

## ICLP: MAKING THEM MORE THAN ENGINEERS

Roger Boyle<sup>1</sup>, Martyn Clark<sup>2</sup>

**Abstract** *Placements and internships are increasingly seen as important components of engineering degree programmes, but they do not often address explicitly the issues of leadership and globalization that are important to the modern graduate. We describe here a novel scheme that integrates placements over two years with specialized modules that operates throughout an engineering faculty, and which uses heavy involvement of experienced industrialists and academics. We comment on the successes of the scheme and the areas for improvement.*

**Index Terms** *leadership, work placements, internships.*

### BACKGROUND

The “sandwich” or placement year is a common and widely reported (e.g., [5, 6, 9]) format in modern Higher Education. Commonly, this involves a student taking a year out in paid employment in the year immediately preceding the final year of study. Apart from the obvious benefit of remuneration, this brings experience of a working environment and an opportunity to exercise what has been learned so far. It usually generates higher motivation on return to university, focussing students on shortfalls in their knowledge, and providing good, “real” project work openings. By-products are enhanced self-confidence, and often opportunities for full time employment on graduation. With very large cohorts, there are dangers of inappropriate employment being offered, or the experience being devalued by under-management or low-grade work being offered.

Recently, many variations on this idea have begun to appear. Raleigh [7] describes a format internal to the university, while Richerson [8] considers close association with a single, large, corporation. Fink [3] describes a large-scale curriculum re-design to accommodate the advantages of internships, while Walker [10] considers a mentored scheme aiming specifically at under-represented groups. Gerhardt [4] describes a well-established international student exchange scheme that delivers different cultural and industrial experiences to students; he also identifies the significant problem of persuading students (and some employers) of the true merits of experience of “globalisation”.

One of the employee shortfalls that many industrial concerns note is that graduates are unprepared for the

international context of modern engineering, and this is usually associated with a need for graduates ready to take significant responsibility early in their careers. The University of Leeds has attempted to address this by developing a novel intern programme that exercises leadership and responsibility in graduates in partnership with their studies; the International Corporate Leadership Scheme (ICLP).

In this paper we outline the scheme (first prototyped in 1999) and its implementation, and make observations from its introductory two years. We conclude that the scheme succeeds in delivering a distinctive brand of real-world experience to students and that the specially designed university modules help to bridge to university/industry divide. There remains scope for development, however, and we also conclude that to achieve the scheme’s international ambitions requires further attention.

### OUTLINE OF THE SCHEME

The ICLP is organised on a Faculty basis, involving six engineering departments, each of which undertakes to place a small number of students (usually less than five). The scheme has a designated coordinator, usually an academic, in each department who acts also as an academic mentor to students during their placement.

These academic coordinators are supported by a central management structure. Together the central management and academics identify host companies that are able to provide a continuous project for a student to be associated with throughout the summer vacation (a three month period). It is important that the project have a sufficient lifetime to be available for the student to continue working on it in the subsequent summer too.

Companies subscribe to enter the scheme; this subscription covers the administrative cost and provides sponsorship to the students of £1000 per year for their final two years of study (in the context of UK higher education, this is a very attractive sum). The company undertakes also to provide a line manager to mentor the student while on placement, and to maintain liaison during time at the university

Students undertaking the ICLP normally are recruited from four-year degree programmes, and begin the scheme at the end of the second year. They engage in the following five inter-related activities:

<sup>1</sup> Roger D Boyle, School of Computing, University of Leeds, Leeds, LS2 9JT, UK. [roger@comp.leeds.ac.uk](mailto:roger@comp.leeds.ac.uk)

<sup>2</sup> Martyn A C Clark, School of Continuing Education, University of Leeds, Leeds, LS2 9JT, UK. [martyn@comp.leeds.ac.uk](mailto:martyn@comp.leeds.ac.uk)

- Summer 1: company placement
- Autumn 1: university based module
- Summer 2: company placement
- Autumn 2: university based module
- Autumn/Spring 2: project

During the academic year(s), the students study two specially tailored modules that operate in direct support of the scheme. These are limited enrolment (only open to ICLP candidates) and structured quite differently from standard lecture-based modules, being workshop/seminar based with strong involvement from the hosting companies. This environment, with the small, selected class, provides excellent learning opportunities.

