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Integrating Education and Industry through Enhanced Projects

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Demands are being made by governmental, institutional and commercial bodies on the university system to produce engineers who are more in tune with commercial values and mechanisms. Conversely, the availability of industrial experience for students is dropping as a result of social and economic pressures. This paper argues that a new approach to the traditional final project can provide a mechanism to bring together the competing demands and benefit all parties.

INTRODUCTION

It has long been recognised that a gap exists between the education of engineers and the skill set of industrial workers, illustrated by much anecdotal evidence from employers that *graduates come to us and we can't put them to use*. Often this gap is a misunderstanding of the role of higher education versus training on the behalf of employers, as illustrated by the graduate entry schemes or fast-track schemes run by the more enlightened, or possibly simply wealthier, companies.

From the point of view of the would-be employee, they suffer from the catch-22 position of *you can't get a job without experience, you can't get experience without a job*. Historically, experience could often be gained by summer work, but this is becoming harder and harder to come by. An excellent solution is often provided by a sandwich degree, where the student is assigned to an industrial mentor for anything from 4 to 12 months as an integral part of their course, but again the economic climate is both reducing the number of employers who can afford to provide the opportunity, and making it economically nonviable for students, who wish to complete their education as quickly as possible.

The Government has made its position clear in its announcement of specialised funding for part-time and industry-based funding for 1999/2000, and through the standards body QAA [1][2]. The Engineering Institutions have particularly expressed their expectation (SARTOR 1999) that programmes which they accredit to satisfy the qualifications for a chartered engineer will include a large element of managerial and commercial information, and a measured set of personal skills which can only realistically be achieved by having personal experience in a commercial environment [3].

At Glasgow Caledonian University an accredited BEng programme has been running for many years, which includes full-time, sandwich (by a full-year industrial placement), and part-time (day-release) modes of attendance. Analysis of the final year statistics over recent sessions (Table 1) has thrown up clear evidence that the overall averages of the students have a direct relationship with the amount of industrial contact that they enjoyed. That is that in general the part-time students scored higher than those who undertook an industrial placement, who in turn scored higher than those who had chosen not to take the placement.

A previous initiative, Structured Industrial Practice System (SIPS), provided an element of the academic teaching and assessment which was based on actual industrial practice and case studies, including industrial visits [4]. This was highly successful academi-

Table 1: Average student marks overall.

Attendance	98 Overall Average	97 Over.	96 Over.
Full-time	55	54	55
Sandwich	57	56	56.3
Part-time	58	59.5	58

Table 2: Average student marks for project.

Attendance	98 Project Average	96 Proj.	96 Proj.
Full-time	52	57.3	N/A
Sandwich	56	59.5	58.4
Part-time	62	62.2	63.4

cally, and was also shown to be worthwhile by the feedback from the students. However, SIPS was very resource hungry in time, management, delivery and in cash expense terms, and funding was not sustainable. Its successor, Case Studies, uses actual industrial sources for student information, but cannot provide large scale industrial contact.

Further analysis (Table 2) showed that the achievement dichotomy was especially true in the scores for the Honours Project, which accounts for over 1/4 of the final grading. The standard of the work performed in the projects of most of the part-time students gained higher praise from the external assessors than those of the full-time contingent, and so an analysis of the range of reports was carried out to identify what elements could be identified that would allow the full-time students to achieve a higher standard of work.

From the analysis, several particular points stood out. Particular personal attributes were much in evidence, in that the part-time student profile showed a greater level of maturity and commitment, which the individuals attributed to their expectation of career development. There was also evidence of better project and personal management - goal setting, timekeeping, recognition of milestones, and modification of the plan in progress.

A major point was that the subject of the project, that is its aims and objectives, set the tone for the level of work to follow - not a particularly original observation perhaps, but analysis showed that even where the subject matter of a full-time report was of a significant and appropriate level, the student had not always prosecuted the work with the enthusiasm or skills shown by the part-time persons. Discussion with the full-time students at presentation time often elicited the information that the project was regarded simply as an assessment, and that the student expected that nothing would come of the results of the work, and that this affected their attitude to work itself. However, similar discussions with the part-timers provided the information that the work itself was most often being done as an integral part of their employment, and would actually be used by their employer, which made it imperative that the results were of a high standard.

