

**The Involvement of Industry in Teaching:
A Guide for Academics**

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Introduction

The involvement of industrialists in teaching can provide mutual benefits for lecturers, students and industry. Drawing on effective practice in this area within engineering and related disciplines at Loughborough University, the guide provides pragmatic advice and support for finding and involving industrialists in teaching.

Who should read this guide

This guide and its accompanying resources are primarily intended for academic staff who are employed in departments that work with the engCETL¹ and who involve, or wish to involve, industry in one or more aspects of their teaching. The information is not intended for industrial tutors based in the workplace who supervise students on University based projects or who have responsibility for students on placement.

How to use this guide

The guide is available in both printed format and electronically at <http://www.engcetl.ac.uk/industry/involvingindustrialists>. The guide has a topic based structure, with sections that can be read in isolation. It has been designed so that readers can dip in and out of it, quickly finding the information of most interest. The sections of the guide consider: the benefits and motivations for involving industry in teaching; ideas for how to go about finding a willing industrialist; advice on avoiding common problems; practical issues that need to be considered and where to go for further information.

Accompanying the guide are two resource documents (RS1 and RS2). These have been designed as handouts to be given, by an academic, to an industrialist who may be considering becoming involved in teaching and to students who will have an industrialist involved in their teaching. These two resources are titled '*Industry involvement in teaching – What can this mean for you and your company?*' and '*Industry's getting involved in my teaching – What's in it for me?*' (Within these two handouts the word 'you' refers to the industrialist/student.) Although designed to be read by industrialists and students, these two handouts also provide a useful summary of the guide. These two resources can be linked to electronically, or adapted and printed as handouts.

Underpinning the guide and its resources are case studies of current industrial engagements within engCETL departments at Loughborough University. Written by academics, industrialists and students, the case studies provide different perspectives of the parties involved on the motivations, benefits and issues encountered through a variety of industrial engagements. Throughout the guide, individual case studies that demonstrate the issues under discussion are referenced by the author, whose name is shown in brackets. The case studies are designed to be read according to the interests of the reader. They can be read in isolation; grouped around a particular activity (thereby providing the academic, industrialist and student perspective); or read according to a particular theme. A summary of the case studies is given within the main body of the guide (Table 1) and each individual case study is provided within the appendix. Like the resources, the case studies can be printed as handouts or linked to electronically. In addition to offering a deeper perception of the issues discussed in the guide and being used as resources for industrialists and students, the case studies provide a useful insight into the variety of industry linked education that is currently practised within the Faculty of Engineering at Loughborough University.

¹ engCETL – Engineering Centre For Excellence for Teaching and Learning (www.engcetl.ac.uk). The five engineering departments that work with the CETL are Aeronautical and Automotive, Civil and Building, Chemical, Electronic and Electrical and Mechanical and Manufacturing. The two engineering related departments that work with the CETL are Materials, and Design and Technology.

Why Involve Industry in Teaching?

Involving an industrialist in your teaching can lead to benefits for yourself, your department, and your students. In addition to meeting the recommendations of various national/government reports (such as the Leitch Review²), the requirements of Professional institution accrediting panels and the QAA (Quality Assurance Agency), involving industry in teaching has the potential to:

- improve your own and your department's links with industry;
- keep your knowledge of industry practice up to date (Willmot, Simmonds, Glass);
- keep industry up to date with developments in research (Simmonds);
- prove a useful source of future research projects and collaborations (Willmot, Simmonds, Glass);
- provide expertise not currently in the department (Dartnall, Grover);
- shape the curriculum to better meet the needs of industry (McCaffer, Hall),
- ensure the degree course remains relevant (McCaffer);
- sustain a good reputation with potential students for strong industry links (Willmot);
- expose students to industry (Simmonds, Littlewood, Cheung, Glass);
- enhance student employment prospects (Newman (B), Willmot);
- enhance non-technical skills (Newman (B), Willmot, Walker (A)).

Contact with industry can **enhance the student learning experience** by:

- providing up-to-date, real world context, illustrating concepts and complementing theory, making engineering come alive (Thomas, Glass, Rielly, Willmot);
- providing in-depth industrial case studies which can enthuse and engage students, providing a different context and outlook on a familiar subject, encouraging debate (Thomas, Glass);
- providing access to knowledge and understanding of specialist engineering topics and industry expertise (Willmot, Thomas, Walker (A));
- providing an opportunity for students to ask questions and engage in discussions with industrialists (Hall, Littlewood, Thomas, Simmonds, Glass);
- providing experience of working on a live site in industry (Mackenzie, Newman (B));
- providing experience of dealing with people in industry (Rielly, Simmonds);
- broadening students' understanding of the business side of industry (Walker (A), Simmonds);
- motivating students with the prospect of working on a 'meaningful' project (Littlewood);
- giving students experience of real world design problems (Curtis, Hall) and their associated realities e.g. limited information (Simmonds, Rielly, Kellett, Cheung).

Industry involvement is most effective when done not for its own sake, but where there is genuine mutual benefit for academia and industry. The case studies accompanying this guide illustrate the benefits realised through different industry-linked activities undertaken at Loughborough. A summary of the 22 case studies accompanying the guide can be found in Table 1.

² http://www.hm-treasury.gov.uk/leitch_review_index.htm

Table 1: Summary of Case Studies of Industry Involvement in Teaching at Loughborough University

Dept.	Author and Perspective	Case Study Title and Features	Ref
Aeronautical and Automotive Engineering	Grover, John Consultant INDUSTRY	<i>Use of business simulation software with final year MEng undergraduates in the Department of Aeronautical and Automotive Engineering</i> <ul style="list-style-type: none"> How a business simulation software package is used in a Year 4 (Part D) management module with 72 undergraduate students to support the teaching of a bought-in teacher from industry. Support from engCETL staff with the trial of 'Marketplace' simulation. Students work in small teams of 5, 6 or 7, competing to win market share. Use of University virtual learning environment (VLE) to communicate. Assessment using business plans, group report and group presentation. 	CS6
	Littlewood, Rob STUDENT	<i>A student's perspective on working on a University project linked with industry</i> <ul style="list-style-type: none"> Group design projects, supported by lectures given by external experts. Each group has a project set by a different company. Student motivations for wanting industry interaction. Reflection of how important it is for expectations to match up. Issues with delays in replies to email questions. 	CS9
	Walker, Steven (A) STUDENT	<i>A student's perspective on working with industry through Formula Student</i> <ul style="list-style-type: none"> Formula student competition organised by the IMechE in partnership with sponsors. Module & extra curricular: supported students become involved on a voluntary basis throughout their course; in the MEng final year a group project focuses on the design, analysis and building of the car. Challenge to design, build, develop, market and compete by producing a single seat racing car to a set of regulations Business presentation to a panel of judges, preparation for which required a partner with experience in business strategy 	CS20
	Walker, Steven (B) STUDENT	<i>Student PowerPoint presentation of DIS placement at Nissan Technical Centre Europe</i> <ul style="list-style-type: none"> Industrial placement providing opportunity to experience working in industry, enhance training, and put theory into context. Attended a 3 week CAD training course and was involved in competitor benchmarking. Benefits of industrial placement. 	CS21
Chemical Engineering	Hall, Alan Syngenta Chemical Engineer INDUSTRY	<i>An industrial perspective on working together to develop the chemical engineering curriculum</i> <ul style="list-style-type: none"> Small group design project set by industry. Design brief for a plant. Information released in stages as in real world. Students need to research and question industrialists. Discusses motivations of companies to get involved with education. Issues of effective communication between students and industrialists. Mismatch of expectations between academics and industry. Benefits for industrialists. How size of company can effect interaction. 	CS7
	Kellett, Adam STUDENT	<i>Student perspective on the MEng Chemical Engineering process design project in partnership with industry</i> <ul style="list-style-type: none"> Small single group, real world, design problem for final year MEng students. Brief jointly developed by company and academic. Links to Rielly (academic) and Simmonds (Industry) case studies. Issues of obtaining information. Benefits to the students of visit and presentation. 	CS8
	Rielly, Chris Head of Department ACADEMIC	<i>Process design project for final year MEng Chemical Engineering students in partnership with industry</i> <ul style="list-style-type: none"> Small single group, real world, design problem. Links to Simmonds (Industry) and Kellett (student) case studies. Partnership with pharmaceutical company (GlaxoSmithKline). Industrialists visited students at University. Students visited the site, met the plant operators and engineers and delivered a presentation to the staff. 	CS15
	Simmonds, Greg GlaxoSmithKline Process Engineer INDUSTRY	<i>Building strong and mutually beneficial networks between the pharmaceutical industry and top technical faculties</i> <ul style="list-style-type: none"> Small single group, real world, design problem. Links to Rielly (academic) and Kellett (student) case studies. Motivations include attracting engineering graduates to the industry. Information flow mimics real world delays. Students given a tour of the manufacturing facility and presented their work to the Site Leadership Team. 	CS18
Civil and Building Engineering	Glass, Jacqui Senior Lecturer ACADEMIC	<i>Guest Speakers in the Department of Civil and Building Engineering</i> <ul style="list-style-type: none"> Guest speakers from industry delivering talks in lecture slots. Discusses mutual benefits. Practicalities of preparing and organising guest speakers. Discusses issues of payment and the need for flexibility in the lecture programme. 	CS5
	MacKenzie, Julian Senior Lecturer ACADEMIC	<i>Practical construction experience for BSc Construction Engineering Management students</i> <ul style="list-style-type: none"> Industry sponsored construction management experience. Working with a company to jointly achieve more practical (construction) experience for students Example of briefing sessions being delivered by industry. Hard to achieve practical experience on 'live' construction sites. 	CS10

	<p>McCaffer, Ron Professor of Construction Management ACADEMIC</p>	<p><i>Industry sponsored degree programmes in the Department of Civil and Building Engineering</i></p> <ul style="list-style-type: none"> • Use of consortium of sponsoring companies, to ensure programme meets needs of industry. • Companies provide an annual bursary, a one year placement, support with project work or other coursework and a job offer. • Consortium model is successful and a similar model is adopted by other departments. 	CS11
	<p>Ruikar, Kirti ACADEMIC</p>	<p><i>Podcasting in a Project-Based Learning Environment (Industry case study architectural design project)</i></p> <ul style="list-style-type: none"> • Real world architectural design knowledge captured to provide students with audio-visual and context-specific design information to improve student understanding of practical design-related issues and enhance learning experience. • Dynamically capturing real world key design decisions mutually beneficial, ensuring buy-in. • Lessons learnt from student feedback on podcasts. 	CS17
Design and Technology	<p>Dartnall, Adrian Dartnall Design Associates INDUSTRY</p>	<p><i>Bought-in teacher at the Department of Design and Technology</i></p> <ul style="list-style-type: none"> • Practising freelance designer is a 'bought in teacher'. Works with students on module which involves design practice. Advises students on the manufacturing implications of their designs. • Bought in for certain number of hours on specific days. • Delivers tutorials with small groups of final year students. 	CS3
	<p>Rodber, Michael Jones Garrard Move INDUSTRY</p>	<p><i>Designer and Visiting Fellow in the Department of Design and Technology</i></p> <ul style="list-style-type: none"> • Practising designer with specialism in transport is a Teaching Fellow in the department. Bought-in for one day a week delivering Product Design module to undergraduate students • Developed New Product Development (NPD) module with colleague • Frustration of not being involved in strategy and tactics of University 	CS16
Electronic and Electrical Engineering	<p>Gabb, Bill ACADEMIC</p>	<p><i>Student Prize awarded by Siemens in the Department of Electronic and Electrical Engineering, Loughborough University.</i></p> <ul style="list-style-type: none"> • Annual industry sponsored prize awarded to the student who has made an outstanding contribution during their industrial placement. • Increases profile of industrial placements in department. • Good publicity for sponsoring company. 	CS4
	<p>Pearce, Amanda Industrial & External Relations Manager University</p>	<p><i>Partnership between BAE Systems and the Department of Electronic & Electrical Engineering</i></p> <ul style="list-style-type: none"> • Partnership between the Department of Electronic & Electrical Engineering and BAE Systems to create and develop the MEng Systems Engineering programme at Loughborough University. • Curriculum co-designed by academics and industry. • Lectures by industrial practitioners is common practice. • Inter-departmental group projects 	CS14
Materials	<p>Thomas, Noreen Senior Lecturer ACADEMIC</p>	<p><i>Industrial case studies module for undergraduate BEng/MEng materials engineering students</i></p> <ul style="list-style-type: none"> • Module with 6 lecture slots delivered exclusively by industrialists. Each lecture is a different industry case study looking at the issues that affect industry. • Coursework assignments set and marked by industrialists (with support from the academic). • Industrialists identified through departmental links. • Motivations of academic to expose students to industry. • Issues of industrialists being late, letting you down at the last minute. 	CS19
Wolfson School of Mechanical and Manufacturing Engineering	<p>Cheung, Emily STUDENT</p>	<p><i>The Teaching Contract Scheme in Wolfson School of Mechanical and Manufacturing Engineering</i></p> <ul style="list-style-type: none"> • Group design project. Real problems set by industry. Each problem usually tackled by one or two groups. Links to Willmot (academic) and Curtis (industry) case studies. • Benefits for students including insight into different aspects of working in industry. 	CS1
	<p>Curtis, Alan JCB Research Engineer INDUSTRY</p>	<p><i>JCB involvement with a mechanical engineering design and build project</i></p> <ul style="list-style-type: none"> • Group design project. Real problems set by industry. Links to Willmot (academic) and Cheung (student) case studies. • Alumni wishing to 'give something back' to education. • Provides continuing professional development opportunities for graduate engineers. • Mismatch of expectations between academics and industry. • Motivations for high company commitment. 	CS2
	<p>Newman, Richard (A) engCETL Industrial Liaison Officer ACADEMIC</p>	<p><i>Industry Advisory Committee in Wolfson School of Mechanical and Manufacturing Engineering</i></p> <ul style="list-style-type: none"> • Industrial advisory committee. • People from industry kept up-to-date. • Industrialists can update academics on company/industry. • How industry can support the School. 	CS12
	<p>Newman, Richard (B) engCETL Industrial Liaison Officer ACADEMIC</p>	<p><i>Consortium of companies who sponsor the MEng Innovative Manufacturing Engineering programme</i></p> <ul style="list-style-type: none"> • Use of consortium of sponsoring manufacturing companies. • Companies provide a bursary and placements. • MEng with industrial experience in 4 years. • Two University modules are used to assess the learning occurring through the placement. • Issue of reducing number of applicants to manufacturing. • Use of website and student case studies to promote degree programme. 	CS13
	<p>Willmot, Peter Principle University Teacher ACADEMIC</p>	<p><i>The Teaching Contract Scheme in Wolfson School of Mechanical and Manufacturing Engineering</i></p> <ul style="list-style-type: none"> • Group design project. Real problems set by industry. (Up to 14 companies provide problems). Links to Curtis (industry) and Cheung (student) case studies. • Partnership with consortium of companies who provide projects for undergraduate students. • Industrialists take part in tutoring and assessing project work. • Students visit the company and industrialists come to the University. • Final year students organise a design exhibition with all partners present. 	CS22

The Ways in which Industry can be Involved in Teaching

There are many ways in which an academic can involve an industrialist in his/her teaching. The level of input varies from casual talks to much closer levels of engagement where the industrialist is key to the delivery and assessment of modules. Below is a list of examples of industrialist inputs, most of which are undertaken somewhere within the Faculty of Engineering at Loughborough; those with associated case studies are indicated.

- **Real world design projects:** students work on projects put forward by industry. A project could be a problem that has already been solved but which is a good exercise for students (Hall, Simmonds, Rielly, Kellett) or an open-ended problem where a company is genuinely looking for a solution (Curtis, Willmot, Cheung). Multiple groups within the cohort can work on one problem (Cheung), or different groups can work on different problems set by different companies (Littlewood, Willmot). An enhanced learning experience is usually gained where the company supports the students undertaking the project as this enables the students to interact with the company over the course of the project. Real world group design projects are one of the most popular options for industry input at Loughborough and have many benefits for the academics, companies and students involved.
- **Visits to Companies:** site visits can be independent of a project, but are often a feature of real world projects. Visits can occur at the start of the project, where it provides a helpful context to the project (Willmot). It is also common to visit part way through a project, so that students know enough to ask questions and the experience can direct future project activity (Simmonds). Site visits can mean limitations for group sizes but otherwise they can provide valuable insights and are a strong motivating factor for students (Littlewood).
- **Guest lecturers:** an industrialist is invited to give a lecture on a specific area of the curriculum.
- **One-off talks:** these can be more informal than a guest lecture and can be used to inspire students about industry or to provide a more in-depth view of a topic (Glass).
- **Industrial case studies:** detailed case studies delivered by industrialists, providing context to the broader subject and detailed insight to the issues in industry (Ruikar).
- **Bought-in teachers or visiting professors:** typically recently retired senior industrialists. Especially useful to provide areas of expertise lacking in the department (Grover, Dartnall, Rodber). Be aware that the University is currently looking to reduce the amount of bought-in teaching (June 2009).
- **Delivery of short courses or whole modules:** industrialist(s) responsible for the delivery of part or all of a module e.g. a series of case studies (Thomas). This requires significant planning and commitment from the company or companies involved.
- **Prizes/Competitions:** if purely providing money/prizes/judges this can be a passive means of industry engagement. However, this type of input can also be very active with companies providing site visits etc. If prizes are applicable to individuals then they tend to be popular with students looking to enhance their CV (Gabb). Supporting students in national competitions, such as Formula Student, provides students with opportunities to engage with industry and to apply and broaden their subject knowledge (Walker (A)).
- **Advice clinics:** student groups working on the same design problem are given access to industry experts in the context of a discussion group; students have the opportunity to ask questions, discuss ideas and learn from people who work in the field and are abreast of current developments in industry.
- **Briefing sessions:** an industrialist can provide briefing sessions on different topics, for example on project management, product development etc (Mackenzie).

- **Student placements:** students undertake a placement within a company. There are many research papers and support guides dedicated to this topic; see the section on further reading for some key references (Walker (B)). It is therefore not covered in detail in this guide.
- **Co-authoring** (students, academics, industrialists): for example, guides that give a real indication of what it's really like to work in industry.
- **Departmental Industrial Advisory Boards:** this provides an opportunity for industrialists to regularly come into the University and allows time for a relationship and mutual understanding to grow. This in turn can then lead to further ideas for interaction (Newman (A)).
- **Industry sponsored degree programmes:** an individual company or a consortium of companies can be part of the design and management of a degree programme ensuring that the course offered to students is relevant to industry (McCaffer, Newman (B), Pearce).
- **Sponsored field courses:** field courses where students get experience of working on live sites. Experiences can include different aspects such as building, planning, costing, safety and risk assessment (Mackenzie). Industry involvement may be limited to the provision of funding but can extend to providing briefing sessions, training, site visits etc.

If you have never had an industrialist involved in your teaching before, start with a small involvement, as there is a learning curve to be surmounted by both you and the industrialist, even if the industrialist has had some previous involvement in teaching. If you begin with something simple, for example a one off talk to students, this might lead on to an industrialist running a workshop for you, which in turn might lead to the sponsoring of a project, and so on.

For more detailed examples of ways to work with industry read the case studies in this guide and talk to their authors. The engCETL team can also give advice and ideas for how you might involve an industrialist in your teaching.

Finding a Willing Industrialist

Depending on your contacts this might be one of the more challenging aspects of involving industry in your teaching. Some ideas for finding people are given below and within the resources section of the guide is a handout, which you can adapt, to give to the industrial company once you have identified it.

1. Make use of **staff in the engCETL** who will be able to help by providing advice and perhaps making some calls and identifying initial contacts for you.
2. Exploit the existing **teaching-related industrial contacts** you have – these could lead you to an industrialist willing to get involved with teaching. For example, consider visiting companies, sandwich placement contacts, existing visiting professors, industrial advisory boards (Newman (A)), links with companies sponsoring degree programmes in your department (McCaffer, Newman (B)), external examiners etc.
3. Does your department have a **database of contacts** you can draw on? John Hooper/Amanda Pearce in Electronic and Electrical Engineering can tell you about theirs.
4. You may also have **inherited contacts**, especially if you are new to teaching a module or to the department. Find out as much about them as possible from colleagues in your department.
5. Other sources are your **industrial conference contacts** (both from teaching and research conferences) and/or **industrialists who are retired or close to retiring and have set themselves up as consultants**.
6. Make use of **previous graduates** from your department, particularly recent ones (Thomas, Curtis). (The University's Development and Alumni Relations Office <http://alumni.lboro.ac.uk> or the engCETL team should be able to help you).
7. Think about any **industrial research contacts** you have and consider whether they, or their company, would be appropriate for getting involved with teaching (Hall). Once a contact is made for one area of work, then this can often be expanded to other areas as the benefits for all can be easily demonstrated. Knowledge Transfer Partnerships³ (KTP) are one example where industry involvement in teaching can grow out of a research relationship. See the associate and academic partner sections of the KTP case studies for examples of this: http://www.lboro.ac.uk/business/collaborations/ktp_casestudies.html
8. engCETL or engSC⁴ staff should be aware of **groups working in your discipline** who are interested in encouraging more industry interaction, for example, Constructionarium (<http://www.constructionarium.co.uk>) who provide hands-on construction experience for students and young professionals (Mackenzie).
9. For contacts within specific industries it may be possible to gain introductions through the relevant **trade association**, government body or other national organisation representing the industry sector.
10. Finally, make use of any **personal contacts** you have – both within and outside work. Friends working in a suitable company are often readily open to ideas and can put you in touch with an appropriate contact. This can avoid many of the problems associated with cold calling.

