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Embedding Bachelor of Engineering University Education with Enhanced Work-Integrated Learning

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Abstract: A study on the effectiveness of engineering education in the development of industry-ready graduate engineers was conducted among academics and industry experts of engineering disciplines who have relevant experience in work-integrated learning in Australia. The hypothesis was that embedding enhanced work-integrated learning into all study semesters has the increased possibility of developing industry-ready graduate engineers. This paper outlines the research outcomes and an enhanced work-integrated learning framework that might be helpful for improving the industry-readiness of graduating engineers. Based on the research results, the researchers propose the allocation of an appropriate level of work-integrated learning for each indicator of attainment component from the elements of Engineers Australia's Stage I Competencies. The aim of this paper is to provide detailed recommendations for implementing an enhanced work-integrated model in Bachelor of Engineering programs in Australia. The authors also present the concept of curriculum development based on industry-integrated learning outcomes, as well as the campus and industry engagement model for enhanced work-integrated learning for the subjects of study in the Bachelor of Engineering program. This framework can be used globally as a reference for developing similar work-integrated learning models.

Keywords: engineering education; engineering curriculum; Bachelor of Engineering; work-integrated learning; WIL; higher education

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1. Introduction

Enhanced work-integrated learning (EWIL) is an ambitious attempt to improve work-integrated learning practices in engineering education. EWIL is an approach proposed by the authors in which work-integrated learning (WIL) is embedded into all semesters of a Bachelor of Engineering program. EWIL is expected to benefit universities by ensuring improved student engagement and industry collaboration, an enhanced curriculum with increased WIL components and quality of student education, and increased student enrolment, government consultation, community engagement, and student satisfaction. It provides a standard WIL structure based on Engineers Australia's Stage 1 Competencies [1]. The model could be directly used by curriculum developers to develop Bachelor-of-Engineering regulations for curriculums in Australian universities. It could also be adopted globally depending on the engineering-education regulations of the country, state, and universities. This paper presents the researchers' findings, proposed EWIL structure, and recommendations for universities. It describes the suggested approach for universities to implement this model at both the course and unit levels in collaboration with relevant industry partners.

2. Background

Work-integrated learning refers to an arrangement in which students, as part of their course of study, learn outside of their education institute, in places such as a workplace or in a facility set up in collaboration with an external partner. This is aimed to ensure the development of students' ability to integrate learning via a combination of academic and work-related activities. Engineering higher education in Australia and worldwide has been facing challenges in developing effective WIL arrangements. The authors have identified that adequate workplace learning opportunities are not available for engineering students to develop industry-readiness, as currently the WIL duration in Bachelor of Engineering programs is very short. To improve the quality outcomes of engineering education, there is a substantial need to increase the weightage of WIL via a more effective work-integrated approach [2].

Universities in Australia have employed different models for WIL in an effort to improve the employability skills of their graduate engineers. Table 1 provides a synopsis of the current WIL arrangements in leading Australian universities.

Table 1. WIL at Australian universities.

University	WIL Features
Monash University	Internships, projects [2,3]. Applicants are screened and matched to workplace opportunities. Prior to the internship, student candidates are introduced to host organisations and need to pass face-to-face interviews. The project must be approved by the academic coordinator. The host will provide mentoring and supervision to the interns. The duration is around 80–100 h of work placement.
Deakin University	Industry-based learning (IBL) [2,4,5]. Students engage with partnering organisation for a three-month paid full-time work placement. Helps to explore the graduate environment. Refines attributes such as self-management, effective communication skills, and ethical behaviour. Develops the ability to implement knowledge in the discipline in a professional setting.
Griffith University	Industrial Affiliates Program [2,6,7]. Trimester-long industry-led capstone project, experiential learning. Community-focussed workplace simulations, virtual internships, career development courses, and study tours.
Victoria University	Authentic professional practice [2,8,9]. Practice-integrated learning, client-driven projects, placements, and practicum. Industry-focussed research, laboratories, fieldwork, cadetships and internships, and simulations.
Royal Melbourne Institute of Technology (RMIT)	Work placements such as industry placements, internships, vocational and professional practices, cooperative and field education, industry and community projects, and offshore and online activities [2,10]. Students undertake Engineering Capstone Project Part A and Part B. Industry-based projects. Focusses on discipline-specific or cross-disciplinary engineering problems. Produces well-managed practical and pertinent solutions.
Australian National University (ANU)	Internship programs [2,11,12]. 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. Duration of the degree remains unaffected by the internship. Mentored by a chartered engineer who is employed by the university.
University of Southern Queensland (USQ) and Central Queensland University (CQU)	Combined degrees or higher-level programs [2,13–16]. Awards a Diploma of Professional Practice with a strong problem-based learning emphasis and an engineering bachelor's degree.
Curtin University	Projects [2,17]. Students can work at major engineering companies. Devised and supervised by practising engineers. Provides opportunities for fieldwork, service learning, co-curricular work experience, and placements.
University of Tasmania	Co-operative Education Engineering Degree Program [2,18]. In collaboration with the National Centre for Maritime Engineering and Hydrodynamics at the Australian Maritime College. The program provides significant exposure for students to industry. The university also offers a dedicated WIL unit in the College of Sciences and Engineering.
Queensland University of Technology (QUT)	Project-based WIL model, short-term work placements [2,19–21]. Contracted with an industry partner 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. Offers short-term work placements of 30–60 days duration. Work-readiness skills and enhanced employability critical outcomes are achieved.
University of Technology, Sydney	Combined degree in engineering and a diploma of engineering practice [2,12,22]. Includes two authentic, professionally focussed, and practice-based internships of at least 22 weeks, each in a real workplace setting. Aims to equip graduates through themes of academic development, personal development, and professional formation. Develop the attributes and skills needed for professional practice and leadership. Provides strong foundations in engineering theory, technical expertise, and professional practice knowledge. Develop advocacy skills, academic literacy, and social awareness.

All the universities in Table 1 provide WIL opportunities to their engineering students. However, the durations of the current WIL opportunities are short and limited to the final semesters of Bachelor of Engineering programs. Thus, there is a good scope for restructuring WIL for better graduate-employability outcomes. Based on our hypothesis that embedding WIL to all semesters is a more effective approach for developing industry-ready graduate engineers, we conducted surveys and interviews to gather experts' feedback. Our research was in view of proposing an enhanced WIL framework (EWILF) and recommending strategies to implement it. This paper describes our findings and recommendations.

Engineers Australia's Stage 1 Competency Standards

The Institution of Engineers Australia is a professional body and national forum functioning to advance engineering in Australia. Bachelor of Engineering graduates are expected to satisfy the Stage 1 Competency Standards for Professional Engineers [1]. The Engineers Australia's Chartered Status Handbook lists the skills that mature professional engineers are expected to have. Graduating Bachelor-of-Engineering students need to meet the three Stage-1 Competencies stipulated by Engineers Australia, which are covered by 16 mandatory elements of competency. The expression of knowledge and a skill base, engineering application abilities, and professional skills, values, and attitudes of the profession that must be demonstrated at the point of entry to practice are represented by these competencies and elements of competency. The indicators of attainment outline the ability expected for the elements of competencies and guide the competency demonstration, assessment processes, and curriculum design [1].

3. Methodology and Findings

As our research involved human participants, ethics approval was obtained from Deakin University. The ethics approval reference number is STEC-46-2019-VAILASSERI. In this research, we surveyed 84 engineering academics from Australian universities. A six-point Likert scale was chosen to avoid the possibility of respondents choosing the middle value. The aim of the survey was to identify the level of support to the idea of increasing WIL in Bachelor-of-Engineering studies by collecting the responses of academics who have exposure to WIL. We also interviewed 31 academics from Australian universities who have work experience in WIL and 37 engineering professionals from Australian industry who have worked as workplace mentors for WIL students. One of the purposes of the interviews was to re-establish the relevance of the proposed concept of increasing WIL in Bachelor-of-Engineering studies. The interviews also aimed to gather suggestions for percentages of on-campus and industry-based learning for each component of the indicators of attainment of Engineers Australia's Stage-1 Competency Standards from academics and engineering professionals to develop the enhanced WIL framework.

3.1. Survey

The survey was developed using Qualtrics, which is a leading online survey tool for building and distributing surveys in addition to analysing data. The survey was prepared by the authors in consultation with the WIL and industry experts. The survey questions and statements were developed to collect data according to the research hypothesis. The survey instrument was tested for reliability and validity before collecting the participants' responses. The two items in the survey were the demographic questions to gain the background information of the participants and the Likert-scale questions on a six-point scale. Participants were selected after studying their background and current work area. The survey was distributed as Qualtrics links to the target population. For the survey titled 'Improving the quality of Engineering Education through Enhanced Work Integrated Learning', we received a response rate of 72.4%, with 84 valid responses from the target population of 116 academic participants. Participants of this survey were academics, including professors, associate professors, senior lecturers, and lecturers in Australian universities who have industry exposure, such as current or previous industry work experience and engagement with industry projects. The survey asked the respondents for their agreement or disagreement to a set of question statements seeking the academics' view about the role of WIL in developing industry-ready graduate engineers. The survey also explored the possibility of improving the quality of engineering education through enhancing WIL by embedding more WIL into Bachelor-of-Engineering programs.

The frequencies and categorisation of the collected data as well as the descriptive data analysis results and conclusions are described below.

Figure 1 shows the percentages of the participants from each engineering discipline out of a total of 84 academics. Academic participation rates were: aerospace, 13.1%; civil, 20.2%; electric and electronic (EEE), 26.2%; mechanical, 29.8%; and telecommunications, 10.7%. The bar chart shows a graphical representation of the data.

