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Mr Simon Fiander, Clerk
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Dear Mr Fiander

Science and Technology Committee inquiry into the Science Budget

The Engineering Professors' Council (http://epc.ac.uk) represents the majority of academic engineers in the UK, with 80 university engineering faculty members comprising over 6,000 academic staff. In May 2015, we published our report "Ingenious Resilience[1]" in collaboration with Cambridge University's Science Policy Exchange. In it, we emphasised why engineering matters to the UK economy, on both a regional and national level, and the profession's contribution to maintaining the UK's position in the world by driving innovation and regional regeneration. In particular, we talk about how engineering departments of UK universities are leading in tackling the "grand challenges" that face society more generally and some of the Government interventions which best support this endeavour. We are therefore pleased to contribute to this important inquiry and have both consulted with our membership and drawn on a range of recent existing research and evidence in offering the following views under the broad headings of the terms of reference for the inquiry. A summary of our recommendations may be found in section 5 below.

1. Engineering's contribution to a resilient and healthy economy: the extent to which any increase or reduction in Government expenditure on science and research will have an impact on the UK's relative position among competitor states. The need for and rationale for any adjustment to the trajectory of future Government expenditure on science and research, and what would be gained from an increase (or lost from a reduction) compared with current expenditure levels.

1.1 The following is an extract from an independent report by Technopolis, published this year: *Assessing the economic returns of engineering research and postgraduate training in the UK*[2]. The report itself provides a rich source of evidence and information about engineering's contribution to the resilience and health of the UK economy and its relative global competitive position.

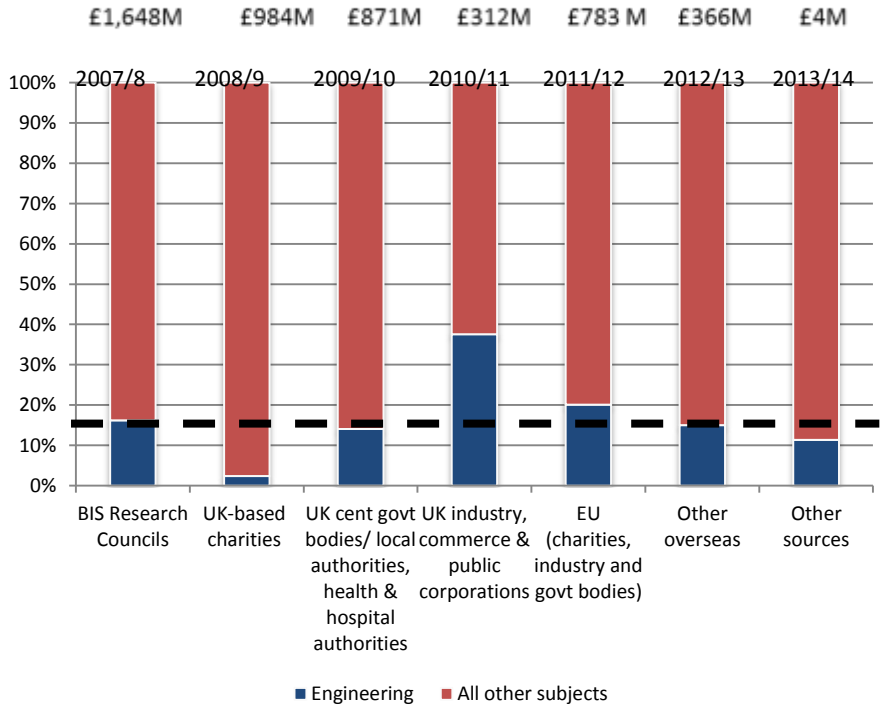
- *Engineering contributed an estimated £280 billion in gross value added (GVA) in 2011, which is 20% of the total UK GVA. This includes the economic output of both the more 'obvious' engineering-related sectors of the economy, such as aerospace, and a share of the output of several other 'less obvious' sectors that employ significant numbers of highly-qualified engineers,*

[1] http://epc.ac.uk/ingenious-resilience-messages-for-a-new-government/
[2] Technopolis, 2015: *assessing the economic returns of engineering research and postgraduate training in the UK (https://www.epsrc.ac.uk/newsevents/pubs/econreturnsengresreport/)*

- *Including, for example, knowledge intensive business services (e.g. advertising, management consultancy), health and finance.*
- *Engineering qualifications attract an additional wage premium on average in comparison with the average for other scientific disciplines, estimated to be around 15% of the median salary for newly qualified graduates – an indication of the value of those skills to employers but also the significant personal tax contributions made by a highly qualified workforce.*
- *Analysis of the UK Innovation Survey (2013) shows that sectors with a higher concentration of graduate engineers, such as high-tech manufacturing, computing and telecommunications or utilities all report higher than average levels of innovation activity and innovation-related income, as well as levels of labour productivity (GVA per employee) above the national average.*
- *Sectors with higher concentrations of engineering skills tend to export more. Each engineering-based manufacturing company exports, on average, £9.3 million, which is more than double that for all other manufacturing companies, at £3.9 million.*
- *Engineering-related sectors exported goods and services valued at around £239 billion in 2011, some 48% of the total value of exports for that year, which is a notable contribution and underlines the critical role played by engineering in the export economy.*