When trying to find a willing industrialist it is prudent to allow a long lead time before you want to implement your chosen teaching activity. Sometimes a company can be very enthusiastic with lots of corporate commitment but can struggle to realise the necessary resources or appropriately skilled individual. The converse is also true. To help an industrialist demonstrate the value of their involvement to their company or employer use the handout RS1, located within the resources section of the guide.

³ See the University's Enterprise Office (www.lboro.ac.uk/business) for more information about Knowledge Transfer Partnerships

⁴ Higher Education Academy Engineering Subject Centre (www.engsc.ac.uk)

Why Industry Might Want to be Involved in Teaching

Individual industrialists and their companies will have many different reasons for wanting to become involved in teaching and these will influence the type of involvement they are prepared to enter into and their commitment.

At an altruistic level, a large company may be motivated by a desire to **enhance engineering education** for the benefit of UK engineering (Curtis, Simmonds) or perhaps a desire to **shape the curriculum** to better meet the needs of industry in terms of graduate knowledge and skills (Hall). Many smaller companies may not have the resources to engage in such ambitions and may need to realise more immediately tangible benefits from the engagement. Their motivations, in common with many larger companies, may include access to basic **low-cost research**, which can lead to the realisation of novel solutions to problems (Curtis, Willmot, Littlewood, Cheung). Long term goals may include access to **research tools and facilities** not available within the company (Willmot) and developing strong **networks**, both with individuals and engineering faculties (Simmonds).

Companies are able to benefit from the **continuing professional development** opportunities that teaching engagements offer its engineers (Curtis). Companies also see teaching engagements as an opportunity to **raise the profile of the company** (and the industry) with future placement students and graduates (Simmonds, Rielly, Willmot, Newman (B)). Contact time gives companies the opportunity to **influence, assess and recruit capable students**. Sponsored prizes, field courses and competitions offer good **publicity** opportunities (Walker (A), Gabb).

When planning how to involve industry in your teaching take into consideration the type of engagement and the benefits that a company is likely to realise and match these appropriately to the size and type of the company. Avoid solely targeting larger companies, as small companies may offer expertise often not found elsewhere. Group design projects tackling problems set by, and therefore of interest to, the company is one example where small companies can directly benefit as well as the students (Willmot, Curtis). See the Thomas case study for an example of where industrialists from small, medium and large companies successfully deliver case studies within a module.

An individual working in industry may have some or all of the following motivations for engaging in a teaching initiative:

- A desire to give something back (Curtis, Thomas).
- Continuing their professional development and personal development (Hall).
- A desire to interact with people with fresh approaches and ideas (Dartnall).
- A desire to inspire young engineers (Curtis).
- A desire to broaden their networks (Hall).
- Personally rewarding (Thomas, Willmot).

To help an industrialist to demonstrate the value of their potential involvement to their company/employer, draw their attention to the case studies written by other industrialists. Included in these are many references to the value that companies attach to their involvement. These benefits are in the resources for industry handout (RS1) located within the resources section.

How to Make it Work

Although the challenges encountered when setting up and running an activity involving industry will vary, a number of issues will be common to all such activities. The commonality of such issues as sharing expectations, ensuring reliability, briefing the industrialist and briefing students is evident from the case studies. The value of giving these issues forethought and preparing to deal with them in a structured manner is also seen from the studies.

Sharing Expectations

Mismatched expectations are common when academia works with industry. This is an issue for the industrialists, academics and students alike. Be aware that the values and expectations of academia and industry can vary wildly and therefore it is necessary to check even the most basic of assumptions e.g. who is going to attend a meeting, what is to be delivered at that meeting, in what format etc (Hall). In some cases expectations can be met, in other cases they need to be managed, but for either to happen they need to be made explicit. Some schemes that occur yearly, such as that described in the Willmot case study, use an agreement document to help make clear the conditions for involvement and how the scheme operates.

Common unspoken industry expectations include:

- That predetermined deadlines will be met.
- They will be kept informed of project progress.
- Reports/documents they receive from students will be to industry standard.
- Staff and students will dress and behave professionally.

Academic expectations:

- Industrialists will keep to time and topic.
- Industrialists will turn up and on time for a timetabled session.

Student expectations:

- Deliverables will be assessed.
- Support will be readily available both from the academic and industrialist.
- Prompt answers to emailed questions.

Early and ongoing communication of expectations is normally necessary to avoid problems.

Issues which may require agreement include:

- The additional deliverables on top of module requirements wanted by a company e.g. reports/presentations to managers. (Curtis, Littlewood)
- The communication channels to be followed by students, including the clarification of whether emails should be filtered through the tutor/team leader to avoid replication and reduce their volume and frequency. (Hall, Littlewood)
- The role of the academic, industrialist and student in driving a project forward when it's not being naturally pushed by assessment deadlines. (Curtis)
- The role of the academic and the industrialist in the provision of ongoing support to the students.

Reliability

When involving an industrialist in a teaching activity a genuine concern can be the industrialist's reliability; unfortunately there are occasions when academics have been let down at the last minute. This can be due to simple issues such as being caught in traffic or commercial pressures taking priority. A practical approach is to ensure that the teaching initiative is **mutually beneficial** so that there is strong commitment from both the industrialist and their employer. Other approaches include working with companies based in close proximity to the University, thereby reducing the need to travel and working with Alumni or industrialists who have established contact with the department (Thomas) (recent Alumni have the additional benefit of understanding the needs of staff and student). However, these latter approaches have the disadvantage of limiting your choice of company.

Sometimes even with the best of intentions your industrialist may have to let you down and this must be catered for by a combination of back-up plans and a flexible programme which allows you to easily swap one of your lecturers with an industrialist's (Glass). It is essential that industrialists understand the difficulties you face when let down and the importance of letting you know in advance as early as possible if they cannot fulfil an engagement.

Reliability will also be important for your industrialist and it is vital that this expectation is realised. Where your industrialist is expecting deliverables make sure that these are delivered on time as promised and that you attend any meetings at which you are expected. Letting your industrialist down at the last minute can be equally frustrating for them (Hall). Key to ensuring reliability is building a **good relationship** with the industrialist, where both parties understand the issues and pressures of the other.

Briefing Industry

Poor briefing in advance of an activity can lead to problems (Hall). Key things to make your industrialist aware of include:

- How their teaching fits into the module and context of the curriculum.
- Where to pitch the level of their teaching, i.e. the age and learning level of the students.
- What the coursework requirements are for the module.
- What, if any, their role in assessment might be.
- What to expect from the students.
- How many students they will be working with.
- What learning space they will have available to them and its location.
- Whether you are going to be on hand to play an active part and/or for classroom management.
- Whether the students will want handouts and, if so, to pass the document on to you in time for it to be photocopied/put on LEARN.
- What audio visual requirements they might have and whether these can be met.
- The importance of sticking to time and topic.
- How to get the best from your students.
- The limitations the University environment might impose.

RS1, within the resource section of the guide, contains an adaptable **resource** document for you to give your industrialist. It is brief and written for the industrialist, referencing key case studies that best illustrate information of most interest to them. This handout is intended to encourage prospective industrialists and to provide guidance for those already signed up.

When thinking about what else you might need to prepare, be aware that other academics who already involve industry in teaching will have resources that they have developed; these could

prove a useful starting point for developing your own. For example, Peter Willmot in the Wolfson School has a pack describing industrial involvement, which he sends to companies expressing an interest (Willmot). This pack also includes an agreement form that makes clear the expectations on the University, company and student. Noreen Thomas in Materials provides assessment guidance to the industrialists involved in her case study module in the form of tutorials.

Good communication is key to making industrial engagement work well. Time taken to make your industrialist feel valued and supported is well spent. Where possible meet with them face to face and build in the opportunity for more informal discussions, such as taking them out to lunch. Such meetings allow you the chance to share ideas for their teaching involvement, agree the conditions of the engagement and to develop a better understanding of each other's expectations.

Briefing Students

Students need to be briefed well for them to get the most out of the experience. In addition to understanding the type of activity that industry will be undertaking with them, it is important for students to know what is expected of them.

Basic information students might need, depending on the type of involvement, includes:

- Who their contact is, if and how they can contact them (including frequency, channels of communication etc.)
- What support they can expect to receive from their industrialist and academic (if it is a project activity).
- Specific details of the task, what it involves, deadlines etc as appropriate.
- Details of how the task will be assessed, if applicable. (Be aware, where students are exposed to external lecture material they may wish to know how they are going to be assessed from it.)
- Deliverables on top of those required by the module (and the opportunities this offers students e.g. a chance to present to company directors).

In addition to this, it is helpful to make sure your students are aware of:

- the opportunities and benefits that interacting with industry can offer them;
- the importance of engaging with the activity and the industrialist;
- industry's expectations of them;
- the expectations they can reasonably have of their industrialist.

Within the resource section of the guide is a briefing sheet (RS2) that covers these four elements. This double sided A4 sheet (the Word version can be edited) can be given out to students in conjunction with coursework briefs etc. This sheet can either be downloaded or the URL given to students. Hard copies are also available from the engCETL, but notice is required for large numbers.

The Littlewood, Kellett and Cheung case studies have been produced from a student perspective and demonstrate both the advantages and challenges of industrial engagement. They can be used as additional leaflets to hand out to your students, to build their motivation and encourage them to become involved.

For ideas on how others have briefed their students, you can contact the academics listed in the further support section. Many will have resources for their activities which you may find a useful starting point. For example, Martin Passmore, in Aeronautical and Automotive Engineering, includes in his coursework brief to his students a section making them aware of the company's

requirement for all students to sign a confidentiality agreement and clarifies the company's ownership to any intellectual property generated in the course of the project.

A Few Practical Considerations

Payment

To pay or not to pay the industrialist? It is very often found that payment to an industrialist for their involvement is not required, but the decision depends on the type of engagement, the motivations for the industrialist's involvement and what the industrialist achieves from it .

Different lecturers and departments have different views. Some pay only if marking and assessment are involved whereas others will pay a **fixed fee** for services like supervision. It is usual for **travelling expenses** to be paid. For self employed industrialists, the going day rate may be beyond what a department is be prepared to pay.

Non-payment is particularly common for design project activities where companies obtain solutions to real problems. Alternatively, In the case of industry-set group problems companies may sometimes pay a **small fee to the University** to cover expenses (site visits, hospitality, basic project costs etc) in return for a full report of the students' findings (Willmot).

Be aware, especially in large companies, it can be difficult to arrange to make or receive payments and therefore delays should be expected. If requesting a fee from a company for their involvement, be mindful of the position of your contact within their organisation and their ability to influence budget holders if they do not control their own budgets.

Relevant University Procedures

There are various University procedures that may have a bearing on your planned industry engagement and this is particularly true of bought-in teachers. Some of the University procedures that you may find useful are referenced in the further reading section; these include Personnel Service's Bought-in Teachers Guide, Teaching Observations and Payment Claim forms from the Finance Office.

Confidentiality Agreements

Some companies may not have a problem with the University having confidential data but may deem students as high-risk due to their transient nature, as they could go and work for a competitor. A company may require students to sign a confidentiality agreement before any information is released for a project (Simmonds, Rielly). Depending on the nature of the project this can be a very straightforward document for the company to produce. However, it is good practice to do this very early on with the company. It can take the University time to agree terms and therefore it may take some time for all parties to sign the agreement. This in turn may delay the release of information at the start of a design project. However, do not be put off by the potential need for a confidentiality agreement, as the challenges of confidentiality and access to information are ones of commercial reality and are a valuable learning experience for students (Rielly).

Sustaining Involvement

Given that finding willing industrialists can be one of the more challenging aspects of involving industry in teaching, it is worth taking measures to retain valuable contacts. Reasons for why a contact might be lost include:

- Your industry contact changes role/company;
- You leave your department;
- Your industrialist's company withdraws its support for resource reasons.

There are a number of ways you can attempt to deal with the above situations:

1. If you know that your contact is going to change role or jobs, ask them to pass you onto their replacement or to someone else in the company who would be interested in working with you. Named contact details and knowledge of your new contact's position within the company's structure are the minimum information required. Additionally, details of someone else you can follow up with in case the new contact proves unresponsive is valuable information.
2. If you are leaving your department, pass the names and details of your contacts onto your replacement, head of department and administrator. Your industrialist will need the names and details of people they can contact within the department.
3. It is easy for industry involvement to be lost if the engagement relies upon personal relationships. When a person leaves that contact can be lost. One way a department can embed its industrial interactions is to have a clearly identified and branded unit (McCaffer). This unit can both maintain existing contacts and can provide a highly visible contact point for companies wanting to approach a department.
4. Over a period of time, natural turnover of companies is likely, so efforts to recruit new companies should be made whenever there is an opportunity. If you have an established teaching activity for industrialists, consider producing an information pack to send to interested parties (Peter Willmot in the Wolfson School produces such a pack). The Teaching Contract Scheme (see Willmot) invites potential companies to a summer exhibition of the students' work. Similar annual exhibitions of students work occur with the industrial design degree show in the Department of Design and Technology and the Department of Civil and Building Engineering's recruitment fair.

Further Support

The engCETL has a remit to support those who work towards achieving the engCETL's aims. These aims include extending the process through which industry makes an input into student learning and enhancing the student learning experience. Staff in the engCETL are always available to discuss the best way of making contacts. Additionally, if you require help in developing resources for an activity involving industry, you can apply through the engCETL's call for proposals, for support in terms of the time and expertise of one or more of the engCETL's staff members. For more information see <http://www.engcetl.ac.uk/activities/bid/>

In addition, all of the academic authors of the case studies can be contacted directly. They all have extensive experience of working with industry and are more than happy to pass on their knowledge and discuss your ideas. Many also act as an informal champion within your department/faculty:

- Chris Rielly, Chemical Engineering
- Jacqui Glass, Civil and Building Engineering
- Julian Mackenzie, Civil and Building Engineering
- Ron McCaffer, Civil and Building Engineering
- Kirti Ruikar, Civil and Building Engineering
- Bill Gabb, Electronic and Electrical Engineering
- Amanda Pearce, Electronic and Electrical Engineering
- John Hooper, Electronic and Electrical Engineering
- Noreen Thomas, Department of Materials
- Peter Willmot, Wolfson School of Mechanical and Manufacturing Engineering.

Bear in mind when talking to these academics that they may already have resources that you could use as a starting point for your own. Examples already mentioned elsewhere in this guide include:

- Noreen Thomas – assessment tutorial for industrialists;
- Peter Willmot – activity description and agreement form;
- Martin Passmore – project brief for students;
- John Hooper/Amanda Pearce – departmental database of industry contacts.

You can also contact the national Higher Education Academy Engineering Subject Centre (EngSC) (<http://www.engsc.ac.uk/>) for some more general advice and appropriate further reading – for example, the ENGAGE Project. This project aimed to facilitate constructive dialogue between employers and academics in Higher Education (HE); to develop a common understanding of the skills agenda relating to engineering, physical sciences and materials disciplines in HE; and to build capacity for future collaboration, including identifying further funding and potential employer engagement projects.

Further Reading

Papers

Newman, R., "The use of student placement case studies to promote a manufacturing engineering degree course", ASET Conference, Cardiff, September 2007.

www.engcctl.ac.uk/downloads/industry/papers/aset_2007_industrial_placement_guide.pdf

This paper discusses the collaboration between the innovative manufacturing engineering degree at Loughborough University and industry.

Willmot, P., Logan, J.S. and Crawford, A.R., "Establishing an Innovative New Learning Environment to Foster Industry Links in Higher Education", *Educating Designers for the Global Context, Proceedings of the Engineering and Product Design Education International Conference*, Salzburg, Austria, September 2006, pp 207 - 212, ISBN 0 9553942 0 1.

This paper describes the creation of the engCETL's new learning spaces. It speculates how the new space and enhanced facilities will help an existing industry based project scheme in the mechanical and manufacturing engineering school to prosper and grow.

Willmot, P. and Twigg, D.R., "Teaching Engineering Leadership", *Education Research and Development: Fostering Economic Growth*, Proceedings of 9th International Conference on Engineering Education, San Juan, Puerto Rico, July 2006, M5E5 - 10pp, ISBN 1-58874-648-8, [Also on CD-ROM], ISBN 1-58874-649-6.

This paper compares two innovative 'leadership' modules introduced to the final year of an undergraduate mechanical engineering programme, one of which involves an industry based project.

Willmot, P., "Running Team Projects in Co-operation with Industry", *A Case Study in "A Guide to Learning Engineering Through Projects"*, Ed. Choo, B.S., Wilson, A., FDTL 43/99, PBLE, University of Nottingham, UK, April 2003, pp 1-6.

http://www.pble.ac.uk/guide-final.html#_Toc56250103

This paper presents a case study highlighting the teaching contract scheme in Wolfson School of Mechanical & Manufacturing Engineering, where small teams of students tackle real problems which are set by industry.

Guides

Teaching guides, Higher Education Academy Engineering Subject Centre:

- Approaches to the Teaching of Design.
- Enhancing the First Year Experience for Engineering Students.
- Introduction to Learning and Teaching.
- Industrial Placements for Engineering Students.

Downloadable from: <http://www.engsc.ac.uk/teaching-guides/>

Guide to industrial placements, Higher Education Academy Engineering Subject Centre and engCETL, Loughborough University.

This provides a brief guide to industrial placements for employers.

<http://www.engsc.ac.uk/downloads/employers-guide-on-placements.pdf>

Industrial placements for engineering students: a guide for academics, Higher Education Academy Engineering Subject Centre and engCETL, Loughborough University.

This guide provides academics with practical advice about developing links with industry and setting up appropriate placement opportunities for students. Students will gain more from their placement if they are properly prepared and advice is given about how they can be supported both before and during the placement.

<http://www.engsc.ac.uk/downloads/scholarart/industrial-placements-guide.pdf>

Projects and Research

ENGAGE Project (<http://www.engsc.ac.uk/engage>)

This project facilitated dialogue between employers and Engineering, Physical Sciences and Materials Academics in Higher Education and created a variety of resources including further relevant case studies (<http://www.engsc.ac.uk/engageconf/index.php/resources/>) and notes on working with a University (<http://www.engsc.ac.uk/engageconf/wp-content/uploads/2007/12/working-with-a-university.pdf>)

PhD Research:

The Impact of Industrial Sponsorship on Students, Academia and Industry. Fakhte Soltani-Tafreshi <http://www.engcctl.ac.uk/about/staff/profile/102>

The Impact of Work Placements on Transferable Skills. Dr Yussuf Ahmed
<http://www.engcctl.ac.uk/about/staff/profile/104>

University Procedures

Personnel Services' Bought-in Teachers Guide, including request for offer of appointment form
<http://www.lboro.ac.uk/admin/personnel/bitinfo/index.html>

Finance Office Claim Form - Payment for Casual Services and Bought-in Teaching
<http://www.lboro.ac.uk/admin/financial/restricted/forms.htm>

Teaching observations (Teaching Quality Assessment)
<http://www.lboro.ac.uk/service/teachingcentre/info/bought.html>

Conditions of service.

Bought-in Teacher jobs fit into the Teaching and Scholarship Job Family at Grades 5, 6 and 7.
<http://www.lboro.ac.uk/admin/personnel/conditions.html>

Other Case Studies

Case Study A: BAE Systems and Loughborough University, Council for Industry and Higher Education, Helen Connor and Wendy Hirsh, Systems Engineering, *Realising the benefits of long term partnership*,

Can be found in *Influence through Collaboration*:

<http://www.cihe-uk.com/docs/0809CollabCaseStudies.pdf>,

Embedding Enterprise in Engineering, The Higher Education Academy Engineering Subject Centre, Liz Willis, *Embedding Enterprise in Engineering - Reality teaching through a business planning module*

<http://www.engsc.ac.uk/downloads/entre.pdf>

Work Based Learning Case Studies, The Higher Education Academy Centre for Education in the Built Environment (CEBE).

<http://www.cebe.heacademy.ac.uk/learning/wbl/case.php>

Engineering Leadership Advanced Awards Scheme: Lee Comerford, The Royal Academy of Engineering, Mechanical Engineering, Lee Comerford,

http://www.raeng.org.uk/education/undergrad/ela/lee_comerford.htm

Engineering Leadership Advanced Awards Scheme: Jane Kendall, The Royal Academy of Engineering, Engineering Science, Jane Kendall,
http://www.raeng.org.uk/education/undergrad/ela/jane_kendall.htm

Engineers for Enterprise Study: Loughborough University, Faculty of Engineering Case study, HEA Engineering Subject Centre and The Royal Academy of Engineering, Fiona Lamb and Richard Dales, *The Diploma in Industrial studies, The Teaching Contract, Sponsored Degree Programmes*

To be published Autumn 2009 <http://www.engsc.ac.uk/an/engineers-for-enterprise.asp>

Placement Case studies: Loughborough University, Wolfson School of Mechanical and Manufacturing Engineering, Students on the MEng Innovative Manufacturing Engineering programme.

<http://ime.lboro.ac.uk/casestudies.html>

Appendix

Resources

Target Audience	Resource Title	Ref
Industry	Industry involvement in teaching – What can this mean for you and your company?	RS1
Students	Industry's getting involved in my teaching: What's in it for me?	RS2

Over the page are two sets of resources, RS1 and RS2. These have been designed as handouts to be given, by an academic, to an industrialist who may be considering becoming involved in teaching and to students who will have an industrialist involved in their teaching. (Within these two handouts the word 'you' refers to the industrialist/student.) These two resources can be linked to electronically or adapted and printed as handouts.

