Work placements for Higher Education engineering students

Judith Watson
School of Environment and Technology
University of Brighton

Abstract
A research project was conducted to examine work experience for higher education students in engineering. Interviews were carried out with employers and with university staff and students. We found that the traditional "sandwich year" is still current in engineering, but that shorter placements are also offered. Placements are virtually always paid, and students are expected to be productive members of staff, and take on responsibilities. On return to university, students often keep up contact with their placement employer, choosing for their final-year project a real task related to the employer's activity. Placements do not seem to be in short supply, at least not in the Greater South East area that we studied.

Keywords: Employer engagement, work experience placements, small and medium enterprises

Background
This area has been little researched, yet it is a particularly pertinent area at the moment. Increased take-up in STEM subjects, where the "sandwich course" tradition (with a year out in industry) is long established and there has been much recent public debate about unpaid internships.

Auburn (2007) studied students' transition back to university following a placement year, although this was in Psychology. He found that students had difficulty re-adjusting to university and had an altered relationship with university staff. They found it difficult to move between "two realms—the realm of work and the realm of academia" and to transfer experiences from one to the other. They did not find it easy to relate their learning on placement to their learning in the university.

Looking at engineering courses, however, Mendez (2008) found that industrial placements led to students getting an improved degree result. Students who had undertaken a placement had a much greater improvement in their final results over earlier results than students who had not taken a placement. "It is possible that the nature and environment of an industrial work placement (and contact with professional work colleagues) instils the meta-cognitive skills necessary for personal reflection, development and enriched independent learning. Therefore, on returning to university, the student transfers this new approach to her/his studies and excels."

A report from Education 4 Engineering (E4E) (2011) looked at barriers to increasing participation in sandwich courses. While the numbers on sandwich courses had decreased in some subjects, engineering, which has historically had one of the highest numbers taking sandwich courses, had seen numbers remain fairly level. Certain universities (pre 1992) were mentioned as having had a tradition of sandwich placements, as well as the post 1992 universities. The most prestigious institutions ("Russell Group") universities are now starting to consider offering sandwich courses.

The authors divided the barriers into barriers for students, barriers for universities and barriers for employers. They concluded that barriers for students were the most important, and were practical in nature. They included the need to fill out application forms during busy periods, and uncertainty in securing a placement. There was also peer group pressure, location of placement, and the feeling that one should complete undergraduate studies quickly and start work. E4E speculated
that the rise in tuition fees may lead to an increase in the number of sandwich courses being offered as HEIs wish to show that they can offer added value to students. In that case, the number of employers offering placements will become a factor.

Oakleigh Consulting Ltd and CRAC made a report to HEFCE in which they evaluated interventions made by HEFCE: Undergraduate Internships in the Professions (UGIP) and Graduate Internships (GI) schemes, i.e. placements taken during the degree course as well as internships taken after graduation. They found that: "During 2010 Government and HEFCE-funded programmes in England contributed to the provision of around 16,000 graduate internship opportunities (c.8,000 through the GTP and 8,500 through the HEFCE Graduate Internship scheme)." This was likely to fall substantially in 2011 while the number of unpaid graduate internships is rising.

They considered the need to apply the HEFCE desire to widen participation in higher education, to placements. There is evidence that ethnic minority students are less likely to obtain a placement. They found when financial support is offered to employers, it does not have to cover the full costs of the intern or the placement student's full wages. Instead, it helps in making the business case to management to offer a placement. They concluded priority for interventions should be to support placements for students during their period of study rather than once they are graduates.

**Rationale**

The general project aims were:

- To develop strategic partnerships between industry and HEIs in the "Greater South East", establishing a collaborative framework for future research and development of good work experience provision.

- To investigate the extent and nature of engagement between employers, HEIs and other stakeholders in relation to internships, work experience and work based learning for undergraduate engineering students.

