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Developing an Industrially Supported Sports Technology Degree Programme: a Case Study*

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This paper provides an overview of the development and implementation of a three-year industrially supported Sports Technology Bachelor Degree Programme (with an optional placement year in industry) from within the School of Mechanical and Manufacturing Engineering at Loughborough University, UK. The paper describes how engagement between course providers, industry and students has been encouraged and integrated into the curriculum. It is highlighted that the degree programme has flourished as a direct result of the already strong research activities in this area. Attention is given to the structure and content of the programme, links and discussions held with the sporting goods industry and the aspirations and career destinations of students and graduates. We have initiated many industry activities and believe that this is a key factor in attracting increasing student numbers. Examples include, one-year student placements in industry, industry sponsorship of undergraduate projects, extensive donations of equipment for teaching purposes, ongoing input from a departmental industry advisory board and a programme steering group that includes senior industry, academic and sports governing body representatives. In addition, industry are involved directly in teaching which includes visiting lectures, site visits and factory tours. Emphasis is given to how the needs of industry have been accommodated and how industrial support was sought and subsequently integrated into the programme. Insights gained from student feedback forms are discussed. It is hoped that the paper will be of interest to others operating similar programmes and perhaps more importantly to those currently considering how to work co-operatively with industry to enhance engineering education for undergraduate students.

Keywords: sports science; sports engineering; undergraduate; admissions statistics.

SPORT AND SPORTS ENGINEERING AT LOUGHBOROUGH

LOUGHBOROUGH UNIVERSITY has a long established tradition of excellence in sport, sports science and engineering. There has been sports engineering research activity at Loughborough since 1987. Currently the Sports Technology Group works with a number of major sports equipment manufacturers on over 24 projects mostly supporting Ph.D. studentships. Projects include modelling, development and evaluation of footwear, apparel, balls and sports equipment. The main industrial partners that support the research and teaching activities of the Group include: adidas; Callaway Golf; Dunlop-Slazenger International; Head; Nike; Puma; Reebok and Speedo International. Furthermore, organisations such as The International Tennis Association, The English Hockey Association and the English and Wales Cricket Board have also supported the programme. Individuals from these organisations, and the companies outlined, regularly provide guest lectures.

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CONCEPTION OF THE SPORTS TECHNOLOGY DEGREE

The concept for a sports technology bachelor degree programme was first discussed in 1992. A steady decline in the number of students applying for manufacturing engineering degree programmes was the major driver. The Engineering Council's publication, *Engineers for Britain* [1] shows a sharp fall in students entering traditional engineering degree programmes between 1993 and 1999 with declines ranging from 12 to 47%. Engineering only attracted 5.7% of the UK cohort of 1999 university applicants as compared to 11.3% in 1989.

Sports-related subject areas are extremely popular with students in the UK. The School of Sport and Exercise Sciences at Loughborough University run a highly regarded and popular 'Sports Science' degree programme which is always oversubscribed (2500+ applications per year for <200 places). A significant number of the students applying to study sports science have qualifications in mathematics and the physical sciences, and as such posses a similar profile to those required to study traditional engineering subjects. It is worth noting that in 1997, 3444 students were accepted on to sports science degree programmes in the UK,

whereas 4578 students were accepted on to mechanical engineering degree courses. By 2000, the year the Sports Technology Programme first recruited, the number accepted on to sports science degrees had increased to 5031 (8073 applicants), in contrast, the number accepted on to mechanical engineering degrees had fallen to 3923 (4929 applicants). It is further interesting to note that by 2004 (most recent data available) 7296 students were accepted on to sports science degree programmes in the UK, whereas 4547 students were accepted on to mechanical engineering degree courses. In summary, whilst there has been a slight decline in students opting to study mechanical engineering in UK universities between 1997 and 2004, the number of students studying sports science degree has more than doubled in the same time period. The data given here was obtained from the UK Universities and Colleges Admissions Service (www.ucas.ac.uk).

SIMILAR COURSES

In 1992 a UCAS search was conducted to ascertain whether any similar sports technology/engineering courses were being offered by other UK Universities. None were listed under either 'Sports Engineering' or 'Sports Technology'. By 2005, five universities were offering a total of eight sports engineering programmes, with a further 13 offering a total of 20 sports technology programmes. The authors are aware of only a very small number of similar courses outside of the UK; to our knowledge there are currently none in the USA although a number of institutions have expressed an interest in setting up such programmes.

STUDENT QUESTIONNAIRE

In 1993 a simple questionnaire was presented to 200 students attending open days within the School of Sport and Exercise Sciences. These students had applied to study one of the sports science courses on offer. The questions asked and responses obtained are outlined in Table 1.