Case Studies

Author	Case Study	Ref
Cheung	<i>The Teaching Contract Scheme in the Wolfson School of Mechanical and Manufacturing Engineering</i>	CS1
Curtis	<i>JCB Involvement with a Mechanical Engineering Design and Build Project</i>	CS2
Dartnall	<i>Bought-in Teacher at the Department of Design and Technology</i>	CS3
Gabb	<i>Student Prize Awarded by Siemens in the Department of Electronic and Electrical Engineering</i>	CS4
Glass	<i>Guest Speakers in the Department of Civil and Building Engineering</i>	CS5
Grover	<i>Use of Business Simulation software with Final Year MEng Undergraduates in the Department of Aeronautical and Automotive Engineering</i>	CS6
Hall	<i>An Industrial Perspective on Working Together to Develop the Chemical Engineering Curriculum</i>	CS7
Kellett	<i>Student Perspective on the MEng Chemical Engineering Process Design Project in Partnership with Industry</i>	CS8
Littlewood	<i>A Student's Perspective on Working on a University Project Linked with Industry (Aeronautical and Automotive Engineering)</i>	CS9
MacKenzie	<i>Practical Construction Experience for BSc Construction Engineering Management Students</i>	CS10
McCaffer	<i>Industry Sponsored Degree Programmes in the Department of Civil and Building Engineering</i>	CS11
Newman (A)	<i>Industry Advisory Committee in Wolfson School of Mechanical and Manufacturing Engineering</i>	CS12
Newman (B)	<i>Consortium of Companies who Sponsor the MEng Innovative Manufacturing Engineering Programme</i>	CS13
Pearce	<i>Partnership between BAE Systems and the Department of Electronic & Electrical Engineering</i>	CS14
Rielly	<i>Process Design Project for Final Year MEng Chemical Engineering Students in Partnership with Industry</i>	CS16
Rodber	<i>Designer and Visiting Fellow in the Department of Design and Technology</i>	CS16
Ruikar	<i>Podcasting in a Project-Based Learning Environment (Industry case study architectural design project)</i>	CS17
Simmonds	<i>Building Strong and Mutually Beneficial Networks Between the Pharmaceutical Industry and Top Technical Faculties (Chemical Engineering)</i>	CS18
Thomas	<i>'Industrial Case Studies Module' for Undergraduate BEng/MEng Materials Engineering Students</i>	CS19
Walker (A)	<i>A Student's Perspective on Working with Industry Through Formula Student (Aeronautical and Automotive Engineering)</i>	CS20
Walker (B)	<i>Student PowerPoint Presentation of a DIS Placement at Nissan Technical Centre Europe (Aeronautical and Automotive Engineering)</i>	CS21
Willmot	<i>The Teaching Contract Scheme in the Wolfson School of Mechanical and Manufacturing Engineering</i>	CS22

The case studies accompanying this guide are also available electronically at <http://www.engceti.ac.uk/industry/involvingindustrialists>.



Industry involvement in teaching – What can this mean for you and your company?

Industry interaction has the potential to greatly enhance the student learning experience at University. Read on to find out more about the ways you can get involved, the mutual benefits, and tips for making it work.

Why does industry get involved in teaching, what are the benefits?

1. Access to low cost, low risk research to solve problems of genuine interest to a company
2. Opportunity to influence, assess and recruit capable students
3. Raise profile of the company with future placement students and graduates
4. Access to research tools and facilities
5. Continuing Professional Development for engineers
6. Opportunity to shape and enhance what engineering students are learning

Personal benefits cited by industrialists

1. Interaction with people with fresh approaches and ideas
2. Personal and professional development
3. Enhanced understanding of their field
4. Broader network of contacts
5. Opportunity to give something back

What ways can an industrialist get involved?

Getting involved does not have to mean class room ‘teaching’. There is a multitude of ways in which industry can get involved in the student learning experience; from low demand undertakings to more involved activities. The most common include: **Design projects** – Proposing and supporting group(s) of students to tackle a design problem of interest to your company; **Guest Lectures/one off talk** – e.g. giving a talk on a specific area of the curriculum relevant to your expertise or providing a detailed insight to industrial issues; **Hosting site visits** – company and factory tours provide valuable insights for students and an opportunity to engage with professionals. **Sponsored Prizes** – rewarding industry linked achievement.

Case studies: <http://www.engcetl.ac.uk/industry/involvingindustrialists/>

To get a better understanding of the realities of getting involved read about the experiences of three industrialists. The case studies, written by industrialists, illustrate their motivations, benefits and issues encountered when getting involved in teaching (See the case studies by Curtis, Hall and Simmonds).

What can your involvement mean for students?

1. Access to up to date, specialist engineering knowledge
2. Opportunity to relate theory to real issues in industry
3. Experience dealing with professionals in industry
4. A broader understanding of the wider business of an engineering company
5. Opportunity to see and experience a live site or factory
6. Opportunity to tackle real world engineering problems

What can academics gain from getting involved

1. Opportunity to enrich the learning experience for the students
2. Up to date knowledge of industry practice
3. Benefit from expertise not available within the department
4. Broader network of contacts in industry

“If small and medium sized companies knew how much they could get from being involved with the students and their group projects they would be keen to be involved. The work JCB needed could have gone to a design consultancy but I feel that the consultants would have had the same results and been less thorough.”

Alan Curtis, JCB

About Loughborough University

Loughborough is one of the country's leading universities, with a reputation that includes excellence in teaching and research and strong links with business and industry. The University's Faculty of Engineering is one of the largest of its kind in the UK with over 4,500 staff and students across five engineering departments; Aeronautical and Automotive, Civil and Building, Chemical, Electronic and Electrical (incorporating Systems Engineering) and Mechanical and Manufacturing. The University also has the engineering related departments of Materials and Design and Technology

If you have already signed up to be involved, below are some tips for making it work well, based upon the experience of other industrialists

Be aware. Industrialists and Academics do not necessarily share the same **expectations**. Good communication is key. Matters you may wish to discuss early in your involvement include:

- If visiting the University for a meeting, who will attend, what is to be delivered at that meeting, in what format;
- The format you would like to receive reports from students, if relevant;
- What additional deliverables the company may require on top on the module requirements, if appropriate;
- The channels of communication, if supporting a group of students with a design project.

Ensure you have been **briefed well**. Make sure your academic contact makes you aware of the following, where appropriate:

1. How your input fits into the whole module and context of the curriculum
2. What to expect from the students
3. Where to pitch the level of your teaching i.e. the age and learning level of the students
4. How many students you will be working with
5. What learning space you will have available to you and its location
6. Whether the academic will be on hand to play an active part/classroom management
7. If handouts are required
8. What Audio Visual resources are available
9. What, if any, your role in assessment might be and what guidance will be provided
10. What the coursework requirements are for the module
11. The importance of sticking to time and topic
12. How to get the best from your students
13. How the students have been briefed
14. The limitations the University environment might impose

Useful Resources

- Pool Room information e.g. AV equipment
<http://www.lboro.ac.uk/designandprint/ts/index.html>
- For advice on Giving / preparing a lecture see:
<http://www.engsc.ac.uk/downloads/LecturesGuide.pdf>
- Marking and assessment
http://www.heacademy.ac.uk/assets/York/documents/resources/resourcedatabase/id3_Assessment_A_Guide_for_Lecturers.rtf



Industry's getting involved in my teaching: What does this mean for me?

This leaflet aims to give you a better understanding of the benefits of an industrialist getting involved in your teaching and provides ideas for how you can get the most out of this opportunity.

What's in it for me?

There are a number of different ways in which industry can become involved in your teaching. This could be through a design project, case studies, site visits, advice clinics or something else. Whatever the context this is an opportunity for you to:

- access up to date, specialist engineering knowledge;
- relate the theory to real issues in industry;
- experience dealing with people in industry;
- see and experience a live site;
- tackle real world design problems;
- broaden your understanding of the wider business of an engineering company.

A discussion with a professional engineer outside the University can help to **broaden your technical knowledge**. An industrialist brings their own view point based on their engineering expertise and experience; industrialists know what is going on and what's realistic. This is a great opportunity to discuss your ideas and get technical advice and more.

Industrialists can provide **a real world perspective** of the engineering industry. Chances are you've only been exposed to one small aspect of industry. An industrialist can give you a broader understanding of the duties, responsibilities and routine of engineers and an insight into the areas they've worked in.

The experience has the potential to **enhance your employment prospects**. The opportunity to broaden your understanding and experience elements of working in an industrial environment are invaluable to your professional development and will give you **industry-linked experience** to draw on in interviews and application forms.

Having an industrialist involved in your teaching is a great opportunity for you to make a good impression and **be noticed** which could open the door to career or placement opportunities. Knowing someone in a company could prove to be a **useful contact** in the future. They might be able to give you an insight into what to expect in their company's technical interview, or put you in contact with the right person for finding work experience.

Getting the most out of the experience

How you get the most out of the experience will vary depending on the task set. However there are three things you can do, irrespective of the task, which will help you to maximise the experience.

1. Be professional

In your interactions with your industrialist, remember that they are professionals and will expect you to act professionally too. Things that they will expect from you as standard include:

- Prepare in advance for your interactions with your industrialist.
- If working on a project, keep your industrialist regularly informed of your project's progress. They will need to feed this back to others in the company.
- Produce deliverables on time, in an appropriate industry standard format.
- Respond to all emails, even if it is only to acknowledge that you have received it.
- When talking on the phone remember to introduce yourself and to check that it is a convenient time for them to talk.
- In emails use formal English and include an appropriate greeting and title.
- If you are visiting the company or giving a presentation dress smartly.
- In all your interactions with your industrialist be on time.
- Prepare in advance for your interactions with your industrialist.
- If working on a project, keep your industrialist regularly informed of your project's progress. They will need to feed this back to others in the company.
- Produce deliverables on time, in an appropriate industry standard format.

2. Interact

To get the most out of the experience you need to engage with your industrialist. Communicating with your visiting industrialist and asking them questions is vital. Remember, they enjoy the experience of exchanging ideas with people with a fresh approach so don't be afraid to ask questions or to chat. If you are working on a task like a design project, try to avoid bombarding your industrialist with hundreds of emails. It may be appropriate to channel your emails through your team leader or lecturer.

3. Have realistic expectations

It can be helpful to be aware of what you might be able to expect in your interactions with your industrialist.

1. **Help:** If you need to ask an industrialists for help at any stage, then be aware that they are likely to provide less step-by-step help than your lecturer and will expect you to be more self reliant.
2. **Feedback:** Be aware that any feedback you receive might not always be constructive.
3. **Information delays:** Recognise that industrialists might not always be able to respond quickly to requests for information.
4. **Conflicting advice:** Expect to receive apparently contradictory advice. You will be able to judge for yourself which advice is correct or you may be able to ask the question in a different way to refine the answer given.
5. **Be proactive:** Don't give the impression that you are expecting them to do the job for you. If you don't know the way forward, approaching them with a range of options asking for their opinion shows that you have given the problem thought. This looks a lot better than asking them to tell you what to do.

Further Reading

For an insight to students' first hand experience of working on a project linked to industry then read the students' case studies at www.engcetl.ac.uk/industry/involvingindustrialists/ (see the case studies by Littlewood, Kellett and Cheung).

The Teaching Contract Scheme in the Wolfson School of Mechanical and Manufacturing Engineering



Emily Cheung, Undergraduate Mechanical Engineering Student, Wolfson School of Mechanical and Manufacturing Engineering, Loughborough University, February 2009.

This case study gives the views of a second year student who participated in the Teaching Contract Industry Based Project (IBP).

Reasons for Engagement

The Industry Based Project is a compulsory module run in both the second year of the Mechanical Engineering degree programme and fourth masters year at Wolfson School of Mechanical and Manufacturing Engineering. The programme has been long standing in the department providing, for some second year students, the first contact with an engineering company in a client based manner.

The benefits for students, although not always immediately recognised or appreciated, include primarily a vital insight into the workings of a company and what it is like to be given a problem that needs a solution or a series of recommendations. For companies, non critical problems are given thought which otherwise would not have received any resources in the immediate future. The school benefits from building a reputation for producing high calibre students.

The Engagement

IBP is the one of the few modules which continues through both semesters and includes a short series of lectures aimed at prompting certain phases in the design process. In addition, a minimum of one group meeting is held each week. Students are divided equally between the companies by a team leader selected on first year peer assessment results. The remainder of the students allocate themselves to a team leader until that team is full. The partially random selection process brings students out of their comfort zones; in many cases they must work with peers they don't know particularly well, to simulate what happens in industry.

The groups of 4-5 then visit the company and are presented with a number of problems. The idea of the visit is to give the groups enough information about the problems to be able to select one which they feel they would like to take on. In the second year there are usually 2 problems between 4 groups, where two groups will work on the same project brief. Having two groups on the same problem is interesting for the company to see the diversity in how the students not only approach the problem, but what solutions they come up with.

The projects are often design based and most students have little experience of the design process so there are a number of supporting lectures. The lectures range from an overview of the design process to specification writing and the format of a technical report, however, greater independence means that students learn to find things out for themselves.

A small number of MEng finalists are allocated to selected groups and the results of the groups are partly dependent on the dedication of the final year student. If a group has a dedicated and willing finalist, the experience and knowledge to the group is great. A student who can share their personal experiences is always an advantage when approaching a problem.

The first deadline is a progress visit from the company; there are 2 progress visits during the course of the year as well as a third final presentation visit. These visits are ideal opportunities to ask questions and request information as well as show the company the progress that has been made. Areas of concern are easily highlighted to the company who can then point the group in the right direction. It is not uncommon for a company to review what the group has done and alter the original brief. The group's focus can either shift onto a previous idea or they may have to divert their attention to something they had not considered in detail. Students learn that one aspect of working in industry is balancing pleasing the client with constraints of time, resources and expertise.

At the end of the first semester a feasibility study to assess the progress of the project is completed, with a final report submitted at the end of the year. The reports accurately simulate the style and formats which are used in industry and students face the challenge of writing as a professional engineer.

IBP ends, after 8 months of work, with an oral presentation. This is presented to representatives from the company, the other groups, the mentors and the lecturers. It is up to the groups to ensure that each member is confident enough to present one aspect of the project. The presentation is followed by a series of questions, which can come from anyone present, and tests the solutions presented as well as the level of detail. Presentation and communication skills are a crucial part of becoming an effective engineer and this is often the first experience which students have to present in front of industry professionals. The presentation contributes to a large percentage of the marks for the overall assessment.

Issues

As with all projects, the IBP has flaws in its execution. As mentioned previously, some groups experience issues with lecturers being very busy and mentors who don't provide much assistance which frustrates the students who experience it.

There are always going to be issues working with people you don't know or discover you don't get along with, however in most cases this can be solved with a "let's just get through this" type attitude. There are groups who suffer greatly because of a lack of communication between the members, or where someone doesn't pull their weight. For the latter problem peer-to-peer assessments are a good chance to voice these concerns and to ensure team members receive their marks fairly.

The largest test of this project is time management, and with so many other group projects going on simultaneously, finding the time to hold group meetings presents a challenge in itself. It is good that one afternoon is set aside solely for IBP but with a project of this scale, one weekly meeting is often insufficient. With deadlines looming, students often have to find the time to meet up, working long hours is not so much of an issue, but more a lesson that things should never be left to the last minute.

Benefits

It should be widely understood that students, especially those in second year, will not appreciate the lessons and skills acquired from this exercise, as only the pain to learn them is remembered. It is only when students work for real, in a similar situation, that they realise that when the lecturer talked about a specific way to format a report it was relevant to industry standards and a client not releasing information is not that uncommon. In many ways, IBP gives students the taste of working in industry but in a learning environment. The IBP prepares students, most likely unawares, of working in the real world.

The companies involved with the second year projects gain two perspectives and solutions at the end of the year. Sometimes there is only one practical solution, but in many cases students have an innate sense of seeing things in a new light, producing two very different solutions. The biggest benefit for companies is getting solutions for problems they need solving but haven't got the resources to do so immediately.

Students can be presented with problems they have no expertise in so they have to explore new subject areas. Projects like this are challenging for students to gain the right level of knowledge required and add a larger breadth to the students' University careers and learning experience. It gives students the chance to research and learn about areas which are not covered in the course. This experience is unique to modules such as the IBP.

Unintended outcomes

Some companies involved with the IBP look at it as a way for recruiting students. However there are cases where the students have not had a positive experience with the company and decide that it is not a company with whom they would like to work. It is often just as useful for students to know areas they don't want to work in as much as those they do.

Student Perspective

It is a highly demanding module in which students have to apply skills which are used in industry. Furthermore, it is important that students are exposed to industry and given real world challenges. It isn't surprising that there is positive feedback for the programme once the student realises the value; often only after an interview for a graduate job.

Reflections

The IBP is a good indication of real engineering problems and the diversity within them. There are a series of experiences that students should be exposed to before working in industry and the IBP is an effective way of delivering them. The majority of students will take these experiences and build upon them to become more effective employees. For those with negative experiences, they will hopefully be able to learn from the mistakes that were made.

Context

Emily Cheung is an undergraduate Mechanical Engineering student, studying for a Masters in Engineering with a Diploma in Industrial Studies. She joined Wolfson School of Mechanical and Manufacturing Engineering in October 2006 and in her second year chaired the department's undergraduate committee, representing the students of the school at Loughborough Students' Union. She is currently completing her year in industry at Atkins, Defence Systems.

JCB Involvement with a Mechanical Engineering Design and Build Project



Alan Curtis, Research Engineer with JCB, July 2008

This case study describes how JCB has been involved with design and build projects at Wolfson School of Mechanical and Manufacturing Engineering, Loughborough University.

Reasons for Engagement

Alan is a Loughborough graduate who studied Mechanical Engineering at Wolfson School and is keen to support the department with relevant projects for the students. "It is my way of giving something back, I have had a good experience throughout University and in my engineering career. I understand what it is that students want and hope my involvement will provide a better future for engineering." Alan has support from JCB in engineering education projects and the company actively look to support engineering in any way. "There is an ethos and culture at JCB which promotes supporting and developing engineers." JCB are also keen to identify talent, for the good of British engineering. It also allows JCB graduate engineers to develop themselves and work towards Chartership (see Willmot case study).

The Engagement

Alan worked with a group of final year MEng students on their design project. JCB supported the group of 4 final year students, to design a test rig to measure airflow characteristics on their engine cylinder heads. JCB provided the funding for the design and build project, they had identified they needed this work to be undertaken and could have used consultants but preferred to involve the students. "I had completed a pilot project myself a few years ago as an undergraduate, so I knew what sort of project would be suitable and so that's why I felt confident to go forward with it." Alan's expectations for the project were exceeded "what I expected at the start and what I thought the project would involve was a lot less than what the students actually did and what they produced at the end, so that was a really good outcome, the results for the project were excellent." The students gave regular feedback on their progress and delivered presentations to staff at JCB.

Issues

"I don't think the department prepares academics well for working with industrialists." Companies tend to want things done their way and unless they get this they will not get involved. Often the academic requirements are not aligned with what industry want. "When I have been involved with projects in the department I am often asked back at work, 'what's happening? what's the progress on this?' and I have had to get a response and feed that back whereas in a workplace environment that sort of thing is a continuous thing I don't know whether that should be brought in as part of the module, making sure you are acting in a professional manner and the importance of keeping everyone informed."

Benefits

One of the reasons the project was so successful was because JCB supported it so heavily, it was something that they really wanted to do, they didn't set it just for the sake of setting the project, so the return on that was that the outcome was excellent. The group project has far exceeded expectations, if small and medium sized companies knew how much they could get from being involved with the students and their group projects they would be keen to be involved (the work JCB needed could have gone to a design consultancy but Alan feels that the consultants would have had the same results and been less thorough). "I have had a great experience working with the students and they have put a lot of hard work in to the project."

Industrialist Perspective

JCB has benefited massively from this relationship. The final product has been delivered to JCB and has been commissioned and is now being used to characterise cylinder heads for prototype engine builds. The dynamic and open minded approach which has been given by the students has resulted in a first class product. The rig will allow in house testing to replace external testing which will increase product knowledge and significantly reduce costs in this area of engine development.

From a personal point of view, Alan feels that the benefits are intangible. "There is a sense of satisfaction working with able minded individuals. The projects have allowed me to demonstrate interpersonal skills through various channels with the University. I think it's great to be able to work alongside and inspire young engineers".

Reflections

"I think I would have made it clearer at the start what I expected in terms of deliverables." Alan met with the academics and agreed how things would work, he wanted additional requirements on top of the module requirements which had to be negotiated e.g. documents and reports which would have to be written by the students for the project. "I think we had quite a good hold on making sure the project was progressing but there were certain instances where we relied on the University to be developing and pushing it forward and it was evident that in those periods things weren't happening at the pace you would expect them to, that is something, which as a former student, isn't taught particularly well, I don't know if you can teach it, how to prepare yourself for industry but that is one of the key things because things do have to keep moving." Alan wonders whether modules which are going to involve industry should revisit the way in which the modules are assessed and delivered and that they should perhaps be developed with an industrial representative on board to make sure that they are satisfying both the academic and industrial requirements.

Context

Alan Curtis is currently working as a Research Engineer at JCB Power Systems. Alan Graduated from Loughborough University in 2006 with a 1st class MEng degree in Mechanical Engineering. Alan was able to secure sponsorship from JCB for his degree which included a one year industrial placement. Alan was short listed for the SET Student of the Year awards 2005 and presented work at the houses of parliament on two occasions, once winning a prestigious prize.

As a registered Engineering Ambassador with both the IMechE and STEMNET, Alan devotes time to developing young engineers. This ranges from small design problems set to young school students, through Young Engineers clubs and the Engineering Education Scheme to University based projects. Alan represents JCB and recent graduates on the engCETL advisory board.

