

## THE ROLE OF VISITING PROFESSORS IN THE SUPPORT OF INDUSTRY BASED TEAM DESIGN PROJECTS

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### **Abstract**

This paper describes the ongoing involvement of two RAE Visiting Professors in Engineering Design in industry based team design projects. The projects form part of accredited BEng/MEng degree programmes in the Department of Design, Manufacture and Engineering Management (DMEM) at the University of Strathclyde. The paper will briefly outline the role of the team projects in the degree programmes offered by DMEM, the learning objectives of the project, the input of the visiting professors and lessons learnt. The presentation at the Workshop will include a number of examples of the output of the projects.

### **1 The Department of Design Manufacture and Engineering Management**

The University of Strathclyde was formed from the Royal College of Science and Technology and the Scottish College of Commerce and received its Charter in 1964. Both these institutions had long traditions of involvement in higher education. The Royal College dates back to Anderson's University, founded in 1796 as a *Place of Useful Learning*. This history gives the University over 200 years of involvement in technical education. Currently the University has approximately 10600 undergraduates, 5000 postgraduates and over 40000 students who attend the University each year to take courses that do not lead to a degree. The University has five faculties including Engineering. The Faculty of Engineering consists of nine Departments currently educating 2300 undergraduates and 500 postgraduates:

- Architecture & Building Science
- Bioengineering
- Chemical and Process Engineering
- Civil Engineering
- Design, Manufacture and Engineering Management
- Electronic and Electrical Engineering
- Mechanical Engineering
- Naval Architecture and Marine Engineering
- National Centre for Training & Education in Prosthetics and Orthotics

The Department of Design Manufacture and Engineering Management (DMEM) aims to produce high calibre graduates in the *create, make* and *manage* processes of product development. The Department has 300 undergraduate, 35 taught postgraduate and 15 research postgraduate students. It has 16 academic, 4 academic-related, 16 research contract, 10 technical and 5 secretarial staff. In the last four years over £750k has been invested in the Department to provide a rapid design and manufacturing laboratory, advanced CAD/CAM

(SDRC Ideas), a design and make laboratory, project and design studios, and modern office space. This complements the existing laboratories housing general, CNC and precision metal cutting machinery, metal forming presses, metrology equipment and manufacturing systems.

The Department offers a suite of three undergraduate courses, all accredited by an appropriate professional engineering institution. All the MEng programmes are offered with a Diploma in Entrepreneurship or Engineering Management for students with high entry qualifications:

- MEng/BEng in Engineering and Enterprise Management
- MEng/BEng in Manufacturing Engineering and Technology
- MEng/BEng in Product Design Engineering

The above degrees share a common first two years, giving the students an appreciation of design, management and manufacturing technology. Currently over 67% of the Department's undergraduates are registered for the MEng/BEng in Product Design Engineering.

In October 2002 DMEM will commence 4 additional degree programmes:

- MEng/BEng in Design Computing – in collaboration with the Department of Computer Science
- BEng in Sports Engineering – in collaboration with the Scottish School of Sports Studies
- BSc in Product Design and Innovation – to complement the MEng in Product Design Engineering
- BSc in Enterprise and Technology Management – to complement the MEng in Engineering and Enterprise Management

DMEM also offers MSc programmes in Computer Aided Engineering Design, Integrated Product Development, Engineering Design, Technology Management and Management of Competitive Manufacture.

## **2 Course Structure**

In Scotland BEng and BSc Honours degrees are usually 4 years long and MEng degrees five years. Students tend to spend one year less at secondary school than in England and Wales and take Scottish Highers in 5 subjects.

The University of Strathclyde runs a modular system. Each year of a degree consists of 120 credits. This is usually taught in module units of 10 credits with each 10-credit unit notionally equivalent to 100 hours of student effort including lectures, tutorials, laboratories, assessments and private study.

The undergraduate degree programmes offered by DMEM contain a large amount of project work. Projects are conducted individually and in teams. Projects commence in the first few weeks of the first year and gradually increase in size and complexity throughout the years of the course.

All of the undergraduate degree programmes listed above have a 10-credit team project in year 4 and a 20-credit team project in year 5. MEng students will therefore take part in two

industry based team projects. The 4<sup>th</sup> year project can call upon at least 400 hours of total student effort and the 5<sup>th</sup> year project 800 hours.

These team projects have the generic title *Product Development Project (PDP)*. The PDP is where the RAE Visiting Professors make their major contribution to DMEM.

### **3 Product Development Project**

The product development projects are conducted in multi-disciplinary teams of four students. The projects are multidisciplinary in that students on all the undergraduate degree programmes are mixed together. Currently this involves 3 degree programmes, by 2005 it will also involve students from the 4 new degree programmes. The teams are selected by the module leader who attempts to ensure a blend of skills in each team including analytical, creative, artistic, CAD, marketing, management and manufacturing technology. The module leader also 'balances' the teams in terms of each individuals performance in previous classes.

