Engineering futures - the sequel.

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In the initial paper I concentrated on arguing for an integrated first year curriculum, a more *problem-based* approach to learning and the introduction of new technologies for delivering lectures. I did not consider the curriculum beyond the first year. In this sequel I will look at how such an integrated first year could be exploited by developing a programme involving 4 basic tracks in the different subjects of the Faculty.

1. Different tracks for different ambitions.

One criticism of our sort of engineering education is that it is highly research-oriented with rather less activities directly related to design, management and industrial practice. Our current approach is *a one size fits all* philosophy which may lead to us losing out in terms of both recruiting the best students as well as delivering a quality product to industry and commerce.

To counteract this and to set out a possible agenda for reforming, further, our degree programmes, I am proposing that the following alternatives should be considered. Four basic tracks are proposed:

a) *research track*. This is aimed at students who wish to progress to academic or industrial research and will be primarily based on a mathematical and analytical approach to their subject. It would probably only be open to those students who had done well in their previous year's (that is year 1) work. Such a track would be available to students on degrees in all departments. In some cases these students would be studying similar material as is currently taken in the existing degrees, supplemented by some courses on research techniques, exploiting research in industry and so on. If the students are self selecting and good then they can probably be taught in years 3 and 4 at a slightly faster pace than is normal thus bringing them up to a similar level in their chosen field as at present - even though they have taken an integrated 1st year and thus covered slightly less relevant material in that year. Such degrees would be SARTOR compliant under the existing policy.

b) *practitioner track*. This is also to produce the SARTOR compliant engineer and would provide a mix of research led modules, design activities together with material on enterprise and business methods, and related professional issues. It should be possible for students to take this in two modes - *single*, specialising in a single professional engineering field and *mixed* mode where students can specialise in two different engineering subjects, perhaps one as a major and the other as a minor component. It is aimed at a slightly more broadly based engineer but one who is still acceptable to the accreditation bodies. This track would include the sector-oriented degrees such as Aerospace and, possibly, Automitive, Biomedical, Sports, Consumer electronics etc. that we might wish to consider. All these are multi-disciplinary degrees with a focus on, for example, educating project leaders and managers in these industries.

c) *design track.* This will be much more focused on the design and manufacture of quality engineering products and services. The idea is that in years 2 and 3 students will take standard courses within their chosen speciality/department. In year 4 the students will spend the great majority of their time in a design studio, something like architecture students do. There will be some other modules on business, enterprise, legal issues etc. but up to 80 credits will be on design. This will be based around University student companies rather like the scheme I have been

running for the past 5 years in Computer Science (the Genesys company - a student run company which carries out external contracts for clients as part of the Software Engineering MEng, Computer Science MComp and Advanced Computing MSc degrees). My experience is that around 30 students per company supervised by 2 academics works about right. For a version to cover the whole of the engineering students on the design track we would need to set up a number of separate companies with around this number of students in each. I would like to explore the opportunities to bring students from different engineering specialities together in mixed teams.

d) *year in industry track.* Time will tell whether the SARTOR approach has been a success. It is possible, however, that it has made engineering degrees less attractive at a time when tuition fees are a major issue. Finding enough students who can afford to study full time for 4 years is likely to get harder in the current climate. This program attempts to provide something that will still be attractive to industry but does not provide a classical MEng qualification.

After year 2 students will take a full year's placement in industry, this will be assessed and will contribute to their final MEng degree, (maybe we should call it an MSc(Tech) or an MTech - this needs to be considered further). The placement needs to relate as far as is possible to the student's programme of study, it would be ideal if they could continue studying during their placement, either through the company's staff development programme or by e-learning which we would co-ordinate. The placement year needs to be properly structured with clear learning outcomes, targets and deliverables which can be used for assessment purposes. Supervisors will need to visit the students and discuss their progress with their section leaders.