JCB is the world's third largest manufacturer of construction equipment by volume and has 18 plants on four continents: 11 in the UK, three in India and others in the USA, China, Germany and Brazil. The company employs more than 9,000 people worldwide. In 2007 the company enjoyed its best ever year when turnover increased to a record £2.25 billion and profits stood at an all-time high of £187 million. The success was achieved as the company sold more than 72,000 machines, another record which saw year-on-year sales increase by 30 per cent. At the same time, the company's share of the world construction equipment market rose to 12 per cent, up from 10.4 per cent in 2006. While JCB retained its position as the world's third largest construction equipment manufacturer by volume, it closed the gap on second place significantly. JCB retained its position as the world's number one backhoe loader manufacturer, producing one out of every three machines sold globally. JCB was also the world number one manufacturer of telescopic handlers in 2007.

Practising Designer and Teacher in the Department of Design and Technology, Loughborough University



Adrian Dartnall, Designer, Department of Design and Technology, October 2008.

How a practising designer works as a 'bought-in teacher' in the Department of Design and Technology.

Reasons for Engagement

Adrian has worked as a freelance designer since 1982 and previously worked for Loughborough Consultants Ltd. (which was a commercial arm of the University) until he started teaching in the department in 1985. He was keen to work in the department as it provided him with a regular salary during a recession which had an affect on the level of freelance work he was offered. Adrian also worked as a part time teacher on the MA in Industrial Design at Leicester Polytechnic (now De Montfort University). He runs his own design consultancy and has designed a variety of products including; televisions, hi-fi and general consumer electronics, medical equipment, Royal Mail sorting equipment, toys for pre-school age children and aids to independent living for the elderly.

The Engagement

Adrian works with students on their project work where the module involves design practice. He is bought-in for a number of hours on specific days; he works 6 hours on Tuesdays with 1st year students, 2 hours on Wednesdays and Thursdays with 2nd year students and for a couple of hours on Thursdays with 3rd year students. He also delivers tutorials with small groups of final year students who are working on design projects. Major projects usually involve designing and prototyping new products. These are exhibited at a Degree Show which potential employers may attend. Students design a 'product' and create a prototype and work on this project during their final year.

The final year students can also enter a Royal Society of Arts competition. The RSA established a student award scheme with the aim of linking education with industry and have developed this in to the Design Directions awards scheme. Those students who produce excellent designs are encouraged to enter the competition and the Department have had several who have won RSA awards.

Issues

Adrian believes that students struggle with the manufacturing process and that insufficient emphasis is often placed on the needs of manufacturers. He feels that students need to be aware of how products are made and often manufacturing is not sufficiently understood and so the students don't respond well to it. Graduates who achieve a good degree and work in industry might find it difficult to be taken seriously if people on the shop floor know much more about these things than they do. He believes it is important that students understand industry and what is involved in producing products in very large numbers and students should be designing products for appropriate scales of production.

Benefits

The department gains the credibility of working with a practising Industrial Designer who has over 20 years of experience. The students gain from the wide variety of experiences Adrian has had working in industry, including advice on careers and research; often students ask for his advice about starting a design consultancy straight from University. Adrian now spends almost as much time teaching as he works as a practising designer as the availability of consultancy work can be unpredictable.

Unintended outcomes

From time to time Adrian gets involved with projects that other members of staff or PhD students have initiated and this can be very stimulating.

Academic/Industrialist Perspective

Adrian feels he gets a lot back from the students, a freshness of approach to design and an opportunity to exchange ideas with students, staff and other practising designers. This is particularly important to him as he often works alone on design projects.

He knows that students 'keep him on his toes'. When his advice or explanations are questioned he is forced to think through again things he might otherwise take for granted and he believes this is no bad thing in a fast changing world.

Reflections

Adrian started teaching in 1985 and now knowing what path British manufacturing was to take he might have pursued a teaching career. He doesn't think of himself as an academic person, he is dyslexic and it wasn't widely known about when he was at school and college so he feels that he probably wouldn't have achieved that career goal.

Context

Adrian is a freelance designer who combines running his own design consultancy Dartnall Design Associates with his work as a 'bought-in teacher' in the Department of Design and Technology at Loughborough University. He studied design at Guildford School of Art, which was founded in 1870 and is now part of the University for the Creative Arts (UCA). Adrian has designed successful products across a wide variety of industries. Further information is available on www.dartnalldesign.co.uk

Student Prize Awarded by Siemens in the Department of Electronic and Electrical Engineering



Bill Gabb, Industrial Liaison Tutor, Department of Electronic and Electrical Engineering Feb/Mar 2009

The Sir William Siemens Medal is awarded annually to the best student in the Department who has undertaken an industrial training placement and has achieved success both academically and in the placement year.

Reasons for Engagement

In 1993 Siemens decided to reintroduce the Sir William Siemens Medal programme originally introduced in 1883. The Medal commemorates the contribution of Sir William Siemens to science and technology and the aim of the programme is to promote an interest in these subjects among young people and reward excellent achievement. Siemens award a Medal and a cheque for £300 to the top science and technology students from 18 leading UK universities each year.

Loughborough University is one of the universities chosen as it is regarded as having one of the leading Electronic and Electrical Engineering departments in the UK.

The Engagement

The criteria for awarding the medals are set by the University and approved by Siemens. The only criteria set by Siemens is that the winner will be studying towards their undergraduate degree when they collect the medal. The medal winners and their tutor meet for a national presentation day where they receive their engraved medal and cheque.

In the Department of Electronic and Electrical Engineering at Loughborough University the Medal is awarded to the student who has made an outstanding contribution during their industrial placement. The Award is based on a proposal from the placement company supported by the visiting tutor and the students own reports and submission.

In January 2009 the Siemens Medal was awarded to Ryan Bakewell. Ryan is a student on the MEng Systems Engineering programme. He was on placement with BAE Systems, most of it with the Autonomous Systems and Future Capability section of the Military Air Solutions division. Ryan was involved in two major projects concerning autonomous vehicles. The Hero, a ground based wheeled vehicle that can be used for inspecting the underside of trucks and other large vehicles. The other centred around a launch mechanism for small unmanned autonomous vehicles (Project Artful).

Ryan played a key role in a month long technical trial of the Hero vehicle and acted as Chief Engineer on the unmanned autonomous vehicle launcher project where he managed a small team. Ryan was awarded a Bronze BAE Chairman's Award for his contribution to the Hero vehicle and a Bronze and Silver BAE award which he received in December 2008 in Washington DC, USA.

Issues

Some years it can be difficult deciding which student should be awarded the prize. The department sometimes struggle to decide which student to nominate for the award. The lecturers look for those students who have patents, papers published or publications and other external awards achieved. The staff have to distinguish how much an achievement is due to the individual student and to the team they are part of. Visits to the students on placement are also useful in determining which students have performed well.

Development of soft skills, often the students who have the best soft skills are the ones that often perform the best on their placement. The students sometimes need to use diplomacy when dealing with their colleagues and managers in industry. Sometimes need to challenge how things are done in the company.

Benefits

The department maintains a good relationship with Siemens and other companies who recruit students for industrial placements. Siemens also look to raise the awareness of students and graduates of Siemens as an employer. During the award ceremony Siemens employees meet with some of the leading engineering students in the UK which allows them to promote career opportunities within the company.

Students have the opportunity to meet people from Siemens and to find out more about the variety of future career options.

Academic/Industrialist/Student Perspective

The award increases the profile of industrial placements in the department and University. The student gains recognition for their achievements whilst on placement and a cash prize. Siemens gain positive media coverage, encouraging young people to study science and technology.

Reflections

I recently created a new annual review document for companies to record how students have made an impact during their placements. This should make it easier for staff in the department to decide who should receive the award.

Context

Bill Gabb is the Industrial Liaison Tutor in the Department of Electronic and Electrical Engineering. He studied at Aston University and worked on Rapid Transit Systems as a Development Engineer at GEC Traction in Manchester. He joined Loughborough University in 1980 and is involved in the teaching of digital electronics in the department.

Siemens is a global company with around 400,000 employees working to develop and manufacture products, design and install complex systems and projects, and tailor a wide range of solutions for individual requirements. Siemens started operating in the UK in 1843. Among its early significant achievements were laying the first telegraph cable that linked Britain with the U.S., installing the first electric street lighting, designing the first water meter, and providing the first public railway. Further information about Siemens and the Sir William Siemens Medal is available at www.siemens.co.uk

Guest Speakers in the Department of Civil and Building Engineering



Jacqui Glass, Senior Lecturer in Architecture and Sustainable Construction, Department of Civil and Building Engineering, December 2008.

Inviting someone from industry to deliver a lecture is often where most academics will start the process of involving industrialists in their teaching.

Reasons

The value of guest speakers is that they provide you and your students with up to date information, an industry insight and company information. The lecture should be discursive, interesting for students and can be provocative. Companies can also make students aware of future employment opportunities.

The Tutor can talk to the industrialist over coffee/lunch and find out more about how things happen and what things they can do together to collaborate e.g. research.

It is important to sustain their involvement, think what the speaker can get out of it and make sure they do get something out of it.

Benefits

Guest speakers are a low risk way of starting industry involvement.
Guaranteed up to date and relevant content.
Sets academic lectures in context and presents the application of theory.
All round positive experience.

Academic perspective

Need to have the right contact/company to help you find someone.
The academic needs to be there during the lecture and play an active part during the session - it is not an escape route for the academic.
Sometimes classroom/crowd management is required.

Handouts – students like to have these, copies of Powerpoint slides – try and obtain these from industrialist before the lecture and produce copy for each student.

It is important to explain what the speaker needs to do beforehand.
Often because talks are provocative sessions will probably over run and this needs to be built in to the timetable; a 1 hour slot needs to have time for questions after the session.

Organising – which lecture theatre room they are in and what audio visual requirements they have.

Industrialist perspective

Industry contact through goodwill, often people are only paid travel expenses.

Problems with people who are self-employed or where an employer wants to charge for their time.
Some self-employed people can have a day rate of up to £1,000 (Faculty will not pay).
Pay by the hour for teaching rate (no pay for travel time or preparation).
Could be £2,000 for a 1 hour lecture (no way Faculty would pay this).

Jacqui has feedback from various speakers saying they really enjoyed delivering the lecture.
"I always enjoy giving guest lectures. The course is always well organised, and the students are usually bright and engaging."
Guest Lecturer.

Student perspective

Students like to hear about real projects; e.g. how we did this technical procedure on the Gherkin.
Students enjoy the lectures and really buzz after the session.
Students have sometimes visited industrialists at their offices.

Issues

Pitfalls; person is scheduled in module and says 'somethings come up, I can't make it.'
People not turning up could and probably will happen.
Speaker needs to let you know in advance.
You need flexibility in programme to swap one of your lectures with the industry lecture.
Tendency from industrialist is to say too much – try and limit the content?
Need right pitch, need to be aware of what the students know and don't know.
Maximum of £250 for a 1 hour lecture – for some people this is unacceptable and an insult.
Field day can cost around £800 so around the same cost.
If we want to have the 'leading lights' in the industry that will cost us and would be difficult to justify not paying them.

Reflections

On one undergraduate module the lecturer invites industrialists from Taylor Woodrow to lecture about design management. The senior manager comes with a recent graduate recruit who talks about their experience with the company. Good for the students to see a recent graduate and a future career path.
Companies who sponsor students want to attract students to their company and they like to show that they are interested in the students.
"Sponsored students hate it when someone from their company does not turn up to an event."

Try to invite guest speakers who the students will relate to e.g. for these students consulting engineers and contractors are invited

Context

Jacqui Glass is a Senior Lecturer in Architecture and Sustainable Construction in the Department of Civil and Building Engineering at Loughborough University. Having studied Architecture at Oxford Brookes University and obtained RIBA Part II in 1994, Jacqui then undertook an EPSRC sponsored PhD on tilt-up concrete construction. She is currently supervising 12 PhD and EngD students many of whom are sponsored by building materials organisations to carry out research on environmental or sustainability topics.

Use of Business Simulation Software with Final Year MEng Undergraduates in the Department of Aeronautical and Automotive Engineering



John Grover, External Lecturer, Aeronautical and Automotive Engineering, Loughborough University, January 2009.

How the business simulation software 'Marketplace Venture Strategy' is used within the Year 4 (Part D) Management module for 72 MEng Aeronautical and Automotive Engineering students.

Reasons for Engagement

It is a requirement of the Institution of Mechanical Engineers and the Royal Aeronautical Society that accredited engineering courses should include management skills. The Head of Department, Rob Thring, also expressed a desire to do more than just deliver lectures, and to provide something of sustainable practical value in the early life of graduates as they enter industry.

The Year 3 (Part C) MEng business modules provide a conventional lecture approach to various business aspects and a limited opportunity to apply this in submission and presentation of a business plan for a new business idea, similar to the BBC TV programme "Dragons' Den". The intention of the Year 4 module was to take this business idea through its early period of business life and provide hands-on experience of the full range of issues facing a business.

Working in teams, using vague or conflicting information, then processing that information with externally imposed time constraints and with only a partly developed understanding of the consequences of decisions are all part of the experience. It was expected that improvements in decision making through heuristic learning and an appreciation of the complex interactions involved in the real business world would emerge as the simulation progressed.

The Engagement

John Grover delivered an initial two-hour lecture to introduce the business simulation to the students. 72 students were randomly placed into one of two simulations, each with seven teams of five or six students. Two simulations were necessary because the software limits team size to six members, and the resulting 14 teams, if competing in a single simulation, could cause lower performing teams to give up prematurely if they perceive that they could not win.

Assessment was by group submission of an initial business plan at the start of week three, a final group report at start of week 11 and a group presentation in week 11. Marks were split 45/45/10%. Web based peer assessment (WebPA) was applied with a 25% weighting of the overall group mark to provide some level of individual attainment.

The University Virtual Learning Environment (VLE) allowed group communication and feedback to students on common or group issues, and students were encouraged to use their group forum for communication. This enabled the lecturer to monitor and intercept any issues or misunderstanding before they affected a team's performance. Email was used for most lecturer incoming communications and some outward notes to individuals when necessary. The volume of email queries initially required daily monitoring and responses, which were sent back to all students in a VLE forum when of general interest or a recurring theme.

Issues

Students were advised that the help system in Marketplace should be consulted in the first instance for technical queries and over-reliance on emails to the lecturer to clarify issues which could easily be found in the help system might result in a 'consultation fee'. While this had the desired effect on email volume it was probably taken too literally and a better balance of the need to clarify versus over reliance on lecturer support needs to be managed.

There is a significant amount of material within Marketplace to be assimilated by the lecturer before the engagement begins so they can speak with some authority (students will expect expert status) and this should

not be underestimated. The material and simulation is, however, very comprehensive and when required the Marketplace help-desk is quick to provide further support.

At the outset of planning the module it did not prove possible to meet the initial requirement to enable students to run their Year 3 business idea using a simulation. Software to enable any type of business to be simulated and compete on an even playing field was not available, and bespoke software would have been prohibitively expensive and timely to commission. A further issue was that the Year 3 teams and business projects could not in any case be retained since around half the students depart on industrial experience for a year with half from the previous year returning. Support was gained from the Engineering Centre for Excellence in Teaching and Learning (engCETL) and they short-listed three potential commercial business simulation products. These were evaluated and “Marketplace Venture Strategy” from Innovative Learning Solutions was chosen.

Some teams treated the simulation as merely a game from the onset and throughout the semester - the general opinion of the Tutor is that these teams did not maximise their learning. These teams had an expectation of a simple cause/effect relationship following a set formula (some comments from students also suggest they thought the game too simple). While the game does have structured hidden relationships between decisions, their level of complexity means that occasionally unexpected things do happen – just like the real world it is trying to simulate. The students’ role in these instances is to try to see some underlying order in the chaos. Some teams just treated these events as “unfair” or as imperfect game rules.

Some of the Marketplace material suggests that different institutions run the simulation in different ways. In particular more support with lectures and tutorials through the semester. This may be an area for improvement. The marks for each element may not have been balanced and the timing of the initial submission too early in the semester. Both of these are recognised issues and potentially will be changed for a future year. Another issue mentioned was that the game runs for 6 simulated quarters and this is insufficient. There are rules intended to avoid a team becoming bankrupt too early, but these also prevent early growth. By the time the rules are relaxed the game only has two quarters to run. Running for more quarters might be a further improvement.

Benefits

Based on team interactions observed in the VLE the majority of teams approached the exercise positively. They reacted as if to real situations, considering other teams as adversaries in a competitive world and responded well to the conflicts and imperfect view they were presented with to make decisions to a deadline. There did not appear to be any significant conflict within teams and WebPA supports this. Mutual support for effort made and honesty when mistakes occurred were in evidence as was a willingness to reconsider decisions in light of new information.

Structured responsibilities and task assignment and delegation were all in evidence as were under-utilised members offering to help others and over-loaded members willing to relinquish responsibility. In short, team working was of a very high standard. There was general, although not unanimous, approval of the simulation in preference to lectures. As a learning mechanism it is a potential viable alternative to traditional approaches, particularly with the changes identified.

Unintended outcomes

Some views expressed by students of the simulation being too simple were not anticipated. It is possible these may be attributed to the same students who persisted in thinking of the simulation as a game and not embracing its full potential. While appearing simple in some areas the game is clearly not predictable otherwise teams’ performance would have been more consistent.

Industrialist Perspective

The simulation was significantly different to conventional lecturing and more enjoyable with less burden on travel to deliver lectures. The criticisms made overall were fair and can be addressed through simple improvements. It is clear that some level of face to face support is still expected/required, possibly more than the level allowed for – this would be more in line with other institutions using the software. The experience of this module alone would not justify the use of software exclusively as a learning medium, but with lecture and tutorial support it could provide a richer experience for students and lecturer.

Reflections

The academic-industrialist partnership in this instance had already existed for two years so this module had the effect of enriching an already firm relationship. The development of the module and bringing it into being was challenging, enjoyable and rewarding. The changes already mentioned, if implemented, would improve the module, and more face to face support might keep the exercise more real and avoid any tendency to treat it as a game. It is possible some teams felt a little isolated and working remotely provoked a tendency to use a game playing mindset. With more experience it might be possible to use interventions to change the business landscape unexpectedly and create more challenge for students as the simulation progressed.

Context

John Grover is a visiting lecturer in Aeronautical and Automotive Engineering at Loughborough University where he delivers the 3rd year MEng Business Strategy TTD200 module. He graduated with a BSc in Chemical Engineering from the University of Birmingham and has an MBA from City University London Graduate Business School (now the Cass Business School). Currently a self employed consultant, he previously spent over 30 years in industry, the last 27 with Ford Motor Company in Product Development, IT systems development and Business Process Reengineering.

www.marketplace-simulation.com

www.webpaproject.com

An Industrial Perspective on Working Together to Develop the Chemical Engineering Curriculum



Alan Hall, Chemical Engineer with Syngenta, June 2008

This case study describes how Syngenta has been involved with chemical engineering departments in several universities, including Loughborough, with a particular focus on group design projects.

Reasons for Engagement

Over the past 10 years or more, there has been a general willingness within the company to 'foster academic relations' for both research and teaching purposes. The research probably came first, but over the course of general discussions, the content of the undergraduate curriculum was raised and this led to universities saying 'come and help us do something about it'. This resulted in cases where the company works with the same member of staff (for example, Chris Rielly at Loughborough) for both research projects and teaching engagement.

It was felt that chemical engineering undergraduate courses were mainly focused at large tonnage continuous type processing, for example; petrochemical plants, and that teaching in the fine chemicals type of technology design was lacking. The company worked with two universities to help them develop fine chemicals modules for their final year students. This evolved into not just helping them with planning the course content but also delivering some of the course.

The Engagement

One particular example of being involved with delivering some of the course is through group design projects at three separate universities with final year undergraduate students usually in groups of 6 to 8. In each case, a design brief was set for an existing plant using an existing process. A relatively small amount of information was provided to students at the outset and they were then actively encouraged to ask the industrialists questions to seek further information – much of which wasn't in the public domain. They were able to get a certain amount of information from doing literature searches but also **had** to approach an industrialist for specific information. It is felt that a key feature of this type of engagement was that not everything was offered up front but instead the industrialists visited the University involved and worked with small groups, encouraging them to talk about the project.

The design project lasted for about a ten week period, with the industrialists going in at the beginning to give the background and to specify the problem, a couple of visits in the middle to check progress and then a final visit at the end to listen to the students presentations. In some cases a site visit was also included.

If the company was involved in observing final presentations, an opinion and feedback was offered to the University staff involved but they were not involved directly in the final assessment. Students looked for the company representatives to ask questions and give feedback during the presentations, probably resulting from the rapport built up between the industrialists and students in the course of the project.

Issues

One obvious drawback of the above approach is that the students often think of their questions in between the planned visits. Tackling this through email has been attempted but this can often be difficult to operate in practice. A more successful solution recently at Loughborough with Chris Rielly, was for Chris to filter all the email so all the requests came from Chris and could be tracked and monitored by him.

Currently, another more generic issue is that as a large company, it used to be relatively easy to be able to commit a certain amount of resources, which wasn't a huge amount of resources, to allow people to attend meetings with universities and encourage them to think about our type of technology. This is getting more difficult nowadays as companies become leaner. The benefits for the company are at a relatively high strategic level (influencing undergraduate teaching) and questions are asked – "you are going to Loughborough for the day today, what's that about?" "I think finding the resources is probably more difficult than what it was".

