Visiting Professors in Engineering Design for SD

Summary of Belfast Workshop: June 19th 2003

Introduction

The theme of this year’s workshop was devoted to the outcomes of the scheme during the first five years of its existence. Thirteen of the twenty one participating universities presented the results, from a teaching perspective, of the development and delivery of the case studies by their visiting professors. Bill Addis, who had been commissioned by The Academy to review the experience of the first round of appointments under the scheme, also presented his findings, based on interviews with the respective universities (Brighton, Heriot-Watt, Hertfordshire, Newcastle and Oxford). A summary of the review and its recommendations has been prepared separately.

Full details of the presentations and discussions are contained in the body of the write up on the workshop. This summary captures the main issues to arise from both the presentations and the discussions.

Curriculum, Core Knowledge and Skill Sets

- All universities were constrained by the fact that the current curriculum is full, and that there is resistance to change. Adding new material, particularly new courses, inevitably meant that something had to be deleted. Some universities had undergone major course revision during the scheme, which gave an ideal opportunity to introduce sustainable Development (SD) into the curriculum. Others had taken the opportunity to update courses in related areas e.g. environment, engineering in society, and one had made SD the “theme” of an IT skills course. However, resistance to curriculum change remained a major obstacle. The role of the professional institutions was seen as significant, and the recent decision by the Joint Board of Moderators (on behalf of ICE and IStructE) to include SD in accreditation was warmly welcomed.
- There was much debate about the need for defining a “core knowledge” requirement. This was seen by some as a “typical engineering approach”, driven by a desire for a tightly defined specification. It was felt that it was more important for students to develop a different view of the world and this could usefully draw on a common set of resources illustrating and arguing the need for sustainable development and what it entails. It was also felt that there was a need to separate knowledge from concepts and principles; students soaked up knowledge, but were reluctant to embrace principles, particularly if loosely defined.
- Engineers are traditionally comfortable deriving “hard solutions for questions asked by others”. There was a strong need for us to become comfortable as stakeholders, with a key role in helping to define the relevant questions.
- It was agreed that ultimately engineers would need to develop a step change in vision, moving to a systems approach that went beyond the purely technical issues.
- There was a broad feeling amongst many academics that SD was merely a political slogan, and not a real issue requiring a technical input. This view
needed to be dispelled, whilst recognising that political aspects of SD had to be fully understood by engineers.

- In terms of teaching effectiveness, a workshop style delivery was seen to be much better than lectures. However, it was recognised that workshops were resource intensive and logistically more difficult to administer than traditional lectures. Delivering case studies also needed more contact time than traditional lectures.
- It was vital for engineers to learn how to engage with other disciplines, and not just the technical ones. Engineers were not the only professionals with knowledge of, or a stake in, SD.
- The concept of types 1, 2 and 3 problems was introduced. Type 1 problems easily lend themselves to purely technical solutions. Type 2 lead to solutions where user behaviour rather than technology is more important. Type 3 are poorly defined problems with no single answers. Students needed to be able to distinguish between these types of problems, and also to be comfortable tackling any one of them. It was particularly important that engineers could come up with their own views in relation to type 3 problems.

### Teachers and Teaching Methods

- Whilst recognising the vitally important soft aspects of SD, teachers needed to be able to engage a body of students that was still more motivated by hard technology. Students do not always recognise SD as an intellectually challenging issue, and show a marked tendency to revert to the detailed technical issues, thereby losing sight of the bigger picture. Getting the right balance was a major challenge for teachers. Ultimately, the most important facet of SD was to get the message, rather than the details, through to students.
- VPs had had some success by demonstrating to students (and teachers) that SD was likely to become a key issue during their working career, and therefore an issue that they could not duck.
- Outside a dedicated core of teachers advancing the cause of SD, there was still apprehension about its long term staying power in the engineering curriculum. Until the majority was convinced that “SD was forever”, there would be difficulties in fully establishing it in the curriculum. It was also recognised that it would be counter productive (in terms of effort involved) to attempt to convert the conservative majority, and the effort should be concentrated on finding more “early adopters”
- Teaching strategies for SD would require a move away from the present bias towards absorption of facts and demarcation between disciplines. However, a balance would still need to be maintained with traditional specialist skills. As a corollary to this, there was a need to put more emphasis on teaching students to acquire the skills needed to understand and to tackle real life problems, rather than just to pass exams.
- Life Cycle Analysis (LCA) was recognised as a vital methodology for getting the message about SD over to students. However, VPs felt that some academics tended to make this over complicated, in an attempt to make it appear technically more rigorous.
Less mature and less able students tended to struggle with the broader inter-disciplinary approach promoted by the VPs. They were happier to be given established methodologies and well defined problems.

The HE 21 methodology had been adopted successfully in one university. This concentrated on introducing students to the basic concepts of SD.

Replicating the workplace was a very effective strategy for getting across the messages of SD. This was easier for the VPs than it was for academics, many of whom had no industrial experience.

VP contact with students was seen as a vital ingredient of the scheme. It was only by interacting with them directly that VPs could get vital feedback on the case study material that they were developing. Some VPs from the early phases of the scheme had modified their case studies significantly after seeing how they were received.

There was some discussion about dissemination methods. Role play exercises proved popular with students, and were also good learning vehicles. Web sites, which incorporated the learning material and tutorial exercises, permitted self paced learning, and gave slower students a chance to keep up. CD ROMs, which could embody large amounts of factual and supporting material, were ideal for distance learning.

Principles

A first draft of a treatise on principles of engineering design for SD had been circulated prior to the meeting. This had been based on the Academy publication “Design – the Engineer’s Contribution to Society”. There was only limited time for discussion on this, but some key points emerged. The original model of “Needs: Vision: Delivery” was felt to be rather restrictive for SD. Indeed, the logic and structure of the model was strongly disputed. Needs had originally been seen as a customer need that could be satisfied by an appropriate technical solution. In SD it was felt that defining needs was a paramount issue, but one that was not resolvable by purely technical considerations. Vision (in relation to SD) was very tightly related to values. These values would vary between stakeholders, and resolving them involved many non-technical steps.

It was accepted that the original model was perhaps too restrictive for defining a set of SD design principles, and the next draft would relax, if not discard, the link with the model despite its Academy provenance. It was also stressed that a set of principles should be understandable to non-engineers, even if engineers were the primary audience.