Engineering students all culminate their studies with an individual project - in the UK, this is usually a requirement of accreditation [2]. ICLP students will use the opportunity to carry their company project work yet further, but as an academic exercise that will count for 30-40% of their final year's study.

It is important to note that the programme has been designed to be more than “two placements and two modules”, which is a format already open to any student in a variety of ways. The key differences are

- Continuity: Unlike other internship schemes with which we are familiar the ICLP is continuous over the second half of the degree programme. Rather than being a discrete part of the programme, the scheme is woven into the fabric of the degree through the special modules and the final year project. Thus once a student embarks on the ICLP they will be either on placement or taking university work related to it for the remainder of their time as an undergraduate.
- Leadership and responsibility: Similarly, the ICLP differs from traditional internship schemes in requiring students to take responsibility for a significant project. Thus ICLP students graduate with experience of the difficulties involved in leading a project. This experience is built upon in the university-based part of the scheme and students are given opportunities to reflect on their experience and to discuss different approaches with their peers from a variety of engineering specialisms.
- “Different” modules: A key way in which the ICLP delivers its aim of integrating university study and work experience is the design of the special modules. They consciously avoid any resemblance to “traditional” modules and, in particular, avoid lectures as a teaching approach. Rather, students from different engineering specialisms are grouped together and invited to explore their experiences whilst working on their industrial projects and to address issues of international leadership in a variety of contexts including case studies and a *future search workshop*.
- Mentors: One of the key difficulties in the organisation of traditional internships is the extent to which

academics can maintain contact with students while they are based away from universities. The ICLP features a novel approach to supporting students on placement, while at the same time building longer term bridges between university departments and industry. In addition to an academic mentor and an industrial mentor (from the company) students are supported by a Visiting Professor. Visiting Professors have real industry experience and can talk as equals to current industrialists. At the same time, they are involved in the design and management of the scheme but are not required to contribute to teaching and research. Thus students are supported by mentors who understand both the industry and university ends of the project and who are (comparatively) accessible. A typical profile of a Visiting Professor is given in Box 1.

### Box 1: Profile of Typical ICLP Visiting Professor

- Senior management and broad business experience.
- Generally aged 50+.
- Often retired, semi-retired.
- Motivated by desire to give something back to companies and students.
- Can bring a clear business dimension to the placement and project and act as overall project manager for the 2 year involvement with the company.
- Prepared to offer at least 6-8 days per year.

## IMPLEMENTATION

### Recruiting

The programme as described needs three components; students, hosting companies and mentors.

### Students

Students are selected when they have two years left to study. It would be tempting simply to ‘cherry pick’ those with the highest grades but this is not done for two reasons;

- evidence suggests that grades at this stage may be a very poor indicator of a student's final performance [1].
- much higher quality information about students is available from personal tutors, who are likely to have a much clearer idea of their true academic worth and commitment, and possibly also their career ambitions.

Grades are, of course, used as a partial indicator - students consistently performing weakly would not be likely to be good material for ICLP, and probably are served better by focusing closely on the basics of their degree programme. However, since numbers are relatively small (perhaps 12, or 20 at most, applying from each department) it is a reasonable investment of time to do some individual homework on each

of them.

**Companies**

Employing companies turn out to be easy to locate through the many contacts held by academic staff in participating departments. It is usually the case that they require very little explanation of the merits of the scheme, which is encouraging motivation in itself. Characteristically, ICLP administrators are put in touch with the Personnel section of medium to large concerns (although some are small), and a loose agreement reached on the number of students that may be taken. There is also an attempt to specify the work the recruits would be expected to do, to the project level.

This route is not without its problems. More than once, we have discovered that the employing section of the company has an inaccurate view of the students on offer; specifically, they seek a technical depth not available in a student only halfway through a degree. At worst, this results in a waste of time for all, but more usually the company's needs are adjusted to accept what is on offer, in recognition that the students are bright and well motivated. Nevertheless, this remains a problem, with a need to reach the true industrial supervisors earlier in the procedure. This would have the undoubted benefit of specifying the student projects fully before recruiting.