- To spread knowledge among STEM employers (particularly SMEs), HEIs, students and other stakeholders about effective work experience practice by disseminating the results of case studies that illustrate the benefits and barriers of work placements in undergraduate engineering education work experience and internship.

The objectives of the research related to the following:

1) Attainment of skills during work placements and how the student experience is enhanced by work experience.

2) Employability of the student. Are employers more likely to employ students with work experience and why? If so is this due to knowledge gained by students and/or value of any 'skills' attained during work experience?

3) Impact of work experience programmes, analysis and recommendations arising from the research.

The title of the project was originally “Benefits and Barriers of Work Experience for Higher Education Engineering Students”, but it was decided not to focus on barriers, which were already being researched elsewhere. Instead, the project focused on identifying aspects of current practice that can be regarded as good practice, and what could be done in future to improve practice.

**The Approach**

The project partners were SEMTA, University of Greenwich, University of Brighton and University of Southampton. SEMTA is the Sector Skills Council for the Engineering sector and thus has significant expertise in labour market and training issues in the whole sector across all skill levels from craft to professional. University of Greenwich has major provision in engineering, close links with engineering companies in the Thames Gateway area, and extensive experience in employer
engagement. University of Brighton also has major provision in engineering, including mechanical, electrical and electronic engineering, and community and employer engagement across the South East region, as well as a large Knowledge Transfer Programme involvement. University of Southampton is the National HE STEM Programme spoke for the South East, helping in particular with networking and dissemination. University of Brighton was the lead partner in the project.

A qualitative research method was used, in order to obtain an in-depth picture of current practice as well as attitudes and interpretations. SEMTA, University of Greenwich and University of Brighton staff conducted interviews with employers, students and university staff, and a case study, in a different part of the Greater South East. The case study companies were of different types and sizes: Selex Galileo, a large manufacturer in Basildon, Essex; Delphi Diesel Systems in Gillingham, Kent; and Hanover Displays, a small manufacturer in Lewes, Sussex. Interviews were also conducted at National Grid, on the Isle of Grain. In addition to student interviews, a number of interviews were conducted with graduates who had undertaken placements.

Employer interviews asked questions about how students were recruited and integrated into the company, about the costs and benefits of providing placements, about support and maintenance and about the role of the university and independent work experience organisations. Student (and graduate) interviews asked questions about how the student had found the placement, the skills and knowledge acquired, attitudes to the placement, and its contribution to the whole degree experience. University interviews asked about liaison with employers, mentoring, support and skills development on placement, and integration of placements with the whole university course.

In some interviews, students were asked to complete a "skills matrix", in order to indicate which skills they had been practising on placement. However, most interviews were too short to allow this exercise to be carried out. This experience was, however, valuable, and could be part of a further research project.

All interviews were conducted according to the University of Brighton’s Research Ethics procedure. This was initially unfamiliar for the project partners but in fact the reflection on confidentiality proved very useful. In all there were 6 student interviews, as well as 2 graduate interviews, 4 employer interviews and 3 university interviews.

An employer consultative group was used, and although this took some time to organise, it was eventually a worthwhile element, providing a wealth of knowledge, as well as opportunities for dissemination and further liaison. It brought evidence from a further six companies, as well as university tutors, placements co-ordinators, and other professionals from the engineering sector with an interest in this area.

During the project there was liaison with the team from Oakleigh Consulting and CRAC that was conducting research into work experience (across industrial sectors) on behalf of HEFCE.

**Assessment**

We found that employers invariably set up systems by which the student’s skills could be assessed. This occurred on entry to the placement as part of the selection procedure, during the placement and at the end of the placement. Liaison with tutors included reports on progress.

There is as yet little formal role for engineering employers in formal university degree assessment. Examinations board requirements were cited as the reason for this. While it is certainly true that a university examination board must have responsibility for the final grade offered, there is ample experience from other sectors of employers’ assessments being taken into account. In education for health professions, for example, successful assessment in the workplace is a prerequisite for the attainment of qualifications, and the same is true in teacher education.