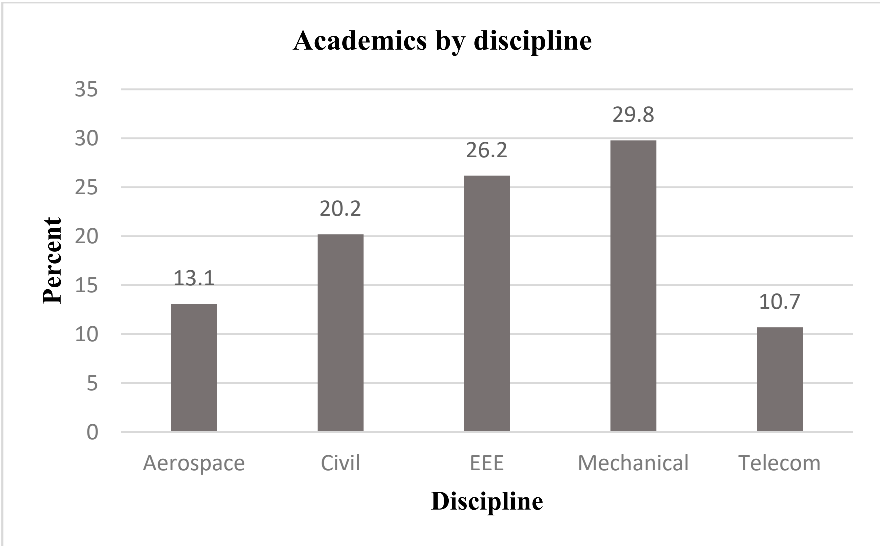

Figure 1. Engineering disciplines of the survey respondents.

Question/Statement 1: "Currently, the graduating engineering students are industry ready."

The mode was 'Disagree', with 45.2% of the responses. Among the 84 academics, 23.8% strongly disagreed and 45.2% disagreed, which adds to 69.1% disagreeing with the statement that 'Currently, the graduating engineering students are industry ready'. Moreover, 11.9% somewhat disagreed and 14.3% somewhat agreed, which adds to 26.2% who are not confident that the graduating engineering students are industry ready. Only 4.8% agreed with the statement. The survey result reveals that a significant proportion of academics are not completely confident about the industry-readiness of outgoing engineering graduates. Practical exposure within the respective engineering discipline will provide in-depth understanding of the theoretical knowledge in specialist bodies. To become industry-ready, engineering graduates need to have engineering-application abilities, and professional and personal attributes, in addition to knowledge and a skill base.

Question/Statement 2: "Engineering students should receive compulsory Work-Integrated-Learning (WIL) opportunities during their bachelor studies."

The mode was between 'Strongly agree' and 'Agree', since both have equal responses of 45.2% of the responses. Among the 84 academics, 90.5% agreed that engineering students should receive compulsory WIL opportunities during their bachelor studies. The remaining 9.5% partially agreed with this. The survey response clarifies that to achieve industry-ready outcomes, engineering students should receive compulsory WIL opportunities during their Bachelor-of-Engineering program. The ability to manage the contextual factors impacting the engineering discipline, engineering design practice knowledge, and skills in the application of engineering techniques, resources, and tools will be achieved through WIL.

Question/Statement 3: "Skills and knowledge of graduate engineers will be highly improved through Enhanced Work Integrated Learning, which is a continuous WIL process embedded throughout the engineering bachelor studies."

The mode was between 'Strongly agree' and 'Agree', with 47.6% of the responses each. Out of the 84 participants, 95.2% agreed that the skills and knowledge of graduate engineers will be highly improved through enhancing work-integrated learning. Only 4.8% of them partially agreed with the statement. Participant academics agreed that a continuous WIL process embedded throughout engineering bachelor studies may be the best method to enhance WIL, through which the skills and knowledge of graduate engineers will be highly improved. Discipline-specific principles, scope, accountabilities, norms, and sustainable engineering practice will be experienced through enhanced WIL.

Question/Statement 4: "Companies should actively initiate Enhanced Work Integrated Learning for engineering students."

The mode was 'Agree', with 36 counts and 42.9% of the responses. From the 84 participants, 75% expressed the opinion that companies should actively initiate EWIL for engineering students and 20.2% partly agreed. Only 1.2% strongly disagreed and 3.6% partly disagreed. The survey result suggests that companies should actively initiate EWIL in engineering. The surveyed academics were very clear about the role of industry in engineering education. This points out the fact that through EWIL, important skills or attributes can be developed, such as project management, design processes, engineering synthesis, professional accountability, ethical conduct, effective oral and written communication, and effective teamwork.

Question/Statement 5: "Universities should actively initiate Enhanced Work-Integrated Learning for engineering students."

The mode was 'Agree', with 44 counts and 52.4% of the responses. Out of the 84 academics, 95.2% agreed that universities should actively initiate EWIL for engineering students. The remaining 4.8% also partly agreed with the statement. The academics agree that universities also need to actively initiate EWIL for engineering students. This implies that academics are very clear about the collaborative approach required from both universities and industry to implement EWIL. Although universities provide theoretical knowledge about engineering fundamentals within the engineering discipline, students can develop hands-on practical work experience and professional attributes from workplaces.

Question/Statement 6: "Formal campus-based engineering education is sufficient to develop workplace skills."

The mode here was 'Disagree', with 37 counts and 44.6% of the responses. Out of the 84 academics, 81.9% disagreed with the statement that formal campus-based engineering education is sufficient to develop workplace skills, and 7.2% partly disagreed. Only 6.0% agreed and 4.8% partly agreed with the statement. Academics disagree with the statement and respond that the campus-based engineering education can be improved to develop workplace skills. The participant academics were aware that workplace skills, are best developed in the workplace.

Question/Statement 7: "Current Work Integrated Learning may need to be transformed to Enhanced Work Integrated Learning, embedded throughout the engineering bachelor studies, to develop industry-ready graduate engineers."

The mode was 'Agree', with 37 counts and 44.1% of the responses. Out of the 84 academics, 83.3% agreed with the statement and 9.5% partly agreed. Only 6.0% disagreed and 1.2% strongly disagreed. A strong majority of the surveyed academics believe that the current WIL programs may need transformation to a better WIL structure. The survey response proves that to develop industry-ready graduate engineers, EWIL embedded throughout the engineering bachelor studies is required in place of the current WIL. The current WIL programs provide limited opportunity to students, in which students search and find their own short-term work placements just to meet the regulatory requirements.

This WIL process may not address the indicators of attainment during short-term workplace exposure, and may not be effectively produce work-ready engineers, and need to be enhanced.

Question/Statement 8: "Work Integrated Learning in engineering academic curriculum reinforces engineering knowledge and skills."

The mode was 'Agree', with 40 counts and 47.6% of the responses. Among the 84 participants, 84.5% agreed that work-integrated learning in an engineering academic curriculum reinforces engineering knowledge and skills, and 9.5% partly agreed. Only 1.2% strongly disagreed and 4.8% disagreed to some extent. The survey emphasises the importance of engineering WIL to reinforce engineering knowledge and skills. The knowledge gained through on-campus education needs to be converted into industrial skills in the workplace. The application of systematic approaches to engineering project management, engineering synthesis and design processes, and engineering tools, resources, and techniques will be able to be achieved through EWIL.

Question/Statement 9: "Universities providing Enhanced Work Integrated Learning will attract more potential students due to the increased job prospects after graduation."

The mode was 'Agree', with 40 counts and 47.6% of the responses. Out of the 84 participants, 85.7% agreed with the statement and 14.3% partly agreed. None of the academics disagreed with the statement. The participant academics agreed that enhanced WIL will be advantageous to attract more potential students due to the increased job prospects after graduation. The students have a possibility of getting absorbed into the companies they work with for WIL. The other students will have solid work experience relevant to their discipline, which can be shown in their profile while applying for jobs. The enhanced WIL students will gain engineering application ability and professional and personal attributes, in addition to knowledge and a skill base.

Question/Statement 10: "Providing undergraduate students with Enhanced Work Integrated Learning increases the university's reputation".

The mode was 'Agree', with 40 counts and 47.6% of the responses. Out of the 84 participants, 85.7% agreed with the statement and 14.3% partly agreed. None of the academics disagreed with the statement. This implies that the participant academics believe that universities' reputations can be improved through providing undergraduate students with EWIL opportunities, which might lead to increased employability.

Question/Statement 11: "Providing undergraduate students with Enhanced Work Integrated Learning may improve the university's ranking".

The mode was between 'Strongly agree' and 'Agree', since both have a count of 32 and 38.1% of the responses. Out of the 84 participants, 64 agreed with the statement that providing undergraduate students with enhanced work-integrated learning improves the university's ranking, and 19.1% agreed to some extent. Only 4.8% were not confident about the statement. Participants believe that universities' rankings could be improved through increasing EWIL opportunities to undergraduate students.

3.2. Interviews

From the target population of fifty participants from each category, 31 engineering academics and 37 industry experts were interviewed in face-to-face, over the phone, and online. The purpose of the interviews was to explore the possibilities of improving the quality of undergraduate engineering education through developing industry-ready graduate engineers by enhancing WIL. The interviews helped to gather inputs from academics for developing the EWIL framework. The interviewees were provided with the Engineers Australia's Stage-1 Competency-Standards document and an EWIL framework template. The template was used to gather the recommended percentage of engagements at universities and workplaces suggested for each component of the indicators of attainment from Engineers Australia's Stage-1 Competencies for applying onto a Bachelor-of-Engineering program.

The audio of the interview responses was recorded wherever possible. The responses were transcribed and notes were prepared. The authors read the interview data several times and categorised and coded them using highlighters, notes, and an Excel spreadsheet. The recurring themes were identified and presented in a cohesive manner. The interview questions and summary of the key common responses are outlined in Table 2.

Table 2. Interview questions and summary of conclusions.

Question	Summary of Conclusions
What is your view about the sufficiency of formal academic engineering education in meeting the graduate engineers' industrial performance requirements?	Majority of the interviewees stated 'there may be extra WIL needed during formal academic engineering education to prepare industry-ready graduate engineers'. They suggested that there should be 'a properly developed framework'.
What is your opinion about the sufficiency of formal academic engineering education in meeting Engineers Australia's Stage-1 competencies?	All the respondents have the opinion that 'the second and third elements may need workplace exposure for achieving the desired competency'. They agreed 'there is a scope for improving the formal academic engineering education to meet Engineers Australia's Stage-1 competencies'.
What do you think about the current Work Integrated Learning arrangements in providing industry-ready engineers?	A majority of interviewees suggested 'more WIL may be needed to increase the effectiveness of WIL in developing industry-ready engineers'. The highlight of the responses is that 'integrating throughout the graduate education will be a more effective approach to achieve this outcome'.
Is there any need to enhance WIL in engineering curriculum? If yes, how can we enhance WIL?	'Increasing WIL will be helpful to bridge the current gap between engineering academic education and industry's expectations about graduate engineers', was a common response received from the interviewees.
Can the WIL methods in engineering education be modified to minimise the Professional Development programs for graduate engineers in the initial stages of their professional career?	The interviewees agreed with 'amending the WIL methods in engineering education' and 'increasing collaboration between companies and universities for mutually beneficial outcomes'. The academic and industry experts agreed with the idea that 'Development of the enhanced WIL framework may address some of the professional development requirements of workplaces for new graduate engineers'.
What are the suggestions you can provide in improving workplace learning methods and developing an engineering curriculum integrated with enhanced work integrated learning framework?	The respondents provided various suggestions to develop the recommendations for universities to enhance WIL. They also provided inputs in the EWIL framework template for the percentage WIL required for each component of Engineers Australia's Stage-1 Competencies.

