL needs workplace mentors to develop the professional identity of the students. To ensure the scalability and sustainability of WIL courses, pedagogy, policy, practice and research need to be appropriately addressed. Barriers for students, such as a lack of communication skills and contacts, financial difficulties, dependants and time management, can be managed through program restructuring, including the proposed EWIL. There is a need for devising engineering programs with EWIL by designing motivational workplace experiences that avoid the current WIL complexity. The proposed EWIL framework may also include developing institutional strategies and the means of implementation and providing exposure to academics. Such a EWIL framework will bring better quality to engineering education and universities will benefit in various aspects, including increased international ranking.

6. WIL and Students

This section will explore the available literature in the critical areas such as increasing the employability of graduates, student-centred WIL approaches, formal, semi-formal and informal learning, enhancing professional identity development and professionalism, benefits of WIL to students and WIL barriers to participating students. Studies conducted in the student engagement requirement with industry partners to determine the support and contribution to WIL, and the role of industry integrated education in choosing the area of engineering studies and career certainty will also be discussed.

6.1 Employability of Graduating Engineers

Higher education is supposed to teach employability skills as one of the most valuable outcomes through WIL. Employability is the capability to gain and maintain employment and keeping fulfilling work [89]. Employability equips a person to choose and secure occupations using skills, knowledge and personal attributes providing success and satisfaction in employment [90]. Employability also refers to the ability to realise the sustainable employment potential through self-reliance within the labour market.

The four elements of employability are:

1. Employability assets of a person, consisting of knowledge, skills and attitude.
2. Career management and job search skills.
3. Presentation, including CV writing, work experience and interview techniques.
4. Personal circumstances and external factors such as the current opportunity level within the labour market.

Some universities also help students grab the attention of top recruiters using work integrated learning. WIL should expose the actual potential of students and has been proven successful in its purpose.

6.2 Student-centred WIL Approaches

If there is no learning framework in an unstructured or informal work placement, expectations regarding the WIL outcomes cannot be completely achievable. However, it provides an opportunity for learning from each other and accessing formal learning experiences. To utilise informal learning in formal training, different modes of workplace learning need to be combined. This learning structure integrates education into workplace learning where the students have access to various learning opportunities, accurate assessment, constructive feedback and reflection on learning.

The workplace informs activities and access guidance; however, there is a risk of limited affordances that may cause the learning process to fail. In addition to workplace-based learning, the teacher and the learner can initiate collaborative and active learning. Curriculum, predictable learning outcomes and techne and phronesis, which are the formal learning characteristics, can bridge learning gaps. In a semi-formal learning environment, work implicit knowledge will be gained through a structured WIL framework. Informal learning includes implicit and explicit knowledge, intentional and unintentional learning, and a focus on tool use and mental activities. Integrating contextualised learning is dependent on other activities and eliminates distinctions between knowledge and skills [91].

Research conducted on Canadian university students regarding the role of cooperative education in changing majors and career certainty, explored the frequency of students changing their major and their reasons for doing so. Interest and impact on career were the two primary reasons cited by non-cooperative students. Both cooperative and non-cooperative students were not aware about career certainty and the students were unsure their further possibilities after graduation. The research found that non-cooperative students switched majors frequently, delaying their graduation. This can be changed by confirming their major during the early stages of their studies. The research suggests that universities must provide co-operative/WIL students with sufficient information about career paths and opportunities for their area of study to help them with long-term planning [92]. Further research is required regarding the link between the academic program and their career path and how to transfer classroom knowledge to practical work experience. A EWIL framework can address this requirement by embedding practical work experience throughout the engineering education program.

Integrating classroom and workplace learning has been increasingly focussed on students. Students are learners in the university context, pre-accredited professionals in the workplace context and facilitators of peer learning in both contexts. Opportunities for transformative learning include student participation in professional roles through workplace learning experiences. WIL plays a very important role and has a critical place in the curriculum in enhancing professional identity development and professionalism [93]. WIL has enormous pedagogical potential in developing professional identity formation between university and work, with WIL and professional identity embedded throughout the course curriculum to educate students to become critical, considerate, global citizens and lifelong learners. This confirms the necessity of the development of a EWIL framework.

6.3 Benefits of WIL to Students

Undergraduate students place a high value on work placements. The outcomes of deliberately planned and managed WIL are students can apply their theoretical knowledge and utilise transferable skills, develop professional attributes and understand and apply ethical practice. They also engage in teamwork, problem identification, problem-solving, self-management and effective workplace communication. Students are exposed to diverse and increased learning opportunities through WIL, which contributes significantly in their university to workplace transition. WIL experiences help students find employment, establish a network of contacts and develop career strategies, providing a competitive edge over other graduates [5]. Students gain the opportunity to work in a real work setting and develop a sense and awareness of workplace culture, enhance their soft skills and apply theoretical knowledge, make a positive impact and offer solutions to real-life problems, manage their future career decisions and aspirations, build a flourishing network of contacts, boost their employment prospects, and broaden their perspectives, awareness of global challenges and industry issues.

6.4 WIL Barriers to Participating Students

Implementing WIL has faced a range of barriers and challenges. The three major stakeholders – universities, employers and students – have different interests, priorities and views. There are barriers and challenges for each of the stakeholders individually. WIL frameworks will need to consider these barriers and provide an optimum arrangement for the realisation of engineering WIL. Little attention has been given regarding the WIL of marginalised students to their needs and potential contribution [22, 94, 95]. Students may face multiple challenges when participating in WIL, although different institutions use various supports and strategies. When participating in a WIL program, students may face financial and time pressures, and student expectations may not be met. Some departments may be reluctant to get involved in WIL due to the lack of awareness and students will be directly affected by this [96]. Physical, mental or social challenges encountered by international students cause difficulties in participating in WIL. The discrimination of employers to these students is a key barrier. International students are unfamiliar with the Australian workplace culture, and they may have prejudices due to their expatriate status [97]. International students also face barriers such as language, culture and visa restrictions to participate in WIL [95].

