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Industry Engagement through Strategic Partnerships

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ABSTRACT

CONTEXT

The Australian Council of Engineering Deans, Engineering Futures 2035 report provided a number of recommendations for Australian schools of engineering to ensure they are effectively equipped to produce the engineers of the future. Chief amongst these recommendations was a stronger engagement between the engineering industry and universities to ensure graduate outcomes are reflective of industry needs and best practice.

PURPOSE OR GOAL

The purpose of this paper is to demonstrate that effective industry engagement can be achieved, through the development of strategic partnerships between industry associations and tertiary education institutions. This paper proposes that industry associations are well positioned to facilitate deeper engagement between industry organisations and the university sector.

APPROACH OR METHODOLOGY/METHODS

This paper will outline, through the use of case studies, how effective engagement between industry associations and the higher education sector can be implemented, as demonstrated by the strategic partnerships between the Institute of Public Works Engineering Australasia (IPWEA) NSW & ACT division and several tertiary education institutions in NSW. Evidence from the case studies, as well as feedback from participants, will be used to demonstrate how effective industry engagement can be incorporated into different types of educational institutions, and how outcomes of mutual benefit can be achieved.

ACTUAL OR ANTICIPATED OUTCOMES

It is anticipated that the evidence and feedback from the case studies will demonstrate that the strategic partnerships have led to the development of industry-based skills in engineering students and graduates, as well as student deliverables which are helping address the skills shortage in the engineering industry.

CONCLUSIONS/RECOMMENDATIONS/SUMMARY

The case studies provided in this paper demonstrate that effective industry engagement can be achieved through strategic partnerships between industry associations and engineering education providers. It is envisaged that the experiences outlined in this paper could be scaled to other industry associations and educational providers and recommendations are provided in the paper as to how this could be achieved.

REFERENCES (OPTIONAL)

N/A

KEYWORDS

Industry engagement, best practice, skills shortage.

Introduction

There is a strong recognition within the Australasian Engineering Education community of the need for more effective engagement with industry in order to increase the preparedness of university graduates to enter the engineering industry. Similarly, there is a growing awareness within the engineering industry of the need for more effective engagement with the university sector to ensure that graduates are job ready from day one. Despite this willingness from both sides, effective engagement between the engineering industry and engineering education sectors continues to allude many organisations.

This paper will provide an overview of effective industry engagement through strategic partnerships that have been developed between the Institute of Public Works Engineering Australasia (IPWEA) NSW & ACT and three NSW universities. Case studies of each of the partnerships will be discussed, outlining how these agreements have led to improved engagement between the university and industry partners. Finally, the paper will discuss the implications of these partnerships and provide recommendations on how other universities, and industry associations, could develop similar arrangements.

Context

The Engineering Futures 2035 project was commissioned by the Australian Council of Engineering Deans (ACED) to "consider the changing nature of professional engineering practice and the implications for engineering education in Australia" (Crosthwaite, 2019, pp. 2). Amongst the 'calls to action' included in this report was for Australasian Schools of Engineering to implement "…industry engagement in all degree programs that lead to professional engineering qualifications", to "provide greater opportunity for industry-based engineering personnel to participate in engineering education" and to "provide greater opportunities for academic staff and students to participate in industrial projects conducted within industry itself" (Burnett et al., 2021 pp. 6). This reflects a clear recognition of the need for greater engagement between the engineering education community and the engineering industry at large.

The report also called on the engineering industry to "Assist in bringing more "real-world" experiences to the education of professional engineers by…providing examples of, and increased opportunities for, students to participate in engineering work through work-integrated learning and other means" (ibid, pp. 6). This provides a clear framework by which industry organisations can engage with schools of engineering, but it does not account for the barriers of implementation of such a framework within the industry itself.

The engineering industry in Australia is in the midst of the worst skills shortage in living memory. Off the back of the COVID-19 pandemic, which stifled the incoming migration of skilled labour for several years, the increased spend on infrastructure by governments as a means of stimulating the economy out of the aforementioned pandemic, and the changing demographics of the engineering workforce as many experienced professionals reach retirement age, the demand for engineers in Australia has never been higher. Taking one sub-sector of the industry as an example; Infrastructure Australia estimated that the national shortfall of engineers engaged in public infrastructure would peak at 70,000 in 2022 – 2023 (Infrastructure Australia, 2021, pp. 6).

