Challenges of developing and sustaining a co-operative education program in Maritime Engineering

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Structured abstract

CONTEXT
With ever increasing pressure on higher education providers to produce more "work ready" graduates whose attributes provide a good match to what employers want. Work integrated learning (WIL) or Co-operative education (COE) programmes are becoming common. In the media and from industry itself, we constantly hear about the critical shortage of skilled employees, particularly in the fields of technology, science, math and engineering. In an attempt to address these concerns the institute set out to develop and promote the COE programme.

Co-operative education programs are proven internationally to improve professional skill levels within undergraduate engineering students. Industry states that professional skills are the most under-developed capability in modern day undergraduates. Our study explores the key factors associated with the development and implementation of a co-operative program and the challenges faced keeping multiple parties satisfied

PURPOSE
Setting up such a programme is a challenge in itself but maintaining engagement from industry is an area of ongoing frustration. This paper will discuss the challenges in developing and sustaining a COE programme at the Australian Maritime College (AMC).

APPROACH
Students undertake 4 work terms within a 5 year period inclusive of 4 years of academic study. Work terms consist of 2 three month and 2 six month periods which provides minimal interruption to existing academic programs. Program structure was constructed based on the successful and long running North American programs. Initial support of the initiative was positive when raised with the Industry Advisory Committee and discussions with industry.

OUTCOMES
The co-op program allows for student development of professional skills with multiple employers under multiple scenarios. Industry showed a preference for senior students with greater academic progress over junior students, which contradicts the stated need for development of professional skills. Regional engineering firms offered placements to junior students due to the lack of response from qualified personnel, yet still benefited and developed professional skills within the undergraduate students.

CONCLUSIONS
Due to lack of industry involvement further changes have been made to the program structure to develop students' level of industry readiness. Current academic programs within the institute place a high value on professional skills in conjunction with Engineers Australia's graduate attribute requirements. It is imperative that academia, industry and accreditation bodies work together to not only provide value-adding for industry but also ensure a secure, and continual stream of students gaining access to professional skills obtained through mentoring relevant to the current 'coal-face' of industry.

KEYWORDS
Co-operative education, WIL, Engineering education.

Introduction

Learning programs consisting of both academic and industry portions (co-operative education) have existed around the world for in excess of 90 years (Sovilla, 1998). These programs take many modern guises from co-operative education (COE) through to work integrated learning (WIL), whilst many people relate to prior variants such as the United Kingdom's sandwich courses (Brewer, 1990) or internships. In Australia not only do naming conventions vary but so to do program structures, creating a high level of confusion within industry partners who may have relationships with more than one academic institution.

This paper has been developed from a review into the development and consequent restructure of the co-operative education (Engineering) program at the National Centre for Maritime Engineering and Hydrodynamics (NCMEH) within the AMC, which is a Specialist Institute within the University of Tasmania.

AMC has attempted the implementation of a co-operative program to provide a structure that fits both with the academic program, and the need for student/industry to be able to have greater work place durations and allow stronger development of graduate attributes in accordance with Engineers Australia requirements.

Co-operative programs as the name suggests consist of three partners that form an intrinsic bond as shown in Figure 1, in the professional progression of undergraduate students. Dobbelstein states that "Cooperative education maybe seen as the close cooperation between higher education institutions and the world of work. The participation of industry is the key to the success of the cooperative education model". All three partners co-operate towards a common educational goal, benefiting all contributing in the program.

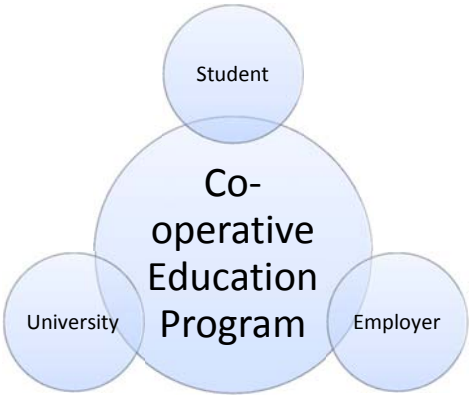

Figure 1: Co-op partners

Co-op programs provide key benefits such as allowing industry (as a possible future employer) to see students in the working environment. This makes for more reliable graduate recruiting, since both employer and student make their choices based on actual experiences. AMC's structure also allows what would normally be labelled 'summer' duties to be rescheduled to take advantage of available co-op talent.

Students also have the opportunity to gain experience in a variety of types of engineering work as well as evaluate various specific companies. Additionally with the inclusion of co-op work term placement results being available on student testamurs, the level of commitment of students to perform effectively is high. The assessment procedures adopted allowed the students to reflect critically and constructively on those experiences. All these goals lead to development of the desired outcomes of cooperative education (Van Gyn, 1996).