Following successful completion of the placement students will continue in the University with a mix of 3rd year and, possibly, 4th year modules. They will then graduate with the appropriate degree. It will be interesting to see how the Engineering Council will react to this type of degree, it may take some time to convince some of the more traditionally minded colleagues of the value and practicality of this approach.

Such a scheme might be attractive to overseas students. I believe that one department found that 2 of their overseas students left Sheffield for Cardiff at the end of year 1 because they could not embark on this type of degree programme. If a traditional 4 year full time degree is not an option for some overseas students then this one might be.

2. Implementation.

a) *research track*. Since this track closely matches our current activities it probably does not need much further work. However, there are possibly some extra modules such as something on the role of research in industry and other similar (RTP-style) modules that might be relevant. Perhaps a seminar course on the current literature such as the Advanced Software Engineering module in Computer Science would be worth considering.

b) *practitioner track*. The major problem is one of allowing students some flexibility to combine one engineering speciality with another. A solution that works elsewhere is to organise all the degree programmes around threads within a department. These will be sufficiently independent to ensure that each thread is consistent with its pre-requisites and can combine in a natural way with other threads both within the department and from contiguous departments. In Computer Science, threads are based around the Department's research groups but this may not be appropriate in every department.

c) *design track*. The Genesys scheme operates as follows: the company is split up into different project teams - in our case these are usually 5 strong - and each team works with an external client on some software development project. Each week the company holds its weekly board meeting, chaired by a student with a student acting as secretary (they each take these roles in turn). General decisions are taken about company policy, working practices and their design environment and facilities. Then each project team reports progress on their project and identifies the sort of assistance it might like from other company members or experts who might have some useful knowledge or experience. The supervisors meet with each team for about 15-30 minutes each week to discuss progress in more detail. Teams produce weekly minutes of meetings, time sheets and documentation pertaining to their project. All this is used in the assessment of the course. I emphasise to all the students at the beginning that it is *their* company and not mine. The response has been amazing and, given the responsibility, our students have been outstanding. They have also learnt a great deal and for almost all of them this is the highlight of their entire degree course. Finding clients is now relatively easy, initially I used my industrial contacts and advertised in the Chamber of Commerce's monthly newsletter. The University Careers Service was also very helpful.

In the context of a more general engineering version the requirements are: some suitable design offices to locate the companies in (perhaps HSL Phase 1/2???), some enthusiastic supervisors from each department, some basic facilities - we are now self-sufficient in terms of computers, software etc., the student's run their own system entirely separately from the University and this has been an excellent learning experience for them. It will be necessary to pump prime these facilities, initially. The purchase of design software, databases and other necessary facilities would need to be covered.

Projects might include the design of specific artefacts or solutions to practical design problems, feasibility studies, consultancy etc. Genesys have also done industrial training courses and this might also be another activity.

d) *year in industry*. The main issue here is the need to find placements and to visit them in order to provide a basis for a suitable assessment. It should be possible to solve these problems if the demand is not too great. However, it is difficult to predict exactly how many students might want to take this track. It might be a way of attracting overseas students to a 4 year programme - I'm assuming that there are no work permit problems with this.

3. Summary.

The ideas outlined above could represent an effective and efficient way to organise out degree courses to capitalise on the common first year - if that comes to pass. The current degrees are subsumed within it and so our traditional audience should not find this a serious disadvantage. There is no proposal to introduce a General Engineering or Engineering Science degree. We should aim to keep as many of our current titles as possible with some reference to the track in the title if appropriate, for example - Electrical Engineering (with a Year in Industry), Chemical Engineering and Design, Civil Engineering with Materials and so on.

The proposal introduces a number of novel types of degree which could prove to be very attractive to both students and employers. Employers have often said that faculties like ours do not put enough emphasis on practical design issues, we would clearly be able to demonstrate that this was no longer the case for those students wishing to move in this direction. The student

company scheme would be unique - probably in the world - and would attract a lot of interest and acclaim. It would also be an excellent advertising ploy since many prospective students would be interested in this opportunity.

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