If greater involvement of employers in assessment is to be pursued, the final year project is the obvious focus for this. Students may make a formal presentation of projects to a “jury” including employer representatives, university tutors, and others with a professional interest in engineering education.
Evaluation

The most difficult part of the project was arranging the "employer’s advisory group", getting employers together. The first meeting scheduled was at University of Greenwich, but not enough employers from across the region had agreed to attend. Then a meeting was scheduled for a central London venue. Again, it was difficult to find people who could attend. Time pressures were cited.

The employer advisory group was eventually convened as an expert seminar in Brighton, and attracted employers, mainly local SMEs, as well as universities, and others involved in engineering education. Some graduates who had undertaken placements also attended and provided an invaluable view, not least into the barriers to placement take-up perceived by students, including international students. The amount of enthusiasm from lecturers was impressive.

An Internet forum was started, and pre-populated with questions and comments. It was kindly hosted by University of Southampton and the South East National HE STEM Programme spoke, but it was difficult to encourage people, even those who were otherwise very willing to engage with the project, to log onto the forum. This appears to be a common phenomenon in internet forums. When people are busy, dealing with new usernames and passwords is simply too much. However, we discovered that placements community already have forums of their own, notably “place.net”.

Discussion, Summary

Our conclusions were in two sections: identification of existing good practice and suggested enhancement of that good practice in future.

Good practice can be summarised under the headings:

- Learning
- Support
- General policy

In the “communities of practice” approach (Lave and Wenger 1991), students undertaking work experience engage in “legitimate peripheral participation”. “Legitimate” because their presence in the workplace is carefully arranged; “peripheral” because they are not necessarily expected to be productive immediately, and may be given tasks for learning and practice purposes, that are not essential to the company’s operations; “participation” because they are engaging in hands-on activity.

In each of our case studies, however, and in other cases we examined, students were expected to be fully productive early in their work experience period. They were initiated into the community of practice of qualified engineers by working alongside engineers in teams, by participating in continuous professional development activities, and in a number of other ways.
Case study: Delphi Diesel Systems

Delphi Diesel Systems Ltd makes rotary direct injection pumps and rail systems in Gillingham, Kent. They offer between 23 and 27 full-time one year placements every year, and six month placements are also sometimes offered. Ten to twenty per cent of students taking up placements are women. They do not work with dedicated work experience companies, but have good relationships with a number of universities, finding this to be a good way to promote the company. The students are paid a salary and the company also bears various other employment on-costs. Within three months of joining, students are expected to be as productive as junior engineers. The fresh skills (particularly in IT) and perspectives that students bring are appreciated by senior staff and team members. Students work in specific departments, and are not rotated. They take part in the company’s appraisal system, combined with a review of performance and achievement. Both line manager and student are interviewed in a detailed exit process. Universities often tell the company the work experience has exceeded student expectations, and often final results improve, typically from 2:2 to 2:1.

Employer, university, student and graduate interviewees all commented that undertaking a placement substantially enhances a student’s employability. This begins in the selection process for placements, when students have practice completing application forms and attending interviews. Students are then placed in real professional roles during the placement, are paid a salary and in return are expected to function as employees.

Employers frequently mentioned employability skills alongside specific engineering skills: soft skills, teamwork, timekeeping and working to deadlines in particular.

.. the year out has also had a knock on effect to other parts of my life like my part-time job. I know what to expect from employment, expectations for professional behaviour and how to find my way in a place of employment. (Student interviewee)

The learning that has gone on during placements – in contrasting environments – is shared and built when students return to university for their final year of study. Sharing of experiences is useful because students have been placed in quite different environments, and when exchanging notes, they are able to gain a more complete view of the engineering sector as a whole. Returning to university for the final year puts the final cap on the learning during the placement year, and allows still more integration of theory with and practical skills. It allows students who have undertaken very different placements to compare notes and learn from each other, thus bringing many different aspects of the industry into the classroom.