One of the results of this shortage is that engineering organisations are short-staffed and over-worked, which leads to a tendency to focus on the delivery of project specific or business as usual activities, over and ahead of investing in longer term strategic priorities. There is quite likely a willingness from many engineers to engage in the types of activities outlined in the Engineering Futures 2035 'calls to action', however a lack of time, resources and support from management preludes widespread engagement.

A potential solution to the barriers from an industry perspective is to outsource the promotion and organisational requirements of university engagement to industry associations. Industry associations are well positioned to act as conduits for the development and implementation of engagement frameworks between schools of engineering and industry organisations. They are commonly

membership based, not for profit organisations with a strong focus on advocating for and advancing the interests of their members. They are able to take a more strategic approach to issues such as the current skills shortage and have strong networks through which to promote such programs.

The followings sections of this paper will provide an example of the implementation of industry engagement between three universities and an industry association, as a means of both increasing the exposure of students to authentic engineering practice, as well as helping to address the overall engineering skills shortage.

IPWEA NSW & ACT

The Institute of Public Works Engineering Australasia (IPWEA) NSW & ACT Division is a membership-based organisation for public works professionals in NSW, whose mission is to "enhance the quality of life of NSW and ACT communities through excellence in public works and services". IPWEA NSW & ACT has over 800 members, predominantly drawn from engineers working in NSW Local Government. IPWEA NSW & ACT is a division of IPWEA Australasia, a technical society of Engineers Australia, and has been in operation in various forms since 1905 (IPWEA).

IPWEA NSW & ACT and its members have had a long association with a number of NSW universities; via alumni, technical committees, cadetship and vocational programs and professional organisations. Associations tended to be formed on an ad-hoc basis as the projects and priorities of each partner shifted over time. However, in recent years IPWEA NSW & ACT has begun to formalise these relationships into strategic partnerships. This decision was driven via a number of factors, namely:

- Recognition that industry and academia need to work together to address the current skills shortage being faced in NSW Local Government.
- Providing pathways from university into the public works sector via work experience, cadetship and graduate programs.
- Sharing of resources and knowledge to increase the technical knowledge of the public works sector and provide professional development opportunities to public works professionals.
- The development of joint projects and initiatives to further the aims of both the public works and engineering education sectors.

The strategic partnerships generally consist of a Memorandum of Understanding (MOU) between the two organisations. The specific clauses of an MOU depend on the needs of each partner but commonly contain the following elements:

- Promotion of public works as a career choice by the university partner.
- Facilitation of work experience opportunities for the university partner's students.
- Participation in joint research projects and other strategic initiatives.
- Providing public works professionals for industry engagement opportunities to the university partner.
- Cross promotion of professional development opportunities via both organisations' networks.
- Advocating jointly on matter of strategic importance to both organisations.

The following three case studies will provide details of several of the strategic partnerships currently in place with IPWEA NSW & ACT, and outline some of the benefits that have resulted from these partnerships.

Case Study 1 – University of Sydney

The Faculty of Engineering at The University of Sydney had been collaborating with IPWEA NSW & ACT for many years through the faculty's Jacaranda Flame Consulting (JFC) Program, operating much like a consulting engineering organisation. Students, from both undergraduate and postgraduate coursework degree programs, apply to become JFC consultants through a written

application, and if shortlisted, attend an interview. Successful candidates are placed with JFC in either the winter or summer semester breaks and work full-time (35 hrs per week) on an assigned project in groups of 4-6, under the supervision of engineers with significant professional practice. The program also has several senior retired engineers who take on the role of mentors for the consultants. Projects are sourced from various organisations including government, private, and community oriented. The JFC program provides an opportunity for students to gain work experience on real projects in an environment that is as close as possible to a real workplace.