The interviews responses reinforced the analysis of the survey data, and provided clarification in accordance with the benchmarks proposed by the interview questions. The inputs gathered from the interviews helped to propose the percentages of industry engagement for each component of the indicators of attainment that correspond to the elements of Engineers Australia's Stage-1 Competencies. The interviewees' responses to the suggested percentages of WIL are presented in the Validated EWIL Framework table (Table 3). For better understanding, the table needs to read along with the Engineers Australia's Stage-1 Competencies [1]. The interviews also helped to develop the recommendations for universities to enhance work-integrated learning in undergraduate engineering education, as discussed in Section 5.

Table 3. Validated EWIL Framework.

Engineers Australia's Stage I Competencies Reference			Industry Engagement (WIL)		Campus/Industry Engagement (WIL) Percentage Range			
			Mean		Proposal		Validation	
Element of Competency	Indicators of Attainment Components	Trigger Verbs and Nouns	Interviews %	Validation %	Campus %	Industry (WIL) %	Campus %	Industry (WIL) %
Element 1. Knowledge and a Skill Base								
1.1	1.1 a	Engage	18	18	90–70	10–30	90–70	10–30
1.2	1.2 a	Develop	21	19	90–70	10–30	90–70	10–30
		Fluently apply	26	29	85–60	15–40	80–60	20–40
1.3	1.3 a	Proficiently apply	27	28	80–60	20–40	80–60	20–40
1.4	1.4 a	Identify	18	18	90–75	10–25	90–75	10–25
	1.4 a	Critically appraise	21	21	90–70	10–30	90–70	10–30
	1.4 b	Interpret	18	19	90–70	10–30	90–70	10–30
	1.4 b	Apply	23	24	85–65	15–35	80–60	20–40
1.5	1.5 a	Identify	17	16	90–70	10–30	90–70	10–30
	1.5 a	Apply	26	26	85–60	15–40	80–60	20–40
	1.5 b	Identify	22	22	90–65	10–35	90–65	10–35
	1.5 b	Understand	23	23	85–65	15–35	85–65	15–35
	1.5 c	Appreciate	20	21	90–70	10–30	90–70	10–30
	1.5 d	Aware of	18	17	90–70	10–30	90–70	10–30
	1.5 e	Aware of	29	28	80–60	20–40	80–60	20–40
	1.5 f	Identify	18	17	90–70	10–30	90–70	10–30
1.6	1.6 a	Appreciate	27	28	80–60	20–40	80–60	20–40
	1.6 b	Appreciate	28	28	80–60	20–40	80–60	20–40
	1.6 c	Appreciate	27	27	80–60	20–40	80–60	20–40
	1.6 d	Understand	17	17	90–70	10–30	90–70	10–30
	1.6 e	Appreciate	23	22	85–70	15–30	85–70	15–30
Engineers Australia's Stage I Competencies Reference			**Industry Engagement (WIL)**		**Campus/Industry Engagement (WIL) Percentage Range**			
			Mean		**Proposal**		**Validation**	
Element of Competency	**Indicators of Attainment Components**	**Trigger Verbs and Nouns**	**Interviews %**	**Validation %**	**Campus %**	**Industry (WIL) %**	**Campus %**	**Industry (WIL) %**
Element 2. Engineering Application Ability								
2.1	2.1 a	Identify	17	20	90–70	10–30	90–70	10–30
	2.1 a	Discern and characterise	19	20	90–70	10–30	90–70	10–30
	2.1 a	Determine and analyse	22	23	90–65	10–35	90–65	10–35
	2.1 a	Justify and apply	26	30	80–60	20–40	75–60	25–40
	2.1 a	Predict	29	30	80–60	20–40	80–60	20–40
	2.1 a	Synthesise	30	29	80–60	20–40	80–60	20–40
	2.1 a	Develop	30	29	80–60	20–40	80–60	20–40
	2.1 b	Ensure	27	28	85–65	15–35	85–65	15–35
	2.1 c	Competently address	26	25	80–60	20–40	80–60	20–40
	2.1 d	Investigate	19	20	90–70	10–30	90–70	10–30
	2.1 e	Partition	20	20	90–70	10–30	90–70	10–30
	2.1 e	Re-combine	21	20	90–70	10–30	90–70	10–30
	2.1 f	Conceptualise	28	26	80–60	20–40	80–60	20–40
	2.1 f	Evaluate	25	24	85–65	15–35	85–65	15–35
	2.1 g	Critically review	21	22	90–65	10–35	90–65	10–35
	2.1 g	Apply	28	27	80–60	20–40	80–60	20–40
	2.1 h	Identify	18	19	90–70	10–30	90–70	10–30
	2.1 h	Quantify	19	16	90–70	10–30	90–70	10–30
	2.1 h	Mitigate and manage	27	26	80–60	20–40	80–60	20–40
	2.1 i	Interpret and ensure	25	26	80–60	20–40	80–60	20–40
2.2	2.2 a	Proficiently identify	21	18	90–65	10–35	90–65	10–35
	2.2 a	Select	25	25	85–60	15–40	85–60	15–40
	2.2 a	Apply	26	28	85–60	15–40	80–60	20–40
	2.2 b	Construct	19	18	90–70	10–30	90–70	10–30
	2.2 b	Select	17	18	90–75	10–25	90–75	10–25
	2.2 b	Apply	25	26	80–65	20–35	80–65	20–35
	2.2 c	Determine	28	28	80–60	20–40	80–60	20–40
	2.2 d	Apply	29	25	80–60	20–40	80–60	20–40
	2.2 e	Apply	31	31	80–60	20–40	75–60	25–40
	2.2 f	Design and conduct	30	28	80–60	20–40	80–60	20–40
	2.2 f	Analyse and interpret	19	20	90–70	10–30	90–70	10–30
	2.2 f	Formulate	19	19	90–70	10–30	90–70	10–30
	2.2 g	Analyse	18	21	90–70	10–30	90–70	10–30
	2.2 g	Minimise or compensate	25	25	80–60	20–40	80–60	20–40

Table 3. *Cont.*

Engineers Australia's Stage I Competencies Reference			Industry Engagement (WIL)		Campus/Industry Engagement (WIL) Percentage Range			
			Mean		Proposal		Validation	
Element of Competency	Indicators of Attainment Components	Trigger Verbs and Nouns	Interviews %	Validation %	Campus %	Industry (WIL) %	Campus %	Industry (WIL) %
Element 2. Engineering Application Ability								
	2.2 g	Quantify	18	18	90–70	10–30	90–70	10–30
	2.2 h	Safely apply	27	27	80–60	20–40	80–60	20–40
	2.2 i	Understand	28	28	80–60	20–40	80–60	20–40
	2.2 j	Understand	28	28	80–60	20–40	80–60	20–40
2.3	2.3 a	Proficiently apply	20	25	90–70	10–30	80–65	20–35
	2.3 b	Address	24	23	90–65	10–35	90–65	10–35
	2.3 c	Execute	30	30	80–60	20–40	80–60	20–40
	2.3 c	Lead	31	31	80–60	20–40	80–60	20–40
	2.3 d	Aware of	21	20	90–70	10–30	90–70	10–30
2.4	2.4 a	Contribute to	29	29	80–60	20–40	80–60	20–40
	2.4 a	Manage	29	29	80–60	20–40	80–60	20–40
	2.4 b	Seek out	23	21	90–65	10–35	90–65	10–35
	2.4 b	Realistically assess	28	27	80–60	20–40	80–60	20–40
	2.4 c	Accommodate	27	27	80–60	20–40	80–60	20–40
	2.4 d	Proficiently apply	27	27	80–60	20–40	80–60	20–40
	2.4 e	Aware of	25	24	85–65	15–35	85–65	15–35
	2.4 f	Demonstrate	24	22	90–65	10–35	90–65	10–35
Engineers Australia's Stage I Competencies Reference			Industry Engagement (WIL)		Campus/Industry Engagement (WIL) Percentage Range			
			Mean		Proposal		Validation	
Element of Competency	Indicators of Attainment Components	Trigger Verbs and Nouns	Interviews %	Validation %	Campus %	Industry (WIL) %	Campus %	Industry (WIL) %
3. Professional and Personal Attributes								
3.1	3.1 a	Demonstrate	23	26	80–65	20–35	80–65	20–35
	3.1 b	Understand	19	20	90–70	10–30	90–70	10–30
	3.1 c	Understand	28	28	80–60	20–40	80–60	20–40
	3.1 d	Aware of	18	21	90–70	10–30	90–70	10–30
3.2	3.2 a	Proficient in	20	27	90–65	10–35	80–60	20–40
	3.2 b	Prepare	20	18	90–70	10–30	90–70	10–30
3.3	3.3 a	Apply	27	26	80–60	20–40	80–60	20–40
	3.3 b	Seek out	18	17	90–70	10–30	90–70	10–30
	3.3 b	Apply	26	26	80–60	20–40	80–60	20–40
	3.3 c	Aware of	19	18	90–70	10–30	90–70	10–30
	3.3 c	Engage	27	28	80–60	20–40	80–60	20–40
3.4	3.4 a	Proficient in	18	28	90–70	10–30	80–60	20–40
	3.4 b	Critically assess	20	18	90–70	10–30	90–70	10–30
	3.4 c	Aware of	19	18	90–70	10–30	90–70	10–30
3.5	3.5 a	Demonstrate	23	23	85–60	15–40	85–60	15–40
	3.5 b	Understand	22	22	90–65	10–35	90–65	10–35
	3.5 c	Demonstrate	15	15	90–70	10–30	90–70	10–30
	3.5 d	Manage	17	16	90–70	10–30	90–70	10–30
	3.5 d	Prioritise	18	18	90–70	10–30	90–70	10–30
	3.5 e	Think critically	19	19	90–70	10–30	90–70	10–30
	3.5 e	Apply	24	29	85–60	15–40	80–60	20–40
	3.5 f	Present	27	29	80–60	20–40	80–60	20–40
3.6	3.6 a	Understand	17	16	90–70	10–30	90–70	10–30
	3.6 b	Function as	29	28	80–60	20–40	80–60	20–40
	3.6 c	Earn	22	21	90–70	10–30	90–70	10–30
	3.6 d	Recognise	28	28	80–60	20–40	80–60	20–40
	3.6 e	Confidently pursue	22	21	90–70	10–30	90–70	10–30
	3.6 e	Discern	23	23	90–70	10–30	90–70	10–30
	3.6 f	Take initiative	29	30	80–60	20–40	80–60	20–40
	3.6 f	Fulfil	29	31	80–60	20–40	80–60	20–40

3.3. Validation

Validation was necessary to verify and authenticate the EWIL framework to assure reliability before implementing the framework in academic, industrial, and student scenarios. Prior to the validation, a validation table template was prepared using the EWIL framework. In the validation table, the columns for 'Engineers Australia's Stage-1 Competencies [1] Reference' were retained and the inputs obtained from the academic and industry interviewees were removed.