Because student throughput was affected due to WIL complications, some educational institutes started revising the curriculum without WIL. According to a study by Mutereko and Wedekind [98], the existing WIL cannot produce work-ready graduates and these authors put forward the idea of devising engineering programs without WIL. In the current system, some employers might exploit WIL students to get cheap labour and thereafter low-waged employees. Although theoretically WIL should give better results, practical challenges may compel a program to drop the work-based learning form of WIL. The WIL costs and its logistics are very high. The new programs without WIL may have a positive impact on student throughput and funding; however, the effects on employability and work-readiness attributes are not established through this study. The study has a limitation that the data sources were only from higher education perspectives and the study had not taken inputs from industry and students who could give valuable insights [98].

From the above literature, there is a need for further research in developing a EWIL framework to enable educators to focus on developing confident, open, self-assured and compassionate, work-ready graduates who are global citizens. WIL delivered based on the proposed EWIL framework will provide the confidence in graduate engineering students to face the challenges of change professionally, responsibly, ethically and without any fear or bias.

7. Examples of International WIL Scenarios

A research study by Conger and Long [99] investigated WIL features and compared it in the international scenario through standard quantitative methods. The study was an attempt to determine the effects of WIL during undergraduate years on the academic performances of students with the following hypotheses: (1) WIL is associated with increased final-year GPA[1] and (2) pre-university grade is associated with increased final-year GPA. Graduating cohorts in Japan and Hong Kong showed a positive effect of WIL on third year GPA for two years and negative results in the following year. To verify this authenticity, the investigation needs to be continued for a few more years for consistency. The learning outcomes and context reflect the quality of WIL. Another result is that about a half of third year GPA was contributed by the first year GPA. There are studies regarding differential patterns of cognitive achievement and gender differences in pre-university achievement [99]. The factors promoting these differences are non-cognitive abilities such as organisation, self-discipline and dependability [100]. The study proposed a standard approach that needed to be developed to collaborate WIL globally for the WIL practitioners and advocates. Because the impact of workplace learning processes on academic development might have implications for placement consideration by universities, it is potential area of future research [101].

The Work Placement for International Student Programs (WISP) project provides workplace experience, career advice and employability for international students [102]. Within the study programs during work placements, international students face issues and concerns [103, 104]. To improve the experience of international students through improving work placement components of study programs for international students, the WISP project aimed to (1) Identify current practices for work placement and assessment, (2) Identify and understand the concerns and successes for the students, mentors and coordinators, (3) Working model development and application for effective practice around internationalisation, workplace socialisation and reflection.

If an inter-cultural approach to understanding and interaction is carried out, the challenges to international students, their supervisors and other relevant stakeholders can be avoided. The WISP model highlights the effective ways to embed such an approach. A theoretical and evidence-based foundation was provided through this model, which developed support materials for all involved stakeholders [105]. The major challenge in the international scenario of WIL is the difference in curriculum and workplace practice globally. There is scope for a standard EWIL framework that needs to be developed and could be applied internationally. The proposed, EWIL framework must accommodate the varying demands and expectations of engineering education.

8. Discussion

A summary of the current WIL practices and research areas discussed in the above sections is provided in Table 4. Authors' recommendations are also listed.

The above sections have outlined the benefits of WIL and identify gaps in the currently available WIL arrangements and curriculum, as listed in the Table 4. There is a scope for research towards the development of a flexible EWIL framework, which will be beneficial to Australian and global engineering education scenarios. The framework could outline WIL in all the semesters of Bachelor of Engineering programs. The EWIL framework could embed industry-inspired content into the curriculum and the outcome of small and focussed investment in university and industry partnerships. The EWIL may include learning, motivation and identity development and can create a range of resources to support industry engagement with WIL. The effective development of engineering and entrepreneurial skills can be achieved by enhanced industry engagement and input into the curriculum through ongoing communication between universities and workplaces. The EWIL framework will help universities provide the WIL students with sufficient information about career paths and the opportunities for their area of study.

[1] GPA is grade point average, which is an American term. In Australia, it would be the weighted average mark (WAM).

