DEBATE: ENGINEERING EDUCATION ISSUES ARE THE SAME ACROSS THE WORLD.

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Abstract *— Do the major issues of engineering education differ globally? Does each country require a different mechanism to support academics in their learning and teaching effectively?*

These issues will be discussed further to explore how engineering education issues differ from country to country, with particular comparison between Europe and the rest of the World. The issues felt in the UK and Australia are presented in this paper as a starting point.

The session will be led by members from the UK's LTSN Engineering centre. LTSN Engineering is the national engineering subject centre of the UK Learning and Teaching Support Network, providing subject based support to promote high quality learning and teaching to all UK engineering academics. This subject focused network has been established in recognition that for many in higher education, most networking and exchange of learning and teaching practice and innovation takes place within the subject discipline.

Index Terms ¾ Australia, engineering education issues, support structures, UK

INTRODUCTION

A major consultation exercise is currently ongoing to establish the UK higher education engineering issues. The initiators of this study, LTSN Engineering, are keen to compare the results from the UK with issues from across the world, in order to address the question *'Do the major issues of engineering education differ globally?'*. This, taken together with the context for the information discovered, then raises a further question regarding the necessary support structure required in higher education to address the issues *'Does each country require a different mechanism to support academics in their learning and teaching effectively?'*

This paper discusses the preliminary results of the UK survey placing them in the context of the UK engineering education background. LTSN Engineering has been put in place to address these emerging issues and its developing plans are described.

LEARNING AND TEACHING IN UK ENGINEERING

Engineering is a large subject in the UK - there are approximately 90,000 students spread across over 100 institutions and 250 departments. Whilst engineering has some common themes there is a wide diversity of subject areas within the discipline. This can be readily identified from the range of courses offered by Universities and by the number of professional institutions and bodies who are affiliated to the Engineering Council. Engineering education draws on a range of underpinning subject areas and cognate disciplines and is characterised by laboratory based teaching, industrially based projects and sandwich courses. The majority of engineering staff and students are highly computer literate. There is by necessity a close relationship with industry, as engineering students need to apply their technical, management and business skills in an industrial context.

Engineering graduates require Continuing Professional Development (CPD) to cope with the sheer diversity of knowledge required by engineers and the rapid rate of change in technology and industrial practice. Initial graduate training builds on the educational base to provide progression towards professional status. Under the current professional training requirements[1] there is a need for more formalised matching sections that could include a significant taught element.

There are many stakeholders in UK engineering education including academic staff, students, industry, professional bodies, the Institute of Learning and Teaching (ILT) and the funding bodies. Involvement with the stakeholders must be maximised, drawing upon the many sources of expertise and information resources that already exist in the community.

MAJOR UK HIGHER EDUCATION ENGINEERING ISSUES

The survey of UK higher education engineering issues has targeted all the major stakeholders but to date, the majority of the responses we have had have been from academics (200 responses) and industry (150 responses). Questionnaires have been distributed through higher education institutions, professional institution magazines, UK engineering education networks and the world wide web. Many more responses are expected in the coming months, the results of which will be presented during our session. Here, we discuss only the first question on the

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questionnaire where the community was asked to rate the major issues in engineering education. Table I shows the responses to date expressed as a percentage of the total number who rated the issue as being 'Important' or 'Very Important'. The academics and industrial viewpoints are shown separately, ordered by the 'Total' column.

TABLE I
MAJOR ISSUES IDENTIFIED BY THE COMMUNITY TO DATE

Issue	Acad	Ind
Preparing graduates with eng skills and knowledge for industry	86%	94%
Content of degree programmes	84%	92%
Students' motivation to learn	82%	82%
Decreasing maths knowledge and skills acquired at 'A' level	81%	77%
Students' key skills, e.g. interpersonal, team working and IT skills	78%	81%
Professional status of engineers	77%	80%
Assessment of students' learning (knowledge and skills)	78%	77%
Limited resources (time, facilities) available for innovation in HE	85%	66%
Continuing professional development and matching sections	70%	75%
Use of IT (including the internet) in degree programmes	74%	69%
Relative status of teaching and research in higher education	75%	58%
The development of flexible/distance learning	52%	58%
Threat to higher education by commercial organisations	39%	21%

Table I shows that academics and industry are broadly in agreement about the general order of the given issues. Both rate content of engineering degree programmes and preparing graduates with the necessary skills as vital issues. Not surprisingly, academics are also very concerned about limited resources whereas industry worries more about the professional status of engineers. Other issues such as student motivation and mathematical ability are also rated highly by both categories. These results are more or less as expected and back up the more informal picture that has developed from departmental visits. More surprisingly, neither academics nor industry have rated the development of flexible and distance learning as an important issue. This is unexpected as this is a common agenda item in HE and much money is being invested in this area through initiatives such as the ESPRC[2], the e-University[3] and DfEE[4].

Considering the more qualitative responses provided to support most important issues, the survey shows that both industry and academics are keen to open up dialogue to ensure that graduates are equipped with the skills industry actually needs, rather than the skills industry is believed to need. Industry feels that too much is being taught in too short a time, which is encouraging shallow learning and less retention of engineering fundamentals. Academics feel that the content of degree programmes needs to be updated and revised frequently. Limited resources usually manifest itself as a lack of time to commit to addressing the known issues, while professional status reflects on all aspects of HE from undergraduate entry to professional salaries.