For validating the EWIL framework, fourteen engineering curriculum specialists were identified who had relevant industrial, academic teaching, curriculum design, quality, and compliance work experience expertise. The validators were a different set of respondents, and did not include the academic and industry experts who were interviewed. The curriculum specialists had extensive work experience in engineering higher education in Australia and thorough knowledge about the stage-1 competencies and their development in engineering higher education.

Validators were presented with the validation table, interview questionnaire, the competency standards, and the ethics documents. After discussing the research aim, objectives, and methodologies, the validators were asked to provide their recommendations for the percentages of on-campus and industry engagements that correspond to each indicator of attainment component of the competencies. Further to gathering the validation data, the responses of the fourteen engineering curriculum experts were analysed, and the results were consolidated.

4. Enhanced WIL Framework

In the EWIL approach, the learning outcomes need to be identified first, and then the learning framework would be designed and the curriculum developed [2]. The framework and curriculum need to be implemented in collaboration with related workplaces in which the students strengthen their learning by means of industry engagement throughout their Bachelor-of-Engineering program. A WIL framework was required to satisfy the Stage-1 Competency Standards and the practical industry requirements. The framework should stipulate the effective industry engagement required during the program. This comprehensive industry-engagement approach is expected to develop industry-ready graduate engineers, which, in turn, would improve the quality of engineering education and increase industrial productivity.

Figure 2 outlines the idea on which the EWIL framework was designed in this research.

In Figure 2, the discipline-specific learning outcomes would be selected by the curriculum developers and program managers. The learning framework and curriculum will be developed in consultation with industry and address the Stage-1 Competencies. The degree program would begin with on-campus training during the first semester to meet the occupational health and safety (OHS) requirements of the EWIL partnering companies. In the second semester, the students will be offered discipline-specific work placements and workplace projects at various company partners, which helps to develop a strong awareness of their future career goals. In the second and third years, the students will be provided with industry engagement opportunities at specific companies that are aligned with their disciplines. The final year will be more focussed and structured to enable the students for a smooth university-to-industry transition. Some students might receive the opportunity to become hired by the partnering companies based on their performance in WIL and position availability.

Engineers Australia's Stage-1 Competencies are knowledge and a skill base, engineering application ability, and professional and personal attributes, and have 16 mandatory elements of competencies. Each element includes different indicators of attainment. To develop the EWIL framework, we segregated the indicators of attainment to achievable competency components. While entering the industry for professional practice, graduate engineers are expected to demonstrate these competencies. By embedding adequate amounts of WIL for each component of the competency indicators, the EWIL framework will equip engineering graduates to be industry-ready and prepare them to performing the job of a graduate engineer. The inputs of the percentage ranges for achieving each component in university and industry were gathered from academic and industry experts during the interviews. According to the program requirements, the curriculum developers need to distribute the components over the four years of education. As appropriate to the engineering disciplines, the components will need to be classified into each year from the theoretical and application levels of the study program and fundamental to advanced competencies.

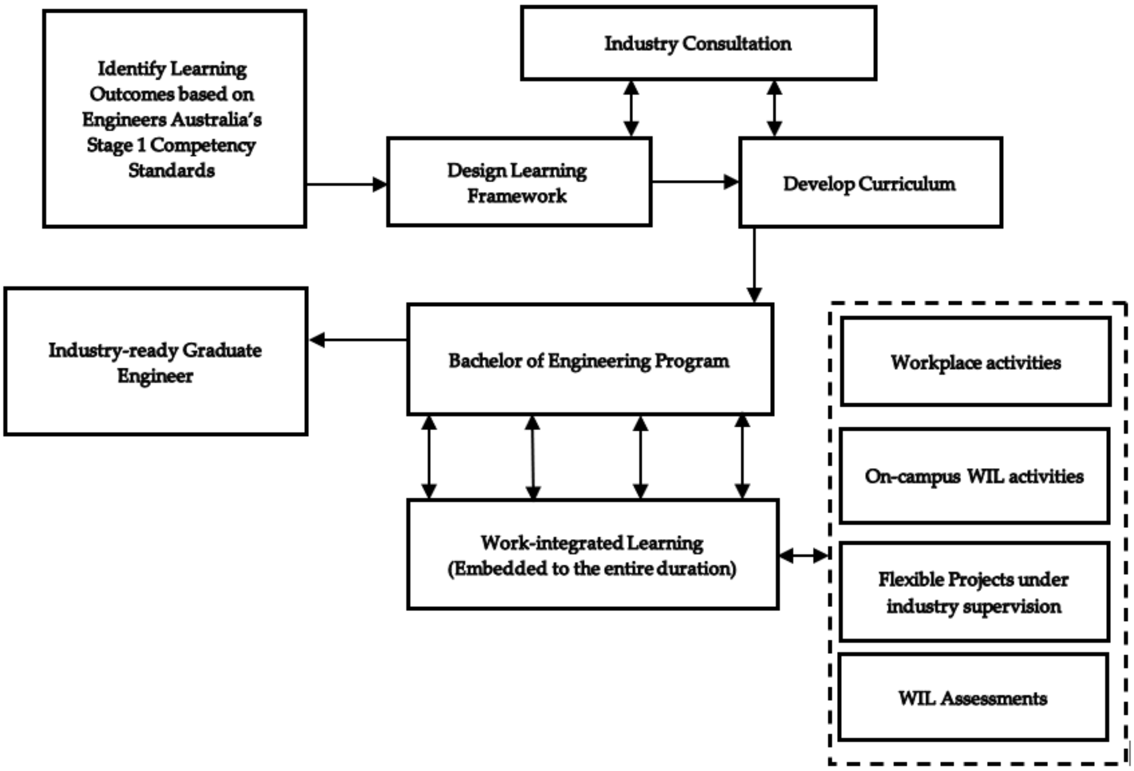

Figure 2. Enhanced WIL framework approach [2].

Table 3 provides the summary of the validated EWIL framework. In the table there are three major columns: The Stage-1 Competencies reference, WIL industry engagement mean percentage, and campus/industry engagement percentage range for achieving Stage-1 Competencies. The columns on the left show the elements of competency, indicators of attainment, and the trigger verbs and nouns for the components. The middle columns show the mean % consolidated from the interviews of academics and engineers as well as from the validation. The columns on the right show proposed and validated campus and industry engagement percentage ranges. Industry engagement percentage is the weightage given to WIL for each component of the EA indicator of attainment.

The campus and industry engagement (WIL) percentage range that the authors initially proposed based on the interview inputs and recommended by the validators are also provided in Table 3.

The EWIL framework table (Table 3) below needs to be used with cross-reference to the Competency Standards. The following terms are outlined in the EWIL framework table:

Elements of competency: The first competency, which is knowledge and a skill base, has six elements, with competency keywords such as comprehensive theory-based understanding, conceptual understanding, in-depth understanding, discernment, discipline knowledge, and understanding. The second competency is engineering application ability, which has four elements, with competency required for four different set of application skills. The third competency is professional and personal attributes, and has six elements, with the required competencies of ethical, effective, creative, professional, and orderly attributes.

Indicators of attainment and components: Each element of competency is further divided into various indicators of attainment. Competency components from the indicators of attainment were extracted according to the competency trigger verbs and nouns.

The framework design concept was that by the completion of four years of Bachelor-of-Engineering studies, students will become competent in performing all the indicators of attainment. Curriculum developers will need to distribute the competency components for the appropriate semester and contexts according to the engineering discipline.

Trigger verbs and nouns: Trigger verbs and nouns are provided to identify the competency component of the indicators of attainment. Curriculum developers will need to use the EWIL framework along with the Competency Standards.

Mean %: The mean value of industry engagement percentages was calculated as below.

Mean (interviews) = ($n_1 \times 10\% + n_2 \times 15\% + n_3 \times 20\% + n_4 \times 25\% + n_5 \times 30\% + n_6 \times 35\% + n_7 \times 40\%$)/(total interviewees), where n_1 to n_7 are the number of interviewees that responded to the corresponding percentages of WIL industry engagement responses.

Mean (validation) = ($n_1 \times 10\% + n_2 \times 15\% + n_3 \times 20\% + n_4 \times 25\% + n_5 \times 30\% + n_6 \times 35\% + n_7 \times 40\%$)/14, where n_1 to n_7 are the number of validators that responded to the corresponding percentages of WIL industry engagement responses.

5. Discussion and Recommendations

The application of EWIL framework is provided in Table 4 with an example of allocating percentage of WIL for the components of the indicators of attainment for the Element of Competency 1.4.

Table 4. Example of allocating WIL% in the enhanced WIL framework.