Table 4. Review summary

Section/Sub-section	WIL practice/research area	Authors' recommendations
2. Engineering WIL and expectations	The purpose and expected outcomes of WIL	Further research to develop a WIL Framework to effectively meet the WIL expectations.
3.1 Male and King's engineering practice model	Industry-exposure for engineering students from earlier stages of studies via virtual work environment.	WIL might be offered in all semesters, including on-site training, workplace simulations, and off-site project works. Direct industry engagement could enable students develop industry-readiness.
3.2 Competency-based WIL frameworks	Modular WIL programs that enable students to move from one modular course to the next with flexible timeframes.	The framework could provide a guideline stating at what stage of the engineering program the WIL will commence and the duration of the WIL.
3.3 WIL assessment models	An approach in which the student prepares the portfolio and the employer, or mentor, authenticates it, which gives greater workplace assessment evidence. The Authentic Assessment Framework supports comprehensive course review and demonstrates the authenticity and range of completed WIL assessments	Continuous competency-based WIL assessments are suggested during the entire duration of the engineering program. The students might need to be assessed for their knowledge and skills in each learning outcome. Assessments need to ensure that the graduating engineers have gained the expected industry-readiness.
3.4 WIL assessment validity and reliability	Workplace skills assessments have more validity and reliability than campus-based assessments. The validity and reliability ensuring that the students have successfully integrated theory and practice.	WIL assessments need to address each of the learning outcomes of the study program. Practical skills might be predominantly assessed on-site authorised by a workplace and academic mentor. In the situations where on-site assessment are not possible, assessments at simulated work environments is acceptable.
4.1 Engineering WIL arrangements in Australian universities	Current WIL facilitation in Australian universities. Although the universities offer WIL, the duration is short.	A more comprehensive WIL framework is required to meet the industry-ready outcomes.
4.2 WIL in the engineering curricula	Developing institutional strategies including objectives and pedagogical aspects to integrate more WIL activities. Academics to have clear goals, pedagogical tools and the opportunity to work outside academia. Long-time value for longer industry-based education. The need for structured learning opportunities and workplace mentors. In current WIL curriculum revolves around a team-based project. There is a need for innovative approach to curriculum and assessment with more emphasis on engineering, environmental, social and economic issues.	A framework in required that enables academics could effectively industry-based education. WIL arrangements might be extended to the entire duration of the engineering program. The recommended WIL framework will need to address all the learning criteria through a broad range of workplace projects and other learning activities.
4.3 WIL and academic workload	Academic WIL in which academics experience current industry practice. WIL and assessments increase academic workload.	The recommended framework need to balance the academic workload by converting part of the campus-based learning to industry-based, without affecting the academic work-load.
4.4 WIL leadership	WIL leadership capacity building. Distributed leadership approach across the university and industry organisations	Improvement in the effectiveness of WIL leadership capacity is required to effectively implement the recommended framework.
4.5 Industry engagement	Industry requires greater clarity on their roles and responsibilities for monitoring student progress. Requirement of developing a range of resources. A curriculum model for progressive integration of effective engineering practice exposure and difficulties in securing student placements.	In the recommended framework roles and responsibilities of the stakeholders will need to be established and resources for to be facilitated prior to WIL commencement. Universities need to have enhanced communication and marketing strategies to arrange WIL opportunities well in advance.
4.6 & 4.7 Benefits and barriers to universities	Benefits such as increased education quality, employability, reputation. Barriers such as handling larger numbers of WIL students, communication issues.	EWIL is spread over the entire duration of learning, increasing the benefits and minimising barriers via increased industry collaboration and WIL facilitation.
5.1 Engineering industry-practice	Importance of industry in informing educators about the new graduates on their needs and expectations. WIL brings the educators and industry together to devise the learning outcome and future curricula. The role of mutually beneficial collaborative partnerships between industry and educational providers.	The learning outcomes will need to be established before developing the framework and curriculum. Learning outcomes need to be based on the discipline-specific industry requirements and Engineers Australia's Stage I competency standards.
5.2 WIL and graduate employability	Pedagogical strategies to effectively embed WIL in the curriculum and employability outcomes. Employers prefer graduates to have more WIL completion experiences. Employability skills framework including personal qualities, core skills and process skills. Summary of Employability Skills Attributes. Employability capabilities and employability outcomes.	Recommended EWIL may increase the possibility of delivering expected industry-ready engineering graduates with a diverse range of skills, attributes, networks, professional identity and active social skills.
5.3 WIL and professional development	Graduate engineers take time out of their work-day resulting in reduced work and productivity in addition to their less output as compared to the experienced engineers.	EWIL is expected to help in reducing professional development needs for graduate engineers in the early stages of their career.
5.4 & 5.5 Benefits and barriers to industries	Benefits such as skilled graduate engineers, reduce costs and recruitment risks. Opportunities to give back to the professional field. Barriers such as the reluctance of employers to provide WIL, difficulties when the number of WIL students grows.	There is a need for devising engineering programs with EWIL by designing motivational workplace experiences that avoid the current WIL complexity. Such a framework will help industries to hire industry-ready graduate engineers and employers will no longer be reluctant to host WIL.
6.1 Employability of graduating engineers	Employability skills is one of the most valuable WIL outcomes.	WIL should expose the actual potential of students.
6.2 Student-centred WIL approaches	The learning structure to integrate education into workplace learning providing the students access to learning opportunities, assessment, feedback and reflection on learning. Changing majors due to career uncertainty. Role of WIL in the curriculum in enhancing professionalism and professional identity development.	The recommended framework provides broad opportunities for industry-engaged learning, assessment, feedback and reflection. Students will receive increased industry exposure to develop professionalism and create a better clarity on their career.
6.3 & 6.4 Benefits and barriers to students	Benefits such as increased employability skills, employment prospects, real work exposure. Barriers such as difficulty in finding placements, financial and time pressures, discrimination of employers.	There is an absence of framework in which the students' workplace learning has a high priority. Universities need to provide complete support to students by organising WIL, increased collaboration with industries throughout the duration of student learning.
7. Examples of international WIL scenarios	WIL increases the academic performances of undergraduate students. The challenge in the international scenario due to the difference in curriculum and workplace practice globally. The need for developing a standard approach to collaborate WIL globally.	The proposed framework needs to be flexible. It should be able to be implemented in any country depending upon the country's professional engineering education standards, government regulations, university and industry scenarios.