**Mentors**

Academic mentors are recruited from the university staff. In an atmosphere of careful workload counting, this is dependent on goodwill and enthusiasm, since ICLP is specialised and carries no (staff) remuneration. Nevertheless, at the current scale this is not a problem.

Industrial mentors are provided by the employing companies; this is usually a simple matter within existing line-management structures, and is especially easy in organisations accustomed to internships.

Visiting Professors turn out to be easy to recruit also, since there is a wealth of staff of all kinds just past retirement who relish the opportunity to stay in touch with industry and education, and who are happy to give their inputs on a charitable basis. Such volunteers are located by the Royal Academy of Engineering, the British Computer Society, and similar Professional Bodies. It is normally the case that Visiting Professors have a wealth of applicable experience, although it is possible, and in some disciplines likely, that their precise technical background will not be applicable. This is not really an issue, since it is their broad perspective that is required rather than day-to-day input.

**Allocation and management**

Allocation of students is via an application and interview process. It is at this stage that the scheme can run very efficiently as the numbers are relatively small and the

vacancies well identified. It is also an opportunity for students to get concrete experience of the CV preparation and job application processes, which are major beneficial side-effects of the process. The success/failure rate at this stage is approximately 50% (good odds in the view of most).

Successful students will meet with their allocated company and all mentors for some indoctrination before embarking on the first placement. They will also be visited by their mentors during their placement and so there is a continuous process of engagement by all interested parties. This does represent a possible weak point, since the placements are during the summer months when it is hardest to gather people together for meetings; the solution has been to devise rigid timetables for meeting early in the scheme.

**Modules**

Full benefits of the scheme are extracted by the two modules the students sit in their final and penultimate years. These have significant contribution from the companies and Visiting Professors, and the students themselves. This is a real opportunity for them to see "Engineering" as a whole as they report to each other the nature of their projects and how they have faced and overcome problems. In conjunction with prepared workshops and seminars, there is the opportunity here to introduce motivated students to concepts that go far beyond the standard curricula in their parent departments. Little if any of these modules is delivered or assessed in the traditional lecture/examination manner.

**OBSERVATIONS**

The scheme has been running for a little over two years, with early participants taking part in a prototype. We have enough experience of it to permit a survey of its successes and failures from the point of view of students, staff, and employers.

**Students**

The sample of students available is by its nature small; nevertheless, a brief survey elicited a response from 10 of 17 (59%) addressed to the questions;

1. Which two advertised features of ICLP most attracted you?
2. Which two turned out to be most important?
3. Did the scheme live up to its original promise?
4. What (if anything) have you learned through ICLP that you could not have learned within the university?

Responses to questions 1 and 2 referred to the advertised list of advantages of participation, and are summarised in Table 1

|                              | Q1 | Q2 |
|------------------------------|----|----|
| Real work experience         | 9  | 7  |
| Involvement in a project     | 1  | 2  |
| International opportunities  | 2  | 2  |
| Enhanced job prospects       | 4  | 2  |
| Experience of responsibility | 0  | 2  |
| Pay and sponsorship          | 4  | 5  |

TABLE 1: STUDENT REASONS FOR FOLLOWING ICLP

This tells us that the predominant student motivator is to win experience and sponsorship, and that these expectations are largely met. Perhaps attitudes to “job prospects” change with first hand experience of a particular company, but it is hard to draw further conclusions.

Recurrent themes answering question 3 were a perceived absence of real international opportunity, and a *perception* of poor communication with the university. Nevertheless, predominant reaction was positive, with comments being addressed largely to procedural matters such as accommodation problems and interview glitches. We might conclude that, understandably, the international flavour of the scheme was an attractor for students, but the pragmatics of most company projects meant this was never going to be guaranteed.

Question 4 told us that all students gained something they felt unavailable in lectures; most of them cited “experience” - that is, seeing how things are done in practice rather than how they are taught. This is, of course, a vague observation. Other points mentioned were seeing design in action, learning the art of leadership, and seeing problem solving in practice.

Feedback to the modules was very positive. The students much appreciated the novel teaching made possible by the motivated, small group, and were receptive to some advanced theoretical material addressing issues of management, although did comment that relating this to their personal experience was not always easy!