University benefits include maintaining and strengthening industry relationships via participation and providing a tangible industry pipeline that continually evaluates the effectiveness of course material and its relevance with current practice (Martin & Hughes (2009).

Program Structure

Australian academic institutes follow a two semester academic year which varies from the North American structure of three semesters. North American structure allows constant rotation between academic and workplace programs every three months. One of the issues faced by AMC co-op staff was trying to engage industry to recruit students for durations outside the standard 12 week work experience timeline.

Australian undergraduate students from both standard and co-operative programs have over a long period of time had to compete for a limited number of industry placement vacancies during the congested November to February time period. The AMC program structure aims to provide industry with potential access to co-op students on a year round basis.

Initial

The institute initially developed a program which allowed co-op students to be engaged in work placements throughout the entire academic year with no variations to the academic program other than a reversal of the third year academic semesters. This program structure allowed for placement variation consisting of two six month placements combined with two three month placements. The three month placements occur within the same timeframe that most engineering students Australia wide are looking to obtain their 12 weeks industry work experience. The program structure can be seen in Table 1 below.

Table 1: Initial co-op program structure

<table>
<tr><th></th><th>November-February</th><th>February-June</th><th>July-November</th></tr>
<tr><td>Year 1</td><td></td><td colspan="2">Current 1st Year Academic program</td></tr>
<tr><td>Year 2</td><td>Work Term 1
(3 months)</td><td>Academic Year 2
Semester 1</td><td>Academic Year 2
Semester 2</td></tr>
<tr><td>Year 3</td><td colspan="2">Work Term 2 (6 Months)</td><td>Academic Year 3
Semester 2</td></tr>
<tr><td>Year 4</td><td>Work Term 3
(3 Months)</td><td>Academic Year 3
Semester 1</td><td>Work Term 4 (6 Months)</td></tr>
<tr><td>Year 5</td><td>Work term 4 – cont.’</td><td>Academic Year 4
Semester 1</td><td>Academic Year 4
Semester 2</td></tr>
</table>

Students undertake their first work placement after only one completed academic year. This first placement caused difficulty for faculty staff in engaging industry to accept the capabilities of student who had completed only one academic year of a four year bachelor program.

The AMC program is not compulsory and is only available to the higher performing undergraduates with an entry ATAR of 85 and above. Students express an interest in joining the program prior to, or within the first academic year and academic progress is monitored throughout the first academic year, with students required to maintain a minimum credit in each unit of study. To assist with student preparation a professional development program was introduced to coincide with key dates which are highlighted in Figure 2 below. This structure however provided little time to review student progress upon completion of semester one prior to professional development in semester two.

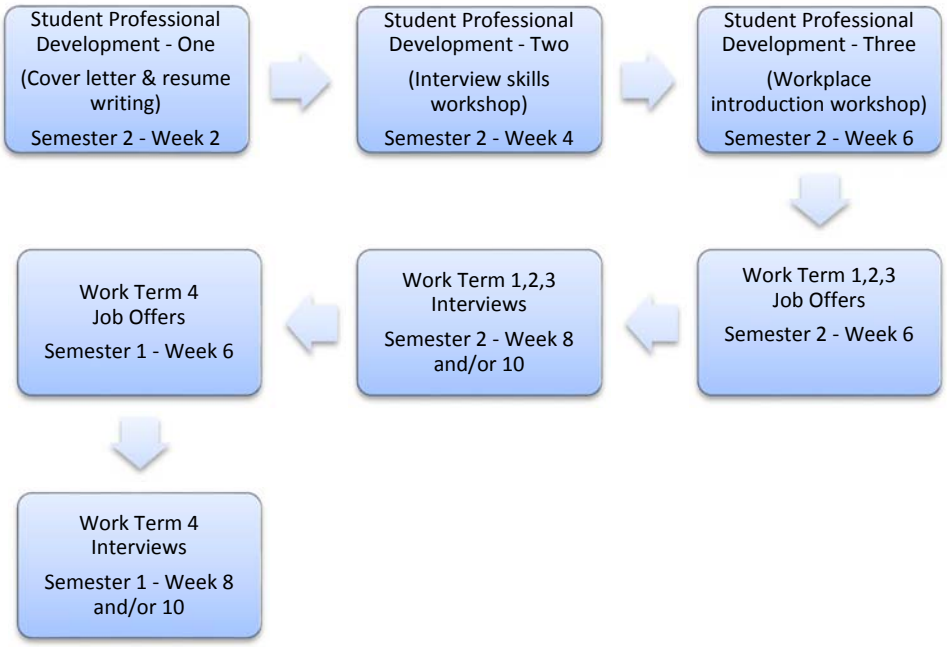

Figure 2: Initial cooperative program timeline

Revised Program

Due to difficulties obtaining sufficient work placement for students on the first work term and after consultation with industry partners, the faculty team investigated alternative options for work term one. Primary focus was ensuring development of an undergraduate with the right knowledge, skills and attitudes to allow them to contribute to society and with input from industry partners development of an engineering practicum unit began.

