Introduction of Student Mentors into a Programme of Industry Linked Projects.

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Abstract — This paper focuses on a novel method of improving the employability of students that are nearing the end of their degree programme. It describes the arrangements and procedures for a successful final year student experience in project supervision. Fourth year Master or Engineering (M.Eng) students are appointed ‘mentors’ to a team of second year students undertaking a year long industry linked project module. The mentors gain practical experience of aspects of project management and leadership in a controlled environment, and are encouraged to reflect and build on their performance through an appraisal procedure similar to that used by the professional engineering institutions.

Index Terms — Project Based Learning, Student Mentors, Working with Industry

INTRODUCTION

Surveys repeatedly show that engineering employers seek virtues such as willingness, drive and self-determination, along with strong commercial and communication skills, ahead of traditional technical expertise. In short, companies look for young graduates with potential, who can perform from day one.

The ‘Loughborough Experience’ suggests that the cornerstone to success in these vocational areas of education is maintaining strong links with industry and building ‘real world’ elements into the curriculum. The introduction, by the Engineering Council, of the extended degree of Master of Engineering in the UK during the late 1990’s provided the inspiration to further develop an existing well-established university/industry project scheme known as the ‘Teaching Contract’ in order to enhance the leadership and entrepreneurial potential of high-flying students: preparing them better for the world of work.

This paper describes a compulsory final year module that was introduced a few years ago to give students the hands-on experience of acting as mentor to a team of younger students engaged on a real world project whilst still under the scrutiny of academic staff. We look at the content of this module and how the considerable logistic difficulties were tackled, the challenge of providing a meaningful, effective feedback and assessment mechanism and an appropriate style of support for the student mentors. The final element is to persuade students to think beyond their university experience to make their acquired skills truly transferable and look for common ground with the management and leadership large and small engineering projects in the industrial world.

THE ROLE OF INDUSTRY

UK Institutional accrediting panels place a greater emphasis than ever on the provision of industrial liaison in academia. The benefits are widely accepted but difficult to quantify. The QAA[1] require engineering students to have an “ability to operate in commerce and industry in a variety of situations”: how is this to be achieved if not through working with industry?

Virtually all institutions set and supervise project work and in many cases, industrially derived projects are set on an ad hoc basis through a lecturer’s personal contact or by speculative approaches from industry. While this all very positive and those students who happen to land an interesting industry-based project are often well served, we recognised that a more formal arrangement was needed if we were to guarantee a similar quality of experience to all students and generate a robust and adequately moderated assessment regime. Hence we introduced a scheme we know as the ‘Teaching Contract’.

The Loughborough Teaching Contract

The foundation of the Loughborough Teaching Contract is a consortium of companies who promise to provide projects for a number of students and give continuity of industrial support through the academic year. The scheme, which has developed over a period of twenty years, guarantees industrially based project work for all our second year mechanical engineering students and final year ‘masters’ students. In 2002/3 there are approximately 200 students in total taking part in projects provided by eleven companies.
Teams of four or five students tackle real problems set by the companies through the academic year and take part in a number of factory visits and progress meetings. The projects are introduced at the factory early in the year. An academic supervisor and an engineer appointed by the company provide guidance for typically four project teams working with each company; 16-20 students in all - see figure 1. In 2002/3 there are eight company groups operating level 2 projects and a further three companies working with level 4 students. After the initial factory visit, teams meet weekly and the company engineer visits the university on several occasions to offer advice and to hear the students’ reports. The level 2 project activity is supported by a generic lecture programme covering topics such as project planning, the information retrieval, design process, decision making, report writing and oral presentation.

We encourage the companies to influence the conduct, assessment tasks and operational procedures for running the projects through an annual advisory meeting of the consortium which coincides with an exhibition of final year team projects. Teaching Contract 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. The fee is set at the AGM.

Companies report frequent positive outcomes and generally welcome the opportunity to work with prospective placement students and graduate recruits. Over the years, the Teaching Contract has brought us into contact with a large number of engineering organisations that range from major international household names to small local enterprises. Notwithstanding the educational benefits for our students, the liaison has also spawned a number of welcome spin-off research and consultancy contracts.

WHY INTRODUCE STUDENT-MENTORS?