Sporting goods industry questionnaire

A comprehensive, open-ended questionnaire was circulated to approximately 60 of the larger sporting goods manufacturers. The majority were based in the UK but several EU and US based companies were also targeted. Replies were received from 37 companies; 24 were strongly positive about the course and stated that they would consider seriously recruiting its graduates.

Three key themes emerged from the feedback:

1. The degree should include textiles and materials to have broadest appeal.
2. As most products are manufactured outside the UK the course needs a global outlook.
3. An industry need for knowledgeable enthusiasts within technical sales was highlighted.

Given that both surveys received largely positive comments, we concluded that there was a potential demand from prospective students and the possibility for industry support.

COURSE INCEPTION

The programme was finally approved in 1999; the first cohort started the course in Sept 2000. The programme has a quota of 30 students per year and attracts approximately 150 applications per year. The UK entry requirements are as follows: 300 points (BBB) from 3 A levels or 2 A levels and 2 AS levels, plus minimum grade C in AS level Mathematics, or grade A in GCSE Mathematics. These grades are consistent with those you would expect to see requested by a 'top 20' UK university for general engineering/science degree programmes. The programme is modular, with 6 modules being run in each of the two teaching semesters.

AIMS OF THE PROGRAMME

The broad aims of the programme can be summarised as follows:

- to produce sports technology graduates ready to play a substantial role in companies concerned with the design, manufacture and sale of sports equipment;
- to provide a high quality educational experience for students in a programme of study that combines the academic and practical aspects of the sports equipment industry, sports science, design, manufacture and marketing;
- to develop analytical and transferable skills that will enable graduates to gain employment in a

Table 1. Questionnaire administered to sports science students in 1993

Question	Yes (%)	No (%)	Unsure (%)
Is sports technology a degree course that would be of potential interest to you?	36	43	21
Would you be interested in the sports technology degree if you do not achieve the required entry requirements for your chosen course at Loughborough?	38	49	13
Do you think that sports technology would be an attractive and interesting degree programme to school leavers?	90	3	7

wide variety of professions and to make a valuable contribution to society.

Intended learning outcomes

Upon successful completion of the programme, students should be able to demonstrate a wide range of knowledge and understanding and both practical and transferable skills, in the following key areas, as defined by the following intended learning outcomes in the core module specifications.

Knowledge and understanding:
- exercise physiology, biomechanics, ergonomics and performance measurement;
- industrial and engineering design;
- manufacturing processes and materials selection;
- management, business and marketing practices;
- instrumentation, measurement and experimental protocol design;
- mathematical methods, engineering science and statistical analyses.

Practical skills:
- collect and collate information and prepare technical reports;
- communicate product design ideas through drawings and CAD modelling;
- perform engineering design calculations and prepare engineering drawings;
- use measurement and test equipment to complete experimental laboratory work;
- test design concepts via practical investigation;
- present technical and business information in a variety of formats;
- demonstrate organisational, management and IT skills.

Transferable skills:
- demonstrate high level numeracy and be able to generate and manipulate data;
- apply creative and evidence based approaches to problem solving and design;
- communicate effectively through written, interpersonal and presentation skills;
- use a range of computer-aided design and engineering software;
- structure, plan and manage group and individual activities to meet deadlines.

Acquisition of the above knowledge, understanding and skills is through a combination of lectures, tutorials, seminars, workshops, group and individual projects, practical laboratory work, and coursework. A mapping exercise has been carried out to ensure that the intended learning outcomes, learning and teaching activities and assessments are constructively aligned [2]. The assessment is through a combination of written examinations and assessed coursework. Coursework comprises laboratory reports, technical reports, CAD assignments, problem-solving exercises, group work, oral and poster presentations and product designs.

INDUSTRIAL WORK PLACEMENT

An opportunity for students to undertake a 45-week industrial training period between the second and final year has recently been introduced following requests from students. It is hoped that this will advance the students' preparation for a worthwhile career by expanding their experience of 'real-world sports technology'. Subject to a satisfactory performance in the academic and professional training elements of the placement the student will be awarded a Diploma in Industrial Studies in addition to their bachelor degree. A number of sporting goods companies have expressed interest in taking placement students, some have already taken students on summer placements.

Examples of industry-relevant coursework

A key component of the degree programme is the emphasis placed upon practical work. Half of the modules taken assess practical skills and are totally coursework based. Practical activities include a wide range of experimental laboratory tasks, dismantle and discover activities and design and make projects. Laboratory-based tasks typically include the use of research grade testing equipment to obtain, collate and analyse data. Labs of this sort are used to support teaching of biomechanics, exercise physiology and experimental design.