Engineers Australia's Stage I Competencies Reference			WIL Industry Engagement		On-Campus Learning
Element of Competency	**Indicators of Attainment**	**Trigger Verbs and Nouns**	**% Mean**	**% Range**	**% Range**
1.4	1.4 a	Identify	18	10–25	90–75
	1.4 a	Critically appraise	21	10–30	90–70
	1.4 b	Interpret	18	10–30	90–70
	1.4 b	Apply	23	15–35	85–65

In Table 4, 1.4 is the competency element 'Discernment of knowledge development and research directions within the engineering discipline'. Of it, 1.4 a is the first indicator of attainment, signifying that a student 'Identifies and critically appraises current developments, advanced technologies, emerging issues and interdisciplinary linkages in at least one specialist practice domain of the engineering discipline'. The second indicator of attainment is 1.4 b, where a student 'Interprets and applies selected research literature to inform engineering application in at least one specialist domain of the engineering discipline'.

Trigger verbs and nouns need to be used when referring to the 'indicators of attainment' in Engineers Australia's Stage 1 Competencies [1]. The trigger verbs and nouns are provided to identify the competency component of the indicators of attainment, which will help the curriculum developers who might be using this framework when implemented in future. Trigger verbs and nouns listed in Table 4 such as identify, critically appraise, interpret, and apply are used to segregate the competency components. The % mean for WIL is the mean of WIL industry engagement percentage recommended by the interviewees. The % range for WIL is the WIL industry engagement minimum and maximum percentage range from the interviewees' recommendations. The % range for on-campus learning is the minimum and maximum percentage range of learning required on-campus as per the interviewees' recommendations.

As provided in Table 4, a mean of 18% WIL is required to achieve the competency of being able to 'identify the current developments, advanced technologies, emerging issues and interdisciplinary linkages in at least one specialist practice domain of the engineering discipline'. Curriculum developers can allocate WIL in the range of 10–25% for this component in consultation with the program managers. It is required to consider various factors such as learning outcomes, university standards and policies, legislations applicable to the country, state and region, and availability of relevant companies for WIL.

5.1. EWIL Preparatory Stage

The engineering curriculum might need to be revised to develop and maximise the graduate employability of students by developing their work-ready skills through WIL curricula and co-curricular programs. Universities might prepare and approve engineering curricula with each unit (subject) clearly defining knowledge and practical skills. They might develop a record book in which students could record what they learned mapped against the competencies and criteria for each unit for each semester.

Universities could prepare a database of relevant engineering workplaces in the appropriate functional areas. WIL representatives would contact the company with a proposal that includes the EWILF and seek the possibility of a WIL partnership. The WIL team then assesses the company's potential to facilitate WIL and demonstrates the process and future benefits to the company. The company communicates to the university the decision regarding WIL collaboration.

Alternatively, universities could advertise their needs for WIL collaboration. Advertisements need to be developed to invite expressions of interest from relevant industry partners for the EWIL-embedded Bachelor-of-Engineering program, and extensively market EWIL and its benefits to attract the attention of the engineering industry. Universities should advertise, inviting applications from domestic and international students, highlighting the program embedded with EWIL and recruit students based on their interests and eligibility. The advertisements should specify the discipline areas and requirements. Universities would publish the application form for expressions of interest on their website. Engineering companies may send expressions of interest to host WIL in their facilities, followed by the process mentioned in the above.

Decisions need to be made regarding industry partners and preparing for collaboration, and a learning plan needs to be prepared to facilitate EWIL in collaboration with students, academics, and industry partners. The WIL partners for each student for each semester would be decided on so that students will complete WIL throughout their engineering studies. It should be assured that the practical application of each unit in each semester will be learned at more than one workplace, and a strong industry partner relationship should be established and maintained.

The administrative or human resources (HR) staff in the workplaces receive the resume or profile of the potential WIL students aligned with the company's functions. HR consults with the technical or operations manager and selects the candidates who can be accommodated for WIL in accordance with the company's capabilities. HR communicates with the university's WIL officers and finalises the individual learning plan for each WIL incumbent. The student, university's WIL officer, and company HR sign the WIL contract as per the individual learning plan.

Prior to the commencement of EWIL, organisations need to articulate, document, and agree to the scope and realistic timeframes for the WIL activity, and articulate the roles and responsibilities of each stakeholder. Partnering companies should discuss and agree on intellectual property, insurance, and non-disclosure agreements, and make decisions on naming rights, taking photos, promotions, and using logos and advertisements on social media. They should make decisions on making judgements in addition to providing feedback, and agree on timeframes for progress reports and responsible people. Start-up companies may need special agreements and legal advice. If start-ups cannot deliver WIL as expected, alternate arrangements should be available. That is, the university should have a backup plan.

The EWIL department should ensure that the academic corresponding to each unit and the WIL coordinator communicate with industry mentors. Universities should conduct authentic WIL assessments and collect evidence in partnership with the partner organisations; progress should be monitored on a weekly, monthly, and semester basis. They need to provide counselling, professional development, and further learning opportunities in addition to the major studies, as well as help students with resume preparation and job interviews. The EWIL department should consult with the industry partners and seek the possibility of employment for the WIL students on completion of their Bachelor of Engineering degree. They also need to support the students with finding employment if they are not hired by any industry partners, and provide post-WIL feedback, career support, and guidance.

5.2. Recommendations for Universities to Enhance WIL

Embedding WIL throughout the degree will help to develop graduate capabilities. We recommend that universities establish effective partnerships with industry and develop flexible arrangements for WIL, embedding professional practice to achieve reciprocal and mutually beneficial outcomes. We recommend the following actions to universities for facilitating EWIL in engineering disciplines.

5.2.1. Structure the Enhanced WIL Program

Using the EWILF structure, the degree program would embed WIL over the four years of study for each unit. Universities should outline and confirm the workplaces for enhanced and structured work experience for each year of study. Changes are possible when required, ensuring compliance with the EWIL framework. A WIL and assessment record book, including learning outcomes, learning plans, WIL resources, WIL activities, and WIL assessments in collaboration with the workplace partner should be developed. WIL activities should be monitored and regular feedback should be provided during the WIL experience in as well as after completion. WIL plans should be developed over the short-term, such as each semester, and evaluated at set intervals.

5.2.2. Encourage and Monitor Self-Reliance in WIL

Universities need to encourage authentic opportunities at workplaces and facilitate personal WIL goals and achievements, encourage self-reliance in workplace learning, and engagement in self-assessment and reflection. They should also promote self-motivation and monitoring in self-directed learning through enhanced work experience.

5.2.3. Ensure Appropriate WIL Activities

Collaboration with partnering workplaces and ensuring that the students are provided with workplace activities relevant to the WIL plan are important. WIL mentors need to motivate students to develop creativity and adaptability and to apply these in the assigned workplace challenges. They should encourage students to perform WIL activities as responsible trainee engineers, and link practical scenarios with theoretical knowledge.

5.2.4. Facilitate and Monitor On-Campus WIL Projects

Universities need to facilitate safe and effective campus-based WIL projects in consultation with the relevant workplaces, ensure the appropriateness of the activity spaces, and prepare and implement risk management plans and strategies. They should develop and maintain a strong relationship with workplace partners, understand diverse learner needs, and ensure reasonable adjustments as required.

5.2.5. Collaborate with WIL Partners and Students

It is required to maintain mutual respect among the stakeholders throughout the student WIL journey, understand and communicate the shared responsibility for WIL among stakeholders, reflect positively, and provide productive feedback regularly.

5.2.6. Evaluate Enhanced WIL

WIL practitioners should set benchmarks for EWIL evaluation and define the purpose. They need to assess and provide continuous feedback to students on their WIL progress, prepare evaluation procedure and set timelines, ensure compliance with ethical requirements, and strictly maintain privacy and consent requirements.

5.3. Bachelor of Engineering EWIL Model

Curriculum developers might need to consider the information outlined in Table 5 when developing the degree curriculum. A suggested model of campus and industry engagement for Bachelor of Engineering students through EWIL is shown in Table 6 [2].

As shown in Table 6, engineering students would learn on-campus and in relevant workplaces. Y1S1 indicates subject one in year one, and companies such as A, B, and C indicate the names of different companies in which the students undertake WIL. Some of the units/subjects in a year of learning might be clustered together while developing the curriculum. Theory may be predominantly learned on-campus and practical applications at workplaces. Each year may have major project works that may be completed on-campus, in the workshop/laboratory, and in the collaborating workplaces. The number of units/subjects and companies indicated in each year are only sample numbers and can be varied according to the universities, workplaces, engineering disciplines, and federal/state/institutional standards and regulations, etc.

Table 5. EWIL curriculum focus.

Year	Key Achievement Focus	Competency Components' Trigger Verbs and Nouns
1	Security and induction procedures. OHS training, including general OHS awareness. Company-specific OHS on-site training. Commence the learning of discipline in workplace scenarios. Achieve competency in the fundamental practical aspects of the indicators of attainment components.	Awareness, identification, expressing, comprehension, and understanding
2	Core practical aspects of the discipline. Corresponding professional and personal attributes.	Interpretation, application, understanding, determination, analysis, ensuring, identification, interpretation, proficiency, construction, selection, determination, addressing, systematically addressing, writing, checking, awareness, proficiency, critical assessment, thinking, application, functioning, and earning
3	Advanced practical aspects of indicators of attainment components.	Engagement, proficient application, critical appraisal, application, appreciation, prediction, addressing, partitioning, conceptualising, critical reviewing, proficient identification, safe application, assessment, ensuring, partitioning, analysis, integration, quantification, seeking out, awareness, demonstration, understanding, functioning, recognising, and confident pursuing
4	Management of advanced practical aspects of indicators of attainment components.	Development, application, appreciation, investigation, critical reviewing, management, design, conduction, analysis, determination, working within, eliciting, scoping, documenting, developing and completing, devising and documenting, prototyping and implementing, documenting, commissioning, reporting, contribution and management, realistic assessment, accommodating, demonstration, proficiency, preparedness, demonstration, presenting, and taking initiative

Table 6. Campus and industry engagement model for enhanced WIL.

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

In the student journey model outlined in Table 6, each student would have the opportunity to undertake WIL throughout the Bachelor of Engineering program. Each student would receive practical exposure to various workplaces. Students could also undertake placement at a given place more than once, if an appropriate opportunity for it was to materialise.

5.3.1. Weekly Schedule Model

In this model, the students learn for four days on-campus and carry out WIL for one day or learn for three days on-campus and carry out WIL for two days (Table 7). The number of days is determined by the curriculum designers and program managers based on the EWILF. The time allocation depends on the engineering qualification and is mentioned in the curriculum structure.

Table 7. Weekly schedule model for EWIL.