The research for HEFCE (Oakleigh Consulting and CRAC 2011 pp.14-16) introduced a typology of placement arrangements:

- ‘Individual’ placements
- Company schemes
- ‘Supported’ schemes
- HEI/regional schemes
- Graduate Training Programme (GTP)
- Commercial schemes
- Sector schemes

The placements we examined in this project were mainly “Individual” placements, but “supported” schemes were also present.

Engineering degree courses are often offered either in straight three year mode or four year “sandwich” mode, with a placement. The courses have different UCAS codes, but when the course begins it seem to make no difference whether the student applied for the sandwich or non-sandwich version. The possibility of a placement year is open to all the students on the course.
(Did you enrol on a sandwich degree course?) Originally no, but I always knew that I wanted to do a placement. (Student interviewee)

All the placements found were paid; we did not come across any unpaid placements in engineering, although universities pointed out that they are common in some related fields such as product design.

Case study: Selex Galileo

The SELEX Galileo Ltd Basildon site manufactures military guidance systems and civil aeronautics. Eight 12 month engineering work placements were offered in 2011/2012. Students are given real and demanding work, working to deadlines and budgets, within established teams. They are paid a salary, and further costs to the company include IT equipment, coaching and mentoring, travel to exhibitions, etc. Each student is assigned a mentor before the work placement begins. Performance is measured by end of placement reports and presentations and a formal review process. Industrial Placement Forums are held regularly to discuss the student experience. Students who achieve well may be recruited into the company’s graduate programme and sponsored through the rest of their degree course.

There were, in all cases, multiple levels of support offered to students. A student interviewee had a mentor (senior engineer), a line manager and also a mentor from A Year in Industry. She also had visits from a member of the School of Engineering staff from the university, so “felt support from all angles”.

Student interviewees in a small company did not have formal mentors, but had trusting and informal relationships with their line managers and colleagues. At least one colleague was a former graduate of the same course.

An advantage of the “sandwich course” model is that students return to university and share knowledge acquired on different placements. The seminar discussion with employers, HEIs and other partners brought out the vital role of the “final year project” in helping students integrate the theoretical knowledge and practical skills they gain during their university course and the placement. Students who take part in a placement nearly always choose a project related to the work of their placement company. The company is an invaluable resource for them, providing a realistic project setting, advising and providing positive critical feedback, as well as opportunities for dissemination.

 Employers and HEIs keep in contact through liaison about these projects and the final exhibition of degree work. A well-designed project executed in a real context is seen as an invaluable addition to a graduate’s CV, a unique opportunity to demonstrate employability. Universities valued the exhibition of final year projects as a way of keeping in regular touch with a range of local employers. This close integration of university and workplace learning, through placements followed by final year projects, is best achieved when there is a critical mass of students choosing to do a placement year. There is scope for more involvement of employers in assessment of student work, as happens in some other sectors.

Workplace learning could become even more integral part of the engineering curriculum if a greater critical mass of students could be encouraged to take up placement opportunities.
Case Study: Hanover Displays

Located in Lewes, East Sussex, Hanover Displays makes LED light displays, gaining a national and international market. Each year they take two students from the University of Brighton, and this number is stable despite the economic situation. Students are paid a salary and are given tasks parallel to those given to graduate engineers, becoming full members of the company environment. They attend meetings, training courses and continuous professional development activities. Key executives in the company have long-standing relationships with the university, and this long-term relationship allows for a high degree of trust. One student did so well on placement that he was immediately recruited as a full-time employee, and completed his degree as a part-time student.

Students may apply for a sandwich course and then not do a placement. Or they may not apply for a sandwich course and then decide to do a placement anyway. The take-up of placements is paradoxically low. Students do not seem to be sufficiently aware of the contribution of the placement year to their final year learning and grade, or to their future employability. Some international students were not convinced that the placement would be of more value to them than a faster completion of a UK degree, and also may have been anxious that companies, particularly small companies, might not have been able to make the necessary visa arrangements.