Another big issue is that when you engage with universities you have got to make sure your expectations match up. For example, during an MSc project with a University, data was provided to do some analysis and after discussion it was agreed that we would return a couple of months later expecting some results. With

expectations high, the company sent four people to the University only to find on arrival that the supervisor was too busy to attend and that the student hadn't finished his report. The experience was awful and the company got almost nothing out of it. However, although it was easy to blame the University initially, on reflection, the company were as responsible as obviously the time hadn't been taken on both sides to agree expectations. From the University perspective they regarded it as a very ad hoc informal thing while from the company viewpoint, they attended a meeting expecting to be presented with results. So, "share expectations making sure everybody is clear about what they want".

Benefits

One of the key benefits for both the students and for the industrialists involved was the opportunity for the students to ask questions and to learn from one another in small group discussions. From the industrialist's point of view in particular, there is no better way of improving your understanding of something than trying to explain to someone else why it's done like that, especially someone who is far removed from it. "It's one thing explaining it to a colleague but to explain it to an undergraduate, its quite a good discipline, this is one of the benefits to industry it develops people, encourages them to have a wider network and context."

An additional advantage of small group teaching is that it is easier to overcome any mismatch of expectations in the material being delivered. It is important that industrialists are well briefed and made absolutely clear how about how their teaching fits into the overall modules and context of the curriculum. In addition, having students come to the workplace is a good way of teaching them about what the company does and has benefits from both perspectives. The drawback is that you can only do that with relatively small groups.

Academic/Industrialist/Student Perspective

The initial purpose of the engagement was all about trying to encourage the universities to change to some extent their undergraduate teaching content and to introduce the fine chemicals module. To a large extent, it is understood that this change has now happened.

Reflections

From this experience of engagement with undergraduate teaching, it is felt that being involved with small groups of students through a group exercise or workshop is the best approach for an industrialist. Stimulating discussion in more informal group settings was found to be much more satisfying from all perspectives. This involvement with teaching was part of a broader engagement with the universities including PhD Case awards, masters projects and industrial placements.

Good communication between the academic and industrialist was also found to be key – preparing the industrialist well for coming into the University. For example, on one particular occasion, I went to deliver a lecture anticipating about 20 students and when I got to the lecture theatre there were 90. I found that really quite unsatisfactory because with a group of that size you are just standing there and delivering material, it is very much one way, you don't get the feedback and the discussion. I didn't enjoy that and wasn't sure the students enjoyed it much either, sitting and listening for 2 hours!

Supporting Information

Alan Hall is a Visiting Professor in Chemical Engineering at Loughborough. He has taught on MSc modules and design projects at Loughborough, Birmingham, Imperial College and UMIST/Manchester University.

Syngenta is a world-leading agribusiness committed to sustainable agriculture through innovative research and technology. The company is a leader in crop protection and ranks third in the high-value commercial seeds market. Syngenta employ some 19,000 people in over 90 countries with nearly 3,000 employees in the UK and Ireland www.syngenta.com.

Over the period this case study covers the company has changed significantly from being ICI to Zeneca and now Syngenta. ICI was a huge multinational company based in the UK and it was easy for them to support people in doing academic liaison. In comparison, Syngenta is much more geographically diverse with a comparatively small process technology organisation in the UK so it is more difficult to find resources to support teaching in engineering.

Student Perspective on the MEng Chemical Engineering Process Design Project in Partnership with Industry



Adam Kellett, MEng Graduate (Chemical Engineering with Management), Loughborough University,
October 2008

This case study gives a student perspective of the Chemical Engineering Design Project in association with GlaxoSmithKline (GSK).

Reasons for Engagement

The final year Process Design module is part of the MEng programme and usually involves a partnership with industry, in this case with GlaxoSmithKline (see Rielly and Simmonds case studies).

The Engagement

Initial contact was between the University lecturer and five students, with the academic handing the students an initial design brief from GSK to develop a process for manufacture of an active pharmaceutical ingredient (API). Students were not handed all the information they needed at once and were instead encouraged to conduct research about the relevant processes, products and operations. The group was encouraged to organize themselves to include one chairman (responsible for organizing and moderating meetings, setting out meeting agendas and keeping an updated project plan) and one secretary (responsible for recording and distributing meeting minutes).

The period of the project was 12 weeks and included a visit to the department by a GSK engineer a few weeks into the project. This allowed students enough time to become familiar with the project and prepare a list of things for discussion.

The course was structured so that in addition to the overall group project, each member of the team had their own individual piece of the project to work on. In the case of this group the individual projects were divided up based on each member having a specific piece of the process to do a detailed design on. The decision as to who would design each piece of kit was decided by the group rather than the academic.

There was also a visit to the GSK API manufacturing facility in Dartford later in the project which gave the students a chance to see the operation of an API plant first hand and another QandA session was held. The students also held a technical presentation of their work so far (8-9 weeks into the project) which was open to GSK employees, the presentation (whilst considered by the students to be an extra burden during the already busy project schedule) was actually a good chance for GSK engineers to give their feedback on what the students had designed so far and for the students to talk about their individual design projects with the GSK staff.

Issues

One of the main issues we had was that some of the information we needed in order to progress our designs required experimental data that quite often had to be obtained in a laboratory. The nature of the chemicals involved along with the extremely high value of the pharmaceutical products meant that lab work was not available to us. Whilst GSK were as helpful as they could possibly be with the information they had, quite often their processes were run from experience of what worked through trial and error. This quite often led to students having to work backwards from a GSK designed process to determine the basic information required to be able to design their own alternative processes. I had to make some fairly large assumptions in order to progress my own design. In hindsight having worked on a real design project for the past three months I feel that this was actually a rather good simulation of a real design project, quite often you don't get all of the information you require and end up having to make assumptions in order to progress a design.

It would have been easy to constantly email our GSK contact with questions as we would have at least five new questions a week. These were normally discussed and overcome in the weekly meetings with our academic and any questions that required GSK input were gathered into a single document and sent to the contact. This structured approach meant that the GSK contact was not constantly receiving emails from us and we were happy with this as long as we got relatively frequent replies.

Benefits

The visit to GSK was a good chance for us to see a real API facility operating and gave us a good idea of the scale of operations involved as well as giving us all sorts of new ideas about how to progress our individual equipment designs. Giving the presentation in a professional environment was a good experience and one that will probably come in helpful in the future.

The project was very well structured with the students able to focus on GSK's suggested report format and structure. As the team leader it was a great help that I had a structured report format to be able to base my weekly project plans around, the weekly meetings with our academic were an excellent opportunity for us to ask questions regarding both our individual projects as well as discussing the group's progress.

Unintended outcomes

I wasn't initially intending to volunteer for group chair but when I saw that the project was centred around a pharmaceutical process I decided to give it a go. I had one year of experience working as a process engineer in an API facility in my industrial placement year and felt that I would be able to provide the group with direction, especially in the initial weeks. The outcome of this was that I was able to develop my people management skills and was able to gain a small insight into what it would be like to manage a group of people during a real design project.

Academic/Industrialist/Student Perspective

I felt that the project gave me the opportunity to develop my skills as a team leader as well as a team member. The project was very well organised, with GSK suggesting a format to our final report very similar to a real design report it helped us remain focused when developing our project plan, with definite milestones to achieve.

Performing the project alongside a real company made me take the project a little more seriously than I perhaps would have. The whole experience felt a lot like a company project rather than one we were doing for University.

Reflections

In hindsight I would have taken a more open view of the design options available to me had I not already spent some time working in an API facility and thus already ruled out some options as 'unfeasible'. For example continuous operation is not generally practical in most API productions but towards the end of the project I had begun to wish I had explored that avenue a bit more closely as there are a lot of marks available for screening of ideas. Even if you think an idea is not feasible to begin with it is worth performing a study just to confirm.

I think at times we followed some of GSK's suggestions with a bit too much enthusiasm without stepping back to explore other possible design options. If we were working entirely from scratch like the other groups were then we may have been a bit more open minded with what options were available to us. It was at times very easy to simply follow the same design approach as GSK do in their manufacturing facilities.

Context

Adam Kellett graduated from Loughborough University with a first class Master's degree in Chemical Engineering with Management. He spent his industrial placement year at Avecia Pharmaceuticals (now a part of Nicholas Piramal India Ltd) and is currently employed as a Process Engineer with Briggs of Burton Ltd, who are involved in the brewing, food, pharmaceuticals and healthcare industries.

A Student's Perspective on Working on a University Project Linked with Industry



Rob Littlewood, PhD Student, Department of Aeronautical and Automotive Engineering, Loughborough University, August 2008.

This case study highlights why a student opted to work on an industry related project rather than develop their own group design project in Part C of the Automotive Engineering programme.

Reasons for Engagement

As part of the Automotive Engineering degree, students are expected to engage in a group design project called 'Vehicle Design' which is assessed in Part C of the course. As the title suggests the objective of the module is for each group to design/develop a vehicle of some sort. The module is conducted as a follow up to a series of lectures, delivered by external lecturers who have a wide range of experience in the automotive design industry. At the start of the module the automotive engineering year is split up into design teams averaging 5-6 students per group. The groups can then suggest their own type of vehicle to design and develop, or choose one of the projects linked with industry.

In my case there were two available projects suggested by the company, but it is my understanding that each year the company and/or vehicle type can change. The project I worked on addressed issues with the current vehicle range, with a focus on improved safety and visibility. I could say that my 'reasons for engagement' with the project were 'to get the marks,' however the reason I chose a project linked with industry were a little less blunt. It was clear that working with a company to try and come up with innovative solutions to real issues the company currently faced, would be a much more meaningful project, and may not just get added to the archives of 'I want to design a race car!' style vehicle design projects.

The Engagement

We were told that if we undertook the project we would go on a tour of the plant, be given access to data from the design office and have questions answered by a contact based there. This was a draw to the group, as it would mean we would be getting answers and advice from current industry specialists as opposed to the usual student project practice of read about it, hope the assumptions you have made are correct and generate a solution, with the only indication of whether your assumptions were correct in the final marks.

Our deliverables in addition to the standard requirements of the module would be that we give a presentation to 3 members of staff at the end of the year. It actually turned out that 2 of the 'members of staff' were the current directors! If that doesn't motivate a student to do some good work and avoid looking a fool at the presentation then I don't know what would.

Everything that was promised to us in terms of support was delivered, and the answers to our technical questions came in the form of email contact with a young graduate employee, who was keen to be involved. We kept the numbers of questions sent to him to a minimum by appointing a team leader who filtered out some of the questions and passed on the emails. Even so, I think he found the time required to find the answers to some of our questions quite demanding.

Issues

As mentioned above, the only real issues were delays in replies to our emails. I can't really offer a solution to this, but I would say that I am sure it would have been even worse if we didn't use the team leader as the point of contact to filter our questions. I think the way the company appointed a graduate engineer helped, as he had an understanding of when and what we needed to hand in to the University, as he had been in our position not so long ago.

Benefits

The benefits for the students were that we had the chance to work on a project that had real meaning, and issues we were trying to solve were of current interest to the company. As we were the only group working on the challenge at hand, we had good exposure to the staff to answer questions. If the whole year group was working on the same design challenge and split into different groups, I am sure the number of questions thrown at the company would have been unmanageable. Working in this way a group can end up with a solution that could be more applicable to the company's current design ethos and manufacturing methods and even possibly be used in the future. However from a company point of view it could be seen as a gamble whether or not you get a competent group of students.

Unintended outcomes

Our design, which was intended to improve safety and visibility, actually encouraged the company to look at a new style of suspension system which could improve stability and manoeuvrability.

Student Perspective

From this project students gain knowledge of working with industry, drive to deliver a first class solution, and possibly even a job. I know of one vehicle design project in the past, linked with industry which has ended up in a student being offered a job with the company before he walked out of the final presentation! Industry can expect to get development work at a low cost, with access to people who are not tied down by corporate deliverables, and can 'think out of the box'. They could also even gain employees.

Reflections

In all I think the project was well run. The obvious interest in what the students have to offer is backed up by sending two directors of the division to the final presentation, which acts as a massive motivator for the students. It is of note that the external lecturers acted as a go between, continually briefing the company with what the students had to deliver as part of the course requirements, and letting students know from the start what the company expected of them. Without this, expectations from either side may not have lined up.

Context

Rob Littlewood is currently a PhD student at Loughborough University having graduated in 2007 from Loughborough with a 2.1 MEng Hons (DIS) degree in Automotive Engineering. As part of the degree course he completed one year in industry, which led to the award of the Diploma in Industrial Studies (DIS), working jointly with Land Rover and Denford CNC Machines Ltd. The case study describes a project undertaken as part of his part C undergraduate course which took place in 2005.

Rob was also a student representative on the engCETL board for just over a year where he attended meetings with academics, fellow students and industry specialists to discuss a range of pedagogical issues in the engineering higher education system. He was also involved with the Formula Student competition from the start of his degree in 2003 to his final year in 2007. During 2005-2007 he was the team leader of the Formula Student team and in his final year of the Automotive Engineering course Formula Student formed part of another group design project, within which resulting designs go on to be manufactured and tested.

Practical Construction Experience for BSc Construction Engineering Management students



Julian Mackenzie, Senior Lecturer, Loughborough University, July 2008

This case study describes how a lecturer organised practical construction experience in partnership with industry for 35 1st year BSc Construction Engineering Management students.

Reasons for Engagement

The Civil and Building Engineering department organises an outdoor management course for 3rd year students and the feedback from the students was that they wished they had this type of experience in their first year. Julian was aware of the Constructionarium, a hands-on construction experience, which combines the academic perspective with those of the design professional and practical site delivery. Constructionarium is held as a 6 day working field course where participants construct scaled down versions of bridges, buildings, dams and civil engineering projects. Students are assessed on the final day in terms of budgetary control, methodology and timely completion. Julian wanted the students to have experience working on a live construction site and the students wanted to 'build something.' Constructionarium usually has a civil engineering focus and is aimed at 2nd or 3rd year students but Julian wanted a change in emphasis from a civil engineering perspective to a construction management perspective aimed at 1st year students. Planning, costing, risk assessment and safety are involved with the experience and Julian was also keen to focus on developing the management and teamworking skills of the students.

Julian attended an event at University College London organised by Constructionarium where people from industry and academics shared their experiences and he said that he was looking for an industry sponsor to enable his 1st year Construction Engineering Management students to participate in Constructionarium. Paddy O'Rourke from Laing O'Rourke said that he would be willing to discuss sponsoring the experience for the students.

The Engagement

Julian wanted to make it a productive learning experience, he wrote a module specification and wanted to properly prepare the students for the 6 day field course. As it happened Laing O'Rourke were building new halls of residence at Loughborough University campus and Julian thought that this could be a platform on which to launch Constructionarium. Julian wanted Laing O'Rourke to give 35 students regular access to the site with a view to observing tradesman working on site. Often it can be difficult to gain access to a live construction site and if a visit is arranged sometimes it can be during the lunch break when there is little or no activity. Julian wanted the students to experience a live site and would have also liked to have an area of the site cordoned off to allow the students to use the hand tools. To make the group more manageable the students were split in to 2 groups, whereby when one group were on the site the other group would undertake surveying practice on campus.

Mark and Adrian (an experienced Project Manager and a Senior Engineer) from Laing O'Rourke worked with Julian on the project. They had 8 weeks to prepare and had to fit it in around their other projects. They decided to have 3 intensive study days (on Wednesdays) where the students would prepare for their 1 week experience. The first day involved health and safety and the students gaining their CSCS (Construction Skills Certification Scheme) cards. The second day involved ethos of thought related to accidents and being 'incident, injury free' and group dynamics. A Human Resources Manager from Laing O'Rourke delivered a 'mind games and memory' session which the students enjoyed. The students were presented with the outcomes of Belbin and had to split themselves in to 2 teams for the site but they couldn't do this and became frustrated. Julian had to split the group in two. Student managers would assess their team (10% of their mark) and the Laing O'Rourke Project Managers assessed the 2 student managers. All the students were peer assessed. The third day involved the project briefing. The students were introduced to the projects. Julian, Mark and Adrian were one tier of management, below them were the two student project managers (Sam and Matt). Julian, Mark and Adrian floated between the two groups. There was a remote site induction with paper plans and health and safety talks where Laing O'Rourke reinforced their health and safety policy. Students received their project pack and had to create a project programme, costs, risk assessment and method statement. One group worked on the Ravenspurn Oil Platform and the other group the Bridge in Durham (scale replica of bridge designed by Ove Arup). The students completed work output was given to Laing's who were impressed with it.

Julian thought it was important for the students to gain some experience using small tools before going on the 1 week programme. Hilti demonstrated the tools and provided the students with hands on practice using them. The students travelled to the National Construction College at Bircham Newton, Norfolk and received their site induction from ConstructionSkills. A typical working day would be 7am breakfast, 7.30/7.45 on site. Toolbox talk at start of the day where everyone is made aware of specific issues and hazards. There was strong sun for the first few days so no shorts were allowed (t-shirts were ok) and sun protection applied. Lunch usually around 12 to 1 and finish 5/5.30. Students had to prepare a report for 8pm and each group had 45 minutes with the management team where they had to give a health and safety report for the day, progress report for the day and a profit/loss statement. Presentations in the evening were challenging for the students because of the questions asked by the Project Managers.

Progress was compared with a Gantt/bar chart which was prepared prior to going to the site. Laing O'Rourke were tough on the students. Costing – group provided with budget costs at the start. If the group wanted to use equipment they would have to go the stores and book out the equipments e.g. a wheel barrow would cost £1,000 an hour to hire - students initially did not return equipment and would be billed for hire even when not in use. This was a good learning experience!

There were numerous problems encountered by the students. In constructing the bridge the concrete was lean (dry) and tough to work with which made it very labour intensive. The students had built dams using sandbags but one of them gave way and the lagoon had filled up again. The site was dusty but then it rained which made it muddy. There was a carpenter, machine driver and a general foreman on the team. At the start of the week they were a little too keen to help the students, they had a paternal attitude and as tradesmen showed the students what to do. The projects are challenging and there is not a lot of time for students to think about how to solve problems. It was make or break on the final day de-brief in the afternoon.

Issues

Two key issues encountered were:

- Obtaining sponsors
- Gaining access to the construction site on Loughborough University campus

The Project Manager was not keen on having the students regularly visiting the site. In the end both groups of students had 2 visits to the site to observe. Due to supervision, risk and distraction issues the Project Manager did not want the students working on site.

Benefits

It was a very rewarding experience, everybody took part and the group dynamics were interesting to observe.

- Management and teamworking skills developed by the students
- Practical experience and confidence gained working on a real construction site
- Experience using hand tools

Context

Julian Mackenzie is the Deputy Programme Director and Admissions Tutor for the Construction Engineering Management degree programme in the Department of Civil and Building Engineering at Loughborough University.

Laing O'Rourke plc is the largest privately owned construction firm in the UK. They have offices in the UK, Germany, India, Australia and United Arab Emirates and over 31,000 employees worldwide. Led by Chairman and Chief Executive, Ray O'Rourke, the business has grown rapidly since the acquisition of Laing by R.O'Rourke and Son Ltd in 2001.

www.constructionarium.co.uk

www.laingorourke.com

Industry Sponsored Degree Programmes in the Department of Civil and Building Engineering, Loughborough University



Ronald McCaffer, Professor of Construction Management/Director of Business Partnerships, Department of Civil and Building Engineering, Loughborough University, November 2008

This case study explains how a consortia of construction companies sponsor undergraduate degree programmes where the University provides the technical education and the sponsoring companies provide professional and commercial development.

Reasons for Engagement

In the late 1980s the Department only had degree programmes in Civil Engineering and a small programme in Building Services Engineering. This was a narrow base from which to serve the construction industry. The department, as part of its commitment to serve its industry and to be the most industry-friendly University department globally, was keen to expand its portfolio of degrees to cover the broad spectrum of skills required by the industry (see Newman (B) case study).

The experience is that construction companies every ten years or so become discontented with the quality and skills of graduates available. The late 1980s was such a time. In particular the industry was complaining about the graduates from building degrees and from quantity surveying degrees which were, at that time, more focussed on professional practice rather than construction companies.

The Engagement

As then Head of Department my colleagues joined me in inviting the major contractors to a meeting and proposed the concept of sponsored degrees. After this meeting three champions from industry emerged: Mike O'Reilly from Wimpey, Andrew Marr from Laing and Eric Ireland from Tarmac. These champions provided the industrial leadership that encouraged the industry to follow.

After many months of negotiations two consortia were formed; one sponsoring a degree entitled 'Construction Engineering Management' accredited by the Chartered Institute of Building and one entitled 'Commercial Management and Quantity Surveying' accredited by the Royal Institute of Chartered Surveyors.

The arrangement was that the day the student started their degree programme they also joined their sponsor's company. The sponsoring company would provide to the student:

- an annual bursary
- a year in industry
- help with project or other coursework
- a job offer on graduation

The sponsoring companies also provided a 'top-up' fee to the department which enabled enhancements to be provided to the degree programme.

Issues

Industry is nervous about dealing with Universities and are frequently put off by what they would see as a lack of professionalism. Thus to deal with industry, University staff have to behave professionally, meet deadlines, attend meetings on time, dress as executives and adopt industry values. Competitor Universities tried to develop alternative proposals during the negotiation period when we were setting up these arrangements. We were vulnerable to another University attracting our sponsors away from us. However the most satisfying comment came from one sponsor referring to another University said 'they dressed as if they were on holiday, they spoke as if they were on holiday, they didn't seem ready to do real business', and then added 'I think we have all got used to dealing with well dressed people from Loughborough.' To some that comment may seem trite but embedded in it was the implication that we had achieved the professional respect of our industrial colleagues. A key and important industry value is for work to be invoiced. If industry isn't prepared to pay for a service they don't value that service.

Benefits

For 18 years we have had a flow of 60-100 sponsored students each year. During a downturn in national demand for our subjects in the 1990s our student recruitment figures stayed buoyant.

