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Successful outcomes of industry-academic partnership in engineering programmes through a cadetship scheme

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ABSTRACT: The linkage between the industry and academia is not a naïve concept and is a very popular model across various universities around the world. In most academic institutions, this partnership often occurs mainly at the postgraduate levels through sponsored research or through final year projects or else through a work experience programme for undergraduates before commencing their final year of study. The support by industries of university undergraduate programmes is often a unique practice. Being a regional and rural campus in a city of a major steel industry, the University of South Australia, Whyalla Norrie, Australia, enhanced the quality of its graduates through collaborative arrangements via a *cadetship* programme sponsored by the local steel industry. This concurrently provided high quality education to potential employees of the local industry. The model of the industry-academic partnership, as well as the successful outcomes of the trial partnership, are reported in the article and the authors recommend such partnerships where a cluster of industries and university campus exist in a region.

INTRODUCTION

The interaction between industry and academia is an old concept and the level of interaction between the two varies quite considerably, depending upon the needs of an industry and the availability of expertise within an academic institution. Ivanco et al outlined the so-called *characteristics of cooperation*, which can be divided into four categories, namely:

- Development of new products for the industry;
- Establishment of joint-solutions to industrial problems;
- Provision of training and consultancy;
- Long-term cooperation in solving research tasks [1].

A possible further form of cooperation of the second kind listed above is in the form of pilot-projects, whose typical scenario is an industry without the necessary equipment and experience in a particular field. The Technical University of Košice in Slovakia established cooperation with industrial enterprises in Košice in the area of computer-aided engineering, following this form of cooperation [1].

At Glasgow Caledonian University, Glasgow, Scotland, UK, cooperation exists by offering a BEng programme through a sandwich course by a full-year industrial placement and part-time (day-release) mode of attendance [2]. This University has particularly close ties with several companies that have embraced the concepts of integrating student projects with company objectives.

Trond Clausen favours a three dimensional form of integration (classroom teaching, practical cooperation with private and public enterprises, and interactions with institutions working at lower academic levels) for academic excellence in future regional university/industry cooperation [3]. In particular, the second dimension proposed by Clausen introduced 25-30% of the total student time for project work in groups. Many small and medium size enterprises (SMEs) had recently shown as active partners for the newborn regional universities in Norway. SMEs have their own expectations, as stated by Clausen:

> *The SMEs expectations are, in short, that graduating engineers have a practical and broadbased background and, in addition, that these engineers should recognise the need for human and organisational matters as equally important as technical literacy* [3].

Thus, as exemplified by the previous examples, in most educational institutions, the industry-academic partnership often occurs mainly at the postgraduate levels through sponsored research or through final year projects, or else through work experience to undergraduates before commencing their final year of study.

Industries fully supporting undergraduate programmes offered at universities is often a unique practice. One such programme was born in the city of Whyalla in South Australia, Australia. Whyalla, located geographically 400 kms north of Adelaide is home to the iron and steel making company OneSteel Manufacturing Pty Limited, formerly owned by Broken Hill Pty Ltd (BHP).

To cater to the continuing educational needs of the employees of this industry, the South Australian Institute of Technology (SAIT) was formed in 1963 at Whyalla, offering certificate, diploma and degree programmes in engineering, social work and accountancy. Initially, the University of South Australia (previously known as SAIT), the largest university in South Australia, had been offering engineering programmes from two campuses: one from the metropolitan city of Adelaide and the

other one from the regional campus at Whyalla. For a number of reasons, the regional campus had to diversify to disciplines other than engineering. Furthermore, there was a decline in the enrolment of students into the undergraduate engineering programmes at the regional campus from the community, which in turn impacted upon the human resources of the local steel industry.

This article discusses the role played by the local steel industry and OneSteel in supporting the engineering programmes at the regional campus (Whyalla) of the University of South Australia, by sponsoring students recruited as cadets through an internal selection process. The cadetship programme was introduced in 1995 and the intake was continued subsequently for two more years up to 1997 on a trial basis. This article outlines the programme structure, delivery mode, the nature of final year projects undertaken by these students and the mutual benefits gained by the industry and the academic institution.

INDUSTRY-UNIVERSITY PARTNERSHIP AGREEMENTS

In 1995, recognising the future need for skilled graduates, the local steel introduced a cadetship programme. OneSteel Company identified the need to provide their cadets with a range of additional knowledge and skills relevant to their job function, while at the same time fulfilling the need for their cadets to be able to achieve a recognised technical qualification. Thus, a new cadetship programme was launched by the company jointly with the Faculty of Engineering of the University of South Australia with an initial intake of 15 cadets in the following three engineering programmes (four for electrical/electronic engineering, five for mechanical and manufacturing engineering, and four for minerals and metallurgical engineering in the following programmes:

- Bachelor of Engineering (Electrical and Electronics Engineering);
- Bachelor of Engineering (Mechanical and Manufacturing Engineering);
- Bachelor of Engineering (Minerals and Materials Engineering).

Table 1 shows the details of the intakes over a three-year trail period from 1995 to 1997.

Table 1: Details of cadet intakes over a three-year trial period, 1995-1997.