Many of the activities undertaken use equipment donated by partner companies. The contributions are occasionally substantial (e.g. golf robot provided by Dunlop-Slazenger International) but more typically also include the provision of assorted balls, racquets and sports shoes. Dismantle-and-discover projects involve the stripping down or reverse engineering of sports products e.g. a mountain bike or football boot, to assess the method of manufacture and physical characteristics of the item. Access to the factories of our industrial partners has proved extremely useful in this regard with video footage collected from several factories being used to illustrate various manufacturing processes (e.g. the manufacture of running shoes; golf clubs; tennis racquets; cricket bats, etc.). Notably Dunlop-Slazenger have allowed student visits to their facilities and have provided genuine manufacturing data to support a 'supply chain' tutorial based upon cricket bat manufacture. Design and make projects vary in breadth and depth; perhaps the most intricate involves the design, make and evaluation of a complex sports product e.g. table tennis ball launcher. Students work in groups of five and compete against each other during the final evaluation. External experts within the chosen field have supported this activity by presenting the design requirements to the students at the start of the project.

Individual projects (equivalent credit rating of 3 modules) are run across the entire final year. The wide range of projects reflects the diversity of the

Research Group, however, virtually all projects are supported by an industrial partner. There is mutual benefit in aligning the final year projects with the research areas of Ph.D. students. The Ph.D. student benefits from the assistance, whereas the undergraduate students benefit from extra supervision and the opportunity to work on more advanced, industry sponsored, projects. Often students are expected to attend review meetings with sponsoring companies and to present their work periodically. Several individual projects have contributed substantially to the current commercial product development activities of the sponsoring companies.

Industry-supported management board

The course content of the programme was shaped, in part, by the formation of a Steering Committee comprising senior industrialists from the sports industry. This Committee met a number of times during the formative years of the programme to provide an industry perspective on what the programme should deliver. A more general Management Board also exists to oversee the activities of the whole School of Mechanical and Manufacturing Engineering; this Board also comprises senior sports industry representatives.

STUDENT FEEDBACK

Student feedback (via questionnaire) is obtained at the end of each module and at the end of the programme. Overall, students are most positive about the core modules, i.e. those that have been specifically developed for the programme or are clearly seen to be directly relevant to the sports industry, than they are about the optional modules which are selected from relevant mechanical and manufacturing engineering modules. Students thus rate highly activities that are applied or have transparent sports industry links.

CAREERS

Informal feedback obtained from group discussions with incoming students suggests that virtually all students joining the programme aspire to pursue a career within the sports industry. The majority wish to engage in either sports product design or research and development. However, many of the students are uncertain about how to pursue a particular career path. We are working with the University Careers Service and industry links to maximise career opportunities for future graduates. A review of first destinations for students graduating in 2004 shows that approximately half of the graduates in full time employment are working in the sports industry. However, it is also evident that mainstream careers such as accountancy, general management, armed forces and teaching are also pursued. Each year several students elect to engage in further study at both Ph.D. and Masters level, in the UK and overseas.

SUMMARY

The process of setting up a new Sports Technology Degree programme has been both time consuming and challenging. The creation of new materials was made easier by having significant research resources (laboratory facilities and research students) already in place and the support of a large number of commercial organisations. The programme has proven to be popular with students both in terms of number of applicants but also in respect of the feedback obtained from graduates upon completion of the course. The most popular aspects of the programme are those perceived to be most directly relevant to sports industry, particularly practical and applied modules. Industry support for the programme has been good, albeit at arms-length and mostly via research collaborators. However, feedback obtained from the industry has been positive and few companies have been reluctant to support the programme when approached. There is evidence that some of the programme's graduates are entering the sporting goods industry within a short period of graduation but many are entering less focussed careers or undertaking further study.

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Roy Jones is a Professor of Sports Technology at Loughborough University. His research interests include dynamics of sports balls, golf club design and testing, racket sports and player perception of equipment characteristics. He has been the PI on numerous research grants, many including substantial contributions from the sporting goods industry, in particularly from Dunlop Slazenger, Callaway Golf and adidas. Roy is an External Examiner for several UK universities. He is a member of the IEE and has received a number of awards for his research publications.

Adam Crawford completed his first degree in Applied Physics, followed by a Masters Degree and Ph.D. in the field of Coastal Engineering. Adam was employed as a researcher and lecturer for 6 years in Civil Engineering before moving into the field of learning technology at Loughborough University in 1998. Adam is now Manager of the Engineering Education Centre at Loughborough, the largest centre of its kind in the UK. He sits on a range of steering committees and management teams for national engineering education projects and also manages and contributes to a diverse range of UK engineering learning and teaching projects.