A similar consortium model was adopted by the Department of Electronic and Electrical Engineering for their Systems Engineering degree programme and Wolfson School of Mechanical and Manufacturing Engineering for their Innovative Manufacturing Engineering programme and later in our Department we achieved a sponsored Civil Engineering Degree.

The relationship between the Department and industry is strong and ongoing.

Other outcomes

The Department has gone on to build other relationships with industry including the European Construction Institute, Centre for Innovative and Collaborative Engineering, Innovative Manufacturing and Construction Research Centre, Off-Highway Plant and Equipment Research Centre, Health and Care Infrastructure Research and Innovation Centre.

All this experience has taught us that the best way to manage industrial interactions is to embed them so that you have a clearly identified and badged unit or centre performing a function that industry can relate to, influence, help manage and deal with. When asked to deal with the 'University' the relationship is not focussed enough. When left at the level of personal relationships it is unlikely to be sustainable.

Academic/Industrialist/Student Perspective

Academic: we have no questions relating to the modernity or relevance of our degrees. As industry is part of the programme design and management modernity and relevance are built in.

The industrialists get the quality of graduates they require. In 2008 two of our graduates won the Chartered Institute of Building's Gold and Silver medals in the Project Manager of the Year award.

Industry's engagement can be seen on graduation day when the training officers come to see 'their' students graduate, note 'their' students, not 'our' students.

Students obtain a good education linked to a sound training. Only industry can offer careers to students, thus to the benefit of the student the University and industry work together. The students' annual bursary, salary for summer vacation work and salary for the year in industry means that students can graduate without debt as well as having secured a job.

Reflections

If we had to do it all again we would do it 10 years earlier. We might even have privatised the Department and attracted even more industrial investment and industrial focus into our work.

Context

Professor Ronald McCaffer was the Deputy Vice-Chancellor of Loughborough University from 1997 to 2002, Dean of the Faculty of Engineering from 1992 to 1997 and Head of Civil and Building Engineering from 1987 to 1993. His previous employers include Babbie, Shaw and Morton, The Nuclear Power Group and Taylor Woodrow. Three undergraduate degree programmes in the department are currently sponsored by industry which include: Amec, Balfour Beatty, Bovis Lend Lease, Carillion, Costain, GallifordTry, hbg, Laing O'Rourke, Kier, ROK, Norwest Holst, Shepherd, Sir Robert McAlpine, Skanska, Taylor Woodrow and Walter Lilly.

Industry Advisory Committee in the Wolfson School of Mechanical and Manufacturing Engineering



Richard Newman (A), Industrial Liaison Officer, engCETL, Loughborough University, November 2008

The aim of the Industry Advisory Committee is:

People from industry are kept up to date with what is happening in Wolfson School and the University. Industrialists have the opportunity to update the academic staff on what is happening in their industry. Focus on numbers of applicants to undergraduate degree programmes, how industry can support the School, industrial placements and the recruitment of graduates.

The committee meet once a year, usually in March or April in the Wolfson School. The committee comprises academics, industrialists and other University staff, including the Head of School (Professor Rob Parkin) and the Head of Industrial Training (Dr Kaddour Bouazza-Marrouf). People from industry include those who are involved with design projects, the teaching contract scheme and sponsorship, including some of the consortium companies who sponsor the Innovative Manufacturing Engineering programme; Bentley, Perkins, Rolls-Royce and Smiths Aerospace.

Wolfson School Update

Usually the Head of School welcomes everyone to the meeting and gives an update on what has happened in Wolfson School and the University over the past year, including the National Student Survey, awards received and the Research Assessment Exercise. Staffing update, student successes, accreditation and validation, finances and undergraduate applications

Industrial Training Report

The Head of Industrial Training gives an overview of the requirements for the award of the Diploma in Industrial Studies (DIS) placement year and how the School prepares students for their placement. Issues around placements are highlighted and statistics showing the number of students placed by programme over the last few years are discussed.

Questions

Questions are taken from members of the committee.

AOB

There is the opportunity for committee members to raise other issues.

Note: there are similar committees in other departments, including Aeronautical and Automotive Engineering, Civil and Building Engineering and Materials.

Consortium of Companies Who Sponsor the MEng Innovative Manufacturing Engineering Programme <http://ime.lboro.ac.uk>



Richard Newman (B), Industrial Liaison Officer, engCETL, Loughborough University, November 2008

How a consortium of companies provide sponsorship and placements for students on the MEng Innovative Manufacturing Engineering (IME) programme in the Wolfson School of Mechanical and Manufacturing Engineering at Loughborough University.

Reasons for Engagement

The Innovative Manufacturing Engineering (IME) programme is a unique MEng manufacturing degree within the Wolfson School of Mechanical and Manufacturing Engineering at Loughborough University. The course was launched in October 2003 and is supported by a consortium of eight companies; ArvinMeritor, Bentley, Perkins/Caterpillar, IMI, Indesit, Rolls Royce, Siemens Industrial Turbomachinery and GE Aviation/Smiths Aerospace. The consortium model is based on the sponsored degree programmes within the Department of Civil and Building Engineering at Loughborough University (see McCaffer case study).

MEng degree programmes at Loughborough usually involve four years of academic study, those with industrial experience usually involve an additional placement year and award the Diploma in Industrial Studies (DIS). The MEng IME programme successfully integrates both academic study and industrial experience in four years.

The IME degree was designed to give students an MEng with industrial experience with sponsorship where the students have excellent employment prospects with high earning potential. The IME programme was created in partnership with the consortium companies because they want to recruit well qualified manufacturing engineering graduates and were keen to work with the University to support students with industrial placements and sponsorship. Students receive £1000 in each of their four years and the industrial placements throughout the course are also paid.

The Engagement

In Part A (Year 1) the students spend two short placements with different companies. The first placement is for two weeks in January and the second placement is for four weeks during the summer vacation. In Part B/C, students spend at least 26 weeks with a sponsoring company - usually one of the two companies visited in Year 1 - involving 10 weeks during the summer vacation and 16 weeks during Semester 1 of Year 3. In Part A and Part B, each student receives sponsorship from the consortium, in Part C and Part D, students are sponsored by an individual company.

Many of the sponsoring companies are aiming to recruit future IME graduates and all of the companies are keen to play their part in attracting students to manufacturing engineering, to increase the pool of potential employees. Companies also benefit from having a student on placement who can work on a specific project but due to the low numbers of applicants this has not happened in all cases.

Students work on an individual project during their 26 week placement, which is assessed by their Academic Supervisor and their Industrial Supervisor. The student completes a project proposal form in cooperation with their Industrial Supervisor, which needs to be approved by their Academic Supervisor.

The placement is assessed using two modules, a Project module and a Personal and Professional Development module. The Project module involves the student writing a project thesis, initiative evidenced by visits, weekly email updates and a viva voce. The aim of the Personal and Professional Development module is "to develop interpersonal and vocational skills appropriate to the student's intended career destination through experience of an engineering company" and "to record this development in a professional manner." The module is assessed through a written company profile report, an oral presentation at the company, assessment of the student's day to day performance, and a personal and professional development record.

Issues

There are a reducing number of applicants to manufacturing engineering degree courses and subsequently a smaller pool of students with good 'A' levels who might be suitable candidates for the IME programme. There are a relatively small number of students on the IME course and there is a need to increase the number of applicants for it to continue to be viable. The degree programme currently has 20 students; nine students on Part A, five students on Part B, three students on Part C and three students on Part D.

In order to promote the IME degree to potential students engCETL created a website and encouraged six current students to write a case study of their placement experience. The IME website and case studies are promoted through various University websites, undergraduate prospectus and the 'Engineering Opportunities' publication aimed at school leavers.

Benefits

Students gain experience in industry, further develop their employability skills, work with people with a wide variety of backgrounds and experience and gain contacts in the manufacturing sector. They often work on several projects that allow them to apply their knowledge and demonstrate their technical abilities. Students develop their written and verbal communication skills, presentation skills, time management skills and report writing skills.

Students often initially spend time on the production line to gain an insight in to the manufacturing process and work with a wide variety of people. They are treated like an employee of the company and often work with different departments and suppliers. They also usually benefit from internal and external training courses funded by their employer.

Companies gain a placement student who can work on a specific project for a 6 month period and can offer the student the opportunity of further employment during and after their degree. The department gains from closely working with manufacturing companies who provide sponsorship and placements for students as part of the degree programme.

Academic/Industrialist/Student Perspective

I enjoy supporting the students and working with people from industry. I communicate with students on a weekly basis via email, visit students at least three times during their six month placement to discuss their projects and any issues they might have. I observe and assess their presentation on my final visit to the company and also meet with their mentor and supervisor as appropriate.

Students gain in confidence, develop their employability skills, gain knowledge and earn a salary. They have the opportunity to impress a future employer who might be in a position to offer them employment after graduation.

Reflections

It provides the students with an industrial experience and the companies also gain from having a student work for them on a specific project. The tutors need to make it clearer to companies that they should try to make offers of employment to students as early as possible in their final two years of study otherwise they may look elsewhere for graduate employment.

Context

Richard Newman is the Industrial Liaison Officer in the engCETL located within the Faculty of Engineering at Loughborough University. Richard is a Visiting Tutor for the IME programme and since 2006 has supported students on placement at Indesit in Yate, near Bristol; Rolls-Royce in Derby and Siemens Industrial Turbomachinery in Lincoln. Case studies written by IME students whilst on placement are available from the IME website (<http://ime.lboro.ac.uk>).

Partnership between BAE Systems and the Department of Electronic & Electrical Engineering



Amanda Pearce, Industrial & External Relations Manager, Department of Electronic & Electrical Engineering, Loughborough University, July 2009.

Partnership between the Department of Electronic & Electrical Engineering and BAE Systems to create and develop the MEng Systems Engineering programme at Loughborough University.

Reasons for Engagement

The original request for intervention came from British Aerospace. The company's Chief Engineer faced a critical employee shortage – not enough systems engineers. Without many more, he feared the company would struggle to stay competitive. British Aerospace was shifting from designing technologically based platforms and products to delivering operational capability solutions. To do this effectively the company needed a huge injection of systems engineers who could operate in a range of disciplines and environments to integrate and manage complexity and to handle risk and uncertainty. The cost of designing an entirely new curriculum was substantial and would not have been undertaken speculatively by the University. The company not only provided the funds to buy academic time but also provided members of their own staff to work on the project, full-time, alongside them.

The Engagement

Initial discussions for an undergraduate degree programme in systems engineering began in 1990. Conventional wisdom said it couldn't be done. The dynamic process - quite radical at the time - of creating, developing and maintaining a curriculum in a new subject still has no parallel of which we are aware.

The fact that initial discussions took place at the highest level between the University and the company was critical for a project of this scale and ambition. Serendipitously, the Chief Engineer at British Aerospace mentioned the need for more systems engineers to Loughborough University's Pro Vice Chancellor for External Relations (Prof Harry Thomason) who saw a business opportunity and acted upon it. He listened carefully and judged that the University had the inherent capability to deliver to the customer's requirements, though this would need work to realise in its novel instantiation.

The discipline of Systems Engineering was put under two spotlights – the industrial skillset and the academic and intellectual attainment and knowledge. The new curriculum was designed from first principles and the resulting degree programme crafted from existing, sometimes adapted, modules where possible and completed with new modules wherever necessary. The current curriculum is still delivered by a multi-departmental team - Electronic & Electrical Engineering, Business School, Computer Science, Materials, Information Science, Human Science, Aeronautical & Automotive Engineering, Mechanical & Manufacturing Engineering and Civil & Building Engineering.

The first intake of 30 undergraduates was in 1992 and comprised largely of selected apprentices from the company. All the students were sponsored and all but one joined the company on graduation. The programme is fully compliant with all the University's and national academic bodies' regulations and is accredited by three institutions: The IET, the IstmC and the RAeSoc.

Issues

- The close coupling of academics and industrialists co-designing the curriculum so that each understood the others' goals, needs and constraints. The result: the graduates fit the job and the programme fits three Institutions' accreditation criteria.
- A completely new core curriculum backed up by solid engineering practice and the bold incorporation of unexpected, yet vital, disciplines such as information and human sciences.
- The breaking down of barriers between traditional engineering disciplines and the embedding of 9 departments' specialist modules, including many non-engineering, into the new programme, without compromising on content, to ensure real quality and depth.
- The introduction of academic experts to how their discipline fits into the new curriculum, its contribution, relevance and importance.
- Lectures from industrial practitioners as the norm rather than the exception.

Benefits

- Long-term commitment on both sides: this working partnership with industry has now been sustained for nearly 20 years.
- Continuous support, both in funding, sponsorship and staff involvement, from a group of leading engineering companies.
- Over 500 systems engineers graduated since '97 and enjoying outstandingly high graduate employment.*
- Success of alumni in senior engineering positions.
- The extension of the systems curriculum into a full range of awards and short courses at postgraduate and post-experience level.

"This breadth of learning has served me well in the Aerospace industry where products draw on technologies from multiple disciplines and are integrated in to highly complex systems."

Systems Engineering Graduate – now Navigation Engineering Manager (Nimrod) at BAE Systems.

"I was immediately useful to the company and able to work on real projects from day one...the advantages this has given me over other graduates are still evident today, 7 years in to my working life..."

Systems Engineering Graduate – now a Level 7 Software Engineer at Qinetiq.

Unintended outcomes

Best practice was transferred in to other undergraduate programmes. The collaboration demonstrated that cross-curricular working could be successful and sharing modules across departments could work. It also led to successful inter-departmental group projects.

The partnership was a catalyst for new fields of research:

- RSSE (Research School of Systems Engineering).
- SEDC (Systems Engineering Doctorate Centre).
- SEIC (Systems Engineering Innovation Centre) which involves co-location with BAE Systems.

The MEng degree in Systems Engineering and partnership with industry was a key feature in the award of a Queen's Anniversary Prize to Loughborough University in 1994.

Academic/Industrialist/Student Perspective

- Top level strategic alliance between the University and Industry.
- Enthusiasm and commitment at operational level.
- Continuous dialogue about changing industry needs (scope and scale) and developments in education to maintain alignment.
- Continued direct input from industrial staff in curriculum development and delivery to ensure ongoing relevance, including the setting and co-tutoring of projects.
- Direct funds from Industry to enrich the learning experience.
- University staff with direct responsibility to engage Industry in the development, support, delivery and monitoring of the Programmes.
- Formal and timely liaison mechanisms such as joint programme development and outcome reviews.

Reflections

An initiative like this that brings about sustained change to learning opportunities needs:

- Champions with vision, determination and courage
- Funding
- Appropriate formal structures
- Trusted informal relationships

Nearly 20 years later, Loughborough University continues to provide industry with a stream of high calibre graduate systems engineers capable of confidently addressing complex multi disciplinary problems.

Context

Amanda Pearce is the Industrial & External Relations Manager in the Department of Electronic & Electrical Engineering at Loughborough University. She studied Psychology at the University of Nottingham and worked initially as a Primary School Teacher in London before running her own business. She joined Loughborough University's Enterprise Office in 1997 where she worked at the interface between the university and its strategic external partners before moving to the Department in 2009.

BAE Systems is a global defence, security and aerospace company delivering a full range of products and services for air, land and naval forces, as well as advanced electronics, security, information technology solutions and customer support services. With approximately 106,000 employees worldwide, BAE Systems' sales exceeded £18.5 billion (US \$34.4 billion) in 2008.

**The Complete University Guide: University League Table 2010, The Independent April 09.*

Process Design Project for Final Year MEng Chemical Engineering Students in Partnership with Industry



Chris Rielly, Head of Department, Chemical Engineering, Loughborough University, September 2008

This case study describes how the Chemical Engineering department at Loughborough worked in partnership with GlaxoSmithKline on a process design project for five final year MEng students.

Reasons for Engagement

Chris is keen to involve industrialists with teaching and asked Greg Simmonds at GlaxoSmithKline (GSK) if he and his colleagues would be interested in working with a group of five final year MEng students on a project which ran throughout the second semester at Loughborough University. The final year Process Design module generally tackles a different project each year and often involves industry partners. This adds some reality to the project, since the design is based on an existing chemical process and it also brings the students into contact with experienced engineers who have designed or operated the plant. Greg was one such engineer, who had been previously a chemical engineering student in the department and now works for GSK at their manufacturing plant in Dartford, Kent (see Kellett and Simmonds case studies).

GSK insisted on a confidentiality agreement before they could become involved as the design project, involved a commercial process to manufacture an active pharmaceutical ingredient (API) that was later formulated into an antiretroviral drug for the treatment of HIV. The project focused on the manufacture of an intermediate molecule from which the API would be eventually manufactured—to consider the whole of the production chain from raw materials to finished API would have been far too complex for a single design group. Although the intermediate molecules are no longer produced at Dartford, it was useful to have a site visit, where the students could see at first hand the types of equipment that they were busy designing.

The students had to take into account safety issues, good manufacturing practice and product quality, as well as to produce a complete technical design of the process. The project allowed the students to practise and develop a wide range of skills and knowledge obtained throughout their University education. Passing the final year MEng design project is an important requirement to achieve Corporate Membership of the IChemE and CEng status.

The Engagement

GSK provided basic information about the process, which was based on the manufacture of an antiretroviral drug which is now out of patent. The project group started the project by doing a thorough literature search, looking at patents and scientific papers, which described the process and chemical synthesis routes. From this they developed an outline process flow sheet, which they then slowly populated by selecting appropriate equipment to achieve each unit operation. By the time that Greg made his first visit to the department, about 5 weeks into the project, an initial flow sheet, mass and energy balance had been established. The students presented their work to Greg and prepared a long list of questions for him to answer. This certainly helped correct some misapprehensions about the way the process operated and suggested a number of improvements to the flow sheet.

Around ten weeks into the project Chris organised for the students to visit the site, where they delivered a presentation to some of the GSK staff and were questioned on some of the design choices that they had made. The students were given a tour of the site, and had the opportunity to visit two plants that were conceptually similar to the one they were designing. One was a more modern than the other, so the students could contrast the ways in which the design philosophy of pharmaceutical plants had changed over the years. The visit also allowed the students to meet the plant operators and engineers who run the equipment, much of which is specific to the pharmaceutical industry. The presentation at GSK was good practice for the assessments which were later held back in the department. Each design group had to deliver a 30 minute presentation to the academic staff and prepare a major written report which gave full details of all aspects of their design: review of the process science, process plant description, process flow diagram including material and energy balances, piping and instrumentation diagram or engineering line diagrams, equipment list and specification of all major equipment including materials of construction, plant layout, start-up, normal shut-down, emergency shut-down procedures, operating instructions for the major item of equipment, process safety and hazard assessment, environmental impact, capital and operating costs, market survey and business plan.

Issues

It took much longer than expected to have the confidentiality agreement signed by all parties, which meant that the project actually started before all the information had been supplied by GSK. When the information did arrive, there were some parts that were incomplete, poorly specified or difficult to interpret. But in fact this was a really useful lesson for the students in how to deal with data that may contain errors or inconsistencies; it made them question the sources of all the information they obtained and to think about consistency checks to validate their data.

Benefits

The students found the project challenging and interesting mainly because it was a real industrial project and they had to make decisions as a group throughout the project. Team working and management was an important component of the project. With a realistic project, the students could clearly identify the requirements of the product and the benefits that pharmaceuticals provide to society in general and HIV victims in particular. There was also a great sense of achievement at the conclusion of the project, to come so far, from almost no knowledge of the process, to the point where they could have detailed technical discussions with GSK engineers.

By carrying out a fairly extensive paper-based design before the site visit, the students had already thought about some of the technical issues that were faced by the GSK engineers. The students were sometimes surprised to find that they had selected the same equipment and methods that were actually used in the GSK process.

For Greg Simmonds and GSK it was an opportunity to showcase their industry sector to the final year MEng students. As a result of this interaction, at least two of the students made an application to GSK for graduate employment.

The students gained experience in dealing with people in industry; about half had already had some industrial training on a sandwich placement, but for the other half this was their first experience of being on site and dealing with practical engineering issues. As a module tutor, Chris felt there was slightly less pressure on him, as there was always some additional support from the industrial partner.

Unintended outcomes

The lack of information quickly forced the students to think about approximate methods of calculation and it made them realise how much of the knowledge about a process is gained during start-up and commissioning of the plant. They also comprehended how difficult it is to gain reliable and detailed data on complex reaction schemes, particularly when the materials have a very high value and are hazardous to handle.

Reflections

Chris would like to involve more companies with group design projects such as the one described above. The problems of confidentiality and access to information are ones of commercial reality and can be overcome, making these types of projects a valuable learning experience for staff and students. He felt the students gained much from this partnership with GSK and it gave the company a good amount of exposure within the graduating class of chemical engineers.

Context

Chris Rielly graduated with BSc (Eng) and PhD degrees in Chemical Engineering from Imperial College, University of London. He held a post-doctoral research position within the Fluid Mechanics Group at Cambridge University Engineering Department, before becoming a lecturer in the Department of Chemical Engineering at the University of Cambridge. During his time there he obtained a year's leave to work for a chemical contracting company, John Brown Engineers and Contractors, where he gained first hand experience of plant design. In 1999, Chris came to Loughborough University to take up a new chair in Chemical Engineering, where he is currently Head of Department. His research interests are in experimental and computational fluid dynamics of multi-phase mixing processes, model-based and direct nucleation control of pharmaceutical crystallisation processes, spray freeze drying and spray drying of foods and pharmaceuticals and de-agglomeration and dispersion of formulated nano-particle products.

Designer and Visiting Fellow in the Department of Design and Technology, Loughborough University



Michael Rodber, Visiting Fellow, Department of Design and Technology, October 2008.