Following a half day induction, consultant groups are provided with a project brief on their first day that is deliberately vague and with partial data and/or parameters. Within a few days, they are required to undertake some research and make some assumptions, and then write a project charter which includes the details of the project including scope, project plan, work breakdown structure and agreed deliverables. After an initial client meeting, this charter is modified and given to the client for sign-off. Projects are generally multi-disciplinary in nature and the teams are composed of consultants from different areas of study in engineering, project management and computer science. Considerable effort is also given to ensuring a balance of personality types, gender and cultural backgrounds across consultant teams to ensure the best probability of a creative and lively team. Over 100 projects have been successfully delivered to a variety of clients since 2017, in many cases surprising and delighting the client. In some cases, student consultants have been offered on-going employment in client organisations.

Some of the projects that JFC has delivered to IPWEA NSW & ACT in the last 3-4 years are:

- Automated detection and classification of roadside hazards in urban and sub-urban areas
- Asset management principles and terminology unification for local government
- Supporting driver aids in modern vehicles through road design and maintenance practices
- Increasing the resilience of Timber bridges to bushfire ember attack
- Using recycled plastics in local roads
- Opportunities for Sponge Cities in NSW
- Feasibility and initial design of Trackless Trams along Parramatta Road
- Freight optimisation tool to assist local government to develop freight strategic plans
- Investigation of strategies and technologies to reduce the urban heat island effect

Several of these projects have been presented at the IPWEA NSW & ACT annual conference where they were well-received. Some graduates who have had a JFC experience have gone on to work in consulting roles in industry and have reported that JFC was a very valuable and authentic experience.

Case Study 2 – University of Technology Sydney

The University of Technology Sydney (UTS), Faculty of Engineering and IT (FEIT) has had a long association with IPWEA NSW & ACT. In recent years this association has focussed on the promotion of the UTS Engineering Internship and Optik Engineering Consultancy programs, as a means of encouraging UTS graduate engineers to consider a career in the NSW public works sector.

The UTS engineering internship program is a requirement for all students enrolled in the four-year Bachelor of Engineering (Honours) Diploma in Professional Engineering Practice. UTS engineering students are required to complete a 6-month full-time internship in the 2nd and 4th year of their degree (2 x 6-months). Students studying Civil, Environmental, Mechanical, and Electrical Engineering apply for internships via the UTS CareerHub and are appointed into a host organisation via a typical interview and recruitment process. Students are paid during their internships and are encouraged to consider taking on roles in organisations outside of their comfort zone, including relocating to a regional area.

The UTS internships provide students with the ability to practice their technical skills in an industry setting, to develop their professional competencies, to increase their employability and to gain an understanding of workplace cultures and expectations. On the host organisations perspective, the UTS internships provide access to young, emerging, motivated undergraduate engineers, willing and

able to contribute to their host organisation. In many cases they also provide an opportunity for the host organisation to promote themselves as an employer of choice to the students before they graduate, with a view to retain them as graduate engineers. Currently there are 23 UTS internships underway within NSW Local Government organisations, with a further 41 having being conducted earlier this year, demonstrating the strong connection between the UTS FEIT and the NSW public works sector. In addition, IPWEA NSW & ACT have previously hosted a UTS intern in their Sydney office.

The UTS-FEIT Optik Consultancy is a program specifically created to partner industry with students to assist them in transitioning from study to the workplace. It's a symbiotic relationship that allows students to experience a workplace environment, working on a project with industry experts, and an opportunity for Industry to teach and mentor university students. Over 12 weeks, interns are supervised daily by a UTS Lead Engineer and a Site Manager. Industry partners join the students on a weekly basis for one hour to interact with and mentor the students and discuss progress on the project. Students' hands-on experience may include concept design, prototypes, technical drawings, preparing procedural documents, reviewing standards, WHS and compliance, writing up safe work statements, commissioning and calibrating new equipment, and preparing examples/online materials of testing completed as case studies for future clients to view.

The Optik Consultancy program has also resulted in meaningful benefits to the public works sector as a result of the partnership with IPWEA NSW & ACT. One recent example is a final year engineering student who worked with a small regional council to deliver a project virtually via the Optik Consultancy program. The council were so impressed with the student's work that they encouraged him to apply for a job with their organisation when he had graduated. He was successful in his application and shortly thereafter relocated to the regional community, thereby helping address the engineering skills shortage in regional NSW (Harris, 2021).