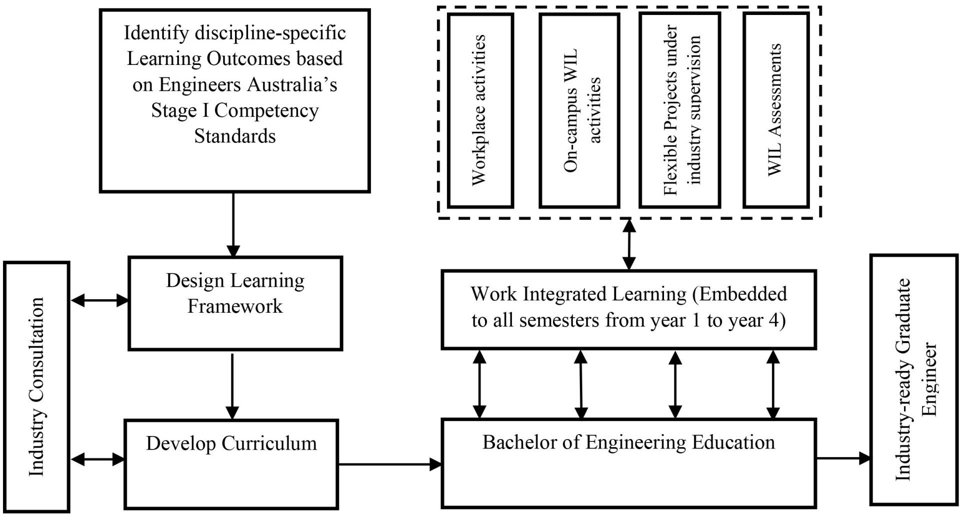

Fig. 4. Enhanced WIL Approach.

8.1 Recommended Enhanced WIL Framework Model

In the EWIL approach, the learning outcomes need to be identified first and then the learning framework and curriculum would be developed in consultation with the industry. Fig. 4 outlines the recommended EWIL Framework.

In the recommended EWIL Framework model outlined in Fig. 4, the discipline-specific learning outcomes would be selected by the curriculum developers and program managers. The learning outcomes will need to be based on Engineers Australia's Stage I Competency Standards for professional engineers. The learning framework and curriculum would be designed in consultation with the industry relevant to the discipline. The EWIL Framework and curriculum need to be implemented in collaboration with relevant workplaces in which the students engage throughout the duration of Bachelor of Engineering program.

The authors suggest the EWIL approach as below:

1. The program will begin with on-campus training during the first trimester to meet the Occupational Health & Safety (OHS) requirements of the EWIL partnering companies.
2. After the successful completion of OHS training, students will be offered with discipline-specific work placements and workplace projects at various company partners. This foundation workplace learning experience will help students to develop a strong awareness of their future career goals.
3. By the end of the first year, the students will have a clear idea about their interests and aptitude, which they can pursue further during the program.
4. The students will be provided with industry engagement opportunities in the EWIL at specific companies in the second and third years. The industry engagement will be more aligned with their disciplines. WIL will also reflect their interest and performance assessments.
5. The final year will be more focussed and structured to enable the students for a smooth university-to-industry transition.
6. Some of the students might receive the opportunity to become hired in the partnering companies based on their performance in WIL and the position availability.

A suggested model of Bachelor of Engineering students' campus and industry engagement through EWIL is as follows (Table 5):

In Table 5, Y1S1 indicates subject 1 in year 1 and companies such as A, B, and C represent the names of partnering companies in which the students undertake WIL. Bachelor of Engineering students would learn on-campus and via engagement with relevant workplaces. While developing the curriculum some of the units/subjects in a year of learning might be clustered together. Theory may be predominantly learned on-campus and practical might be primarily learned at the workplaces or via industry engagement including on-site training, workplace simulations, and off-site project works. Major project works could be included in the WIL curriculum that might be completed via different modes such as on-site/workplaces, in the workshop/laboratory and in the on-campus workshops. The units/subjects and companies indicated in each year are only samples and can be varied according to the factors such as engineering disciplines, universities, workplaces, and federal/state/institutional standards and regulations.

Table 5. Campus and industry engagement model for EWIL

Year	Units/Subjects	Theory		Practical			
1	Y1S1 Y1S2 Y1S3 Y1S4 Y1S5	On-campus	Workshop/Lab Companies A, B & C	Workshop/Lab, On-campus	Company A	Company B	Company C
	Y1 Project	On-campus, Workshop/Lab, Companies A, B & C					
2	Y2S1 Y2S2 Y2S3 Y2S4 Y2S5	On-campus	Workshop/Lab Companies D, E & F	Workshop/Lab, On-campus	Company D	Company E	Company F
	Y2 Project	On-campus, Workshop/Lab, Companies D, E & F					
3	Y3S1 Y3S2 Y3S3 Y3S4 Y3S5	On-campus	Workshop/Lab Companies G, H & I	Workshop/Lab, On-campus	Company G	Company H	Company I
	Y3 Project	On-campus, Workshop/Lab, Companies G, H & I					
4	Y4S1 Y4S2 Y4S3 Y4S4 Y4S5	On-campus	Workshop/Lab Companies J, K & L	Workshop/Lab, On-campus	Company J	Company K	Company L
	Y4 Project	On-campus, Workshop/Lab, Companies J, K & L					

The development process of graduating engineers in Australia is expected to satisfy the Engineers Australia Stage 1 Competency Standard for Professional Engineers. The authors recommend further research for establishing the learning outcomes for Bachelor of Engineering programs and the industry engagement proportion based on Engineers Australia's Stage 1 competencies. The authors hope that all students will receive adequate opportunities to achieve the appropriate skill levels and confidence via EWIL as part of university education. This comprehensive industry engagement approach is expected to develop industry-ready graduate engineers which in turn might improve the quality of engineering education and increase industrial productivity.

