Towards a framework for successful learning outcomes in industrial visits

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Abstract: Industrial visits for engineering students have significant potential benefits for all involved. For the student, it is an opportunity to broaden their understanding of the industry and experiencing the practical application of theories learnt in class. For the industrial organisation, it is an opportunity to showcase itself as a potential career destination to the students, whilst for the university it is an opportunity to enrich the student experience through authentic learning. However, student visits to industrial organisations are often fraught with difficulties, and all the three parties involved may come away dissatisfied. They may all view these visits as unnecessarily time-consuming, with students failing to see their relevance, academic staff failing to appreciate the efforts made by the industrial organisation, and staff of the industrial organisation simply viewing these visits as just another onerous task fraught with related risks. The research reported in this paper explores the relationships and interactions between students, academic staff and the staff of the industrial organisations involved with industrial visits. This was done in the context of a final year MEng module on industrial visits and case studies run by a research intensive university in the UK. A key outcome arising out of this research is a framework for industrial visits outlining the required nature, frequency and timings of engagement between university departments and industrial organisations.

Introduction

Industrial visits are an integral part of most engineering education programmes. According to Sanromán, Pazos and Longo (2010), industrial visits give students insights into their future professions by giving them the opportunity to observe industrial processes in operation. In addition to benefiting the student, industrial visits also benefit companies by bringing them into contact with prospective employees. Moreover, industrial visits enable universities to fulfil the accreditation requirements of most professional engineering institutions relating to the familiarisation of students with professional practice [JBM, 2009].

Although industrial visits are widely acknowledged as being useful, they are also viewed in negative terms as being time consuming educational activities that often require a lot of travelling, and that often inconvenience everyone involved (Ashford and Mills, 2006) – the academic staff who have to spend time away from their research, the students who have to spend time away from their curricular and extra-curricular activities, and the host companies who often have to put up with the visits in the face of pressing business demands.

Industrial visits can also fail to deliver their educational objectives, thereby rendering them potentially expensive pedagogic flops. Orion and Hofstein (1994) analysed field trips in Geology, and concluded that for the trips to be pedagogically effective the students should first have attained the necessary level and type of knowledge and skills required for them to engage effectively with the learning processes in the field. In addition, the students should be psychologically prepared for the task and
lecturers accompanying the students should be familiar with the issues to be covered in the field trip. McLoughlin (2004) observed that whilst teachers often viewed field trips in a positive light, most teachers underestimated the difficulties associated with making the visits meaningful to students. To remedy this he proposed general field trip guidelines that include taking into account their pedagogic aspects as well.

At the University of Exeter we have a final year module on industrial case studies that involves taking final year Master of Engineering (MEng) students on industrial visits. This module has been in place for a considerable number of years, and whilst it has generally received good feedback from the students, it has also received considerable criticism from both students enrolled on the module and academic staff assigned to run the module. In this paper an in-depth assessment of the perceptions of both the students and academic staff is presented. These perceptions were assessed through informal and opportunistic interviews with academic staff and students on the module. Feedback from the students submitted through the university’s formal feedback mechanisms was also analysed. Based on these perceptions, a number of issues that need to be addressed are identified and presented. This analysis may also be important to other engineering departments, given the importance of field and industrial trips in the engineering curriculum.

Overview of the Industrial Case Studies Module

The Industrial Case Studies module is a final year (fourth year) MEng module. The module has been structured with the objective of easing the student’s transition from university into industry by raising their confidence and equipping them with relevant skills. It is compulsory for all MEng students across all the engineering disciplines at Exeter – Electronics, Engineering Management, Civil Engineering and Mechanical Engineering. Broadly, the module seeks to broaden the student’s understanding of the operations and management of a variety of industrial organisations. It also seeks to provide the student with a greater degree of industrial awareness than would otherwise be gained from a purely theoretical lecture programme.

In this module students visit large companies such as manufacturers of telecommunication equipment, automobile engines, aircraft, helicopters, pumps, paper converting machines, medical disposables and ceramic tiles. Visits are also organised to civil engineering and construction sites. The responsibility for organising the visits is shared between students and the College. The students are encouraged to organise individual visits and the College is committed to organise a significant number of visits.