**Staff**

The members of staff involved in the ICLP also were invited to comment of the working of the scheme by answering the following questions.

1. Of the advertised advantages (to students) of ICLP the most important are
2. Which two of the advertised advantages do you feel most attract students?
3. Give your best estimate of the mean number of hours per week you have spent on ICLP during the 00/01 academic year.
4. Do you feel students have learned anything through ICLP that could not have been learned within the university? If “yes”, give one example.

As with student feedback, the first two questions relate to the advertised list of benefits of the scheme and responses were in the form of a rank order. Responses to question one are summarised in table two.

|                              | Q1  |
|------------------------------|-----|
| real work experience         | 1.6 |
| involvement in a project     | 3.6 |
| international opportunities  | 4.8 |
| enhanced job prospects       | 3.1 |
| experience of responsibility | 4.1 |
| pay and sponsorship          | 3.8 |

TABLE 2: STAFF RANKING OF THE BENEFITS OF ICLP

Perhaps surprisingly, given the distinctive ambitions of the ICLP, staff were virtually unanimous in believing that the most important benefit to students is real work experience. Neither pay and sponsorship nor involvement in a project were rated highly as benefits to students but the availability of international opportunities was seen generally as the least significant benefit of the scheme.

These findings raise questions about the extent to which staff have assimilated the purpose of the ICLP and its relationship with other schemes which aim to give students real world experience. Clearly, in any engineering discipline real world experience can be vital in helping students to contextualise the content of their academic studies, but the ICLP aims to go further. The staff involved in the scheme could be expected reasonably to view working on a project and international opportunities as key to the success of the scheme. Nevertheless, when asked if the students participating in the scheme had gained anything which they could not have gained within the university the emphasis tended to be on real world experience. Typical comments include: *The practical constraints of working in industry*, *Practical experience relating to practical problems* and *Yes, there's no substitute for real work experience*.

Staff were asked also which of the advertised benefits they thought most attractive to students. They opted almost unanimously for real world experience as the most attractive benefit. In addition to experience staff see pay and sponsorship and enhanced job prospects as the motivation for students to sign up to the ICLP.

It should be noted that these members of staff are responsible for recruiting students to the scheme and that this role puts them in contact directly with both students who are accepted onto the programme and those who apply but are not selected. Their assessment of the student views should, therefore, be reasonably accurate.

The emphasis on real world experience is common to the views of staff and students and given that students do undertake the two placements the ICLP is clearly successful in satisfying expectations. We emphasise, however, that the scheme is designed to go beyond such experience and to

focus on the international dimension and on corporate leadership. Clearly, the scheme has had only limited success in communicating these higher goals but the real potential of the ICLP might be exemplified by the observation that one thing not available to students within the university was experience of *“working in a project team and dealing with the corporate, commercial and industrial realities such as group dynamics, and communications issues and the differing perspectives of corporate realities ... i.e., big ideas at a high level do not necessarily equate to ground level reality and vice versa !!!”*

Finally, the ICLP has achieved its success at a realistic cost. Staff report that, on average, running the scheme in their own disciplinary area within the faculty takes little more than one hour per week.

### Companies

Companies were asked as part of a quality monitoring exercise to complete a short questionnaire on the scheme; principally this was to ensure administrative procedures were functioning, but it permitted space for broader comments.

From this we learned that companies are reassured, and sometimes favourably surprised, by the ability and aptitude of the student they recruit, which confirms that the selection procedure is adequate at least. What critical remarks they make surround the difficulty of regular and efficient mentoring meetings being held, and the thorny issue of internationalism. This latter issue appears more than once in their comments, with some companies simply not having suitable international connections, and others not being able to make them available to students engaged in ICLP work.

As indicated above, the use of Visiting Professors is intended to improve mentoring by giving a large part of this role to people with credibility both in industry and within the university. It would appear that mentoring remains an issue. To an extent this may be an insuperable problem, given the timing of the placements. Equally, these difficulties may reflect the fact that the scheme remains relatively new and they may ease over time as everyone involved in the scheme becomes accustomed to it.

### CONCLUSIONS AND FURTHER DEVELOPMENTS

Our reflections allow a number of positive conclusions to be drawn about the ICLP.