9. Conclusions

Developing an effective WIL arrangement has been a challenge in engineering higher education in Australia and worldwide. This review paper has outlined the research focussing on a range of major WIL areas and the efforts by Australian universities for the inclusion of different versions of WIL in their curriculum. However, there is a scope for improvement in the effectiveness of WIL by producing industry-ready graduate engineers. There is a need for developing a EWIL framework to work towards this outcome. The authors recommend further research to develop a flexible, standard EWIL framework that might address the current barriers. The framework is expected to help facilitating effective EWIL, which will be beneficial to graduate engineers, academics and industries. The authors also outline a recommended framework structure that might be helpful for improving the effectiveness of Bachelor of Engineering education.

Acknowledgements – The first author would like to express gratitude to his research supervisors who provided him with valuable guidance and constant encouragement throughout his research journey. He extends his sincere thanks to all the academics, engineering experts, curriculum specialists and graduate engineers who whole-heartedly shared their experiences and provided their suggestions. He is thankful to the researchers who provided him with their permissions to use the reproduced tables and figures from their publications.

References

1. D. Peach and N. Gamble, Scoping work-integrated learning purposes, practices and issues, *Developing learning professionals*, Springer, Dordrecht, Netherlands, pp. 169–186, 2011.
2. A. Rowe, T. Winchester-Seeto and J. Mackaway, That's not really WIL!–building a typology of WIL and related activities, *Australian Collaborative Education Network National Conference*, Geelong, p. 246, 2012.
3. H. Connor and K. MacFarlane, Work-related Learning (WRL), *HE–a scoping study*, Glasgow, Scotland, Glasgow Caledonian University, 2007.
4. J. Orrell, Work Integrated Learning: why is it increasing and who benefits?, The Conversation, https://theconversation.com/work-integrated-learning-why-is-it-increasing-and-who-benefits-93642, Accessed 12 March 2021.

5. S. A. Male and R. King, Improving industry engagement in engineering degrees, *25th Australasian Association for Engineering Education Conference*, Wellington, New Zealand, 2014.
6. S. A. Male, Virtual work integrated learning to support engineering student transitions, *STARS: Students Transitions Achievement Retention & Success*, Adelaide, South Australia, 2017.
7. J. Trevelyan, Are we accidentally misleading students about engineering practice?, *Universidad Politécnica de Madrid*, pp. 268–278, 2011.
8. W. Faulkner, Nuts and Bolts and People' Gender-Troubled Engineering Identities, *Social Studies of Science*, **37**(3), pp. 331–356, 2007.
9. D. Bennett and S. A. Male, An Australian study of possible selves perceived by undergraduate engineering students, *European Journal of Engineering Education*, **42**(6), pp. 603–617, 2016.
10. S. A. Male, Gender inclusivity of engineering students' workplace experiences Report on analysis of motivational experiences, Sydney: *Office for Learning and Teaching, Australian Government Department of Education*, 2015.
11. M. D. Tamin, D. M. D. Plooy, S.V. Solms and J. Meyer, A Proposed Modular Work Integrated Learning Framework for South Africa, *IEEE Access*, **7**, pp. 2559–2566, 2018.
12. P. Bonnet, Development of a competency-based work-integrated learning program to facilitate science, engineering and technology retention in South Africa as a developing country, *International Journal of Work-Integrated Learning*, **10**(2), p. 65, 2009.
13. L. Dunn, M. Schier and L. Fonseca, An innovative multidisciplinary model for work placement assessment, *International Journal of Work-Integrated Learning*, **13**(3), p. 135, 2012.
14. K. Zegwaard, R. K. Coll and D. Hodges, Assessment of workplace learning: A framework, *International Journal of Work-Integrated Learning*, **4**(1), p. 9, 2003.
15. D. Hodges, B. W. Smith and P. D. Jones, The assessment of cooperative education, *International handbook for cooperative education*, Boston, pp. 49–65, 2004.
16. S. Ferns, G. McMahon and J. Yorke, Course assessment profiling for enhanced educational and employment outcomes, *AAIR conference*, Adelaide, Australia, 2009.
17. A. M. Bosco and S. Ferns, Embedding of Authentic Assessment in Work-Integrated Learning Curriculum, *Asia-Pacific Journal of Cooperative Education*, **15**(4), pp. 281–290, 2014.
18. J. Dewey, Experience and education, *Taylor & Francis Group*, **50**(3), pp. 241–252, 1986.
19. C. Smith, Assessment of student outcomes from work-integrated learning: Validity and reliability, *Asia-Pacific Journal of Cooperative Education*, **15**(3), 209–223, 2014.
20. R. M. Epstein and E. M. Hundert, Defining and assessing professional competence, *JAMA*, **287**(2), pp. 226–235, 2002.
21. The Queensland University of Technology (QUT), https://www.qut.edu.au, Accessed 15 March 2021.
22. J. Orrell, Good Practice Report: Work Integrated Learning, *Australian Learning and Teaching Council*, Surrey Hills, Australia, 2011.
23. R. M. Iyer, D. J. Hargreaves, C. Lenz and H. Beck, Liaison with industry in modelling work integrated learning for engineering undergraduates, *Australasian Association for Engineering Education*, p. 446, 2004.
24. Monash University, https://www.monash.edu, Accessed 15 March 2021.
25. Deakin University, https://www.deakin.edu.au, Accessed 15 March 2021.
26. P. McIlveen, S. Brooks, A. Lichtenberg, M. Smith, P. Torjul and J. Tyler, Career development learning & work-integrated learning in Australian higher education: A discussion paper, *National Association of Graduate Careers Advisory Services*, Australia, 2008.
27. Griffith University, https://www.griffith.edu.au, Accessed 15 March 2021.
28. N. Gamble, C. J. Patrick and D. Peach, Internationalising work-integrated learning: Creating global citizens to meet the economic crisis and the skills shortage, *Higher Education Research & Development*, **29**(5), pp. 535–546, 2010.
29. Victoria University, https://www.vu.edu.au, Accessed 15 March 2021.
30. K. O'Brien, S. Venkatesan, S. Fragomeni and A. Moore, Work readiness of final-year civil engineering students at Victoria University: A survey, *Australasian Journal of Engineering Education*, **18**(1), pp. 35–48, 2012.
31. RMIT University, https://www.rmit.edu.au, Accessed 15 March 2021.
32. The Australian National University (ANU), https://www.anu.edu.au, Accessed 15 March 2021
33. S. Male and R. King, Best practice guidelines for effective industry engagement in Australian engineering degrees, *Australian Council of Engineering Deans*, Brisbane, Australia, 2014.
34. University of Southern Queensland (USQ), https://www.usq.edu.au, Accessed 15 March 2021.
35. Central Queensland University, https://www.cqu.edu.au, Accessed 15 March 2021.
36. P. Howard, Developing professional practice skills through reflection on experience, *19th Annual Conference of the Australasian Association for Engineering Education: To Industry and Beyond; Proceedings of the Institution of Engineers*, Australia, Yeppoon, Queensland, Australia, 7–10 December 2008, p. 69, 2008.
37. D. Dowling, Managing student diversity in the Master of Engineering Practice program. *20th Annual Conference for the Australasian Association for Engineering Education: Proceedings of the*, Engineers Australia, Adelaide, Australia, 6–9 December 2009, p. 176, 2009.
38. Curtin University, https://www.curtin.edu.au, Accessed 15 March 2021.
39. University of Tasmania (UTAS), https://www.utas.edu.au, Accessed 15 March 2021.
40. University of Technology Sydney (UTS), https://www.uts.edu.au, Accessed 15 March 2021.
41. J. M. Hills, G. Robertson, R. Walker, M. A. Adey and I. Nixon, Bridging the gap between degree programme curricula and employability through implementation of work-related learning, *Teaching in Higher Education*, **8**(2), pp. 211–231, 2003.
42. M. Yorke and P. T. Knight, Embedding employability into the curriculum, *York: Higher Education Academy*, **3**, 2006.
43. J. B. Biggs, Teaching for quality learning at university: What the student does, *McGraw-Hill*, UK, 2011.
44. M. Borrego, J. E. Froyd and T. S. Hall, Diffusion of engineering education innovations: A survey of awareness and adoption rates in US engineering departments, *Journal of Engineering Education*, **99**(3), pp. 185–207, 2010.
45. M. Magnell, L. Geschwind and A. Kolmos, Faculty perspectives on the inclusion of work-related learning in engineering curricula, *European Journal of Engineering Education*, **42**(6), pp. 1038–1047, 2017.