Case Study 3 – Charles Sturt University

The Charles Sturt University school of engineering (CSU Engineering) commenced in 2015, with a focus on developing a new and innovative engineering program, designed to integrate professional practice into every aspect of a student's study experience. IPWEA NSW & ACT has been involved with the CSU Engineering program since the very beginning. Many of the original industry partners, who signed on to support CSU Engineering before the program had commenced, were drawn from councils in regional NSW. Included amongst them was the current president of IPWEA NSW & ACT, Mr Grant Baker. The key distinctions of the CSU Engineering program are a focus on project-based learning, the employment of a large number of staff with recent or current industry experience, the on-demand delivery of technical knowledge, and a strong embedded work placement program.

The main course offering from CSU Engineering is a five-and-a-half-year Bachelor of Engineering Technology (Civil) / Master of Engineering (Civil) combined degree, which involves students studying for three semesters on campus before undertaking four years of embedded paid work placements in industry whilst continuing their studies online part-time. The on-campus portion of a CSU Engineering student's study includes working on a series of group projects that are in most cases drawn directly from industry partners, allowing the students to gain experience liaising with professional engineers, as well as providing the engineers and their organisations with access to new ideas and perspectives from the students. In addition, students are assigned an industry mentor during their second session of their on-campus study, to act as a guide to prepare them to enter the workplace. Currently, two thirds of these mentors are drawn from the NSW public works sector and all of them either work for, or are members of, IPWEA NSW & ACT.

As students enter their third session of study they begin the cadet placement process, which involves them applying for a one-year paid placement with a host organisation. The process itself involves an interview and is akin to a typical industry recruitment process. Upon appointment students are then employed as cadet engineers for four days per week with their host organisation. The host organisation provides an industry mentor for the cadet, and also provides support for some of the studies that students undertake. Since the very first placement process in 2017, there has been

strong representation by NSW Local Government in hosting CSU Engineering cadets. This representation continues to this day, with almost half of all CSU Engineering cadets being hosted in public works organisations, including 13% with State Government organisations, and over 35% with Local Government organisations.

The strong focus on industry engagement and the development of practical engineering skills has led to the CSU Engineering program being recognised for its innovation within academic circles (Graham, 2018, pp. 24). However, the quality of the cadets and graduates produced by the CSU Engineering program has also been recognised by the engineering industry. Numerous cadets have been offered fulltime employment before graduating, and in some cases have been successful in applying for positions against fully qualified graduates as a direct result of their industry experience. This is typified by the following comment from an industry design engineer in regards to a third year CSU Engineering cadet working for him: "<our cadet engineer's> design skills are highly respected by Wagga City Council. Indeed, I would back <our cadet engineer> against any fully qualified design engineer any day of the week". The recognition of CSU Engineering's cadets has grown to the point that there are more host partners wishing to come on board, than cadets available to meet the demand.

Discussion

The three case studies above highlight the variety of industry engagement opportunities that have arisen as a result of the strategic partnerships with IPWEA NSW & ACT. This is particularly relevant when considering the diversity of these educational institutions; ranging from large to small cohort sizes, metropolitan to regional, and with significant variation in the typical approach to students' industry experience requirements.

The key to the success of these partnerships, and indeed to any effective industry engagement, is for both parties to understand the needs of the other, and for both parties to derive benefit from the partnership. When considering the case studies above, the types of industry engagement can broadly be grouped as follows:

- Short term project-based engagement: such as the USyd JFC program or the 12 weeks of industry experience offered under the UTS or USyd BEng programs. The value for the university in these engagements is that their students are gaining direct experience in the engineering industry, in order to meet the Engineers Australia compulsory industry experience requirement prior to graduation. The value for the industry organisation is that they are able to access additional resources to address a specific project need. The challenge with this type of engagement is to ensure that a meaningful project can be scoped and delivered within the engagement timeframe. This often requires a significant initial time investment from the industry partners perspective, as well as periodic oversight throughout the project. These types of engagements also typically have a lower administrative overhead than other types of industry engagement programs, which is reflected in the fact that these are by far the most common types of industry engagement programs encountered in Australian universities.
- Longer term work placement engagement: such as the UTS professional practice stream or the CSU cadetship program. The value for the university in these types of engagement is that students gain significant on-the-job experience in the engineering industry. The value for the industry organisation is the ability to invest in a student for a longer period of time, and correspondingly, to guarantee a return on this investment in terms of the student's contribution to their organisation. This type of engagement requires a higher investment from both the university, in terms of managing the organisation of the work placement, and from the industry partner, as these types of placements are typically paid appointments. For example, in the case of CSU, it is estimated that approximately 30% of a FTE staff member is required to manage and coordinate all placement related activities for approximately 100 cadets. Whilst some economies of scale would be expected, similar resourcing requirements would be expected for other institutions seeking to adopt this form of industry engagement.