The module consists of two assignments. The first one is an individual assignment in which individual students are required to write a report comparing the management and operation of the large companies visited. The second assignment is a group assignment in which the students are required to investigate and analyse a management or operational project in a local company. The project may either be proposed by the company, or be proposed by the students after meeting and discussing with company management. Examples of projects that have been undertaken as part of this module include investigating the use and effectiveness of IT within a company, assessing the effectiveness of staff training programmes, assessing the effectiveness of a company’s computer user support system, identifying and recommending new ways to deal with production waste materials, helping a company to decide which CAD system to adopt, improving disability access within an organisation, improving a company’s web page site and developing a new tourist attraction. In addition to agreeing with company management on the nature and scope of the group projects, students also give the company weekly updates on their progress, and at the end of the project they write a report and give a presentation on their findings to the company management.

Results and Discussion

As has been previously mentioned, the module on industrial visits comprises two sections: industrial visits to large companies, and mini projects undertaken in small to medium enterprises (SMEs) located in and around the city of Exeter. Industrial visits are carried out in the first term, between October and December. Mini projects are carried out in the second term, between February and April.

Staff and Student Perspectives on Industrial Visits

Most of the students on the course showed little enthusiasm for the industrial visits. This was partly because the industrial visits had been scheduled to take place on Wednesdays, a day traditionally reserved by the University of Exeter for academic staff meetings and student sports activities. As a
general rule, no lectures are scheduled on this day. With regard to the final year MEng programmes, no lectures are scheduled on this day except the industrial visits. From the perspective of the Department of Engineering, therefore, Wednesday was the only day of the week in which students could go out on industrial visits the whole day without the possibility of missing other lectures. Consequently, the final year MEng students were forced to choose between industrial visits and sports activities. Whilst most students could easily forgo sport, some students were involved in sport at semi-professional level and therefore had a lot to lose by missing out on sport. Consequently, a number of students felt that the Department was unreasonably infringing on their right to engage in sport. Some of them had had to give up membership in sports teams and this had not gone down well with them.

The academics running the module also expressed misgivings with the module. Whilst the module does not have scheduled lectures, the academics felt that it placed a lot of demand on their time. For instance during the summer months when there is no teaching, they have to arrange industrial visits with the large companies as well as identifying and agreeing on possible projects with local companies in and around Exeter. Company approvals also tend to take a long time, given the requirement for most company representatives to refer all requests for visits up the company hierarchy. In addition, whilst most organisations expressed a willingness to accommodate student visits during the specified first term period, others had business cycles which made it difficult for them to schedule visits within this time-period.

Prior to an agreed visit, academics have to organise transport for the visit and do all the security-related paperwork required by the host company. To further compound matters, some companies would cancel visits too close to the scheduled day. A commonly cited reason for these cancellations was the lack of personnel to host the visits on the specified date. Academics felt that whilst organisations would be eager to host students, their main priorities were on meeting business objectives, and whenever business schedules coincided with a planned visit, this would invariably result in the visit being cancelled, often at short notice. When this happened, the academic staff would then have to run around to reorganise alternative visits. If this was not possible they then had to inform the students who would invariably complain since they, in turn, would have to rearrange their sporting and social engagements.

Academics also expressed concern that industrial visits eat into their research time. Typically an industrial visit would mean that the academic staff concerned had to take a whole day away from university. This is because the University of Exeter is in the largely rural South West of England whilst large organisations that may be of interest to the students are located in the major cities like Bristol, Cardiff and Birmingham. This often necessitates a journey time of three to four hours to get from Exeter to the company premises, and a similar amount of time back.

Academics also felt let down by students who often chose not to turn up for the trips without offering any reasons. To ensure that visits would be meaningful, the number of students on each trip was kept to a maximum of 15. However, some students often failed to turn up without telling the academic beforehand. This meant that a scheduled trip of 15 students would often have 9 or less students. Rescheduling visits for the absconding students was tedious and time consuming.

Whilst presentations by company representatives were generally of good quality, both staff and students expressed concern with the requirement by some organisations preventing them from taking mobile videos of the presentations. Both students and academics also felt let down by most organisations refusing to give them copies of presentations primarily because of company regulations governing intellectual property. In some cases students complained that companies tended to concentrate more on advertising their potential as good employers to the students rather than focussing on meeting the learning objectives of the visit as agreed between the university and the company. By the time students get into the final year, most of them would have secured offers of employment from organisations that offered them work placements in previous years. Consequently, their main objective would be to learn enough on the visit to enable them to do their assignment.