46. I. Skinner, K. Careyb and F. Luciena, A retrospective on work integrated learning by engineers, *In AAEE Conference*, Queensland, Australia, 2013.
47. G. A. Jenkins, A work integrated learning approach to teaching Water Resources Engineering, *In Proceedings of the 2013 AAEE Conference*, Gold Coast, Queensland, Australia, 2013.
48. D. Dowling, R. Hadgraft, A. Carew, T. McCarthy, D. Hargreaves, C. Baillie and S. Male, Engineering your future: an Australasian guide, *John Wiley & Sons*, 2020.
49. M. B. Whelan, Academic work-integrated learning (WIL): Reengaging teaching-focused academics with industry, *Journal of Teaching and Learning for Graduate Employability*, **8**(1), pp. 172–187, 2017.
50. D. Bennett, L. Roberts and S. Ananthram, Teaching-only roles could mark the end of your academic career, The Conversation, https://theconversation.com/teaching-only-roles-could-mark-the-end-of-your-academic-career-74826/, Accessed 15 March 2021.
51. J. A. Mackaway, T. Winchester-Seeto, D. Coulson and M. Harvey, Practical and pedagogical aspects of learning through participation: The LTP assessment design framework, *Journal of University Teaching and Learning Practice*, **8**(3), p. 5, 2011.
52. J. McNamara, The challenge of assessing professional competence in work integrated learning, *Assessment & Evaluation in Higher Education*, **38**(2), 183–197, 2013.
53. M. Bates, Work-integrated Learning Workload and Recognition–Review, *Griffith University*, Brisbane, 2010.
54. M. Bates, Work-integrated learning workloads: The realities and responsibilities, *International Journal of Work-Integrated Learning*, **12**(2), p. 111, 2011.
55. S. Male and R. King, Improving industry engagement in engineering degrees, *25th Annual Conference of the Australasian Association for Engineering Education: Engineering the Knowledge Economy: Collaboration, Engagement & Employability*, School of Engineering & Advanced Technology, Massey University, p. 363, 2014.
56. A. A. Bilgin, A. D. Rowe and L. Clark, Academic Workload Implications of Assessing Student Learning in Work-Integrated Learning, *Asia-Pacific Journal of Cooperative Education*, **18**(2), pp. 167–183, 2017.
57. G. E. Lefoe, H. Smigiel and D. Parrish, Enhancing higher education through leadership capacity development: Progressing the faculty scholars' model, *Proceedings of the 30th HERDSA Annual Conference*, Adelaide, Australia, 8–11 July, 2007.
58. C. McInnis, P. Ramsden and D. Maconachie, A handbook for executive leadership of learning and teaching in higher education, *Office for Learning and Teaching, Department of Industry, Innovation, Science, Research and Tertiary Education*, Canberra, 2012.
59. C. J. Patrick, W. Fallon, M. Campbell, I. Devenish, J. Kay, J. Lawson, L. Russell, F. Tayebjee and P. Cretchley, Leading WIL: A distributed leadership approach to enhance work integrated learning. Final report 2014, *Office for Learning & Teaching*, Canberra, 2014.
60. D. Edwards, K. Perkins, J. Pearce and J. Hong, Work integrated learning in STEM in Australian Universities, *Report for the Office of the Chief Scientist*, Canberra, 2015.
61. S. Ferns, L. Russell and J. Kay, Enhancing industry engagement with work-integrated learning: Capacity building for industry partners, *Asia-Pacific Journal of Cooperative Education*, **17**(4), pp. 363–375, 2016.
62. Engineers Australia, Stage 1 Competency Standard for Professional Engineer, www.engineersaustralia.org.au/ resource-centre/ resource/stage-1-competency-standard-professional-engineer, Accessed 10 March 2021.
63. D. Jackson, D. Rowbottom, S. Ferns and D. McLaren, Employer understanding of work-integrated learning and the challenges of engaging in work placement opportunities, *Studies in Continuing Education*, **39**(1), pp. 35–51, 2017.
64. D. Peach, K. Moore, M. Campbell, T. Winchester-Seeto, S. Ferns, J. Mackaway and L. Groundwater, Building institutional capacity to enhance access participation and progression in Work Integrated Learning (WIL), *Final Report: Australian Government Office for Learning and Teaching*, 2015.
65. T. Hinton, The impact management planning and evaluation ladder (IMPEL), *Office for Learning and Teaching, Australian Government*, Sydney, 2014.
66. A. Guerra, R. Ulseth and A. Kolmos, PBL in engineering education: international perspectives on curriculum change, *Springer*, 2017.
67. S. Ferns, L. Russell and C. Smith, Designing work integrated learning to optimise student employment readiness, *Research and Development in Higher Education: Learning for Life and Work in a Complex World*, **38**, pp. 161–175 2015.
68. T. Bowen, Depicting the Possible Self: Work-Integrated Learning Students' Narratives on Learning to Become a Professional, *Asia-Pacific Journal of Cooperative Education*, **17**(4), pp. 399–411, 2016.
69. K. L. Harris and R. James, The Course Experience Questionnaire, Graduate Destination Survey, and Learning and Teaching Performance Fund in Australia, *Springer*, pp. 99–119, 2010.
70. D. D. Dill and M. Beerkens, Public policy for academic quality: Analyses of innovative policy instruments, *Springer Science & Business Media*, **30**, 2010.
71. S. Palmer, K. Young and M. Campbell, Developing an institutional evaluation of the impact of work-integrated learning on employability and employment, *International Journal of Work-Integrated Learning*, **19**(4), pp. 371–383, 2018.
72. S. Chillas, A. Marks and L. Galloway, Learning to labour: an evaluation of internships and employability in the ICT sector, *New Technology, Work and Employment*, **30**(1), pp. 1–15, 2015.
73. J. Gault, E. Leach and M. Duey, Effects of business internships on job marketability: the employers' perspective, *Education and Training*, **52**(1), pp. 76–88, 2010.
74. P. Gardner, Framing Internships from an Employers' Perspective: Length, Number, and Relevancy, CERI Research Brief, *Collegiate Employment Research Institute*, 2013.
75. N. Wilton, Employability is in the eye of the beholder Employer decision-making in the recruitment of work placement students, *Higher Education, Skills and Work-Based Learning*, **4**(3), pp. 242–255, 2014.
76. A. D. Rowe and K. E. Zegwaard, Developing graduate employability skills and attributes: Curriculum enhancement through work-integrated learning, Special Issue: Advancing the WIL curriculum to enhance graduate employability, *Asia-Pacific Journal of Cooperative Education*, **18**(2), pp. 87–99, 2017.
77. M. Yorke and P. T. Knight, Embedding employability into the curriculum, *York: Higher Education Academy*, **3**, 2006.
78. I. M. Suarta, I. K. Suwintana, I. F. P. Sudhana and N. K. D. Hariyanti, Employability skills required by the 21st century workplace: A literature review of labor market demand, *International Conference on Technology and Vocational Teachers (ICTVT 2017)*, Atlantis Press, 2017.