Student feedback also highlighted the need for a program break after first year as a settling period to allow for adjustment to academic life. This includes opportunity to return to home state upon completion of academic year one and removes the need for multiple returns to the institution as the TAFE component completion is aligned with commencement of academic year two.

Faculty staff worked closely with TAFE staff to integrate TAFE training packages into the co-op curriculum as a replacement for work term one, thereby allowing students to achieve both a break after academic year one as well as undertake an intensive TAFE session consisting of various MEM modules. Intensive modular training packages allows co-op students to achieve practical engineering training covering basic engineering methods in a four week period prior to commencement of academic year two. Topics covered include use of hand/power tools, engineering measurements, general machining, selecting welding process and applying safe welding practices, brazing and/or silver soldering, manual heating and thermal cutting.

Table 3: Revised co-op program structure

	November-February	February-June	July-November
Year 1		1st Year Academic program	
Year 2	TAFE Engineering Practicum (4 weeks)	Academic Year 2 Semester 1	Academic Year 2 Semester 2
Year 3	Work Term 2 (6 Months)		Academic Year 3 Semester 2
Year 4	Work Term 3 (3 Months)	Academic Year 3 Semester 1	Work Term 4 (6 Months)
Year 5	Work term 4 – cont.'	Academic Year 4 Semester 1	Academic Year 4 Semester 2

Revision of the professional development program structure allowed academic staff to make some key changes to delivery of the program. Firstly under the initial structure students enrolled early in first year with academic staff monitoring academic progress and confirming continuing enrolment based on academic performance. Under the new structure students are provisionally enrolled in co-op during first year with academic achievements monitored, then confirmed as co-op students upon completion of two academic semesters. This allows monitoring and inclusion/exclusion prior to professional development and ensures students have longer confirmation period to ensure committed program selection.

This structure as shown in Figure 3 below combined with an informal interview with academic staff regarding student reasoning for co-op enrolment ensures that student commitment to the program is confirmed.

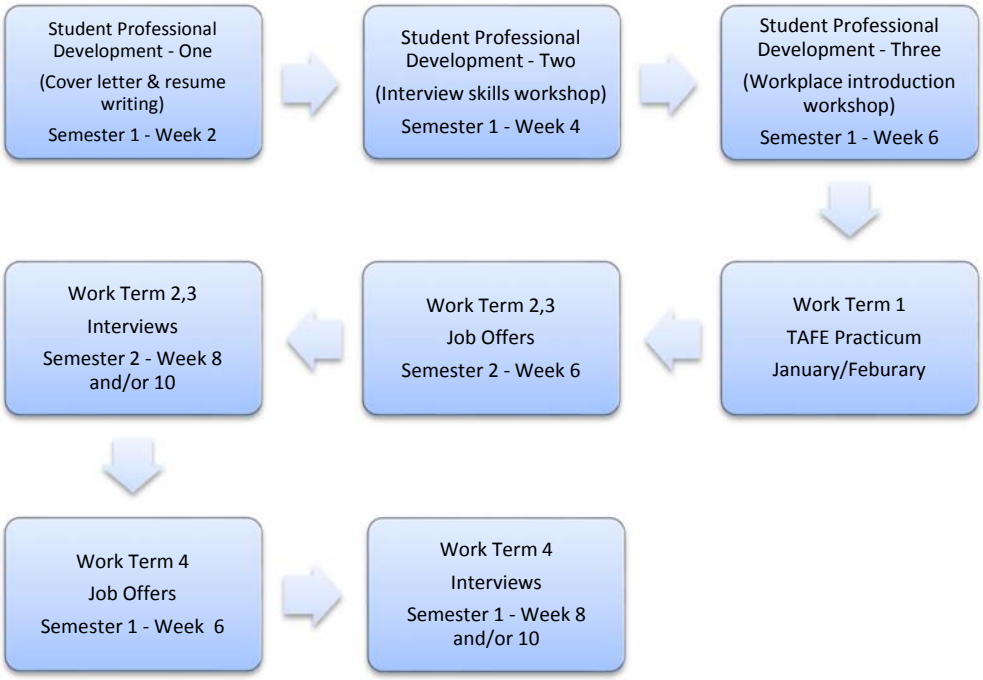

Figure 3: Revised cooperative program work term timeline

Industry Engagement

Industry feedback has been positive in multiple factors including but not limited to the two longer work placements and the engineering practicum module. Work placements of 6 months duration allows students to be fully emerged within their workplace allowing greater involvement in projects possibly through to completion. Employer comments such as '*the tools produced are being used Australia wide and have taken a considerable burden off* us' highlight the feeling that the students are an integral part of the organisation and that their input is positive and meaningful. Included in this integration is a feeling of increased capability leading to confidence and an increased desire to continue along a path of lifelong learning.