The widespread introduction, in the UK, of the four-year degree of Master of Engineering (M.Eng) in the late 1990’s required institutions to add breadth and depth to their 3-year Bachelor’s degree programmes. Along with this came requirements to consider the professional competences of graduates and the key transferable skills appropriate at master’s level. The IMechE [2] state that the extended degree should “enable the M.Eng graduate to progress rapidly to a position of responsibility”. Our aim in building an additional role for M.Eng finalists as mentors to our existing Teaching Contract projects was to prepare them more specifically and in a practical way for leadership and entrepreneurial roles.

How student-mentoring works

We appoint a finalist ‘mentor’ to each second-year team. Projects run from mid October to early May timetabled for one afternoon per week, with a four week break during the mid year examination period.

The mentoring experience forms the central activity of a final year module ‘Project Leadership’ which is a 10 credit module that, crucially, takes place at the same time as the mentors are themselves participating in a 30 credit team project; hence there are opportunities for the role of team-player to inform the task of leading a team through a smaller but similar style project. Students are encouraged, for example, to pass on their experience at project planning and control to the second year team they are working with.

The module leader coordinates the activities of all the participants and draws up a schedule of events for the duration of the project that includes the weekly team meetings with mentors, observed team meetings where the supervisor sits in and two progress meetings where the industrial sponsor is also present. With 8 companies, 8 staff members, 36 mentors and 130 students this is no minor organisational task and we allow for occasional assistance from a member of departmental clerical staff. At the end of the year teams make a formal oral presentation to the company and their peer group.

Mentors are expected to chair team meetings that last about an hour; they must produce an agenda in advance and work to it. Teams record their meetings through minutes that are copied to the supervisor via email. Mentors must ensure this is done but may choose precisely how. They most commonly rotate the secretarial duties amongst the team members, though some prefer to prepare their own minutes.

The Mentor’s Role

The mentor’s primary role is that of project manager, who deals with project planning, gives advice and guidance, allocates duties to team members and encourages effective progress. While it is perfectly permissible for mentors to assist with the promotion and development of ideas, and to offer sound assistance with analysis and evaluation, they are asked to refrain from directly generating solutions or actually performing the technical tasks. Mentors are also required to give leadership and encouragement through which they quickly learn the effects of different styles of working with teams. Academic supervisors are ultimately responsible mentors and the student teams within their company group and for assessment of both.

SPACE REQUIREMENTS

An important consideration in setting up this scheme is the need to provide meeting space for a large number of teams at the same time. We have a large studio with separate project areas and 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 Teaching Contract scheme has enabled us to gradually bring in additional facilities and presentation equipment.

**MONITORING THE MENTORS PERFORMANCE**

We require a monitoring system that allows staff to keep track of the second year students for which they have ultimate responsibility and which will also provide formative assessment of the mentors. If the mentors are to grow through the experience, it is vital that they are given effective staged feedback. We have therefore developed a simple appraisal system based upon the Engineering Council’s [3] Monitored Professional Development Scheme (MPDS).

Approximately every third week supervisors observe team meetings and conduct an appraisal of the mentor’s performance; completing a standard questionnaire form. At the same time, they check the progress of the project team but only intervene if problems or difficulties are apparent. The supervisor meets each mentor in private shortly afterwards to discuss the appraisal, with the purpose of identifying the mentor’s strengths and weaknesses. Both supervisor and mentor comment on and sign the appraisal record. Our students are mostly unfamiliar with reflective appraisal and take a little while to adjust but usually build a mature working relationship with their supervisor. As mentors start to reflect on their performance, we find they are usually more critical than the staff observing them. To get the best out of appraisal, it should be introduced as a separate topic within the module support programme.

To further encourage self-reflection, supervisors host an informal management meeting once each semester with all the mentors in their company group together. Mentors are encouraged to exchange ideas on what they perceive as being effective and what has not worked so well for them. They identify problems and discuss how best to tackle them. These sessions are particularly useful and universally welcomed.

In recognising the usefulness of an appraisal system, we arrange for intermediate feedback on the mentors’ performance by the mentees. We have prepared a simple anonymous questionnaire for this purpose that mentors distribute amongst their teams. Information received through this does not directly affect module marks but helps the mentors identify their own strengths and weaknesses.

**STUDENT SUPPORT AND CONTEXT**

The mentoring activity is, of course, central to the ‘Project Leadership’ module, but if participants are to realise the maximum benefit from it they should take time not only to reflect on their leadership and management performance but also to place the activity into the wider context. There is therefore a support programme running in parallel with the mentoring activity. Few lectures are given because the seniority of the high calibre students lends itself more readily to participative workshop style teaching. The taught element of the module has three functions.