Field	1995	1996	1997	Total
Electrical/electronics	4	5	4	13
Mechanical/manufacturing	4	6	4	14
Minerals/metallurgical	4	4	4	12
Total	12	15	12	39

Twelve cadets were selected for the initial group, covering job functions that ranged from the electrical/electronics discipline to mechanical and manufacturing, and the minerals and materials disciplines within the company. They all had one thing in common prior to joining as a cadet, namely that they had all completed year 12, although many had not seen how a steel company actually works.

The cadet's recruitment procedure included an aptitude test and a personal interview. The initial screening was undertaken by BHP. Keeping in mind the minimum entry requirements for an engineering degree at the tertiary level and based on their year 12 results, the cadets were finally chosen.

As per the industry-academic partnership programme, the curriculum offered by the University had to be relevant to OneSteel. It was envisaged that the cadets would complete the four-year degree programme in a seven-year timeframe in a part-time mode. The first two years of the degree was to be completed over four years at the local rural campus at Whyalla for the mechanical and metallurgical cadets, while the rest of the degree was to be completed at the metropolitan campus at Mawson Lakes in Adelaide.

In the case of the electrical/electronic engineering cadets, the full programme of study was to be undertaken at the Whyalla Campus itself, due to the availability of adequate resources. The cadets from this group were required to complete the first six years of their study at the regional campus, completing the three years in the degree and were to complete the last year of the degree undertaking only the final year projects and Broadening Undergraduate General Education (BUGE) courses in a full-time mode.

Flexibility was provided to these cadets to complete the BUGE courses before entering the final year, to enable them to focus only on heavily weighted projects (nine units each) and related advanced study courses (4.5 units each) in the final year.

A schedule was developed at the local steel industry for the release of these cadets on a full-semester basis in order to undertake their full-time study at the metropolitan campus beyond the fourth year of their programme. The schedule was developed in consultation with the unit managers of the local steel industry, so as to ensure that the ongoing projects in which cadets worked were not affected by their absence from the industry during their full-time attendance at the University.

A MODEL FOR THE ONESTEEL COMPANY

For the electrical/electronic engineering cadets, the final year projects included one industrial project that was to be carried out in an industry. All cadets were to select projects relevant to the technical units where they were working, and in consultation with an industrial supervisor and an academic supervisor. The industrial supervisor, invariably, is a professionally qualified engineer and a member of the Institution of Engineers (Australia).

The learning needs of employed cadets differ from those of a standard full-time student. The cadets need a flexible approach to learning in terms of their time, pace and modes of learning. Thus, a work-based and workplace learning model was encouraged for undertaking the final year honours level projects within the steel industry [4]. Final year projects fostered the *Learning at work* concept – a framework similar to the one adopted by the Ford Motor Company for their managers [5].

SUPPORT FACILITIES PROVIDED TO CADETS BY THE EMPLOYER

As part of the commitment to the cadetship programme, the local steel company made working arrangements with the regional campus of the university for the seven-year period.

According to the mutually agreed arrangement, the following facilities were provided to the cadets by the company.

- The cadets were to be enrolled only in two courses per semester in a part-time mode (normally only nine units). Few cadets were exempted to accelerate their programme of study, under special circumstances.
- Release for four hours from work (day-release) in order to attend face-to-face lectures, tutorials and practical classes. In the case of final year students doing the course at the regional campus, one full day for attending to University business.
- Payment of Higher Education Contribution Scheme (HECS) fees for all of the enrolled courses.
- Reimbursement of expenses for books and other relevant course materials.
- Reimbursement of expenses incurred for the final year project.

EVALUATION OF THE PROGRAMME BY CADETS

A simple evaluation of the cadetship programme was initiated by the Programme Director of the Engineering Programmes, University of South Australia at the Whyalla campus at different levels by the end of year 2001. Through the informal sessions and through telephone interviews, cadets expressed a very high level of satisfaction with the cadetship programme.

Two positive aspects that every cadet appreciated covered:

- Earnings while studying a professional course;
- Early involvement with professional engineers of an industry right from the start of the cadetship programme.

Few others pointed out the length of their course completion period (seven years) of this programme as a negative factor in comparison with a full-time student, who would have completed the same course in four years. However, they were convinced about how the other factors, such as HECS fees of the courses, books for the various courses, and the prospect of employment after graduation with the same company, offset this negative point.

On the social side, few mentioned the opportunity they had staying with their parents and maintaining the same circle of friends while residing within the country, even after leaving school.

Follow up evaluations conducted this year have revealed that the generic skills learned have been valuable for their life-long learning. Students believed that the exposure to an industrial environment in the early stages of the programme had proved valuable throughout their study programmes, particularly in their final year project work. The majority of cadets strongly agreed that the experience they have gained during the seven-year period as cadets would be beneficial to their professional careers.

SUCCESSFUL OUTCOMES OF THE PARTNERSHIP

The success of the industry-academic partnership programme through the cadetship programme was evaluated from the perspectives of both parties involved, namely the University of South Australia and OneSteel keeping the three criteria, namely attrition rate, success rate and employment rate.