The scheme is undoubtedly delivering to students opportunities to gain valuable real world experience. Students have been placed with a range of different types of company and have undertaken a range of projects. It is clear that this type of experience is important to both academics and students and the ICLP has been successful in generating opportunities to gain it.

Further, the relationship between university and industry

has not been one-way. Students have taken responsibility for substantial projects which have a real value to the host company. Generally, our industrial partners have been impressed with the academic background and the skills of the students placed with them and have been enthusiastic to remain part of the scheme beyond their initial commitment.

Another positive is the way in which the university modules have been received by students and industrial partners. There is evidence that teaching the students as a group irrespective of degree specialization has been a positive experience and has helped to bridge the university/industry gap.

It is fair to say, however, that there is scope for further development of the ICLP. The two concerns highlighted in these reflections relate to the scheme’s international aspirations and the operation of its mentoring provision.

The ICLP international objectives are driven by a desire to respond to the increasing economic globalization and seek to provide students with international experience at a very early stage in their careers. On current evidence it may be that the best we can achieve is to place students with companies who are in a position to offer an “international environment” rather than actual experience abroad. If this is the case we may need to be clearer in advertising the scheme to potential recruits. Alternatively, it might be possible to remove the current links between the two placements and to manage the international placement separately.

That problems of mentoring persist is a disappointment but we remain confident in the basic ICLP model and the role of the Visiting Professor. Whilst highlighting mentoring as an issue for further review, we are content to view these problems as teething troubles.

Taken as a whole, therefore, we see the ICLP as being quite successful. It certainly provides a distinctive flavour of real world experience to students and its focus on leadership through managing projects clearly goes beyond other types of internships available to the same cohort of students. If further development is required before its international aspirations can be achieved unequivocally, this does not seem unreasonable in a scheme that has existed for such a short time.

### ACKNOWLEDGMENT

With thanks to the students, staff and administrators who spent time giving us their first hand experiences..

### REFERENCES

- [1] Boyle R, Carter J and Clark M. “What makes them succeed? Entry progression and graduation in Computer Science”, *Journal of Further and Higher Education*, 25(3), 2001, to appear.
- [2] Engineering Council, “Assessing Engineers – Standards and Routes to Registration (SARTOR)”, <http://www.engc.org.uk/sartor>.
- [3] Fink L.D, Kolar, R L, Muraleetharan K K, Nairn R W, Sabatini D A, Sack R L, Rhoades T R, and Shirley D L, “Reengineering sooner civil engineering education”, *Proceedings of the 30<sup>th</sup> Annual Frontiers in Education Conference*, 2000. FIE 2000, 1, T1F/3 -T1F/8.

- [4] Gerhardt L A and Martin S, "The Global Engineering Education Exchange Program-a worldwide perspective", Proceedings of the 29<sup>th</sup> Annual Frontiers in Education Conference, 1999. FIE '99, 1, 11B7/10 - 11B7/13.
- [5] Kajaval J and Varonen R, "The professional growth of ICT experts through progressive sandwich training", Proceedings of the 5th annual SIGCSE/SIGCUE conference on Innovation and technology in computer science education, 2000, Page 189.
- [6] Ketler K and J Walstrom, "Information systems internships: the student perspective", Proceedings of the 1993 conference on Computer Personnel Research, 284-290.
- [7] Raleigh D M, "Internships link user services to academic departments", Proceedings of 1989 ACM SIGUCCS conference XVII on User Services, Bethesda, MD, 133-138.
- [8] Richerson, M E, "Managing a summer intern program in a large corporation", Proceedings of the Portland International Conference on Management of Engineering and Technology 1999, PICMET99, 1, 503.
- [9] Shackelford K, "Assessing the benefit of in-house work experience for university student", Proceedings of the 2000 conference on User services: Building the future, Richmond, 354-358.
- [10] Walker M B, Grove E C and To V A, "Building the next generation of high performance computing researchers in engineering and science: the NCSA/ARL MSRC PET summer internship program", Proceedings of the 30<sup>th</sup> Annual Frontiers in Education Conference, 2000. FIE 2000, 2 F2F/17 -F2F/20.