The House of Commons Education and Skills Committee

Call for Evidence: The future sustainability of the higher education sector: purpose, funding and structure

Submission by The Royal Academy of Engineering

1 The Academy (Note 1) considers that to thrive in today's intensively competitive global environment the UK needs highly talented people with a wide range of intellectual and technical skills together with organisations and processes that can deploy them effectively. Enhancing national capabilities, recognising excellence and inspiring the next generation are strategic priorities in which the universities have a major role to play.

2 The Academy is well informed of the role and requirements of the universities through its current study on *Educating Engineers for the 21st Century* (Note 2). The initial phase, conducted with Henley Management College, established the industry view based on in depth interviews with twenty UK major international companies and replies of 444 companies to a detailed questionnaire, 53% of which came from small and medium sized enterprises (SMEs) with less than 250 employees. Further interviews were conducted with recent graduates from the Academy's schemes. A detailed questionnaire has been sent to all university departments of engineering to discover how they intend to meet the industry requirement.

The role of universities over the next 5-10 years

- **What do students want from universities?**

3 All engineering students want to gain a world-class internationally recognised degrees which will enable them to qualify as professional engineers. While the majority are content with the courses provided they agree with the industry view that there should be more practical experience and "hands on" content but not at the expense of understanding the fundamentals of engineering science.

4 The perspective of the graduates in the study focus groups emphasised what motivates students to study engineering: a good all round degree course offering a wide range of career options. There was a strong sense of wanting to make a difference, contributing to society and being able to see the results of your creativity.

5 UK degrees have a good reputation and international students are attracted to our universities' courses: indeed several universities are setting up overseas campuses to cater for demand. In research there is a high proportion of international students and there is a need to attract more UK students into taking higher degrees (doctorates) in engineering, in line with the recommendations of the Roberts' Report (Note 3), if the UK is to achieve its economic growth target of increasing R&D spend to 2.5% of GDP by 2014.

6 Also there is concern that the numbers of UK entrants to engineering degree courses are static or even dropping. If we are to deliver the vision of the UK as a global leader in turning knowledge into new products and services we need a step change in the number of students entering engineering degree courses. Also the demographics are against us as there will be fewer children in the next ten years who will be available to go to university.

7 The issues need to be tackled on several fronts. Contributions will come from: increasing the numbers of students studying maths and physics at school; increasing the proportion of these students who opt to study engineering; retaining a higher proportion of engineering graduates in industry and allowing overseas students who have studied at UK universities to remain in the UK to work for a longer period than the current one-year.

8 Solutions will include better maths and physics teaching in schools, effective schemes, especially in schools, to encourage students to consider studying engineering and more inspiring degree courses with closer industrial engagement.

- **What do employers want from graduates?**

9 Many companies report difficulties today in recruiting graduate engineers particularly in Civil Engineering, Electrical and Electronic Engineering and Systems Engineering. They comment that it is difficult to get "enough of the best" and identify graduates in Information and Communications Technology and Materials as being key to future growth.

10 Shortages of suitable engineering graduates and skill gaps are affecting the performance of UK businesses. Over one third of companies responding indicated that shortages and skill deficiencies impacted on new product development and business growth as well as recruitment costs. Specific gaps were identified in problem solving and application of theory to real problems, breadth and ability in maths.

11 The quality of the best UK engineering graduates is considered by industry as good as their peers in Europe despite our shorter degree courses and there is no desire to move to five-year courses in line with other parts of Europe.

12 There is, however, no room for complacency. Employers seek to recruit graduates with some previous industrial experience preferably gained as part of their course. They consider that university courses need to provide more experience in applying theoretical understanding to real problems.

13 It is considered that UK engineering degree courses need development by recognising the changing requirements of industry and in order to attract and maintain the motivation of students. In terms of priorities for future graduate skills, companies responded consistently in placing practical application, theoretical understanding, creativity and innovation as top priorities. While broader technological understanding is considered important it should not come at the expense of understanding fundamentals. Multidisciplinary system integration skills are seen as becoming increasingly important in future technology development.

14 Key business skills are envisaged primarily as commercial awareness or sensitivity (an understanding of how businesses work and the importance of the customer) combined with a basic understanding of project management.

15 The strong focus on creativity and innovation supports the conclusions of Sir George Cox's Review (Note 4) about the importance of creative skills in improving the UK's competitiveness in the face of the challenge from emerging economies.