How a designer spends 1 day a week in the Department of Design and Technology delivering a module with around 90 second year undergraduate students.

Reasons for Engagement

Michael's motivation to become involved with teaching was that he could see that there were a lot of things changing in the world of design. *"I felt it would be quite nice to take some time out from my normal work to go on a voyage of exploration myself in terms of where design was going and using the University environment to explore that. That was my motivation where is the world going and where should design go with it and that very much set the tone for everything I have done really."*

After working in the department for over a year he investigated studying for a PhD in design research. *"The department did agree to this but in fact what was interesting was that when I actually sat down to do the research itself I realised that it was going to be far too demanding for the amount of time that I could put in and I felt, and the department also agreed, that perhaps that wasn't really the best way for me to spend my time."*

The Engagement

One of the things Michael had in mind was the amount of work companies do before the traditional design brief particularly in terms of those activities that go ahead of a design brief. *"The design process is just a small part of a much bigger process of new product development. I came across this in Jones Garrard working with companies like Proctor and Gamble where they did a lot of work in to consumer understanding to try and identify what products consumers wanted."*

Michael and his colleague Paul Wormald developed the New Product Development module which is about understanding consumers, understanding the brand and understanding the business context. *"By designers understanding some of these things perhaps make them a more broadly thinking designer and better equip them to be more effective. So we have been developing that, essentially it started off as an optional module and now is a compulsory module for 2nd year BA students and has been developing from strength to strength."*

Michael and Paul plan to bring the New Product Development module in to MA level and then to set up a complete MA programme in this aspect of study so it will be a self standing qualification which will be a mixture of design, business studies and management.

Issues

Michael feels frustrated that he is not involved in the strategy and the regular tactics of the University and believes that this is partly because he only comes in on 1 day a week so doesn't get involved in staff meetings which he would like to.

"I still feel a fairly isolated pocket and every now and then we try to branch out of that but it doesn't quite work really. It's probably a bit on both sides I suppose it's the difference between stuff that you can do and take on and just get on with and the stuff you have to stand back and think about with other people and in some ways it is easier to go away and do it rather than spending more time looking at the bigger picture thinking strategically."

Benefits

Michael does try and have the discipline of spending one day a week in the department, which is usually a Monday, and people get used to him being here on that day.

Currently the New Product Development module is aimed at those who have studied a product design or industrial design undergraduate programme and want to study at a more advanced level.

Ultimately the goal will be when it is a self standing programme which would attract not just designers but also marketing people and it will be about new product development not just about product design, product design will be a component within new product development.

“In new product development it’s very much a fusion of lots of different disciplines and understanding how all these disciplines come together and what they contribute and how you can manage those multidisciplinary activities to create successful new product development.”

Unintended outcomes

Michael finds working with the students is always fascinating. *“Working with young people and actually seeing where they are coming from and how different they are from when I was a student, their motives are different and it is obviously interesting to know where they are coming from and what motivates them.”*

Reflections

“When they are in the students probably wonder what it’s all about sometimes particularly something like this module which is a bit different from what they are used to and I think it’s a bit hard for them. They probably find it a little bit confusing or a bit difficult and I think with some people you feel it perhaps goes over their head, it’s not what they expected but we do get feedback from some people that go out there and realise what it is all about and its probably only then that they fully appreciate it.”

Context

Michael Rodber is a designer who has worked in the industry for over 35 years and is a Director of Jones Garrard Move. He studied Transport design at Lanchester Polytechnic (now Coventry University) and after 3 years of study graduated in 1974 with a Polytechnic certificate. At that time this was a new course about transport which appealed to him and the only similar course around was the RCA car styling course. During the course he completed a 6 month placement with Ford Motor Company in Essex.

“The first job I got I was made redundant from after about a month and it was actually during the period when the 3 day week had just ended and there was a lot of disruption, trying to get a job was very difficult so my introduction to industry wasn’t particularly good, this was in the mid-1970’s. I went in to the car industry for about four and a half years in car design and then joined Jones Garrard and set up a transport sector within that company. We did a lot of work mainly in trains and planes and then in the early 2000’s we split and I hived off the transport side and set up this new company Jones Garrard Move purely to focus on the transport sector.”

Jones Garrard Move www.jonesgarrardmove.com

Podcasting in a Project-Based Learning Environment (Industry case study architectural design project)



Dr Kirti Ruikar, Lecturer in Architectural Engineering, Department of Civil and Building Engineering, Loughborough University, June 2009

This case study explains how architectural design knowledge was captured/utilised to improve student understanding of practical design-related issues. It used the example of an urban master-planning project in the South of England, which involved interviewing the lead design architect. Conceptual design drawings and other graphics were used to highlight key factors influencing the design rationale. This was captured and broadcast using a podcast of 30 minutes in length to provide students with audio-visual and context-specific design information to enhance their learning experience.

Reasons for Engagement

At an *individual level*, the idea of this project emerged from a real need to enrich the quality of teaching material by utilising practice-based examples to improve student understanding of design-related issues from an architectural design project perspective. Initial attempts to time-table lectures from practitioners had been unsuccessful especially since lecture times and dates are fixed and offer little time flexibility. With a view to address this ongoing issue without compromising on student learning, the project began by exploring innovative ways in which this issue could be resolved. This led to a pilot study (awarded by the Teaching Award Scheme) that aimed to demonstrate the potential of multi-media podcasts in project-based learning environments. This approach had the potential to overcome previous hurdles to engage industry as it offered time flexibility to the industry practitioners and yet could be delivered to the students during the lecture slot.

At *departmental level*, the pilot aligns with the Department of Civil and Building Engineering's strategy pertaining to growth in work-based, flexible and distance-learning.

At *University level*, the flexibility this approach offers through the exploitation of technology to aid learning aligns well with Loughborough University's Strategic goals for education, particularly with objectives that concern: meeting changing needs of students and employees, developing flexible and distance learning provision, increasing the profile of 'quality enhancement in relation to learning, teaching...'; and making a leading contribution to the application of electronic learning technologies.

The Engagement

The first step was to gain access to architectural design-project data with details of the functional requirements, spatial organisation, the design brief, design decisions and drawings, and other related information. To initiate the dialogue with industry, practitioners with design experience i.e. architects, property developers and design engineers were contacted. Email exchanges and face-to-face discussions with them took place in order to explain the context and purpose of the pilot; and attain buy-in. From their perspective, the prospect of dynamically capturing key design decisions (i.e. project knowledge) was considered attractive as it aligned well with their employers long-term strategy and had the potential to address an ongoing issue of loss of project knowledge due to recurring changes in staffing and/or redundancies. Considering the potential long-term benefits to their organisation, obtaining initial buy-in from design practitioners was not difficult.

The next stage involved identifying a project for this pilot. Senior management from the client organisation helped to identify the project that could most benefit from an electronic archive of design decisions. An urban master-planning project in the south of England was selected for this purpose. The rationale: given that phase one i.e. the conceptual design of the urban master-plan had only recently been completed, the design team was still intact and records of design data easily accessible. This is important because, quite often complex urban master-planning projects, such as the one selected, last several years and involve a large number of stakeholders who form transient design teams through their lifecycle. Such projects are at a risk of losing vital design knowledge when teams disperse. Considering this, an archive of key design decisions that influenced the conceptual development would be advantageous, especially since subsequent design teams would be better informed about the design rationale and therefore take measures to ensure that the core project ethos defined at the conceptual stage is not lost in subsequent design stages.

The next step involved identifying the stakeholder/s who could best represent the design team. A senior manager from the client organisation identified people, depending on their role in the project. After much deliberation and face-to-face discussions, it was thought appropriate to interview the lead architect, who would

represent the design team. During this period the uncertainties of the current economic downturn began surfacing. For example, in one instance, despite buy-in from senior management of client organisation, a near-successful attempt to interview the design practitioner fell through. This was because the lead contact at the client organisation moved to a different business unit within the organisation and was therefore no longer directly involved in the project. This had a negative impact on the project's schedule. Due to this set-back, the pilot could no longer be run in Semester one for the architectural design project module, but instead on the e-Construction module in Semester two of academic year 2008-09. This led to modification of the project scope to align with the learning objectives of the e-Construction module. In response to this new challenge, a revised strategy was developed, so that the primary objective of the project was not compromised. Primarily it considered:

- Revising scope of the project to align with the new modules intended learning outcomes;
- Revising project schedule and dissemination plans; and
- Modifying evaluation criteria.

Issues and lessons learnt

The time taken to initiate dialogue with industry should not be underestimated, during your planning allocate sufficient time for initiation of meetings and dialogue. The current economic climate often means that recording a podcast is probably not a priority for practitioners. Be flexible and prepared for changes, and develop a contingency plan. Delays in recording a podcast impacts on when it is delivered and tested. In this case, it was tested on a different module to the one originally intended. Podcasts require software and hardware components, which if not tested prior to recording may not always work. Prepare a 'test' recording to avoid this anomaly. The electronic capture of project data means there are IPR (both University and company IPR) issues that need consideration. Jointly discuss and agree on the approach to be adopted. Richness of audio-visual project content is largely dependent on the company's willingness to share data or even the availability of such data. Work with what is available and 'fill in the gaps' during lectures. The more audio-video content a file has, the larger the file size, therefore issues pertaining to larger file sizes need consideration. Handling the technological challenges posed by software and hardware malfunction would largely depend on the academic's competence and the available support from IT staff. Seek support prior to starting.

Issues arising and lessons learnt from student feedback on podcasts:

- If it is too lengthy, the listeners may 'drift' or lose attention.
- If the content is not interesting it may be ignored. To avoid this issue, include Q&A sessions
- If not supplemented with lectures, students may not have the opportunity to ask questions/clarify doubts.
- Podcasts should not be considered a substitute for clear reporting and lecturing.
- Efficiency depends on the level of detail in the podcast content and clarity and tone of the speaker to grab attention. It might be prudent to introduce humour to captivate the listeners' attention.
- Podcasts may not be suited to some learning styles.

Benefits

The project improved the lecturers understanding and generic know-how of using innovative multi-media based learning technologies. Podcasts can easily provide complementary material for teaching and a suitable addition to on-line learning, which aligns with both University and Department strategies. Podcasts enhance the teaching and learning experience through online publication of audio-visual case studies containing topical interviews with industry experts and other speakers. Content, such as interviews, are better delivered in audio/video formats rather than as pure text. Audio/video podcasts are re-usable knowledge repositories of considerable value to the learning experience given that 'experts' knowledge is accessible on demand as suited to time-table requirements. Podcasts offer flexibility to access knowledge independent of practitioner availability. Students benefit from expert knowledge and practitioner viewpoints regarding success and/or failure factors in building projects. Podcasts set academic lectures in context and assist in self-paced learning. The content is portable and can be downloaded online, but accessed at convenience. In a project-based environment audio-video-textual content of the podcast adds context, improves attention and increases interest and motivation to learn (read supporting discussion on student perspectives). They offer time flexibility to industry practitioners and the opportunity to archive project knowledge. The audio/video files contained in podcasts are online knowledge-repositories that can be shared (thus, RLOs-Re-usable Learning Objects).

Academic perspective

The project required the right contact within the company to assist in finding someone who would want to get involved. It required 'orientteering' and 'steering' input from academics to set the context for the podcast including alignment with the modules' overarching aim and intended learning outcomes. Interactive discussion on the podcast content was needed to engage students and respond to any queries. Audio-visual facilities had to be established and tested in the lecture-halls. The project enriched my personal learning and experience in using podcasting technologies, improved my understanding and know-how of podcasting technologies in project-based learning environments and also contributed towards my continuous professional development.

Industry perspective

Establishing the availability of practitioners beforehand and agree on recording dates is important. Since this is done through goodwill, be prepared for changes to these plans and the potential impact on the delivery and broadcast date. Make sure you test equipment beforehand and comply to the company and the University IP rights pertaining to re-using/broadcasting data. Practitioners may not always work on 'goodwill' and may charge for their time, so you might have to budget for this.

Practitioners motivation to participate is primarily because of the potential to present recordings of audio-video content *in absentia*. The dynamic, re-usable archives of project knowledge are suitable for future use by industry. Archives of design decisions influencing design are beneficial to successive design teams as they would be better informed about the design rationale and therefore take measures to ensure that the core project ethos is maintained in subsequent design stages.

Student perspective

The discussion presented here is based on student feedback received during an in-class evaluation that was carried out to assess the effectiveness of podcasting as a mechanism to *support learning* and *capture knowledge* in project-based environments. An evaluation questionnaire was distributed in class and the results are from those present (i.e. 22 students out of a possible 30).

Feedback from students revealed that the audio-visual content of the podcast 'added context', was 'easily understood', 'attractive in appearance', and 'clear'. A few considered it to be better than traditional whiteboards, because of the 'visualisation' potential. Some students thought that the visual element combined with audio and text was effective in capturing their attention and therefore very interesting. They, however, pointed out that in order to avoid 'drifting' and 'boredom' and to keep students attentive, it was important that 'podcasters' avoided monotone speech and introduced humour. One even stated that the voice over *must be engaging* and thought that the timely animations and use of contextual graphics (plans, elevations, sections, maps, etc) in the podcast, gave a better visual understanding of the project and increased their interest in the designers' dialogue. It was also thought that the audio-video-textual content added context and it was therefore difficult to get distracted and increased their interest in the topic and therefore their motivation to learn. Another stated that: *'the visual data gives a clearer picture of the project and improves understanding of the design project and captures 'my' attention...and therefore my visual memory.'*

The flexibility and personal convenience of 'anytime' access that podcasts offer was considered important, as it is easier to re-listen and revisit details/lectures, which have been missed. Also, the students felt that simply knowing that podcasts could be re-accessed, took the note-taking pressure off them and they could focus more on listening to the speaker rather than juggling multiple tasks.

Many students highlighted the importance of self-paced learning and the opportunity such an approach presents. It also provides an opportunity to catch-up on elements that were either missed or misunderstood during the lecture. This opportunity was considered very important especially if English wasn't their first language.

Reflections

In spite of the 'timing' issues, the experience of this academic-industrial partnership has largely been fruitful. In the main, the content of the podcast determines its success. It is therefore important to select a project with a good 'recording history', be it presentations, photographs, video-files, drawings and other related documents. Considering this, projects at early stages of design are relatively straightforward, given that the design teams are more-or-less intact and data in this case would be developmental. If, however, post-project or 'retrospective' discussions are the focus, then time taken to contact and interview dispersed design team members would be longer. However, such projects could benefit from additional visual components such as construction videos, site 'development' photographs and such like.

To keep listening and watching interests up, it is important that the presenter (i.e. podcaster) pre-prepares dynamic audio-visual presentations with animations, delivers speech in a variable tone (not monotone) and where possible, introduces humour. Where the 'ready' data is fragmented or static (few animations), the storytelling exercise becomes time-consuming and onerous in attempting to introduce the dynamism. However, care should be taken to keep file sizes manageable.

Context

Kirti Ruikar is a Lecturer in Architectural Engineering in the Department of Civil and Building Engineering at Loughborough University since 2007. With a first degree in Architecture, Kirti undertook a Doctor of Engineering (EngD) degree at Loughborough University. The focus of her EngD was to examine the business process implications of e-Commerce in Construction Organisations. En- route the doctoral studies, she completed an MSc in Construction Innovation and Management. Following this she was awarded a research fellowship at the 6* Salford Centre for Research and Innovation (SCRI) in the University of Salford. Her research interests are in the fields of ICT, knowledge and information management, strategic technology management, collaborative working, process improvements, e-readiness and electronic-business. Her research is widely publicised and she has over 40 publications in these fields. Recently, she has co-edited a book on e-Business in Construction (Wiley-Blackwell) and has also authored 5 chapters in this book.

Building Strong and Mutually Beneficial Networks Between the Pharmaceutical Industry and Universities



Greg Simmonds, Process Engineer, GlaxoSmithKline Primary Pharmaceutical Supply, September 2008.

Through building strong educational networks with science and engineering faculties, GlaxoSmithKline hopes to improve the quality, focus and context of teaching, and raise the profile of the pharmaceutical industry as an attractive place to start and build a career.

Reasons for Engagement

GlaxoSmithKline (GSK) has long been active in supporting and improving science and engineering education within the UK and worldwide, with the aim of developing an understanding of science and engineering issues in everyday life and inspiring young people to take up careers in technical subjects. GSK works with primary and secondary schools as well as higher education institutions to achieve this goal through a large number of schemes and initiatives (see Kellett and Rielly case studies).

More recently, it has become apparent to the organisation that it is becoming increasingly difficult to attract top quality science and engineering graduates not just to GSK, but to the entire fine chemicals and pharma sectors. One of the key reasons for this is the content of many degrees; this is typified in chemical engineering, where the vast majority of teaching is aimed at large-scale, liquid phase, continuous processing, and predominantly oil and gas. In such a challenging global business climate, it is essential to all UK industries to attract a steady stream of top engineering talent if they wish to thrive.

Through building strong networks with top science and engineering faculties, GSK believes that it can address both of these areas: responsibly improving the standard and availability of education; and raising the profile of the organisation to potential future technical leaders of the company.

On a personal level, having graduated from Loughborough with a degree in Chemical Engineering in 2007 and now working within the pharmaceutical industry, I was both pleased with the quality of my University education but also amazed at how biased the degree course is against smaller-scale fine chemicals and pharma processing. Although I was aware of this during my degree studies, it became more obvious once I started working within the pharmaceutical sector. I have a keen passion for getting involved with education initiatives, and wanted to help to re-address the balance through a collaborative project which would mutually benefit the students, the University, GSK and me.

The Engagement

In order to initiate and develop the concept of a collaborative project between GSK and technical departments, I thought that the best place to start would be with what I already know. Along with contacts within the Chemical Engineering department at Loughborough, I discussed the opportunity to provide a real-world design problem for the MEng final year design project. The department – known for its strong links with industry – was very keen and, after a short period to jointly develop the design brief and supporting information, the project started in earnest.

One of the key concepts that the industrial and academic sides were keen to reinforce was that it is common to begin a project without all of the required information and data, and that one of the necessary skills was to be able to identify the gaps and what to do about them. Because of this, it was decided to give the students a general project brief – similar to the first intent information often received in industry – and for their tutor to hold a lot more information, which could be released to them as and when they asked for it.

Supporting the design project process was relatively straightforward after the initial set-up: an intermediate trip was made to the University department to meet with the students and review the state of their design and to answer questions. Some of those questions could be answered directly, some required further investigation, and some required the students to make a 'best-guess'. The realism of this is especially key to development, and is easy to overlook when studying at University.

Later in the design project (which lasted a total of 16 weeks), the students were invited to a manufacturing facility where they presented their project work to the Site Leadership Team (no pressure!) and took a tour of facilities to improve their understanding of the concepts relevant to their own design: how can you load toxic solids to a reactor? Do you have to transfer fluids using pumps? What does Good Manufacturing Practice (GMP) look like in reality?

The students learned a lot from the visit to site especially, as it allowed them to visualise their own designs more fully, and learn another key industrial concept: if you want to learn more, ask the people who work with, or on the plant!

Besides feedback on the progression and technical details of the students' design, GSK was not involved with the formal assessment of the project, which remained the responsibility of the students' tutor.

The project concept has now been rolled out to other universities and is believed to be meeting the original aim of building a strong network with engineering faculties.

Issues

The most likely issue that is raised when trying to arrange an engagement of this type is that of resource: how much time is required to set up the project, and how much time and money to support it? Experience has shown that a project of this type only needs to be fully set up once, and will likely only take a matter of hours over what ever period is available for planning. It's a matter of pulling together data and literature pertinent to the project, and then creating a suitable project brief: easy!

Ongoing support is whatever is decided to be feasible and appropriate by both the industrial and the academic parties: in the case of the GSK – Loughborough Chem. Eng. Project, the students' questions were handled by their project tutor, filtered and sent forward by email. It is important to note that this was limited to align with the project meeting at the University and then at the GSK site. This way, minimal time was required to support the project once it had kicked off. The beauty of it is its reproducibility – the same project can then be rolled out at any University, any year, so long as the necessary Confidentiality Agreements are in place. Again, in experience, due to the nature of the project, this is a very straightforward document to produce and gain agreement for.

Benefits

The most important aspect of the engagement is that all parties: the University, the company, and most importantly the students all mutually benefit.

For the University, stronger links with industry and individual companies serves to increase the flow of knowledge in both directions, opening up chances for further collaboration. In addition, at a time where companies seek to cherry-pick talent at the earliest stage, strong links with universities should result in an increased likelihood of placements or full-time employment being offered.

For the company, there are several aspects: first and foremost for GSK is that it is part of our core mission to improve the quality and availability of science and engineering education wherever it can. Besides the corporate social responsibility aspect, it is quite logical to see that if students are leaving University better prepared, then the whole of industry can reap the benefits. This can be delivered through complementing the students' core academic technical understanding with an advanced understanding of industrialised processes, business factors and 'softer skills' borne from team working in a collaborative project of this kind. The company benefits more individually in a further way, especially if the company is less well known or less visible: a student is much more likely to apply to a company that they know about, especially if they have had a positive experience of working with them.

For the students, there are multiple benefits to undertaking a project as part of a collaboration with industry. Firstly, the subject is placed strongly in context – the students can do research on the topic using public domain literature in conjunction with the supplied information covered by intellectual property rights. The students also learn that the scientific and technological skills they have acquired through the education system forms the basis for a career in a field such as chemical engineering. Further development can only be derived through experience and exercising judgement.

Academic/Industrialist/Student Perspective

The initial reasons for engaging with universities were to develop strong links with top technical faculties in order to raise the profile of the pharmaceutical industry as a good place to begin and develop a career; to enhance the core University curriculum by means of a real-world case study; and to build a foundation for future collaborative projects.