Options	On-Campus	WIL
1	4 days	1 day
2	3 days	2 days

5.3.2. Monthly/Semester Schedule Model

In the monthly model, the students spend three weeks on-campus and carry out WIL for one week. In the semester model, the students spend four to five months on-campus and one to two months are devoted to WIL (Table 8). The model and number of weeks in a semester will be determined by the curriculum designers and program managers. The time allocation depends on the qualification and is mentioned in the curriculum structure.

Table 8. Monthly/semester schedule model for EWIL.

Model	On-Campus	WIL
Monthly	3 weeks	1 week
Semester	4–5 months	1–2 month/s

To implement EWIL, an engineering unit could be structured for delivery as shown in Table 9.

Table 9. Engineering unit (subject) structure for enhanced WIL.

Theory		Practical				
On-campus	Workshop/laboratory, Companies A, B, and C, and more as required	Workshop/laboratory and on-campus	Company A	Company B	Company C	More companies as required

The theory will be predominantly studied on-campus and partly at the workshop/laboratory on-campus and partnering companies (Companies A, B, and C, and more companies as required). The practical aspects need to be learned and assessed through industry engagement in collaboration with partner companies and the workshop/laboratory on-campus. The curriculum needs to be prepared to include the percentages of achieving competency, referring to the EWILF.

5.4. Engineering Unit (Subject) Structure for the Enhanced WIL Framework

The EWILF recommends that each engineering unit should clearly describe achieving the ability to apply the knowledge, skills, and attributes stipulated in Engineers Australia's Stage-1 Competencies, relevant to the discipline and industry to which the unit belongs. Each engineering unit should be developed using the EWILF, which will ensure the application of the relevant knowledge, skills, and attitudes consistently over the four years of the degree in appropriate workplace situations and environments. The unit should specify all workplace performance aspects, including undertaking and managing different individual tasks, contingencies, and breakdown responses, handling workplace responsibilities, and teamwork.

Curriculum developers need to ensure that a specific work activity for each unit is described, including the conditions of the scenarios for the activity and the required evidence of competence, strictly following the EWILF. To do this, the engineering unit developers need to thoroughly understand the EWIL framework, knowledge and skills, required specific skill levels, employability skills, conditions, the relevance of the tasks involved, evidence for achieving competency, and the assessments required to perform specific learning activities.

Bachelor-of-Engineering units need to have a standard format that contains all the required components across Australia. The standardisation of units enables easy understanding. Standardisation also helps for the recognition of prior learning assessments and the transferability and portability of qualifications. The EWILF recommends the following structure for each unit in the Bachelor of Engineering course.

5.4.1. Unit Name and Summary

The unit's name needs to describe the unit and indicate the content and workplace application. The unit code also needs to specify the abbreviation of the unit name. The purpose, focus, and outcome of the unit need to be described in the unit summary. The summary should provide a clear overview as well as information about the content and relevance of the unit to the specific engineering qualification. The summary needs to include the skill areas addressed by it and its relationship to any other engineering unit. The details of any contextualisation, equivalence to the original, and reasonable adjustments required for equivalence need to be specified in this section. The unit's relationship to legislative, regulatory, licensing or certification requirements applicable to the unit could be described.

5.4.2. Industrial Application

The scope, purpose, and function of the unit and how the competency applies in the workplaces of the corresponding industry need to be specified in this section. This section should not be excessively job-specific, because the unit will need to apply to a broad range of different workplaces functioning in the core area addressed. The application of knowledge and skills in various environments, situations, and complexities needs to be indicated. To avoid or minimise misinterpretation, this section may provide industry-relevant information useful for the activities, such as the purpose of job descriptions, job analysis, and recruitment advice.

5.4.3. Sector/Field

The industry sector/field may be added to provide direct identification of industry applications for the readers. The name of the industry sector, function, or specialisation, such as mechanical, electrical, mechatronics, manufacturing, and so on, as well as further categorisation of the competency field may be mentioned.

5.4.4. Knowledge and Skills

The expected knowledge and skills outcomes need to be described in this section. Details of the required knowledge will cover the information required to be gained. The skills description will address the application and workplace outcomes of the knowledge gained by graduate engineers. Engineering curriculum developers need to clarify the parameters of knowledge and skills, and create a strong and clear association with the unit specifications. This section provides the delivery and assessment of the unit with clear articulation of the required knowledge in addition to clear and assessable workplace outcomes.

5.4.5. Subject Range

This section provides the context of the unit, elaborating on critical terms or phrases highlighted in bold and italics in the indicators of attainment and components section. It includes contextualising the key subject contents, relating these to knowledge and industry requirements, providing assessment focus and guidance for reviewing and updating the unit. This section may also specify any essential operating conditions, student needs, technical accessibility, and local industry as well as regional contexts.

5.4.6. Competency Elements

This section could cover all the applicable elements in the Stage-1 Competencies for the unit that the graduate engineers need to demonstrate by completing the unit. Competency elements make up the outcomes of the learning contents and tasks.

5.4.7. Indicators of Attainment and Components

All the relevant indicators of attainment components could be listed here. The knowledge and performance requirements for the units need to be clearly specified for each component and indicator of attainment. Trigger nouns and verbs could be highlighted in this section and might be defined or elaborated in the subject range section.

5.4.8. Employability Skills

The employability skills addressed by the unit need to be indicated in this section.

5.4.9. Pre-Requisites

This section needs to mention the pre-requisite requirements of the unit, if any. If it requires the completion of any particular unit prior to undertaking it, this must be mentioned with this unit code and name.

5.4.10. Evidence Guidelines

This section needs to provide the assessment guidelines to the university and academics. It could provide a range of evidence and assessment contexts, including assessment conditions (for example, assessment environment and necessary equipment), methods of assessments (for instance, written examination, practicals, workplace simulations, workplace projects, and a workplace portfolio), interdisciplinary relationships or clustering of the assessment with other engineering units, restricted access to any equipment, infrastructure or facilities, performance consistency, validity of the assessment, and evidence, as well as sufficiency of evidence.

5.4.11. Occupational Health and Safety (OHS)

OHS components need to be included in the unit according to the performance level and scope of the unit, relevant industry requirements, and following the OHS regulations. The curriculum developers need to embed OHS components related to the skills and knowledge required to identify workplace hazards, assess the level of risk, and control the risk of exposure. OHS is included in the subject to emphasise the workplace health and safety responsibility level of graduate engineers that is compatible with legislative requirements. Engineering curriculum developers may include OHS in the engineering unit by adding these to the indicators of attainment components, OHS regulations in the subject range, standard operating procedures, evidence guidelines, and industry core standards meeting industry conditions and characteristics.

5.4.12. Regulatory Requirements

Curriculum developers need to consider discipline- and industry-specific licensing, registration and regulations, and variations between states and territories. Applicable OHS licences or certificates for industry operations should be mentioned in the performance requirements of the unit. The skill requirements and OHS regulators need to be identified by the curriculum developers to ensure the licensing requirements [23].

5.4.13. Analyse Job Requirements

The EWILF will help curriculum developers embed employability skills into the curriculum by analysing job requirements. Developers need to analyse factors such as communication skills required for the job and how these communication skills could be used for the job, reporting the procedures and people involved, problem-solving requirements for the job, level of autonomy, and teamwork requirements of the job. Curriculum developers need to consult industry experts to embed the relevant employability skills for the specific occupation [23,24].

The integration of theory into practice in EWIL can be applied using the three progressive stages adapted from Collingwood's three-stage theory framework [25]. In stage one, students use theoretical knowledge to adapt to the workplace setting. In stage two, the 'what' and 'why' will be informed using theory and potential intervention strategies. In stage three, students identify and practice specific knowledge, skills, and values to inform and intervene using theory.

Applying theory to practice can be facilitated by workplace supervisors in three ways: connecting theoretical material to practice by discussing theory and helping students, translating conceptual material into more practical language using examples, and allowing student to make connections by exclusively presenting the practical material [26].

5.5. Learning Plans

After establishing learning outcomes and assessment measures, the stakeholders, including the university WIL coordinator and the company HR manager, need to set up a learning plan for EWIL. The learning plan will help engineering students meet the learning outcomes. The students and workplace supervisors will be consulted, and the discipline, unit, and workplace contexts will be considered while developing the learning plan. The learning plan clarifies tasks or activities to the stakeholders and produces a positive educational experience [27,28]. The enhancement of self-directed lifelong learning skills will be developed in learners using individual learning plans [29]. Different approaches can be adopted to develop specific workplace tasks that correspond to the learning outcomes [29,30]. They provide models for work experience design, focussing on activities such as work participation and project implementation, and present different ways to achieve learning outcomes in the workplace. The different approaches are outlined in Table 10.

Table 10. Learning plan approaches and methods [30,31].

Learning Plan Approaches	Methods
Project work	Complete project works, including a written report within a set time.
Case study	Present a study of an individual feature or event in the workplace, including a plan for improvement.
Direct observation	Observe the student over a period in the workplace. Maintain the record of observation.
Work/learning contract	Completion of a set of workplace responsibilities assigned by a workplace supervisor within a period.
Required work	Performance on an agreed set of tasks.
Critical incident analysis	Record a workplace incidence and analyse it through discussion using learning guide; evaluate actions for better effectiveness.
Reflective assessment	Observe workplace practices and reflect on decisions made. Maintain a reflective diary.

Learning plans for EWIL established in consultation with students and workplace supervisors will assist engineering students to meet their learning outcomes. Learning developers and workplace mentors need to include specific tasks for achieving learning outcomes; assessment and observation methods; clear, measurable, and realistic learning outcomes; host organisation guidelines; assessment methods; and timeframe for learning outcomes [27–29]. The learning plan will be supported by tasks/activities developed to meet each learning outcome, evidence to determine the demonstration of a successful outcome, creation and continuous modification of tasks and plans representing realistic and current contexts, and timelines and methods for achieving tasks incorporated into workplace activities. Learning plan developers may attend project meetings, observe the activities of engineers in the project, and understand the purpose, involvement, and procedures of the project [32].

5.6. Enhanced WIL Academic Practices

Academic and workplace mentors play an important role in facilitating the connection between theory and practice [28,33]. Academic and workplace mentors may contribute to the WIL student journey by becoming involved in activities such as understanding WIL theoretical frameworks, assisting in or making suggestions in designing curriculum, developing learning objectives, preparing content for delivery, facilitating knowledge and skill development for the program, facilitating student- and instructor-led learning, transferring skill demonstration, and fostering student learning (Table 11).