79. S. Ferns, C. Smith and L. Russell, Complex problem complex research design: Researching the impact of WIL on employability, *WACE 10th International Symposium on Cooperative and Work-integrated Education Conference Proceedings*, Trollhattan, Sweden, 2014.
80. C. Hook and A. Jenkins, Introducing Human Resource Management, 8 edn., *Pearson*, 2019.
81. K. Collin, B. V. Heijden and P. Lewis, *Continuing professional development*, Blackwell Publishing Ltd Oxford, UK, 2012.
82. R. B. Hourani and P. Stringer, Professional development: Perceptions of benefits for principals, *International Journal of Leadership in Education*, **18**(3), pp. 305–339, 2015.
83. S. Harbour, Ways to Promote Professional Development in the Workplace, https://smallbusiness.chron.com/ways-promote-professional-development-workplace-45524.html, Accessed 21 February 2021.
84. C. Reddy, Staff Training: Importance, Benefits, Advantages & Disadvantages, https://content.wisestep.com/staff-training-importance-benefits-advantages-disadvantages, Accessed 1 March 2021.
85. Asset Wisdom, Employee Development: The Pros & Cons of Training Staff, https://asset-wisdom.com/news/employee-development-the-pros-cons-of-training-staff, Accessed 25 February 2021.
86. J. Garnett, Authentic work-integrated learning, *University teaching in focus, a learner-centred approach*, ACER Press, Camberwell, pp. 164–179, 2012.
87. K. P. A. Phillips, Engaging employers in work integrated learning: current state and future priorities, *Department of Industry*, Australia, 2014.
88. C. Reddy, Advantages and Disadvantages of on the job Training Methods, WiseStep, https://content.wisestep.com/advantages-disadvantages-job-training-methods/, Accessed 31 January 2021
89. J. Hillage and E. Pollard, Employability: developing a framework for policy analysis, *Research Brief No. 85*, Department for Education and Employment, London, 1998.
90. L. D. Pool and P. Sewell, The key to employability: developing a practical model of graduate employability, *Journal of Education and Training*, pp. 277–289, 2007.
91. L. Nagle, J. Lannon and J. McMahon, Integrating formal learning into work-integrated learning to create a semi-formal environment, *International Journal of Work Integrated Learning*, **19**(2), pp. 181–191, 2018.
92. M. T. Drysdale, N. Frost and M. L. Mcbeath, How Often Do They Change Their Minds and Does Work-Integrated Learning Play a Role? An Examination of "Major Changers" and Career Certainty in Higher Education, *Asia-Pacific Journal of Cooperative Education*, **16**(2), pp. 145–152, 2015.
93. F. Trede, Role of work-integrated learning in developing professionalism and professional identity, *International Journal of Work-Integrated Learning*, **13**(3), p. 159, 2012.
94. B. Oliver, Redefining graduate employability and work-integrated learning: Proposals for effective higher education in disrupted economies, *Journal of Teaching and Learning for Graduate Employability*, **6**(1), pp. 56–65, 2015.
95. C. J. Patrick, D. Peach, C. Pocknee, F. Webb, M. Fletcher and G. Pretto, The WIL (Work Integrated Learning) report: A national scoping study, *Queensland University of Technology*, 2008.
96. R. A. Malatest and Associates (Firm), Barriers to work-integrated learning opportunities, *Higher Education Quality Council of Ontario*, 2018.
97. L. T. Tran and S. Soejatminah, 'Get foot in the door': International students' perceptions of work integrated learning, *British Journal of Educational Studies*, **64**(3), pp. 337–355, 2016.
98. S. Mutereko and V. Wedekind, Work integrated learning for engineering qualifications: a spanner in the works?, *Journal of Education and Work*, **29**(8), pp. 902–921, 2016.
99. D. Conger and M. C. Long, Why are men falling behind? Gender gaps in college performance and persistence, *The Annals of the American Academy of Political and Social Science*, **627**(1), pp. 184–214, 2010.
100. A. L. Duckworth and M. E. Seligman, Self-discipline gives girls the edge: Gender in self-discipline, grades, and achievement test scores, *Journal of Educational Psychology*, **98**(1), p. 198, 2006.
101. Y. Tanaka and K. Carlson, An international comparison of the effect of work-integrated learning on academic performance: A statistical evaluation of WIL in Japan and Hong Kong, *International Journal of Work-Integrated Learning*, **13**(2), p. 77, 2012.
102. G. M. Barton, K. A. Hartwig and M. Cain, International students' experience of practicum in teacher education: An exploration through internationalisation and professional socialisation, *Australian Journal of Teacher Education*, **40**(8), p. 9, 2015.
103. N. Brown, Assessment in the professional experience context, *Journal of University Teaching & Learning Practice*, **5**(1), p. 8, 2008.
104. R. Spooner-Lane, D. Tangen and M. Campbell, The complexities of supporting Asian international pre-service teachers as they undertake practicum, *Asia-Pacific Journal of Teacher Education*, **37**(1), pp. 79–94, 2009.
105. G. Barton, K. A. Hartwig, M. Cain and D. Joseph, Improving work placement for international students, their supervisors and other stakeholders: final report 2016, *Australian Department of Education and Training*, 2017.