The 4<sup>th</sup> year project can be expected to attract 400 hours of total student effort and the 5<sup>th</sup> year project 800 hours.

Each project is conducted in association with an industrial partner who sets the initial brief in association with one of the visiting professors or a member of staff. An example of a design brief is given in Appendix 1. Table 1 lists the projects running in 2001/2002.

The projects have the general aim of integrating and applying design knowledge and skills, acquired in previous years of the course, to an industry based design project. In addition the project should further develop team working skills. The specific learning objectives are given to the students as:

1. To plan, control and lead a design project from inception through to the manufacture of a prototype which meets the customer / client and company requirements.
2. To integrate engineering, design, management and business tools and information to the efficient running of a design project.
3. To work responsibly as part of a design team
4. To understand the nature of a design team, the various roles, disciplines and responsibilities within it, and the need to blend constructively individual strengths and weaknesses.
5. To appreciate the role and responsibilities of a team manager, as an organiser, guiding influence, catalyst and project champion.
6. To understand the need to document and communicate design information throughout a design project.

The team are expected to take the outline product brief through to the building and testing of a prototype product. In addition the final product should be fully costed. After the facilitation of the first meeting of the team between the students and the company, the teams are expected to fully manage the project and contacts with the company. The academic supervisors and visiting professors are available at specific times each week for face to face studio sessions

and contactable via email at other times. Teams also ensure all information is logged using BSCW software that enables web-based data management. Staff, visiting professors and companies have access to BSCW. The visiting professors and a number of companies are active users of BSCW.

The project is assessed through a team project report (50%), individual report (15%), team presentations (15%), project file (10%) and project log (10%). The team is expected to make both an interim and final presentation (or product 'pitch') to the senior members of the company.

#### **4 RAE Visiting Professor Support**

DMEM currently have two RAE Visiting Professors: Martin Bell and Arthur Slight. Both Professors have been in post since October 1997.

Professor Bell has previously worked as an Engineering Director and CEO. He has extensive design, manufacture and marketing experience. He is currently an independent consultant working for Scottish Enterprise Glasgow.

Professor Slight has previously worked as a technical director. He has experience in innovation, commercialisation and product design. He is currently working as a consultant for Targeting Technology, a company who aims to maximise the transfer of technology and ideas into successful products and businesses in the West of Scotland.

The RAE visiting professors help the product development project in two ways. Firstly through their contacts in Glasgow and the West of Scotland they identify, visit and negotiate with companies who may benefit from a student project; Secondly they attend the weekly team project sessions together with the academic staff to provide tutorial support and input to the design process and project management of each team.

More generally the visiting professors also contribute to the Department through membership of the Industrial Advisory Panel and the promotion of the Department within their network of industrial, government and local authority contacts.

#### **5 Student Response**

The students find the product development projects one of the most frustrating but also worthwhile parts of the course.

The Department does not attempt to fully protect the students from the frustrations of consultant-client communications. Requests for information and meetings are not always met with the promptness that the students would wish for and product specifications change as the company see the project progress and observe what the students are capable of achieving. Students must continually balance the academic requirements to pass the module with the desire to design a product that will be accepted by the company. The Department considers these frustrations as part of learning process. The weekly contacts enable staff and the visiting professors to monitor how the teams are coping with the frustrations and offer appropriate advice.

The students find the project worthwhile because they involve working on a 'real' product and presenting results to senior members of the company. In addition to promoting team working skills students claim that the projects increase their confidence in giving oral presentations to, and communicating with, industrial managers, some of who are in senior positions. Students must 'pitch' their solutions to an often critical and cynical audience, who sadly often exhibit the 'not invented here' or 'we have always done it this way' syndromes. Students thus learn how to manage expectations in terms of what can be achieved within the time and financial resources available and in terms of responses and enthusiasm from collaborating companies. These claims are reflected in the comments made by multi-national companies who actively seek graduates from the Department's courses.

Conflicts between team members are rare as are instances of individuals failing to contribute to the team effort. It is thought that this is because the ethos of working in teams and methods for conflict resolution are inculcated from the first year of the course.

Students consistently comment that the input of the visiting professors is very worthwhile. The students see the visiting professors as 'outsiders'. This has two positive effects: firstly the professors are able to provide an independent arbitration service between the academics and the company; secondly they are perceived as 'real' engineers who have experienced the product development process rather than 'theoretical' academics. (This is rather unfair on some of DMEM's design staff who have had previous industrially based product development experience).