BENEFITS TO THE UNIVERSITY

It has often been observed statistically that the attrition rate is higher in programmes that enrol students (school leavers) in a full-time mode for economic and social reasons. This is particularly true in the case of students from the non-cadetship category, who are able to survive on their own with minimal parental support for their full-time study.

Furthermore, as demonstrated by William McKee, the overall performance of students has a direct relationship with the industrial contact that they have enjoyed [2]. Cadets who undertook the programme in a part-time mode scored higher than those students who had less industrial environment exposure.

Overall, the major benefits to the university are the following:

- A retention rate was achieved between 50-100%;
- The burden was relieved in organising work experience for students at the end of their penultimate year, as the cadets had paid employment (as part of the requirement of the Institution of Engineers, Australia, students enrolled in an accredited degree programmes were to complete 13 weeks of paid industrial experience before their graduation);
- Increased level of quality of graduates;
- The school was relieved of the need to organise interviews for students with potential employers.

Table 2 gives the success (completion) rates of cadets over the period 1995-1997 for all three disciplines.

Table 2: The success rates of cadets.

	Elect/Enic	Mech/Manu	Minls/Metal
1995 (2001)*	100%	50%	100%
1996 (2002)*	80%	50%	75%
1997 (2003)*	100%	100%	50%

* Figures in parenthesis in the first column indicate the year of completion.

The completion rates of cadets from the discipline of electrical/ electronic engineering shown over the three-year period was excellent. A result of 80% in 1996 is due to one student leaving the cadetship programme and transferring from the electrical/electronic engineering discipline to the discipline of computer science within the same campus for personal reasons.

In the case of the mechanical/manufacturing discipline, the results shown for 1995 and 1996 are due to cadets leaving the company for personal reasons. In the minerals/metallurgy category, the result for 1997 is due to cadets leaving the company during the transition period of management change (BHP to OneSteel).

BENEFITS TO THE INDUSTRY

From the point of view of the local industry, the cadets were meeting their educational needs, while at the same time they were being exposed to the practical aspects of being professionals in industry. They were able to be responsible for a range of projects depending on their expertise and were exposed to Company systems and procedures.

CONCLUSIONS

This case study clearly demonstrates that the formal linkage between industry and an academic institution, through such cadetship programme at the undergraduate level, not only benefits the sponsoring industry, but also graduates students who are of high quality and ready to meet the challenges in the real world. Concurrent industrial experience over seven years meets the expectations of engineering employers [6]. This is because these cadets have acquired the necessary skills and attributes required for engineers in order to meet changes in an engineering profession [7].

From the University's point of view, the cadetship programme has resulted in the production of high quality graduates, the majority of who have been employed by the same local industry as professional engineers. Table 3 gives the details of cadets employed by the same industry after their graduation. The 1997 intake is yet to complete the course.

The trial period has now been successfully completed and the partnership programme is now coming to a close by the end of 2003.

Table 3: Employment rates of cadets by the Onesteel Company.

	Elec/Enic	Mech/Manu	Minls/Metal
1995 (2001)*	100%	50%**	100%
1996 (2002)*	80%	50%**	75%
1997 (2003)*	Graduating in 2003	Graduating in 2003	Graduating in 2003

* Figures in parenthesis in the first column indicate the year of completion.
** Result of BHP to OneSteel management change process and natural attrition.

As a by-product of this pilot cadetship programme, the city of Whyalla was able to retain the youths within the country town with minimal *brain-drain* to other states of Australia by employing them as full professional engineers in the local steel industry after their successful completion of their degree programmes. Therefore, it is recommended that where, the regional campus of a university and a cluster of industries are present in a region, a cadetship scheme could possibly be negotiated with the industries so as to meet the requirements of both parties.

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REFERENCES

1. Ivanco, V., Kostolny, K. and Kubin, K., Co-operation between the Technical University of Kosice and industry in its region. *Global. J. of Engng. Educ*., 2, **2**, 157-160 (1998).
2. McKee, W, Integrating education and industry through enhanced projects. *Global. J. of Engng. Educ*., 3, **3**, 287-289 (1999).
3. Clausen T., Future regional university/industry co-operation: academic excellence through three-dimensional integration. *Global. J. of Engng. Educ*., 2, **2**, 135-137 (1998).
4. Chisholm, C.U. and Burns, G.R., The role of work-based and workplace learning in the development of life-long learning for engineers. *Global. J. of Engng. Educ*., 3, **3**, 235-241 (1999).
5. Barlow, N., Lyons, A. and Margham, P., Learning at work within the Ford Motor Company. *Global. J. of Engng. Educ*., 2, **2**, 195-197 (1998).
6. Nguyen, D.Q., The essential skills and attributes of an engineer: a comparative study of academics, industry personnel and engineering students. *Global. J. of Engng. Educ.*, 2, **1**, 65-75 (1998).
7. Nguyen, D.Q., Pudlowski, Z.J. and Kerr, I.R., Qualities and attributes of an engineering graduate as seen by Australian industry. *Proc. 1st Asia-Pacific Forum on Engng. and Technology Educ*., Melbourne, Australia, 200-204 (1997).