The Engineering cohort at the University of Exeter is unevenly distributed, comprising largely of Civil Engineers and Mechanical Engineers, with far smaller numbers of Electronics and Engineering Management students. Consequently, Electronics students often found themselves going on company visits where the main focus was on processes and activities relevant to Civil Engineers or Mechanical Engineers. Owing to the uneven distribution of visits between the engineering disciplines, some Civil Engineers ended up going on non-civil engineering visits. Even though the main objective of the visits was to focus on management practices, students going on visits outside of their disciplines often felt that the visits were irrelevant. Consequently most chose to drop out of visits entirely. Others attended
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the visits, but were often disruptive during the visits. This was further compounded by the fact that by the time the visits took place in the first term of the final year of study, most students, especially those already in receipt of employment offers, would be quite sure of the areas they would be working in after graduation. Consequently any visit outside of their prospective area of employment was viewed as a waste of time. In view of this, academics in charge of the module felt that the visits were ill-timed. Rather, they felt that the visits should be timed to take place in the second term of the third year so as to coincide with the period in which most students would be actively seeking work placements with prospective employers.

Staff and Student Perspectives on Industry-based Mini Projects

Mini projects are carried out in companies, typically SMEs, in and around Exeter. This is to minimise travelling time and costs since the students have to visit the company premises a minimum of three times. From the perspective of the academics, local companies tended to show more enthusiasm to interacting with students than the larger companies. The projects agreed between local company management and students tended to be those projects that the local companies viewed as important, but since they were not in the critical path of company business objectives they tended to be set aside. Students in the second term of their fourth and final year tend to possess sufficient theoretical knowledge to adequately handle most of the day to day issues faced by local SMEs. In addition, these students would have had at least one or two summers of work placements, the first one at the end of the second year, followed, in most cases, by a second work placement in the summer period between the third and fourth year. Consequently, by the time the students embark on the mini project phase of the module, they possess sufficient work-related skills, including business awareness, to carry out an effective job. As a result, in contrast to large companies which are often sufficiently well-resourced, local SMEs view the students as an important resource that can impact positively on their operations.

Carrying out mini projects for the local SMEs gives the students a measure of responsibility, and most students take the opportunity to prove themselves by carrying out a good job. Students get to relate to company management as professionals, and their views are often taken seriously. Students also report identifying skills and attributes they were previously unaware that they possessed. This phase of the module is often welcomed by students. However, students are often concerned by the fact that this is a group project in which they do not get an opportunity to select project partners. Some feel that underperformance by other group members could lead to them being awarded low scores. At this point in time most students would have received conditional offers of employment specifying that the students should achieve a minimum degree class, typically an upper second class, and anything that threatens the achievement of this class is viewed negatively.

Improving the Industrial Visits Module

At the final year stage when this module is offered, the main focus of the student is on the world of work. Companies are better placed than universities to effectively impart work-related skills to the student who is at the point of leaving academia for the world of work. It is therefore necessary for companies to be encouraged to take seriously their role as a valued partner in the training and education of the students. Doing so would lead to fewer visit cancellations. Moreover, companies would be more apt to go the extra mile towards ensuring that the personnel they assign to handle the industrial visits have the requisite skills to undertake such a task.

From the perspective of the students, visit cancellations are interpreted primarily as lack of organisation on the part of the academics with primary responsibility for the industrial case studies module. Such a perception often leads to student dissatisfaction with the module. Consequently, it is essential that cancellations be reduced as much as possible. Where cancellations are unavoidable, they should be replaced by appropriate fall-back activities. Moreover, changes in visit schedules should be conveyed to the students in a timely manner. This aspect is in agreement with the suggestion by Rahman and Spafford (2009) that poor organisation “might jeopardise the benefits that could be derived from field trips”.

A company may be forced by genuine unforeseen circumstances to cancel an industrial visit to its premises by students. However frequent cancellations may suggest that the company does not see the value to itself for investing staff-time in facilitating student visits to its premises. Academics on the module felt that visit cancellations could be reduced by improving relationships between the university and the companies. However, as business entities, companies only value relationships with university departments if they expect to reap some benefit from the relationship. As Maffia (2000) observes with regard to employer involvement in student project supervision, access to research expertise is a key
reason for a company to seek to establish and maintain strong relationships with a university department. Such strong institutional relationships are mediated primarily through personal contacts between academic staff and the company's employees (Bolden and Petrov, 2008). This therefore suggests that universities need to view industrial visits in the wider context of improving and maintaining employer engagement in all the key activities of an academic department, including in education and research.

Turning to the academics in charge of the module, both academics and students alike felt that academics needed to be more aware of industrial practices. This would enable them to appreciate both the concerns of the companies as well as their modus operandi. With the university being a research intensive institution, lecturers assigned to the module often view the long hours needed to establish and maintain relationships with industry as a burden that eats into their research time. This can be addressed in the long run by assigning this module to teaching-focussed lecturers who have had substantial experience in industry, and who, ideally, have developed a number of useful contacts during their time in industry. In the short term, this can be addressed by assigning most of the administrative tasks to professional services staff, and leaving the academic to concentrate on pedagogic issues. However, this short term solution is less than optimal since companies often wish to speak directly to the academic concerned.