- **What should government, and society more broadly want from HE?**

16 So far as engineering is concerned the above evidence clearly supports the view that the universities should continue to maintain their excellence in research while at the same time developing their taught courses in such a way as to deliver motivated world-class engineering graduates with the skills required by industry in order to fulfil their role in delivering the Government's Science and Innovation Framework objectives (Note 5).

17 The strategy for continuing to maintain research excellence has already been laid out in the Academy/EPSRC review *The Wealth of the Nation: An Evaluation of Engineering Research in the United Kingdom* (Note 6). This recommends the continued close cooperation between industry and the universities and a closer integration of research in engineering and that in pure science. It draws particular attention to the needs of industry for personnel with postgraduate degrees.

18 There is, however, a current imbalance between teaching and research in the universities which needs to be addressed. While research and teaching are complementary activities many feel that the status of teaching has suffered as a result of the focus on the Research Assessment Exercise performance. Initiatives are required to redress the balance and recognise the importance of excellent teaching as a key contributor to the economy.

19 As discussed above engineering courses must become better aligned with the changing needs of business and industry. In particular more and better quality project work is needed based upon real-life problems, ideally delivered in collaboration with industry.

20 Work is also required to improve the approach to teaching to ensure students remain motivated and engaged and graduate keen to pursue engineering careers. There are already important developments in this area such as the pedagogic approach taken in the CDIO (Conceive/Design/Implement/Operate) initiative (Note 7) and team based hands-on engineering experience such as Formula Student (Note 8) and the Constructionarium (Note 9). The Higher Education Academy's Engineering Subject Centre (EngSC) (Note 10) and the UK Centre for Materials Education Materials (Note 11) have instituted a well thought of programme for sharing and implementing best practice between universities which needs to be encouraged by the Academy, the professional institutions and HEFCE. Developments of this sort will not only improve graduate performance in companies, but can also improve recruitment into engineering courses and student motivation. **The increased cost of "hands on education" engineering training needs to be recognised (see below).**

21 Industry itself needs to commit to greater involvement with undergraduate engineering education if the changes it requires are to be delivered. For example: through industrial project topics, compulsory assessed vacation placements, visiting professors' lecturing, leading industrial case studies, industrial advisory boards on course content and material. This is particularly important in areas where there is not yet a strong engineering academic research base such as systems engineering, design, sustainability, service and support engineering. These new subjects should be of great concern to society as whole as they underpin the ability to deliver a sustainable development strategy.

22 As detailed above there is tremendous potential, as well as economic necessity, for increasing the number of students reading Science, Engineering and Technology (SET) degrees. This means encouraging more school students to study maths and physics at A level, another key feature of the Government's Science and Innovation Strategy. There are opportunities for the universities to engage more closely with schools and to collaborate more closely with other providers such as the schemes in the Best Programme (Note 12).

23 To achieve the targets for graduates appropriate to a high-skill economy there is considerable scope to widening participation and contributing to social mobility through universities working closer with companies, schools and the FE sector in providing access through vocational courses. The Academy has set out to provide examples of best practice in the National Engineering Programme, a consortium effort to strengthen engineering higher education by working with universities to create inspiring, attractive engineering degree courses, and then working with local FE colleges and schools to provide candidates for those courses (Note 13). Industry has a strong role to play: on one hand they co-fund the programme along with government, on the other hand they are able to go into schools and assure students that there is good employment on offer after graduation. This model of cooperative working is proving effective in raising the profile of engineering (and the wider SET curriculum) in schools where it has not been a priority in the past. Particular attention is being paid to groups so far underrepresented in engineering higher education: women, minority ethnic students, students from families with no experience of higher education and adult learners.

University funding

24 Despite the grave reservations about the funding formulae for both HEFCE and EPSRC grants, university engineering departments can work within the current system. However, the funding problem does mean that the current system is not adequate for industries' aspirations (Note 2).

25 There are, however, strong criticisms of the Research Assessment Exercise (RAE) (see above paragraph 18) and its adverse effect on teaching quality in the universities. The Academy has made detailed recommendations for reform in this area in its response to the DfES in its *Reform of Higher Education Research Assessment and Funding* consultation (Note 14).

26 The Academy considers that the funding of HE should accord with the government's wider economic objectives (Note 5) and be planned and directed to provide industry with the skilled workforce required to achieve these.