Pradeep Vailasseri is a PhD candidate at Deakin University. He was a Professional Member of The Institution of Engineers Australia and has 21 years of work experience including industrial and academic expertise. He has worked as Mechanical Engineer in Oil & Gas and Marine industries and has extensive work experience in engineering education and academic quality. He has developed a broad range of learning resources and assessment tools for various tertiary education organisations. His current research is in the area of Engineering Education. He is also interested in Thermal Engineering, Manufacturing Engineering, Fluid Mechanics and Engineering Management.

John Long originally trained in physics at the University of Michigan (USA) and in materials science with General Motors Corporation. He graduated in 1987. In 1995 he completed a PhD in physics at Monash University in Australia. Since 1995 he has been a lecturer at Deakin University, teaching physics, materials, and electronics. In 2016 he was a recipient of an Online-Learning Consortium Effective-Practice international award for his work in online physics education. His research interests include materials science and engineering education.

Matthew A. Joordens (Member – IEEE, Fellow – The Institution of Engineers Australia, Mensa) began his career with Industrial Control Technology designing control systems to automate various different industrial processes. For 5 years he designed microprocessor-based control systems for companies such as Ford, Pilkington Glass, Webtek and Blue Circle Southern Cement. He then moved to Deakin University in 1992 and wrote their first electronics units. Using his industrial experience, he designed one of the first Australian Engineering degrees in Mechatronics that still runs at Deakin University. He currently lectures units in Robotics and Artificial Intelligence. His research is in Engineering Education and in Robotics. His research in robotics is centered on the control a system or systems of underwater robots. His Engineering Education interest is around Design Based Learning and has been working on this for over 20 years.