Developing and maintaining relationships between academics and industry contacts takes time. Consequently, academics assigned to this module should be expected to stay with the institution for a number of years. In addition, the investment in time and effort that academics make towards this module should be seen to enhance their progression prospects, rather than impeding them as is the current situation where excellence in research is the primary ingredient for academic staff promotion in research intensive institutions. In the long term therefore, this calls for research intensive institutions to address the parity of esteem issues pertaining to teaching-focussed and research-active academics (Ramsden, 2009).

Another issue which academics felt should be improved was on the timing of the module. At the stage when it is offered, most students have secured conditional offers of employment and they are not interested in exploring anything else outside their immediate area of interest. The effectiveness of the module could be improved by running it during the time when most students are actively looking for work placements leading to full-time employment. This is often in the second and third term of the third year of the MEng degree programme. Pedagogically, aligning course content with student interests often leads to improved learning. In addition, this would also make the module accessible to third and final year Bachelor of Engineering (BEng) students.

Academics also agreed with the view expressed by Sanromán, Pazos and Longo (2010) that sufficient time should be invested in preparing students for the industrial visits. For instance pre-visit lectures could be organised to tell the students about the host organisations, and to enable them to think through the possible questions they might want to ask the company's representatives. However, to do so the lecturer should be relatively familiar with the company's organisational structure as well as its business processes. Over and above pre-visit preparations, Bozdogan (2008) recommends that in fact careful consideration of the field trip must be carried out during the preparation before the visit as well as during the visit itself, and in addition, an evaluation should be carried out after the visit. A possible evaluation approach would be to hold post-visit surgeries with both academics and students to identify and document what went well and what went badly during the visits. The outcome of a post-visit surgery would then feed into the next visit organisation.

Another key issue is to address the issue of poor student engagement with the module. This has been manifested by the students' reluctance to reorganise their sporting activities around the visit schedules. Sport is important for the well-being of the student, and Astin (1984) suggests that student participation in sports has positive benefits such as higher student persistence and retention and lower student attrition. Whilst timetabling issues may be of concern, student engagement can be significantly improved by ensuring that academic activities such as industrial visits do not encroach onto the time set aside for sport and other extra-curricular activities. This can be done by reducing the travel time associated with industrial visits by focussing more on organising visits to local companies instead of visiting the big companies that are often located far away from Exeter. As a consequence, it becomes possible to conduct industrial visits within the normal timetabled learning and teaching sessions.

Whilst there is scope for students to suggest and organise industrial visits, few students have taken this up, thereby leaving everything to the academics running the module. During the final year of the MEng programme, students should be encouraged to show initiative in organising their own learning
activities. After all, at this stage of their academic life, they are more or less certain of the next stage of their career trajectory after graduation. This could be done by encouraging students to arrange visits to the companies that have previously offered them work placements. Students could be encouraged to do so by awarding credit points towards their attainment in the industrial visits module.

An example is the contact with practice credit scheme by the Department of Built Environment at Coventry University in which part time students can earn credits through organising and running events to share their work experiences with full-time students (Davis and Davies, 2008). These events include making presentations on their work experiences as well as arranging class visits to their workplaces. A visit arising out of this initiative would have the added benefit that the student has insider knowledge of the company and is therefore able to furnish the other students with pertinent knowledge about the company and its processes. On the side of the company, this is helpful since the student is in a position to spell out to the company representatives how best to meet the visit’s pedagogic objectives.

Conclusion and Future Work

We are currently reorganising the Industrial Case Studies module to take into account the recommended improvements outlined in this paper. However, whilst academic staff feel that the module would be better pedagogically aligned to the students if it is delivered in the third year and not the final year of the MEng programme, such a move would require substantial reorganisation of the whole MEng programme. It has therefore been decided to keep the module in the final year of the MEng programme in the short-term.

It is anticipated that the reorganised module will be introduced at the beginning of the 2012-13 academic year. During the coming academic year regular feedback will be solicited from the academic staff and students on the module through questionnaires, indepth interviews and focus group meetings so as to continue with incremental improvements to the module. Given the dynamic changes currently taking place within engineering education, we anticipate that constant feedback and discussion with students on the module will be a regular feature of this module over the foreseeable future.

References


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