Engineering Professors' Council

Promoting excellence in engineering in higher education

P O Box 789 Godalming Surrey GU7 9FW

T: +44 (0) 7786 176 028

W: www.epc.ac.uk

The Future of Higher Education in England: call for evidence

SUBMITTED BY: ENGINEERING PROFESSORS' COUNCIL

The Engineering Professors' Council

The Engineering Professors' Council (EPC) exists to promote excellence in engineering in higher education. Our primary purpose is to provide a forum at which academic engineers can exchange ideas about engineering education, research and other matters of common interest and come together to provide the authoritative voice of engineering in UK Higher Education (HE). All branches of engineering are represented within the membership: Aeronautical, Civil, Chemical, Electrical, Electronic, Manufacturing and Mechanical Engineering, as well as Minerals, Metallurgy and Marine Engineering, the broad areas of General engineering studies and those in which engineering is combined with a range of other topics. There are currently 77 institutional members encompassing around 10,500 academic staff.

The Directors of the Engineering Professors' Council (http://epc.ac.uk/epc-people/) acting on behalf of its membership have drafted a response which seeks to address questions 4, 5, 6 and 7 of the consultation document. This draft response was shared with the Committee (http://epc.ac.uk/our-committee/), as representatives of the complete membership of the EPC, for input and approval. This is the result of this consultation exercise and relates specifically to the issues we believe need to be taken into account with regard to engineering in Higher Education.

In summary, we highlight:

- The very substantial direct and indirect contributions engineering in higher education makes to the economic and cultural health of the UK and its regions via its wide and diverse provision.
- The risks to engineering associated with the recent changes to the funding mechanism and the seemingly disproportionate financial impact for such strategic and vulnerable subjects and on social mobility.
- The risks associated with the recent changes to UK immigration regulations: its direct impact on the financial and intellectual sustainability of engineering in UK HEIs and hence the longer term impact on the technological development of the UK economy.

We highlight the following reports in particular:

- "*The State of Engineering 2011*": Engineering UK
- "*Enhancing Impact: The Value of Public Sector R&D*": Council for Industry and Higher Education (CIHE) 2012
- "*Enhancing Collaboration Creating Value: Business Interaction with the UK Research Base in Four Sectors"* Council for Industry and Higher Education (CIHE) 2012
- *"The Costs of Teaching Engineering Degrees":* Engineering Professors' Council and the Engineering Technology Board, 2007
- *The Benefits from Publicly Funded Research:* Ben R Martin & Puay Tang for the DTI, June 2007

4. *What role can higher education play in promoting a rebalanced economy across England and safeguarding our position in the global economy?*

- *Is the economic role of universities best understood as a direct contribution to the economy through research commercialisation or an indirect contribution through the development of a better-educated population and rigorous academic research?*

Engineering UK's 2011 report "*The State of Engineering*" [1] states that the engineering sector makes up nearly a fifth of the UK economy (19.6% of GDP) and employs over 4.5 million people and that the engineering research base anchored in our internationally excellent universities will be essential for future technological change and economic growth.

In the past, the economic role of higher education institutions (HEIs) has tended to be expressed in terms of adding to the supply of 'knowledge', which was then applied in the development of a new technology and, in turn, to innovation: the so-called "linear" model of innovation and its economic impact. However, this has been demonstrated over and over again to be a very narrow view. In many towns, the university is by far the biggest employer and spawns an economy of secondary employment by shops, accommodation and other services. The "economic impact" model developed by Universities UK in 2006[2] was built to evaluate this explicitly. Universities that are strong in science and engineering tend to attract and enhance hi-tech local industries. Numerous and extensive research, surveys and case-studies have identified several mechanisms - direct and indirect - or 'channels' through which the benefits of higher education flow into the economy. These were summarised in 2007 by Professor Ben Martin and Dr Puay Tang[3] of the University of Sussex's Science and Technology Policy Research Unit (SPRU) in an independent report commissioned and coordinated by the University of Manchester Intellectual Property Limited (UMIP) and The Gatsby Charitable Foundation in response to innovation and enterprise issues then under review by the Office of Science and Innovation, DTI as:

1: increase in the stock of useful knowledge;
2: supply of skilled graduates and researchers;
3: creation of new scientific instrumentation and methodologies;
4: development of networks and stimulation of social interaction;
5: enhancement of problem-solving capacity;
6: creation of new firms;
7: provision of social knowledge.