27 **The major issue in England is that currently the unit of resource allocated by HEFCE to deliver engineering courses is far below the cost of delivery so that there is no incentive for universities to increase numbers or, more seriously, fund the facilities required for curriculum development**. The key factor is the ratio/multiplier. Medical studies receive four times the basic unit of resource, but engineering, classified as a full lab-based subject, receives only 1.7 times. Engineering is a high cost subject to teach – for example small group design is vital to effective and engaging teaching, but by its nature requires modern equipment , a good teaching staff/student ratio, and of course technicians – both for teaching support and maintenance. Engineering was funded at a ratio of two times the standard unit, but this was lowered to 1.7 between 2003 and 2004. This has had a detrimental impact on engineering with universities applying downward pressure on engineering undergraduate numbers. The extra money allocated by HEFCE for Chemistry, Physics, Chemical Engineering and Materials is very welcome, however, given the problems engineering has to encounter one wonders why the extra resource is being denied to the other engineering disciplines.

28 Acknowledging that there is only a finite level of money to spend on HE, it is possible to envisage an interim, cost-neutral proposal – one we have raised with HEFCE. The Academy believes that quality of engineering education is crucially important and that it would be preferable, in the short-term, to increase the per-student funding to at least the two-times-multiplier at the expense of student numbers. Engineering departments would be given the same amount of funding, teaching fewer students. This is not the preferred solution given the need for a step change in the number of engineering students required if the UK is to meet the economic and SET targets set out by the Treasury. However, it is a pragmatic way forward in the short-term.

29 It is too early to a say what the overall effect of the top-up fees will be. Initial returns seem to indicate a slight overall decrease in the number of applications for engineering degrees. Industry is concerned at the rise in student debt which could affect the numbers taking the longer Masters courses and advise against any further increase in top-up fees.

The structure of the HE Sector

30 From our survey of university engineering departments the current structure of the HE sector is appropriate and sufficiently flexible to allow for the necessary developments. **It is, however, only sustainable in the future if appropriate level of funding is provided by government as detailed above.**

31 The current under funding of engineering degree courses is causing most departments to hold numbers static or slightly decrease them. There is an aspiration to increase numbers which is necessary, and proper, to support the government's priorities in the Science & Innovation framework 2004-2014. This provides clear goals for the Sector which the government should adequately fund and steer particularly in the area of strategic subjects such as engineering.

Notes

1 The Royal Academy of Engineering [RAEng] brings together over 1200 distinguished engineers, drawn from all the engineering disciplines. Its aim is to promote excellence in engineering for the benefit of the people of the United Kingdom. (www.raeng.org.uk)

2 See (www.raeng.org.uk/henleyreport).

3 *SET for Success* HM Treasury April 2002

4 Cox Review of Creativity in Business: building on the UK's Strengths HMSO November 2005

5 Science and Innovation Investment Framework 2004-2014 HM Treasury July 2004

6 The Wealth of a Nation-An Evaluation of Engineering Research in the United Kingdom EPSRC/RAEng February 2005

7 See http://www.cdio.org

8 See http://www.imeche.org.uk/formulastudent

9 See Constructionarium: Build to learn CEBE Transactions, Vol2.Issue1 pp6-16 April 2005

10 See http://www.engsc.ac.uk

11 See http://www.materials.ac.uk

12 The Best Programme provides support to over 80000 students in science, engineering and technology for age 9 to 36 years. The Best Programme works in primary schools to build an enthusiasm for SET subjects, in secondary schools to promote engineering and related SET careers, in universities to support gifted engineering students and beyond university to develop engineers in their careers. Best is already making a significant impact with over 1300 Young Engineers Clubs established in schools. Through the Smallpeice Trust and the Engineering Education Scheme over 3000 (mostly Year 12) students gain direct experience of working with industry and studying in university engineering departments each year and a further 800 students attend one week induction courses in SET subjects in 26 universities through the Headstart Programme. A further 700 students take a gap year in industry through the Year in Industry scheme. The schemes are proving successful in attracting women into SET with attendances of 30-40%. Evidence from the Headstart and Engineering Education Schemes show that generally over 75% of attendees proceed to take SET degree courses. (www.raengbest.org.uk)

13 The NEP started with the London Engineering Project pilot in Southwark in late 2005. This will work with five universities and 50 schools over 4.5 years. The pattern will be repeated, modified and enhanced, as appropriate, in six regions in England over the ten years. The NEP supports schools with their raised profile for SET by providing students with access to hands-on SET activities in class, residential and other SET learning events out of school and a system for mentoring of students with a capacity for higher education and ability in SET. This attention paid on schools and groups so-far unengaged in engineering is seen as key to strengthening the engineering profession in the long-term. The NEP is led by the Royal Academy of Engineering with the generous support of the Higher Education Funding Council for England (HEFCE).

14 See http://www.raeng.org.uk

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