Reflections

Having now rolled out the initial project concept across different universities, it is clear that if good preparatory work is done for the first project trial, far less resource is required for subsequent projects. The projects have been enthusiastically taken on by the students, and it was found that the level of information supplied to the academic allowed a multiple-tier structure for obtaining information, much like is commonly found within industry. The students responded particularly well to the visit to the industrial site, as this allowed them to put some of their paper concepts into context and helped them think about more practical problems and potential solutions. If this can be supported, it is strongly recommended, and it also allows for the students to present to senior managers at the site – good preparation for the real world of industry that awaits them!

Context

Greg Simmonds is a Technical Development Process Engineer for GlaxoSmithKline working at the Dartford Primary Pharmaceutical Supply site. He graduated from Loughborough University with a MEng in Chemical Engineering in 2007 and is a member of the GSK Global Manufacture and Supply Graduate Technical Development Programme.

GlaxoSmithKline (GSK) – one of the world's leading research-based pharmaceutical and healthcare companies – is committed to improving the quality of human life by enabling people to do more, feel better and live longer.

GSK produces medicines that treat six major disease areas – asthma, virus control, infections, mental health, diabetes and digestive conditions. In addition, we are a leader in the important area of vaccines and are developing new treatments for cancer.

We also manufacture other products through our Consumer Healthcare division, many of which are global brands and market leaders: over-the-counter (OTC) medicines including Gaviscon and Panadol; dental products such as Aquafresh, Sensodyne and Macleans; smoking control products Nicorette/Niquitin; and nutritional healthcare drinks such as Lucozade, Ribena and Horlicks.

For further information please visit www.gsk.com

'Industrial Case Studies' Module for Undergraduate BEng/MEng Materials Engineering Students



Noreen Thomas, Senior Lecturer, Department of Materials, Loughborough University, September 2008

People from industry deliver industrial case studies on specific topics to 42 undergraduate materials engineering students in their final year.

Reasons for Engagement

Industrial Case Studies is a relatively new module (around four years) which has six lecture slots where people from industry deliver talks to the students relating to a specific topic.

Noreen was keen to have people from industry deliver case studies about real issues that affect industry and have the assessment for the module related to the industrial case studies. Noreen used the contacts that people in the department have to ask industrialists if they would like to deliver a case study to the students. All of the industrialists currently involved have a link with the department.

Having worked in industry Noreen appreciated how important it is to give the students as much exposure to people from industry as possible.

The Engagement

Initially most of the people who delivered case studies were retired industrialists but more recently they have been people who currently work in industry. The industrialists include those who work for a large power generation company, a medium sized motor vehicle research company and a small composites company. All of the companies are within relatively close proximity to Loughborough.

The industrialists each deliver their case study during a three hour lecture slot over a six week period. There were 38 students who were in the final year of their BEng degree and two students in the final year of their MEng degree. The industrialists deliver lectures related to a wide variety of topics including packaging materials, polymer composites, metals and specific to the company e.g. *materials in power generation* and *failure analysis of automotive components*.

At the end of each lecture, the industrialist will provide a question, problem or topic as an assignment for the students to complete as part of the coursework assessment for the module. Each assignment requires an answer of about 1000 words. Students must complete four assignments in total.

Issues

It can be difficult to find the right people to deliver the lectures, all of the current industrialists have a link with the department. Many of the industrialists are previous graduates or Masters students who studied at Loughborough, one studied for his MSc around 25 years ago! One of the industrialists is a graduate and former PhD student who now works for a power generation company.

The industrialists mark the assignments completed by the students and for some who are not familiar with this process it can initially be difficult for them. Noreen has delivered tutorials for the industrialists to support them with the marking criteria and has looked at scripts where necessary. The assignments are usually set between Noreen and the industrialists.

There is a risk in involving industrialists in teaching part of a module as people from industry can sometimes let you down due to commercial pressures. Also there may be travel delays, particularly if they are coming a long distance. "Sometimes I feel as if I'm not in control. At present I only involve people who already have contact with the department and are fairly local."

Benefits

“All of the lectures delivered by the industrialists are good and the technical content is very good. The students get a lot from it, one student told me that a particular talk given by an industrialist was the best lecture he had been to in his four years at University.”

The industrialists are keen to work with the students and sometimes gain new ideas from them. The industrialists want to put something back in to education as they feel they have got much from their experience.

“It is good for people from industry to have contact with people in universities, exchange ideas with academics, try ideas out and talk something through.”

Reflections

The module is a great experience for the students because they can relate their academic theory to a real issue in industry. The presentations given by the industrialists are professional and often the industrialists are looking for answers to real problems.

Context

Noreen Thomas is a Senior Lecturer in the Department of Materials at Loughborough University. Noreen previously worked at ICI's technical centre at The Heath in Runcorn, Cheshire and in 1990 joined the research department of European Vinyls Corporation (now INEOS ChlorVinyls) as a Project Leader, developing new applications for PVC and providing technical support for customers.

A Student's Perspective on Working with Industry Through Formula Student



Steven Walker (A), MEng undergraduate, Department of Aeronautical and Automotive Engineering, Loughborough University, September 2008

This case study highlights the interaction between a student and an industrial partner on the business proposal for Loughborough University's Formula Student team.

Reasons for Engagement

Formula Student is a competition organised by the Institution of Mechanical Engineers, (IMechE) in partnership with a large number of sponsors. The challenge is to design, build, develop, market and compete by producing a single seat race car to a comprehensive set of regulations.

Within the department there is a faculty adviser for the team, however their role is to make sure everything is run safely and to organise purchasing, rather than being directly involved in designing and making the car. Formula student is also supported by a final year MEng automotive module, which completes a large amount of design work for the team. However, this work is only taken on by the team for final design stages and manufacturing if they think the work is of a satisfactory standard and the budget allows it.

The UK competition, held annually at Silverstone race circuit attracts competitors from across the world to include mainland Europe, the Americas, Asia and Australasia. There are also further events throughout the year in the US, Germany, Italy, Brazil and Australia. As a team LU Motorsport competes annually in both the UK and Germany.

During each event, students are challenged in a number of key areas, to include; a design presentation, cost analysis and business plan. Furthermore, the prototype is tested dynamically in a 75 metre acceleration, a figure of eight handling test, an autocross (a single sprint lap of a circuit) and an endurance race (which is 22km in length and incorporates a driver change).

Within the business event presentation, each team must indicate a comprehensive knowledge of the cars commercial viability, to include the market research from which the vehicle was developed, a manufacturing plan, marketing strategy and the financial projections. This is then pitched to a panel of judges, who play the role of a manufacturing company interested in supporting such a project. Overall this element of the competition represents 75 out of 1000 possible points, a significant amount when considering 10 points can separate 4-5 teams

As LU Motorsport currently consists of entirely engineering students, experience in business strategies is very limited. Consequently, finding an industrial partner with such knowledge would clearly benefit the team.

The Engagement

Ultimately, a relationship was developed through the Loughborough University Development Trust to leading financial consultants, Deloitte. Such a relationship is mutually beneficial, as Deloitte are one of the largest recruiters of graduates within the UK, with a particular interest in the skills of engineers.

The relationship began with a meeting at the University. This formed a brain storming session to look at possible ideas for the project which was attended by three members of the FS team and a Deloitte employee, himself formally a Loughborough University student. Starting with the previous year's business plan, a large number of ideas were developed where key areas for improvement were indicated. It was then the team's responsibility to draft a new business proposal. Throughout the writing process, contact via both email and telephone ensued, where advice was offered.

Following the completion of writing the business proposal, it was arranged for the team members involved to travel to Deloitte's office in Birmingham. During this time, the presentation was given to a number of employees, including a Partner, who holds responsibility for an entire function within the Midlands region. Further feedback was provided, not only into the content, but also the style of delivery.

In return for such support, Deloitte's company logo is in a prominent position on the 2008 car's nosecone. Furthermore, arrangements are being made for the car to be available for their graduate recruitment events in Loughborough at the start of the 08/09 academic year.

Issues

Throughout the partnership to date, there haven't been any issues. Sometimes it can be frustrating waiting for email replies, but this is inevitable. However, having a consistent contact helped so that the advice received was consistent throughout. At times, pressures from car construction provided small delays as naturally the priority of engineering students is always with the vehicle.

Benefits

The benefits to the team are quite clear, sound and professional advice into the content and structure of a business plan prior to the event. It also increased motivation in the project and ensured that all preparation was completed within the required time frame.

Unintended outcomes

Although originally Deloitte's involvement with LU Motorsport was to offer advice and assistance when compiling the business plan, the relationship has further developed to them offering financial support. Subsequently this helps fund the manufacturing of outsourced components for the vehicle.

Student Perspective

This opportunity offered access to invaluable advice, broadening knowledge of the business side of an engineering company. Their involvement also seems to make logical sense, in an effort to make engineering students aware of opportunities in other industries whilst also advertising the Deloitte brand.

Reflections

Overall the project worked well, however results at the event didn't quite match the teams expectations. However, this broke down to the difference between the perspective given by the Deloitte personnel and the judges. At the event, all the judges are from engineering backgrounds so were looking for slightly more details about the vehicle and the manufacturing plan than provided. Following such criticism small changes were made for the German event which is one month after Formula Student UK, where the result was significantly improved.

Context

Steven Walker is currently a final year undergraduate student at Loughborough University, studying Automotive Engineering, (MEng). As a part of the degree course he completed a year working in industry for Nissan cars at their European Technical Centre in Cranfield, Bedfordshire. Working in Upper Body Design department, he held responsibility for all internal components on the back door of a new vehicle through its digital design phases.

Throughout Steve's time at University, (since Sept 2004,) he has been involved in Formula Student. Within this time he has progressed through the team, from general manufacturing, to a component designer which included the pedal box for the 2006 car, to finally become the chief designer in 2008.

Prior to joining University he also competed as a design engineer in the Jaguar sponsored F1 In School competition, with his team winning the national post 16 award in 2004 along with three regional titles.

Student PowerPoint Presentation of a DIS Placement at Nissan Technical Centre Europe



Steven Walker (B), MEng undergraduate, Department of Aeronautical and Automotive Engineering, Loughborough University, September 2008

This case study highlights from a student perspective the benefits of undertaking a Diploma of Industrial Studies (DIS) placement in industry. (Information taken from PowerPoint slides)

Background to student

Name – Steve Walker

Degree Program – Automotive Engineering (MEng)

Degree Year – Placement Completed After Part B

Placement Company – Nissan

Location – Nissan Technical Centre Europe, Cranfield Bedfordshire

Department – Upper Body Engineering



An Introduction to Nissan Worldwide

- Nissan was established in 1933 and is now present in most major automotive markets throughout the world.
- As a manufacturer Nissan has 24 production facilities within 21 different countries, producing 2.5 million vehicles per annum.
- Nissan employs 120,000 people worldwide
- In 1999 Nissan and Renault agreed an alliance making the 4th largest automotive group in the world

Nissan Technical Centre Europe and my Department

- Nissan Technical Centre Europe, (NTCE,) was established in 1988 and initially based in Sunderland and Barcelona, but with close links to the Nissan Technical Centre in Japan
- Early projects included the Micra and Terrano II
- In September 1991 NTCE moved to the current site at Cranfield in Bedfordshire
- NTCE is responsible for new vehicle development, including the highly successful Qashqai and life cycle management for all European models

Throughout my time at Nissan I work in DS6 section which has two main functions, these are as follows:

- Nissans global leader for anti-theft solutions
- Design responsibility for both of the types of back door for a new commercial vehicle, which is yet to be launched
- Throughout my time at Nissan I was primarily involved within the design project, however I also supported the anti-theft engineers

My First Day and Further Training

- On my first day at Nissan I was given the necessary safety briefings which were directly applicable to my job and I was given a tour of the entire facility
- Furthermore, I was introduced to everyone in my section, allocated a desk and given my first few introductory tasks.

After being at Nissan for approximately 2 months, I was enrolled on a three week full time CAD training course. To include training in the following areas

- Component modelling
- Creating assemblies and storing the data correctly, according to the Nissan standard procedures
- Technical Drawing
- I was also given further training on a further CAD data release process and storage system, when new software was released during my year with Nissan

My Primary Responsibilities

When working within a design department, the majority of the year is allocated to a number of digital lots. Digital lots require CAD storage of the entire vehicle, to enable manufacturing and assembly the time to check the design and ensure it can be produced. The following timetable is a typical example of a digital lot structure;

Week															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Digital Lot															
Planning Phase (CAD Data is prepared and stored)										Lot Phase (Manufacturing departments feedback, design to supply a response)			EDM (Overview of the success of the lot)		

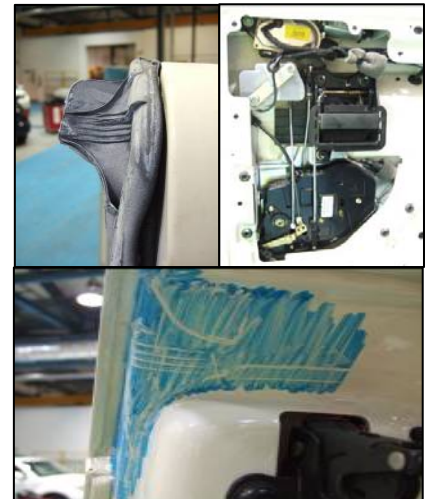
My personal responsibilities were to all the French Back Door trim components. This includes;

- Locks and locking system
- Hinges
- Check links
- Seals
- Glass

Bench Marking

Competitor benchmarking is an important part of the design process, to ensure that your new product will be competitive.

On the right are images from benchmarking activities I organised; The left hand and bottom images are from a set of seal study work which was undertaken on some of the direct competitor vehicles. This particular test is to look at the seal to door contact points to determine any potential areas for water ingress. The second image is of the back door locking system, interior release handle and wiper motor, which was analysed to help improve the packaging of our door components.



Further Work Undertaken

- At times I also helped the anti theft team, by performing a number of different tasks
- I helped with Pre-Thatcham evaluations and then assisted in the documentation of the results
- I also learn to perform basic locking logic tests on vehicles and gathered data on foreign markets, prior to the team visiting that specific area of the world.
- Some of my other tasks were fault finding exercises for warranty concerns, which included finding the route cause of a window regulator screech and leaking into the passenger compartment.
- Throughout the year, I was also involved in a number of cost reduction activities, designed to maximise the vehicles profitability without reducing the perceived quality.

Overview

- I have held a key role in the digital design phases for the development of a new vehicle, working with colleagues and suppliers from throughout the world
- Completed further projects based on quality or cost initiatives
- Assisted my colleagues in achieving their targets
- I became a respected engineer within my department

On a more personal note, I thoroughly enjoyed my time on placement at Nissan and the experience has been greatly beneficial in my development as an engineer

Benefits

When you consider doing a placement many people will inform you how you will benefit from the experience, typically in the following ways:

- You will gain an appreciation for the industrial environment
- It will allow you to place your subject in context
- You will earn a salary
- Become more attractive to employers when you graduate

From my experience all of these aspects are true, however the most important thing I gained was confidence in my ability. This has enabled me to be more pro-active in group work and write all my coursework with greater belief in what I am reporting. In turn this has significantly improved my exam grades, once again making me more attractive to graduate employers.

The Teaching Contract Scheme in the Wolfson School of Mechanical and Manufacturing Engineering



Peter Willmot, Principal University Teacher, Wolfson School of Mechanical and Manufacturing Engineering, Loughborough University, November 2008.

This case study highlights the partnership between Wolfson School of Mechanical and Manufacturing Engineering and a consortium of companies who provide projects for second year and final year mechanical engineering students.

Reasons for Engagement

The Teaching Contract Scheme is an integral part of the Mechanical and Manufacturing Engineering degree programme. Since the 1980s and the publication of the Finniston⁽¹⁾ and Grant⁽²⁾ reports into training in the engineering profession, universities have placed greater emphasis on the provision of industrial projects; the benefits of which are widely accepted but difficult to quantify. Most institutions set and supervise project work as part of their curriculum and in many cases projects are generated through personal industrial contacts within companies or by speculative approaches from industry on an ad hoc basis.

The Teaching Contract at Loughborough is now well established and ensures continuity of industrial support at points within the curriculum. This scheme guarantees an industrially based design project for all second year mechanical engineering students as well as for M.Eng finalists from both mechanical and manufacturing disciplines. It provides additional well informed tuition and annually gives approximately 15 engineering companies a significant involvement in mainstream curricular activity at Loughborough. The work is based at the University, and the students are encouraged to make use of the extensive facilities available. The company chooses to work with either second year or final year students depending on the expected difficulty of the project (see Curtis case study).

The Engagement

The Teaching Contract is a consortium of companies who agree to provide the projects and each company will work with approximately 16 students working in small teams of 4 or 5. The industrially based project work is written into the programme structure for second year students and final year masters students and almost 200 students take part each year. The modules involved are Application of Engineering Design (Year 2) and Project Engineering (Year 4). The work continues throughout the academic year after the problems are assigned during an initial factory visit, early in the year. The industrialists take part in tutoring and assessing the project work as it develops through a programme of scheduled meetings at the University and can exert influence on the practices and procedures used. Companies report frequent positive outcomes and generally welcome the opportunity to work with prospective placement students and graduate recruits. The companies pay a small fee to the University that allows us to fund the necessary industrial visits, hospitality, cover basic project costs and maintain a high standard of report presentation. Over the years the scheme has involved a large number of engineering companies which range from major household names to small local enterprises.

During the summer period the student groupings and academic tutors are assigned to companies who, in turn, prepare an initial statement of their project ideas. Most commonly, a tutor visits the company to discuss the suitability of the project before it is revealed to the teams. For finalists we insist on a different topic for each team but for second years it works just as well when student teams compete on the same topic. In some cases, this is more rewarding for the company as they get a better breadth of concepts and investigations.

The project time-line requires students to visit the company in mid-October, industrialists come to the University in late November and early February and teams make their final presentations to companies and academic tutors in mid-May. At the end of the projects, students prepare a formal written report and deliver an oral presentation to the company. Copies of all the reports and drawings are made available. Academic supervisors are responsible for all aspects of assessment but will normally consult with industrialists in order to set realistic standards. Finalists are also required to mount a design exhibition and with all the teaching contract partners present (together with external examiners) this has evolved into a major annual undertaking.

Issues

The primary task of the Teaching Contract Director is to ensure that there is sufficient capacity within the scheme for the student numbers. There is a natural turnover of companies and an effort must be made to recruit new companies at every opportunity. Industrialists are usually keen to talk about working with the department but less eager to make a time commitment. An information pack is sent to interested parties but face-to-face discussions are undoubtedly the most effective recruiting sergeant. We also invite any company managers who express interest during the year to the summer exhibition of students work. Much of the recruiting activity takes

place during the summer vacation. In the present climate it seems that company recruiters are being very selective and targeting specific universities. The Teaching Contract has proved to be excellent and very cost-effective advertising for companies targeting graduates from Loughborough. Companies express a preference for working with either second year students or finalists. Some prefer second year because of the reduced commitment and the possibility of recruiting future sandwich placement students while other prefer the more advanced level of the final year work.

Benefits

The benefits for students are that they gain knowledge and understanding of specialist engineering topics, awareness of industry and commercial realism, research techniques, team-working and communication skills, problem solving, written and oral presentational skills, prototyping and model making and structured project management practice. They also study a specific unfamiliar topic area in depth using a student-centred approach.

Many of the ideas put forward by the students have been taken up and developed by the participating companies. Many more companies have told how they benefit from the unrestrained basic research done with fresh and open minds and how this often leads to novel and otherwise ignored conceptual solutions to longstanding problems. The scheme allows companies to tackle problems that the company would like to solve but which are perhaps not critical to daily production and which they would not usually resource. The scheme also provides excellent publicity for the company amongst the student body in respect of placement students and potential employees and access to University research using tools that may not be available in the company.

Good industry links enhance the department's reputation with potential students and provides a positive and powerful feature at professional accreditation. Contact with industry keeps staff up-to-date and the small income stream covers expenses.

Unintended outcomes

An important consideration in setting up such a scheme is the need to provide meeting space for a large number of teams at the same time. We provide a large studio with separate project areas and have a number of small study rooms for team meetings. Motivation is soon lost if suitable accommodation is not available. Coping with this demand has proved difficult however the income from the scheme has enabled us to gradually bring in additional presentation equipment and other audio visual resources.

Academic/Industrialist/Student Perspective

Feedback from graduating students which is now reflected in some ways in the National Student Survey never fails to mention experiences of the 'Teaching Contract' and these are heavily weighted as positive experiences. Reports from students suggest that prospective employers are impressed by the experience that this scheme gives otherwise inexperienced students and ask extensive questions about the projects at interview, which anecdotally suggests that it improves the employability of the graduates.

Reflections

Industry projects provide an excellent vehicle to apply engineering science in context and practice key transferable skills that are so valuable to employers. Furthermore, industrial companies appear keener than ever to work with universities who they consider will provide them a source of high calibre graduate employees. Universities involved in engineering can only gain from such liaisons but they must weigh the benefits against the administrative complexity and the considerable time and space demands.

Context

Peter Willmot is Principal University Teacher in Wolfson School of Mechanical and Manufacturing Engineering. He gained a BSc in Mechanical Engineering from Nottingham Trent University in 1976 and worked in manufacturing industry for 11 years, initially through an engineering apprenticeship and into various Design, Production Engineering and Project Management roles. Peter joined Loughborough University teaching staff in 1983 and was appointed Lecturer in Engineering Design in 1985 in the Department of Mechanical Engineering. He completed his PhD in Agricultural Machinery/Renewable energy in 1990 at Loughborough.

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