MAJOR AUSTRALIAN HIGHER EDUCATION ENGINEERING ISSUES

Engineering education in Australia is in transition[5]. Although there has been no national survey in Australia on the issues in engineering education since the report "Changing the Culture; Engineering Education into the Future", written for the Institution of Engineers, Australia, was published in December, 1996, a recent paper has stated that the over-riding theme in engineering education in Australia is one of change[5]. This is due to factors such as the background of students entering engineering degree courses, the nature and status of the work for professional engineers in a global economy and the Australian government policy affecting quality assurance of high education. These issues are all very similar to those expressed and felt by UK academics.

The Australian response to these concerns is to provide courses that contain more professional education approaches, providing a practice-related situation in which to use the new theoretical knowledge learnt by students. One example of this is team-based learning and this has been used in a unique way at Monash University, Australia for the last three years where team projects are multi-disciliplinary, bringing together students from engineering, product design, marketing and accountancy, with idustrial support.

UK SUPPORT STRUCTURE

The UK-wide Learning and Teaching Support Network (LTSN), launched in January 2000, is funded at over eight million pounds sterling per annum over an initial five-year period. It comprises 24 subject centres, a Generic Centre and a programme director to manage and co-ordinate the network, based at the ILT at York. As well as LTSN Engineering, engineers are also likely to interact with the Built Environment, Physical Sciences, Materials, Languages, Computer Sciences and Mathematics centres.

The Network was established following a review[6] of existing learning and teaching initiatives which acknowledged that academics best appreciate, assimilate and implement a pedagogic approach when presented to them within their own discipline. It recommended establishing a subject-based support network with a broad focus across all learning and teaching activity.

The LTSN supports the Teaching Quality Enhancement Fund (TQEF), which delivers the Higher Education Funding Council for England's (HEFCE) Learning and Teaching Strategy through a single integrated fund[7]. HEFCE's Learning and Teaching Strategy has five main purposes:

- Encouragement and reward.
- Co-ordination and collaboration.
- Disseminating and embedding good practice.

- Research and innovation.
- Building capacity for change.

These five purposes of the Learning and Teaching Strategy are delivered through three funding strands: institutional, subject and individual. The institutional strand involves university Learning and Teaching strategies. The subject strand is supported through two streams of funding: the LTSN and the Fund for the Development of Teaching and Learning (FDTL)[8]. The individual strand includes the National Teaching Fellowship Scheme[9].

LTSN ENGINEERING

LTSN Engineering, hosted by Loughborough University, promotes quality learning and teaching by stimulating the sharing of good practice and innovation through the provision of subject-based support. The Centre's three key aims are to:

- Create a national *focus* that is an accepted and essential point of contact for all involved in higher education engineering.
- Collate and disseminate *good practice* and innovation in learning and teaching in higher education engineering.
- Provide co-ordination and *support* for learning and teaching in higher education engineering.

The Centre is developing operational and strategic plans in line with the emerging issues being expressed by the survey. Both academics and industry have been asked what they feel the Centre's priorities should be. Their responses are shown in Table II expressed as a percentage of those who rated statements as 'very important' or 'important'.

TABLE II
RATING OF CENTRE'S PRIORITIES

Centre's Priorities	Total
Understanding and sharing	90%
Material source	81%
Implementation & embedding	81%
Links with stakeholders	80%
Information and advice	77%
Identifying funding	74%
C&IT	71%
Research	64%
Register of expertise	60%
Subject Review	56%
Diverse Learners	53%

The services deemed by academics to be 'very useful' or 'useful' to support these priorities (industry was not asked this question) are shown in Table III.

The identified priorities and services wanted map onto each other fairly well. For example, the top three priorities of understanding and sharing, material source and implementation and embedding are all supported through the top five services. However, there are discrepancies, for example, forming a register of expertise is not seen as a priority, although academics believe it would be useful to have one. Researching and publishing in engineering education is not seen as high priority, or a particularly useful service. This probably reflects the desperate need by engineers for practical solutions and direct support for the pressing issues identified.

TABLE III
RATING OF CENTRE'S SERVICES

Centre's Services	Total
Good practice reports	89%
L&T case studies	88%
Collection of L&T resources	80%
Workshops and seminars	79%
Register of expertise	74%
Local contacts	70%
Regional events	65%
Question banks	64%
Working groups	61%
Software & book reviews	60%
Advice and consultation	55%
L&T journal	52%
Encouraging publications	51%
L&T research conferences	49%

CONCLUSION

The survey has already revealed that the UK engineering community feels that many engineering education issues are of vital importance. The issues in Australia appear to be very similar to those felt in the UK. What are the major issues in your country and how do these compare to the UK?

The limited resources and resulting lack of time becomes particularly important as structures to address these issues are put in place – direct support and practical solutions are what is wanted by engineering academics. These findings added to the diversity and scale of learning and teaching in UK engineering provide a challenging task to provide effective, useful support. Can we work together on an international field to support each other in this task?

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