From this it is clearly recognised that if the full-time students are given the opportunity to become involved in a real industrial problem, they will gain exposure to an environment which will bring them several advantages:

- One immediate advantage is that of simply gaining a familiarity with the commercial environment. A straw poll of final year full time students showed that the majority of the students had never spent any time in an industrial or commercial environment (retail aside). This clearly contributes to the culture shock that the student feels on taking formal employment.
- Students are often unaware of the attitudes prevailing in the modern workplace, where simply *doing your job* is no longer sufficient. The university environment does not and cannot provide the types of stimuli that instil proactive attitudes.
- The student will see practical implementation of the work management processes which they have been taught, and will recognise the importance placed on personal management by industry, thus encouraging them to use these skills in their own project.
- The outcome of the industrial project is far more likely to be used as the basis for some continuing work, and thus the students will perceive a higher value put on their efforts, and will thus associate the work with their self-value and will strive harder.
- The student will likely be working with professionals in their field, who will provide extra help and support exceeding that which they already get from university staff and peers.
- It is likely that the student will gain access to equipment and services that the university might be unable to match.
- The student will have access to a wider range of information sources, some of which may not even be in the public domain.
- The student will also perceive that they are increasing their *salability* in the job market. The contacts they make in industry will provide a good basis for the networking skills so important in modern commerce.
- Overall the personal skills which the student will gain will also improve their performance in the other areas of the course, increasing their overall grading.

Thus the student stands to gain greatly from partaking of an industry-based project. It is clear however that the majority of these advantages are only conferred with the willing participation of the personnel in industry. Apart from a warm feeling of benevo-

lence, what return does industry get for its effort?:

- Primarily, the graduates that they hope to employ will now have a good grounding in the personal skills and attitudes they feel are lacking at present - in their own words, they will get work out of them in a shorter time.
- Surveys of industrial contacts have shown that there are always more questions than they have time to answer, and topics that are not cost-effective to investigate. The availability of a highly intelligent person with *free* time and skills can often allow a feasibility study to be completed which can then direct a more effective decision on a future course of action.
- Industry has commercial secrecy and often are too busy to keep aware of technical advances not directly related to their product. However, cross-fertilisation of ideas, technologies and techniques can produce very large savings and advances. Students are *de facto* aware of a wide range of current topics, and as *outsiders* are often more likely to make lateral suggestions.
- More generally the industrialists will be able to influence the skillset of the students directly, perhaps to add a *training* element to the academic theory.
- The closer ties between industry and academia, as previously commented upon, can only be augmented by the high level of interaction involved in these projects.

Glasgow Caledonian University has particularly close educational ties with several companies that have embraced the concepts of integrating student projects with company objectives. The characteristics of such projects have been clarified to ensure that assigned projects are:

- at an appropriate academic standard;
- can be achieved in an appropriate timescale;
- have appropriate resource requirements;
- provide a suitable level of payback to the company;
- but do not put too much pressure on the student.

For example, Motorola Cellular have established in their Bathgate factory a working party of senior managers and engineers (known as the *black belt* group) whose task it is to identify areas of their processes which may benefit from an in-depth study, and then to assign appropriate resources to these topics. Some of these have been further identified as being suitable for final year honours students to attempt, and suitable candidates are being allocated for projects next session.

CONCLUSION

The involvement of students with industry is strongly supported by Government via the QAA statements, the Institutions via SARTOR, by industry itself through its management statements, by academia, and by the students themselves. However, the mechanisms which supply this involvement are under strain due to the changing commercial climate. This paper therefore concludes that a more formally defined mechanism for involving industrial needs and resources in the final year Honours project can provide a means to gaining the majority of the stated goals.

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BIOGRAPHY

Mr McKee joined the Department of Engineering at Glasgow Caledonian University in 1990 from Digital Equipment Co, where he was employed as a Senior Support Engineer in the Sales and Service division.

His teaching fields are Computer Technology, Digital Electronics, Software Engineering, and Distributed Multimedia Systems. His research, consultancy and publication areas encompass Electronics Testing and Maintenance Technology, Industrial Automation and Control of Real Time Systems, Distributed computing and networks, Multimedia systems and technologies, and Computer-Aided Learning (CAL) technologies and applications.

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