- To support the mentoring activities through a number of lectures and training workshops on subjects like project planning, team building, motivation and leadership, appraisal and how to conduct and record meetings.
- To remind students of contemporary project management theory (studied in depth at level 3). In particular, we look at team dynamics and psychometric testing, and how personality factors influence the effectiveness of different management and leadership styles.
- To consider, through case study, different types of projects, large and small, and tease out the common skills and expertise needed by those who lead them.

**ASSESSMENT**

Assessment comprises three elements. The project supervisors mark assignment 1 against pre-defined criteria but the module leader marks assignments 2 & 3.

1. Mentors write up their experiences including a reflective critique of their performance and the responses of their mentees. The appraisal system provides information for the report I that it identifies strengths, weaknesses and growth from the perspective of both supervisor and subordinates. Students are expected to report how they reacted to the issues raised and how they adapted to personalities and to circumstances. The appraisal forms are appended to the reports and their numerical scores (staff appraisal only) contribute a small percentage of the report mark.
2. A short essay based on a reading assignment is set midway through the year to encourage students to research project management techniques for themselves.
3. A two-week case study assignment, delivered by a practising company director towards the end of the year. This widens the scope of the module by challenging students to consider how they might initiate and manage a major venture capital project. This interactive team exercise uses role-play to demonstrate the different views of interested parties on a board of directors. Assessment is part oral, part written and students draw parallels with their mentoring experiences.
**BENEFITS**

This module is quite a departure from our usual diet of engineering science, laboratory investigations and lecture-based tuition. The potential benefits in the students' personal development, however, are obvious. The leadership scheme is a self-building experience: mentors recall their own experiences at level 2 and this, added to the experience many have gained in industry during our optional third year sandwich placement, makes the whole experience come to life. What is most noticeable is the mature attitude the finalists invariably bring to the work. The motivation not to let their charges down is very high, but the acquired responsibility of mentoring a team also influences the performance in the parallel final year project work where we now see an unprecedented degree of professionalism.

It is particularly pleasing when we contrast this with the initial approach of the same students at level 2. First and second year university coursework assignments are commonly typified by mark-driven, minimalist effort and it requires real motivators to overcome this. Working with industrialists on real projects motivates many and we are convinced that the introduction of student-mentors has further improved the work ethic and quality of the projects. It appears that students respond more readily and attentively to instructions and suggestions from mentors than from academic staff. Perhaps they relate in a manner that seems more relevant.

When compared with directly supervised level 2 projects the main benefit for supervisory staff is the reduced number of tutorial meetings that they need to attend as many of the weekly meetings are now taken by the mentor. Weighed against this, however, is the additional marking (mentoring reports and appraisal), management meetings with mentors and the obligation to monitor and take responsibility for project teams at arms length. On balance, there is no significant change in the time commitment for the academic staff.

**REFLECTIONS**

A lot of administrative work goes into providing the leadership experience for students but the result is a stimulating experience. We have not yet attempted any scientific analysis of the outcomes but module feedback is consistently good. Occasional comments like “the most useful module I did at Loughborough” are gratifying and show that at least some students gain from it. A number of finalists also reported that they discussed this experience during job interviews and that employers were keen to hear more. Their signed appraisal record provides direct evidence of the experience. Where negative comment has been received, it was traced to a single poorly motivated supervisor who failed to give proper feedback. It is clear, therefore that the staff involved must be fully committed the scheme.

The professionalism and maturity, referred to earlier, is probably the product of final year mentors working ‘with’ academic staff rather than ‘for’ them to assist and motivate their project teams. Team leadership comes more easily to some than to others and some otherwise very capable candidates are surprisingly ill at ease in a position of authority. Confidence improves noticeably as they gain experience.

University-Industry projects offer a wide range of benefits to all parties involved. Above all, the team players are seen to noticeably develop in professional stature through this work. Perhaps not surprisingly, they begin rather slowly and hesitantly when faced with an unfamiliar open-ended problem at year 2 but end the scheme with confidence and commitment. We believe that, taken together, these modules represent a modern and novel approach to appropriate vocational training.

**REFERENCES**


FIGURES AND TABLES

FIGURE 1
HIERARCHICAL SUPERVISION STRUCTURE

Academic Supervisor  Industrial Tutor

Mentor
Level 4

4 or 5 teams

Team Member
Level 2  Team Member
Level 2  Team Member
Level 2  Team Member
Level 2