Discussions with industry whilst attempting to place work term one students led to comments relating to lack of practical skills within this cohort. First year undergraduate students are predominantly school leavers who have not had the opportunity to develop said skills. These discussions along with faculty staff's desire to promote practicality led to the development of the practicum module conducted through TAFE.

Exposure to practicum allows industry involvement to be expanded from the purely design / consultation realm into the more practical/construction engineering fields. Practicum provides an avenue to show all engineering students regardless of stream or specialty the physical factors associated with engineering. With the continued development of computational methods within engineering practice it is refreshing to provide students with practical exposure to the fundamentals of engineering and bridge the gap between technical engineering and design engineering.

With two long work placements in the program industry were more comfortable with the aspect of payment as they can clearly see benefits associated with having students in longer term work placements. Some employers understand that '*the idea of co-op is to encourage students and give them real world experience in industry, and they can earn a few dollars along the* way' whilst also being personally involved in undergraduate student development. This combined with the administrative requirements necessary for employment makes longer work placements an attractive option.

Development of professional skills is also a key component of co-op education with industry mentors commenting strongly along the lines of '*the level of communication and interaction required by engineering staff within all areas of a company is also very important for students to learn early. Engineering is not just designing, analysing and number crunching. Safety, data management, process and communication are all part of day-to-day activities.*' Comments like these highlight the ability of co-operative education to present a united front from both academia and industry towards factors that may not be specifically assessed by any party, but are a necessity in day-to-day business.

Benefits

Modifications to the original program structure have resulted in the following benefits;

Students

- Students gain greater practical understanding of engineering outside the design space.
- Students are not required to undertake employment interviews within the first academic year of their degree program
- Greater buffer period for students to confirm participation in co-op program
- Gain experience with the 'job application and interview process'
- Participation in pre-employment training, whereby valuable skills are taught that assist students during their co-op experience
- TAFE practicum provides greater level of work readiness within student cohort

Industry

- Not required to place students after only one completed academic year
- Practicum ensures more 'shop floor' ready students

- Opportunity to train and test potential employees to company needs – a cost saving human resource advantage
- Students can be placed in either an engineering office or workshop environment
- First placement is 6 months allowing industry to realise benefits from initial outlay relating to employing students

Institute

- Faculty workload in assisting students to find placement for work term one is reduced
- Longer timeframe available to assess students viability for entry into co-op program
- TAFE practicum is easily integrated into existing course structure

Reflections

For any co-operative education model to be successful it is imperative that all partners maintain a solid working connection as fundamentally the learning is situated within the act of working (Cooper et al., 2010). Co-operative programs require constant reflection and modification by staff to ensure positive outcomes for all parties.

AMC had great difficulty in placing students that had completed only two academic semesters (1 calendar year) into a highly specialised maritime field. This was not the case with local regional engineering firms that committed to taking junior students due to the difficulty associated with attracting qualified engineers and commented on the high levels of enthusiasm and willingness of the junior students. Regional industries highlighted the fact that junior undergraduate students held no pre-conceived notions as to their capabilities within the organisation, and were always willing to listen and learn from the Para professional, but lacked some of the fundamental hands on experience to make a valued contribution. Identifying these issues and what motivates industry to be involved with the co-op program is essential.

Workforce model challenges remain within all streams of maritime engineering in Australia as business focus continues to rely heavily on contract based models and structures. Comments from industry partners during placement interviews allude that it is difficult to plan workforce requirements as further projects are based on the success or failure of contract tendering. This presents difficulty engaging industry in focusing on the AMC co-op program providing a steady stream of undergraduates into their engineering practice uncoupled from current contract status.

The rollout of the revised co-op program model will start with the 2013 intake of co-op students, with the TAFE practicum in 2014, and close liaison with students and co-op staff will be maintained to evaluate these changes. AMC believes that its program strength lies in maintaining the triangle of participation between the university, the student and the employer. Although no physical ties exist between all three parties one organisation does interact with all three parties that the authors believe must take a more active role in promoting the benefits of a co-op program.

Engineers Australia (EA) provides competency standards recommendations for academic institutes and industry practitioners (EA, 2012) and as such is the one organisation that is present through the transition from undergraduate students to certified practising engineers. Options such as requiring practicing engineers both junior and senior to mentor undergraduates as part of continuing professional development, would go a long way to ensuring industry put in place processes that continue to nurture the development of our undergraduate engineers in cooperative programs regardless of external forces.

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