Table 11. Enhanced WIL stages and academic practices [28,33].

Stages	Academic Practices
Pre-WIL	Identifying appropriate workplaces Mapping workplaces for the engineering qualification Orientating students for effective engagement Briefing WIL requirements and stakeholder responsibilities Preparation of WIL and assessment record books Preparing students for WIL Pre-WIL pre-requisites training Workplace risk management training
During WIL	Ensure proper workplace mentoring Coordinate WIL arrangements for each student at various allocated workplaces Encourage student engagement with learning outcomes Verification of WIL and assessment record books Facilitate student engagement
Post-WIL	Provide an opportunity for sharing learning Endorsing WIL and assessment record books Identification of WIL learning outcomes and workplace practices Encouragement of further learning

The academic and workplace mentors may motivate the students who are undergoing EWIL using the strategies shown in Table 12.

Table 12. Factors for student motivation [34].

Factors	Strategies
Academic/workplace mentor	Create enthusiasm for practical and theoretical elements of WIL, create realistic expectations for integrating theory and practice, build rapport with students, provide clarity in learning and attitudes, and provide positive feedback about the WIL environment.
Content/information	Provide clarity and establish a connection between theory and WIL practice, demonstrate the usefulness of the knowledge/skills to students in their work, provide clear and accurate learning activities, deliver the designed learning outcomes to enable learners to progress to the next level of understanding, and blend theory and practice to improve learning outcomes.
Delivery/presentation	Encourage the active involvement of students in the development of learning outcomes, encourage them to share learning outcomes with others, motivate them to be actively involved in discussion, questions, and writing, engage in a hands-on demonstration of interlinked theory and practice to involve the mind and body, engage in debates, and position papers and discussion to involve values, attitudes, and feelings.

5.7. Enhanced WIL Assessments

To ensure educational integrity in work experience, student learning needs to be measured by properly designed assessments [33], fostering student learning and encouraging students to be reflective and participate actively in the assessment process [35]. To determine discipline-specific competencies, educational learning outcomes and experiences need to be linked with industry in WIL learning assessment [36].

Assessment developers need to integrate theory into practical application in EWIL assessments. EWIL assessments should assess the continuous achievement of learning outcomes on an incremental basis, and need to cover contextualised, complex, variable, and unpredictable outcomes that reflect the EWILF indicators of attainment components. Students, academics, course instructors, workplace supervisors, and the employer organisation play a key role in WIL assessments [28,31,37,38]. Universities need to ensure that industry partners, academics, and students actively participate in the WIL-assessment process. Students need to be provided with self- and peer reflection opportunities because regular feedback will help improve work-ready skills development by knowing their strengths and limitations. Realistic and strong feedback helps WIL curriculum development by setting goals and addressing gaps in skills [30].

While developing the student learning plans and learning outcomes, assessment activities need to be discussed with the workplace supervisor and program manager. Assessments may include summative assessments to evaluate workplace learning experience outcomes, implemented at the initial stages of a learning experience. Formative assessments recognise challenges and improvements throughout a learning opportunity, and integrated assessments provide clarity for students regarding what they are learning, merging summative and formative assessment tools [39]. While conducting WIL assessments, provide clear indicators of attainment, assessment measures, performance scales, different assessment methods and multiple assessors, and assess over different periods. Miller's (1990) triangle might be used as a reference for designing WIL assessments, which has the components of knowledge, competence, performance, and action. EWIL assessments may include the following methods and activities shown in Table 13.

5.7.1. Enhanced WIL Assessment Guide

Each subject needs to have an assessment guide as part of the curriculum. The assessment guide needs to provide a clear idea to the academics and workplace mentors of the contexts and conditions of assessments and the required resources, tools, and equipment. The assessment guide needs to outline the assessment evidence required to demonstrate the skills and knowledge mapping against the components of the indicators of attainment. It also needs to provide the subject range and assessment guidelines.

The assessment guide should help the assessor gather evidence for making a professional judgement by relating to particular discipline-specific knowledge and skills, demonstrating consistent performance, assessment methods for certain circumstances, the requirement of direct observation, and special licensing, regulatory, legislation, or certification requirements. The assessment guide should indicate the assessment methods, conditions, contexts, equipment, resources, assessment process, and expected outcomes.

Table 13. Enhanced WIL assessment methods and activities.

Assessment Methods	Assessment Activities
Workplace examinations	Written examinations and practical examinations
Practical written assignments	Written portfolios, case studies, analytic papers, reflection essays, journals, progress reports, writing activities, and article/reading review
Performance observation	Workplace performance assessment, peer assessment, simulation, demonstration, and task-oriented assessment
Presentations	Poster presentations, PowerPoint presentations, concept maps, individual or group interview, online discussion group, and video diaries
Workplace projects	Capstone projects and mini-projects
Workplace portfolios	Photography portfolios, critical incident analysis, reflective writings, and performance evidence

5.7.2. WIL Assessment Contexts

EWIL assessments can be undertaken either in an appropriate workplace or accurately simulated workplace environment. A simulated environment may need to have additional assessments to ensure that it covers the expectations of a realistic workplace situation. In certain contexts, conducting assessments may not be practically possible in the workplaces, such as the assessments involving collisions and chemical spills. In such cases, to achieve valid assessments in a simulated environment, assessment developers should guide the assessment process on the corresponding simulation techniques and assist those involved.

5.7.3. Enhanced WIL Assessment Tools

EWIL assessment tools could include the following sections as shown in Table 14.

5.8. Industry Partnership for Enhanced WIL

Industry partnerships enrich the student experience by engaging students with learning opportunities or achieving research and innovation outcomes [40,41]. Work experience for students is contributed to by partnering organisations that have domain-specific knowledge and expertise [42]. Building and sustaining effective partnerships with workplaces to host students is a key factor in advancing a WIL program. To enable EWIL, universities need to partner with several relevant organisations to work towards common goals involving key internal and external stakeholders. This engagement applies and produces knowledge via mutually beneficial and reciprocal partnerships. Engineering students gain expert knowledge related to content and theory from their academics and apply this knowledge in distinct workplace contexts. The authority over curriculum and pedagogy is shared in a successful WIL framework by building impactful partnerships with workplace organisations.

While developing partnerships for implementing EWIL, universities need to ensure that the partnership enhances the curriculum, work-readiness, and teaching as well as learning experiences of graduates. Such partnerships should also enrich scholarship, research, and innovation; build effective relationships with the university's broader communities and a shared sense of commitment and responsibility; exchange knowledge and learning by creating and leveraging connections; contribute to the public good and build healthy and caring communities; enable the sharing of resources, skills, knowledge, and funding; strengthen social, cultural, and human capital; respect and build on the partners' works; encourage responsibility towards community needs; accomplish work that is difficult to accomplish alone; and seek real, meaningful, and lasting relationships with communities and industry partners.

Table 14. Enhanced WIL assessment tools.

Sections	Addressing/Consisting of:
Workplace description	Description of: Worksite. Student roles and responsibilities. Methods of learning tasks, observations, interactions, etc.
Learning outcomes	Description of: Proposed learning outcomes. Learning goals updates.
Examine the workplace experience	Examination of: Work experience including pre- and post-work experience. Student achievements in the workplace. Student challenges in the workplace. Changes in the student's thinking and perspective. Use of specific workplace examples. Prior to the work experience, understanding the construct. Strengths and challenges in workplace application of this construct.
Learning articulation	Articulation of: Job-specific knowledge and skills learned in the workplace. Learning about one's self from the workplace. Methods of learning such as situations, tasks, and feedback mechanisms. Why the above matters. Students' future activities/goals. Learning practice, considering the future.
Formatting and referencing	Correct sentence structure. Accurate spelling, grammar, and punctuation. Proper structure, headings, and sub-headings. Completion and formatting of reference list (APA 7th ed.). Correct in-text referencing.

5.8.1. Effective Practices for Developing Workplace Partnerships

The authors recommend the integral involvement of workplace organisations in the planning, designing, implementation and evaluation of the WIL curriculum. Universities and workplace organisations need to collaborate at each stage of WIL, such as student recruitment, admission, student orientation, curriculum development, program planning, delivery, assessment, evaluation, moderation, feedback, and completion. For the implementation of EWIL during the development of workplace partnerships, the following elements and rationale are recommended, including recommendations by Seifer [43] (summarised in Table 15).

EWIL can lead to successful partnerships that demonstrate good relationships, mutually beneficial and reciprocal actions, representativeness, balance of power among partners, institutional commitment, reciprocity of resources and rewards, mutual trust, genuineness, and respect and commitment. These partnerships should also address strengths and weaknesses, shared responsibility, leadership and oversight, a common language, clear and open communication, and understand intellectual property, as well as improve processes and the partnership through continuous feedback, collaboration with partners and stakeholders, clearly defined principles and processes, and understanding the value and purpose of the contribution by universities and partner organisations.

Table 15. Effective practices for developing workplace partnerships [43].

Recommendations	Rationale
Goal setting	Mutual agreement on the partnership mission, vision, values, goals, and outcomes.
Respect	Mutual respect, trust, commitment, and genuineness.
Equality	The power and responsibilities are shared and balanced among partners.
Communication	Clear, open, and accessible communication among partners, and a priority to listen to each need, validate and clarify terms, etc., should be ensured.
Collaboration	Roles, processes, and norms need to be established with agreement from all parties.
Feedback	Continuous improvement of partnership and outcomes should be the aim of feedback.
Improvement	Identified strengths, assets, and areas that require improvement need to be the foundation for building partnerships.
Recognition	The accomplishment of partnership needs to be shared by the partners.
Growth	Partners should be patient and allow time for the development and growth of the partnership.

5.8.2. EWIL Staff Structure

The EWILF might have the staff structure in the universities as shown in Table 16.

Table 16. Enhanced WIL staff structure [44].