All of these need to be taken account of in considering the role higher education has to play in promoting a rebalanced economy across England and safeguarding our position in the global economy. Indeed, the model developed by Universities UUK in 2006[2,4], now being updated, together with the, now annual, Higher Education Business Interaction Survey (HEBCIS)[5] all recognise the variety of contribution, both direct and indirect made by the higher education sector. In the academic year 2010/11, of the £441.9M of research income attracted in to UK universities from industry, commerce and public corporations around the world, the engineering disciplines[6] attracted £137.7M in research income, the highest of all of the academic disciplines[7] and this will have catalysed innovation across all seven of these areas.

[1] http://www.engineeringuk.com/_db/_documents/6152_EngUK11_ES&C.pdf
[2] http://www.universitiesuk.ac.uk/Publications/Documents/EconomicImpact4Full.pdf
[3] http://www.sussex.ac.uk/spru/documents/sewp161.pdf
[4] http://www.strath.ac.uk/projects/uuk-modelling/;
[5] http://www.hefce.ac.uk/whatwedo/kes/measureke/hebci/
[6] General, electrical, chemical, mechanical, metallurgy and materials, software
[7] Next highest was Clinical Medicine at £118.0M.

- *Does the introduction of impact criteria in the Research Excellence Framework intrude on academic freedom?*

While the introduction of "impact" as a criterion in the Research Excellence Framework may ostensibly seek to measure some of the wider benefits outlined above, the way in which it is to be measured still relies on tying the impact to an original piece of "high quality" peer-reviewed published research, ignoring some of the more creative contributions to innovation which often cannot be linked to such research. It is also still a relatively small part of the overall "quality" measure, the greater part of which is still comprised of publications and grants. Indeed, it is probably the grants element which impinges most on academic freedom with EPC members representing the range of HEIs providing anecdotes about serendipitous discoveries made while working on projects funded for something quite different. Our response to this specific question is probably therefore best illustrated by the following quotes reproduced in some recent work by the Council for Industry and Higher Education (CIHE) "*Enhancing Collaboration, Creating Value, Business interaction with the UK research base in four sectors* - Construction, Energy, Pharmaceuticals, and Creative, Digital and IT", which also happen to encompass the range of engineering disciplines[8].

"*Academic incentives, e.g. promotion criteria, are still substantially built around publications and grant proposals rather than industry collaborations or industry experience. This hinders labour mobility between industry and academia even where industry expertise would be needed in research, education or commercialisation activities. When somebody is coming up for a promotion, it is important that there is due value given to commercial partnerships, to consultancies, to industrial income as much as to some of the other forms of academic scholarship*." Senior Academic

"*The movement of people between industry and academia is improving, but in the UK people are not nearly as flexible as they are in the US…..I think the system does conspire against you in terms of enabling that free movement. It's so difficult to be in the scientific environment getting grants, writing papers, then taking a period out and then coming back and trying to write grants and start writing papers again. Experience outside of the science isn't really recognised that much in the university system. It's not recognised and it's not valued. It's almost seen as something that you shouldn't really do. There ought to be much more movement.*" Pharmaceuticals Executive

A slightly different angle on the promotion criteria issue is that students appreciate the contribution made by staff who have industrial experience. Our members tell us that in engineering departments, it is becoming increasingly common to replace senior staff with such experience with those whose research work "ticks the REF publication and grant boxes".

• *How can the economic benefits of higher education be more evenly spread across the regions of England? Does the concentration of research funding in elite institutions prevent the HE sector from playing a more active role in rebalancing the economy on a regional basis?*

We believe that research excellence should be funded wherever it is found. Members transferring from so-called "elite" institutions to others to continue their research have provided anecdotal evidence of feedback from Research Council grant applications commenting on the perceived weakness of the university rather than the quality of the application and research team. Research and post-Level 4 education in engineering are offered across the university spectrum and in all regions of the UK as attested by the 'kitemark' of accreditation by the Engineering Council for Chartered Engineer or Incorporated Engineer registration and often in collaboration with major employers. In that regard, we would agree with this statement.