- Intermittent industry engagement: this is typified by ad-hoc forms of industry engagement such as guest lectures, mentoring programs or casual adjunct staff appointments. The value for the university in this type of engagement is in providing students with direct access to industry professionals, who can often provide real world examples of engineering theory in practice. The value for the industry organisation is in having access to students to promote their particular industry or organisation as a career of choice. The challenge with this type of engagement is in finding the industry professionals who have the willingness and capability to take on such a role, and for the university to ensure that they are suitable for the task. This could lead to situations where the administrative costs associated with this type of engagement are prohibitive, or even situations where the chosen industry professionals are unsuitable to act in an academic role, leading to reputational damage for the university or the industry organisation.

Beyond the benefits of strategic partnerships outlined above, it is also worth highlighting the ancillary benefits that arise from informal networking and collaboration. Whilst often ad-hoc, these interactions can have significant impacts on a student's industry experience and career development.

For example, as noted in the University of Sydney case study above, each of the JFC student groups who engage with IPWEA NSW & ACT are invited to attend the annual IPWEA NSW & ACT state conference to present on their work. At the most recent conference in March 2022, one of the student team members was offered employment with an audience members organisation following discussions after that student's presentation. Similarly, in the most recent round of JFC projects undertaken in June – July 2022, the student team working on the "Freight optimisation tool" was invited to present their project findings to the IPWEA NSW & ACT local freight strategy working group. One of the members of the working group was so impressed with the project that he asked to collaborate with the team on a project he was working on in relation to freight data analysis, going so far as to offer to fund the team's involvement in his project.

It is also worth considering the value of engaging with IPWEA NSW & ACT as an industry association as opposed to engaging with individual organisations themselves. IPWEA NSW & ACT represents the interest of all 128 councils in NSW, and has established lines of communication to many of the senior managers within these organisations. A university that partners with IPWEA NSW & ACT therefore has access to these established networks. Contrast this to the alternative of trying to negotiate with 128 organisations independently, often on a cold-calling basis. This is not to say that there is not benefit in an industry organisation and university directly engaging with one another. There will always be instances, particularly where it is geographically convenient, that such an arrangement makes sense. However, when considered strategically, engaging with IPWEA NSW & ACT as a means of engaging with the NSW public works sector is far more efficient. Of course, the same theory can be applied to any other industry association, and universities who are looking to broaden their industry engagement in jurisdictions outside NSW, or outside of public works in general, are encouraged to seek out and partner with industry associations in a similar manner to the case studies outlined in this paper.

Indeed, this theory could even be applied to the university sector itself, with a strategic partnership formed between AAEE or ACED and IPWEA Australasia or Engineers Australia to develop a framework for effective industry engagement between the engineering education and engineering industry sectors.

Recommendations

This paper provides the following recommendations for consideration by the AAEE community:

1. That all Australian universities consider developing strategic partnerships with engineering industry associations in order to increase engagement with the engineering industry.
2. That the AAEE or ACED consider developing a strategic partnership with IPWEA Australasia or Engineers Australia to develop a national framework for effective industry engagement between academia and the engineering industry.

Conclusion

This paper has highlighted a number of examples of how effective industry engagement can be achieved through the development of strategic partnerships between schools of engineering and engineering industry associations. Through a clear understanding of the benefits for both parties, solutions can be implemented that both increase the exposure of engineering students to authentic engineering practice, and provide additional resources to engineering organisations in order to address the current skills shortage.

Furthermore, this paper has provided specific examples of how effective industry engagement can be implemented in universities with a range of geographical, demographical, pedagogical and organisational needs. A number of recommendations are included for Australasian schools of engineering to more effectively work with industry, and indeed with one another, to increase industry engagement with the engineering industry.

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