Staff Structure	Responsibilities
EWIL Committee	Drive development and implementation of enhanced WIL. Recommend organisational best practices. Guide the development of enhanced WIL blueprints. Approve resources and enhanced WIL blueprints. Evaluate the success of enhanced WIL framework.
EWIL Administrator	Develop proper documentation system to plan, schedule, conduct, assess, and record enhanced WIL. Administer training grants.
EWIL Developers	Conduct job and task analysis. Recommend relevant pedagogic courses for enhanced WIL. Develop enhanced WIL blueprints. Conduct validation of enhanced WIL blueprints. Improve enhanced WIL blueprints.
EWIL Instructors	Prepare for enhanced WIL. Prepare learners for enhanced WIL. Prepare workplace for enhanced WIL. Conduct enhanced WIL. Evaluate enhanced WIL. Recommend improvements for enhanced WIL.

5.9. Academic WIL

For the maximum effectiveness of EWIL, it is recommended that academics undergo workplace training and participate in workplace activities as employees. Whelan [45] suggested preparing a learning plan for academics, including learning outcomes, and having their activities monitored and their performance assessed by a workplace supervisor. The workplace accomplishments will form part of the professional development of the academics that can be added to their portfolio. Academic WIL is helpful to enhance the curriculum by aligning it with current industry practice and improving assessments, providing greater authenticity. Academics receive opportunities to test and verify the curriculum in the workplace and provide feedback and recommendations to revise the curriculum to meet updated industry requirements. Academics directly experience applying what they teach on-campus, maintaining their industry currency. When they deliver classes with the workplace experience, the quality of delivery is expected to increase. Academics become inspired by industry exposure and teach students with using this improved enthusiasm. Through academic WIL, industry will receive the benefit of expert theoretical and technical solution advice.

5.9.1. Training of Enhanced WIL Mentors

Mentor training is conducted in a one-on-one or small group setting, usually by a staff member (for example, manager, supervisor, or senior staff) familiar with the job task. In this training, new WIL mentors will acquire the competencies to effectively conduct on-the-job training. This includes preparing mentors for EWIL, preparing the workplace for EWIL, conducting EWIL, and reviewing the effectiveness of EWIL.

5.9.2. Learning Outcomes

At the end of the training, academics will be able to: (1) explain what EWIL is and its benefits to employers, students, and supervisors; (2) explain the role and core skills of an EWIL consultant; (3) determine the scope of the consulting assignment; (4) conduct diagnosis and analysis to establish EWIL requirements; (5) develop an action plan for setting up the EWILF and implementing EWIL; (6) implement the action plan; and (7) evaluate the effectiveness of on-the-job training [44].

5.10. Enhanced WIL Mentoring

Quality mentorship is an essential component of EWIL for creating effective and positive learning spaces [46–49]. In EWIL, mentors play a critical role in providing practical real-life instructions, facilitating theory to practice transition, developing teamwork skills, encouraging positive attitudes in professional settings, encouraging the taking of risks, facilitating reflection, providing productive feedback, social integration, and sharing expertise knowledge in the relevant engineering disciplines.

Mentorship has different areas to facilitate optimal student learning [50]. To help improve industrial productivity, we suggest that EWIL mentorship focuses on three areas. The first is supported learning, in which mentors plan for student learning areas, provide students with help in planning their learning activities, understand the learning levels of students through probing questions, and deliver constructive feedback. The second area is relationship building, in which mentors patiently facilitate learning and remain approachable and understanding, feel valued and safe to satisfy the needs of the students, invest time in the placement, and build a relationship with the student to develop their confidence and competence. The third area is role modelling, in which the mentors exhibit workplace values and behaviours to be observed by the students and mould them into being industry-ready.

In EWIL, mentors need to ensure awareness of the student-learning goals and how they change over time. Mentors must make a plan and follow it to achieve the learning goals, so that students learn new techniques, skills, and the required improvement in the skill areas. They must provide regular productive feedback, should be available and approachable to students, provide encouragement to ask questions, make the student feel valued and safe in the workplace, model professional values and behaviours aligned with the student's learning goals, identify students' challenges from various workplace tasks and responsibilities, and provide scope for further learning opportunities.

5.10.1. Mentor–Student Communication

For effective mentor–student communication, mentors need to plan, discuss, and set up the communication schedule, discuss and decide the mode of communication, and offer opportunities for frequent and varied communication. They should communicate with mutual respect, providing comfort, bringing positive outcomes, and provide a clear overview of the workplace culture. Mentors need to explain to the student about the expectations regarding communicating with stakeholders at different levels and clarify effective communication styles as per the varying situations. They should set a high standard for external and internal communication and review and provide regular feedback for improvement for reports and other written documents [27].

5.10.2. Feedback by Mentors

Mentors need to ensure that students evaluate their progress. Concerning feedback, mentors need to maintain confidentiality and honesty, and remain constructive and objective. Feedback may also be gathered from other team members who have worked with the student. Mentors must check specific actions and understanding, provide clarification, and allow information processing time for the students. They should set realistic and achievable goals as well as reinforce learned knowledge, skills, and values through positive feedback. Mentors must provide individualised feedback and documents. The workplace mentor may contact the academic coordinator and provide feedback regarding the progress of the student and any concerns [50].

5.11. Enhanced WIL Evaluation

EWIL evaluation is important to make the outcome measurements, assess the involvement of the organisation, assess the return on investment from EWIL engagement, discuss with the partnering university and provide realistic feedback, discuss the possibilities and opportunities for improving the quality of WIL engagement, and use a collaborative approach to review WIL implementation and outcomes [51].

Program evaluation is required for quality assurance and improvement and contribute to effective services and societal progress [52]. Evaluation is a continuous growth process and a tool for understanding that improves ways of thinking, developing, implementing, and changing programs [53–55]. The purposes of WIL evaluation are to assess the effectiveness of the program within a particular context and identify possible improvements. Evaluation is a major part of the EWIL program and includes the evaluation of question development, choosing an evaluation paradigm, evaluation model selection, evaluation tool development, data collection and analysis, and presenting findings to stakeholders.

This paper recommends six quality criteria:

- Structured WIL program.
- Structured work experience with learner autonomy.
- Opportunities for relevant workplace challenges for students.
- Effective learning environments.
- Strong student–workplace partnership.
- Continuous assessment and WIL program evaluation.

The process commences with setting evaluation standards to determine the criteria of evaluation as appropriate to the program. The evaluation model consists of a set of rules, restrictions, guiding frameworks, and regulations. Evaluation tools might include measurement and data collection such as surveys, observation, interviews, testing, focus groups, and case file reviews. Evaluation questions should be developed in consultation with students, academics, industry mentors, and other stakeholders to establish maximum effectiveness. Data collection and analysis should be undertaken to collect evaluation data to ensure adequate data are collected through evaluation questions, and that they are answered accurately and effectively, to measure the effectiveness of the program. In this process, the evaluation of feedback and presentation to stakeholders in different formats is the last step.

The quality of the program should be continuously improved over time according to changing contexts using EWIL evaluation that meets the needs of the stakeholders.

Different methods can be adopted for program evaluation as long as they provide the outcome of enhancement in the quality of the program.

5.12. Benefits of Enhanced WIL in Academic Perspectives

EWIL experience offers numerous benefits to students, academics, universities, workplace supervisors, employers, industry, the government, and community partners. The structured work experience facilitates the benefits to arise with the integration of theory and practice [30,56,57]. Structuring the learning program and grounding it in empirical learning theory ensures that the work integration to learning is most effectively achieved.

In EWIL, students will practice self-management, self-monitoring, and motivation, and experience discipline-specific challenges, timely and accurate feedback, teamwork, and collaboration opportunities. Students will need to reflect based on their personal experience, progress, interlinked theory and practice, learning outcomes, goals, achievements, diverse WIL contexts, and inductive as well as deductive learning [58,59]. The integration of theory and practice, which is a shared responsibility of all the involved stakeholders, should be built into students' learning outcomes, assessment, learning plans, and facilitated pre- and post-WIL experience [39]. In EWIL, the effective practices include experimentation plan development, encouraging the creativity and adaptivity of students.

6. Limitation and Further Research

One of the limitations of the EWIL model might be the broad and generic nature of the framework in the current format. Further research is required to apply the EWILF to engineering study streams, such as mechanical, electrical, civil, and aerospace. The authors suggest that future researchers develop and test discipline-specific EWIL frameworks. The elements under the competencies 'engineering application ability' and 'professional and personal attributes' of the Stage-1 Competencies need to be given high priority in piloting and testing the frameworks. The concept of embedding WIL across all the semesters also needs to have adequate emphasis while testing.

This paper does not sufficiently present opinions from the minority of participants that did not welcome the EWIL ideas. The factors that influenced this minority might be personal perspectives, such as the difficulties of a change and the lack of clarity in the work involved. While implementing the EWIL framework, academics may possibly have concerns about the amount of work involved. The total work hours and the amount of work will be balanced for the academics by converting part of the classroom and workshop sessions to industry-based learning. The workplace mentors' workload might not be increased; but reduced, as they are getting extra support for work from WIL students. The paper also has not addressed the possibility of the difficulties in finding sufficient placements for the WIL students. Universities may need to increase marketing to spread the awareness of the mutually beneficial EWIL, so that they might receive more and more collaboration from industries. This paper has not detailed these areas because the focus of this paper is to present the EWIL framework and the implementation recommendations. Most of the limitations discussed in this section are scopes for further research. This model may be used globally as a reference for developing similar models, which broadens the scope for further EWIL research in various countries across the world.

7. Conclusions

A key factor in the definition of quality of engineering education is student employability, leading to the fulfilment of career outcomes. EWIL is an innovative approach to improving the employment prospects of students in the continually evolving and increasingly competitive labour market. Graduate engineers may work in different job roles in their careers for which they need to have a broad range of industry-relevant skills. EWIL equips graduate engineers with graduate capabilities and skills in innovation and entrepreneurship, global citizenship, and sustainable thinking to enable them to adapt to new contexts in a rapidly changing world. Graduate capability and career-ready programs may be developed and implemented for universities to develop graduate capabilities for current industry and entrepreneurship, and staff development programs can integrate EWIL curriculum with employability capabilities. Bachelor-of-Engineering courses can be transformed using the EWIL framework to provide industry experience during studies and future employment opportunities. Universities need to collaborate and consult with students and employers to set up EWIL programs. To implement EWIL, universities need to make strong partnerships with employers, focussing on industry-relevant skills such as cognitive skills, career management skills, flexibility, and social intelligence, in addition to personal attributes such as resilience, passion, curiosity, and empathy.

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