We would offer the Engineering Department at the University of Lincoln[9] as an excellent case study illustrating the benefits to be derived from higher education. It is the first completely new engineering department to be established for 20 years in England and was established as a result of a combination of the demand of the local people (which established the University in 2001) and then by the needs of local industry – a high tech engineering cluster had developed in the Lincolnshire Fens over a number of years and it was felt that having a local university would be essential for their future technological development and to meet their skills

[8] http://www.cihe.co.uk/category/knowledge/publications/
[9] https://www.lincoln.ac.uk/home/engineering/

requirements. It is more common to see such industrial clusters established as a result of a university being in a region. This therefore potentially turns the "spillover" theory on its head.

It should also be recognised that there continues to be a degree of market failure in the strategic and vulnerable subjects – in particular related to the fact that the full cost of science and engineering degrees is in excess of the £9,000 maximum fee universities are allowed to charge for an undergraduate programme[10]. If it is accepted that these are an economic good then there needs to be a continuing subsidy (currently in the form of the SIVS/STEM premium). Indeed, James Dyson in his interview on BBC Radio 4's Today programme on 7 September 2012 [11]called for abolition of tuition fees for science and engineering subjects.

• *Is there a cultural gap between HEIs and industry?*
There will always be cultural barriers to overcome when any two organisations seek to work together but, with the right incentives and a common vision for what each can contribute from the relationship and are seeking to achieve, these are not insurmountable. Once again, we offer the University of Lincoln's recently established Engineering Department and its relationship with Siemens Industrial Turbo Machinery as an excellent case study illustrating what can be achieved.

• *What institutional and policy reforms would facilitate better university–industry collaboration?*
There is a range of such reform; encouraging universities to think more creatively about pricing their services for industry, tax incentives, innovation vouchers, explicit recognition in promotion criteria of "industrial sabbatical", reward for creation of intellectual property (IPR). Professor Paul Wellings in his 2008 paper "Intellectual Property and Research Benefits" for the Rt. Hon. John Denham, MP, the then Secretary of State for Innovation, Universities and Skills highlights more, once again re-iterating the point about promotion and career development. : "*Their policies in relation to IP assigned to the University by undergraduate and post-graduate students do not act as a disincentive for enterprise development and that students are properly informed before assigning ownership ; and b) That incentives for staff in relation to IP matters, including those linked to promotion and career development, are designed to encourage active participation[12]."*

5. What role should higher education play in providing skills for the job market?

Does HE provide the right sort of skills for meeting the needs of employers? In what ways should higher education prepare students for the job market? In what ways do we best incorporate employment skills in the higher education experience?
This is an issue which HEIs across the UK has taken very seriously in recent years[13]. We still believe that higher education has a very particular role in developing the leaders and thinkers of the future but that much can be done by working closely with the employers of our graduates to prepare them for the world of work. There is a range of excellent examples from engineering departments involving problem-based learning, contextual application of learning and team-working to name but a few. Illustrative examples:

> University of Lincoln[14] provides 'real-life' engineering challenges for students with the goal of creating 'industry-ready' graduates with the skills to master tomorrow's complex engineering challenges. Siemens, their partner in this, say that it can't get enough engineering graduates from engineering degrees. It estimates that the Power Industry sector alone will need up to 34,000 new graduates, and 'green engineering' sectors, including wind power, between 50,000 and 70,000. The University's and Siemens' headline objective for the programme is to prepare "*industry-ready' graduates who can go directly into cutting edge industry*."
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> Teesside University[15] "*Our Undergraduate students will spend a considerable part of their course involved in challenging and exciting team-based activities which form the centrepiece of our curricula. We offer a range of other activities such as field trips, a unique professional mentoring scheme*