## **6 Lessons Learnt**

Professors Bell and Slight are DMEM's second 'batch' of RAE Visiting Professors. The Department believe that the visiting professors have been successful because they:

- have the appropriate personalities to work with DMEM's staff and engage with the students
- have 'been there and done that' i.e. they have credibility with the students
- are still active in design related activity
- have a good network of contacts
- live and work near the University
- are able to devote regular time to their role
- are 'responsible' to a single Department

The Department has also had to do a number of things to maximise the visiting professors contribution to the projects, namely:

- given them time to recognise that Universities operate differently than industry. Issues surrounding education, assessment and flexibility must be addressed. This took at least one full academic year.
- made them full members of the PDP teaching team. They are expected to be available during the timetabled sessions and contribute to the annual review of the module.
- given them a clear and focussed role in the department.

It was initially envisaged that the Visiting Professors would become self-financing. Raising enough funds from the collaborating companies to pay for their stipends. Unfortunately the majority of the SMEs DMEM works with, although willing to pay for the building of

prototypes, are reluctant to pay for student effort. The usual dilemma faced by the module leader is between ensuring payment and losing an appropriate and challenging project.

## **7 Conclusion**

The three major contributions that the RAE Visiting Professors make to DMEM are credibility, networking and release of staff time.

Credibility is essential in engaging both the students and the companies.

Networking is hard to quantify. Table 1 shows the product development projects run this year. Approximately two-thirds of the projects are attributable to contacts that can be traced to the visiting professors. The product development activity also adds to the Department's overall portfolio of activity some with Teaching Company Programmes, Consultancy and case study lectures being directly attributable to the product development projects.

Design classes, when taught the way they are taught in DMEM, are staff intensive and are thus expensive. The visiting professors provide tutorial support that enables the academic staff to spend more time on some of the other activities expected of them by Heads of Department, Deans and Vice-Chancellors.

The RAE Visiting Professors are a valuable resource; it is essential that the Head of Department finds ways of rewarding and retaining their contribution.

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<b>Project Title</b>	<b>Company</b>	<b>SME</b>	<b>Year Group</b>
Roof Safety System	Prime Fabrication Ltd	Y	4
Laser Assembly Workstation	Coherent Technologies Ltd	Y	4
Personal Care Products	Albyn of Stonehaven Ltd	N	4
Door Security Viewer	Engraved Direct Ltd	Y	4
Rotilt Handle Design	Rotilt Ltd	Y	4
Prefabricated Modular Structures	Castle Composites Ltd	Y	4
Salmon Storage Station	Innes Walker Fish Harvester Ltd	Y	4
Quality Guitar Amps	Sonus Amplifiers Ltd	Y	4
Gateaux Cutter	D & G Precision Engineering	Y	5
Toilet Cleaning System	Unilever plc	N	5
3-Axis Motion System	Zisys Ltd	Y	5
Household Data logger	OTS Electronics Ltd	Y	5
Synthetic Bagpipe Reed	Pipe Dreams Ltd	Y	5
Fluid Level Sensing	Zisys Ltd	Y	5
Tip Pick Up	Zisys Ltd	Y	5
Roller Cleaning Device	W L Gore Ltd	N	5
PCB Tooling – predicting tool properties	Datum Dynamics Ltd	Y	5
Forklift Truck Charger	SEG	Y	5

**Table 1 – Team Projects 2001/02**

## Appendix 1 – Example Design Brief

# PRODUCT DEVELOPMENT PARTNERSHIP PROJECT DESCRIPTOR

**Project Title:** Fall Arrest System Design

**Company:** Prime Fabrications Ltd.

**Date:** 8<sup>th</sup> November 2000

### **Brief:**

Prime Fabrications currently design and manufacture a roof anchor/fall arrest system. Recent European legislation requires that all European buildings must provide safe access to roof structures for activities such as maintenance, cleaning etc. Prime Fabrications are in the fortuitous position of having a roof safety system which has already been approved to the relevant standards, and are at this stage one step ahead of the competition. However, this position is unlikely to last long and the company therefore, have to focus on their marketing mix to take full advantage of the prime mover advantage they have.

This project will involve identifying opportunities for the company to satisfy their customers more effectively than their competitors. Familiarity, with the companies external marketing environment and customer chain is essential and will allow the existing product range to be challenged with a view to developing innovative new products.

### **Objectives**

1. Full analysis of customer chain and external marketing
2. Challenge existing product range
3. Design/prototype innovative new roof anchor/ fall arrest system

### **Deliverables**

1. A project report providing details of objectives 1 & 2
2. Layout drawings and prototype for new roof anchor/fall arrest system

**Start Date:** 8<sup>th</sup> November 2000

**End Date:** 8<sup>th</sup> May 2001

### **Milestones:**

1. Agree product design specification. **Date:** 20<sup>th</sup> December 2000
2. Agree concept for redesigned system. **Date:** 21<sup>st</sup> February 2001