We found that some students and companies had worked with dedicated work experience promotion organisations, for example A Year in Industry (YINI), despite the fact that universities also provide a service, free to students and employers. Employers and students are thus paying for a service that might duplicate what is available for free. The service these organisations offer obviously has some attraction, and our interview evidence shows that it is related to the number of applications students are required to make, and to the extra mentoring and liaison provided by these organisations.

The student arranged her own placement through an organisation called “A Year in Industry”. There was a £25 administration fee and companies paid a fee (roughly £2000) to secure a student for placement. The student was entirely responsible for joining the placement finding scheme and found out about it through friends. Once joining the finding scheme, the company sent out CVs and arranged interviews on behalf of the student, who was at liberty to turn down any interviews that she chose. (HEI interviewee)

Student and graduate interviewees suggested that one reason was that applying through YINI meant only filling in one application form, as opposed to making applications to a number of employers with placements to offer. Universities felt that it was useful to students to gain as much experience as possible of making applications and attending interviews, gaining skills that will be used at graduation and further in the professional career. Interviewees also mentioned that international students felt that work experience organisers would help them with obtaining visas, although the universities were also able to help with this.

Sandwich courses in engineering have a long history. Although there are other models now, the one year placement, between the second and third years of study (Levels 5 and 6 in the framework), remains the norm. Unlike in many other economic sectors, the norm is for placements to be paid. Advantages mentioned by company interviewees and others included the opportunity to save money on graduate recruitment.

There is likely in the near future to be more interest in paid work placements. Students are encouraged to expect more “value for money” from their university courses, and there is an emphasis on employability. There will also be more scrutiny of the inequities of unpaid placements, conflict with widening participation objectives, and there is a realisation that unpaid placements violate minimum wage law.

While students are likely to become increasingly aware of the need to gain employability skills, it seems that it is necessary to overcoming reluctance on the part of students, for example, allowing those who have had a successful placement to meet first year students and explain to them the
benefits of the placement. Linkage between students and the world of work can be started much earlier.

There is an educational advantage of having a greater proportion of students engaging in placements, because of the opportunity for post-placement sharing of learning, but if this proportion is increased, different problems may start to emerge. It may be that demand starts to outstrip supply; the relatively generous pay in engineering may begin to limit the number of placements on offer. Greater take-up among students would also mean that students with greater support needs would be brought in, and the liaison between universities and companies would need to be strong.

Poor students are a difficulty – as they alienate the employer and often don’t follow through with the placement. The university vets students as well as they can, by obtaining tutor references and interviewing students for the placements that the university finds directly. (HEI interviewee)

Our three case studies show the extent of buy-in by employers. As well as paying a salary, they meet on-costs in treating the students like employees. They generally treat students as professional employees, make high demands on them, and are rewarded by the students responding accordingly. The experience allows students to integrate their previous engineering learning and their new learning. The “sandwich year” model in engineering still represents some excellent practice, and it is worth considering whether it could be extended to other sectors.

Further Development

Dissemination activities have begun. A STEM poster presentation was attended in December 2010 at University of Southampton. An event was attended at The Royal Academy of Engineering on 18 January 2011 and a dissemination event at the University of Coventry on 13 September 2011.

The research was presented in November 2011 at a symposium at the University of Warwick, Centre for Education and Industry. A network of academic researchers into work experience and placements has been set up. They involve academics at University of Southampton, University of Brighton, University of Westminster, University of Warwick, and Sheffield Hallam University. Their research interests in work experience range from school education through to further education and higher education. The network will explore commonalities and differences in work experience issues across these education levels.

References


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Further Reading / Bibliography

A full research report will shortly be available for employers and other interested readers.