[10] http://epc.ac.uk/wp-content/uploads/2012/08/EPC-ETB-Costings-report-final-version.pdf
[11] http://news.bbc.co.uk/today/hi/today/newsid_9749000/9749614.stm
[12] http://www.bis.gov.uk/assets/BISCore/corporate/docs/H/he-debate-wellings.pdf
[13] Engineering Graduates for Industry" 2007, http://78.158.56.101/archive/engineering/downloads/egi/201002-egi.pdf

[14] http://www.siemens.co.uk/en/news_press/index/news_archive/lincoln-new-engineering-school.htm
[15] http://www.tees.ac.uk/schools/sse/welcome.cfm

involving employers who also contribute to, and in some cases lead, the design and delivery of parts of our courses. Our courses are based around extensive professional case studies and simulation exercises which have proven very popular with students, providing great learning environments".

Coventry University[16] : Coventry University has competed in Formula Student for ten years. It features in the final year BEng (Hons) Motorsport Engineering course, where typically four to five teams (with up to six members) have the responsibility to design an area of a car. "*This mimics the 'module sub-teams' commonly seen in professional race teams, and provides 'industrial typical' experience of working in a race-car programme.*"

6. What contribution should higher education make to improving social mobility and building a more socially just nation?

Higher Education has a very real role to play in the social mobility of the nation. However, we are yet to see the impact of the recent changes to the funding mechanism although have some major concerns. One in particular is related to the removal of the cap on the numbers of students with the equivalent of grades AAB and above at A level.

Some limited data made available by UCAS indicated that applicants to engineering programmes are much more likely than applicants to other disciplines to have alternative qualifications to A levels, such as BTEC. While there have been representations from across the sector about these issues, c*ombinations of qualifications are not exempted from the student number control (for example, a student holding both a BTEC and an A-level)*." To expand, the extended BTEC diploma is equivalent to three A levels and will be accepted as equivalent to AAB at A level if a student earns at least three distinctions. However, a student who combines these other qualifications to achieve the same tariff as an extended diploma will not count as an AAB equivalent. It cannot be gleaned from the publicly available summary data provided by UCAS how many potential applicants this affects, but the Million+ Group of Universities and the Director of the Supporting Professionalism in Admissions Group have both made representations on the basis that this policy is bound to disadvantage students who didn't take A levels and hence impact negatively on social mobility. It may, also have significant financial implications for departments such as engineering for whom such students comprise a significant minority.

In addition, a number of institutions have been running a Foundation Year (note this is not a Foundation degree) prior to year 1 of an undergraduate degree. Some universities have used this as a mechanism for 'converting' students with arts and humanities 'A' levels to be eligible for entry to science and engineering degrees. Others have used it as a mechanism to give students with weaker science and maths 'A' level grades a 'second chance'. There is evidence from our analysis of the data that 'widening participation' students are disproportionately represented on the Foundation Year. This may partly provide evidence of less than optimum science teaching in schools as a number of students coming through on the Foundation Year delivered in a university setting go on to do very well indeed on demanding and robust accredited engineering degrees. We would therefore strongly advocate attention being given to supporting (financially) the provision of this route into higher education.

Given the real differences in regional economic health and social mix, any negative impact on the ability of students with impaired or non traditional educational backgrounds is unwelcome.

7. Does higher education have a role to play in shaping our national culture and strengthening ties of common citizenship?

This is one of higher education's core roles. We would add our voice to the call from across the sector that the UK must demonstrate to the world that it is still "open" to overseas students and staff. The cultural diversity and intellectual contribution that could be lost through the current stance on student Visa legislation will take many years to recover. Engineering in particular recruits the majority (60%) of its postgraduate taught

[16] http://m.imeche.org/news/archives/2012/04/30/coventry-university-motors-forward-with-industry-ready-engineering-graduates

students from overseas and while the financial contribution lost is clear and substantial, the indirect economic and cultural contributions to the future of UK Plc are incalculable.

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Professor Helen Atkinson FREng, FIMMM, FIMechE, DIC

President, Engineering Professors' Council

Contact via: Susan Kay, Director, Engineering Professors' Council s.kay@epc.ac.uk