1.2 Without significant investment in research and development in engineering, by both Government and industry, the above would be simply unsustainable. Investment in sustaining academic excellence in engineering translates into tangible economic benefits. Government research and development (R&D) grants can stimulate around 30% more self-investment from industry[3] and for every £1 spent by the government on R&D, private sector R&D productivity rises by 20p per year in perpetuity[4]. Engineering as a discipline has proved its ability to deliver these multipliers. It is also demonstrably successful in attracting funding from industry both at home and overseas:

Research Grants and Contracts funding (excluding HEFCE quality-related funding) – engineering only



Engineering represents c.15% of all research grants and contracts income to UK HEIs…it does however receive 38% of all funding to UK HEIs from UK industry and 20% of the funding from EU sources.

Source: EPC analysis of HESA Finance 2013/14 from the Higher Education Database for Institutions (HEIDI)

[3] Jonathan Haskel, Alan Hughes and Elif Bascavusoglu-Moreau, The Economic Significance of the UK Science Base, 2014
[4] Department for Business, Innovation and Skills, Estimating the effect of UK direct public support for innovation, 2014

1.3 We therefore encourage Government to increase investment in research and development to reach the levels (as a percentage of GDP) of the USA and Germany. Despite the context of austerity in government spending in both the EU and the US in recent years, R&D spending has increased in Germany (as a % of GDP from 2.8% (2010) to 2.92% (2012) and in the US from 2.74% to 2.79% over the same period[5]. The UK is sliding further back from the EU target of investing 3% of GDP in R&D by 2020 (1.72% in 2012).

2. Increasing expenditure on engineering research and development provides a positive contribution across the range of public services by providing the pipeline of highly skilled and knowledgeable engineers[6] thus ameliorating the opportunity cost of government expenditure foregone on other public services and providing transparent complementarity with the Science Budget.

2.1 The 2014 Research Excellence Framework's (REF) database of case studies provides a rich evidence base of excellent examples of the contributions of engineering research to the better provision of public services in areas such as security and safety, human and mental health, the environment and transport, amongst others. From the Technopolis report [7] again:

- *The presence of, and engagement with, engineers and scientists is crucial to the operation of many areas of government work and policy-making, particularly in formulating evidence-based policy in technical areas, as evidenced by the Government Office for Science…*
- *There are several specific examples of how engineers' skills are widely spread across several areas of public policy, including Department of Environment, Food and Rural Affairs (DEFRA), Ministry of Defence (MOD), Department of Health, Department of Transport, to name just a few.*
- *Regarding environmental policy, engineering skills are key assets for the Environmental Agency (EA), which focuses on risk management mainly in response to flooding. The development of adequate responses to flooding generates millions of pounds in savings for HM Treasury.*
- *The importance of engineers to DEFRA's intelligent customer capabilities, cannot be overstated, a role that is becoming more important over time, with increased use of outsourcing and marketization of products and services. There is also a strong role to be played within the context of pre-commercial procurement of innovative solutions for various public bodies.*

2.2 While providing excellent evidence, the REF set out to measure the impact of work in particular universities, rather than of the impact of research disciplines such as engineering as a whole, in areas like regional economic regeneration, policy-making and most importantly, delivering the highly skilled people industry needs and which help make the UK attractive to overseas investors. Thus, transparency and arrangements for academic institutions to access R&D funding allocated to other Government departments would be welcomed. Furthermore, in order to continue to provide the pipeline of highly skilled and knowledgeable engineers, a continuing contribution to the costs of teaching high cost subjects like engineering which are not currently met by the capped undergraduate tuition fee is needed.

[5] http://data.worldbank.org/indicator/GB.XPD.RSDV.GD.ZS

[6] The Heads of the Government's Science and Engineering (GSE) profession estimate there are over 12,000 specialist science or engineering posts across the civil service and around 8,000 people that identify science and engineering as their primary role within government. A GSE survey (2012) of scientists and engineers obtained responses from more than 2,100 science and engineering professionals of which around 30% had engineering backgrounds, ranging from marine to mechanical engineering. Around 34% of respondents had PhDs.

[7] Technopolis, 2015: *assessing the economic returns of engineering research and postgraduate training in the UK (https://www.epsrc.ac.uk/newsevents/pubs/econreturnsengresreport/)*

3. Consistency of Government expenditures on aspects of science and research with other government policies, including the Industrial Strategies and the Eight Great Technologies and fiscal incentive policies for research investment.

3.1 The Engineering Professors' Council (EPC) has welcomed the development of an industrial strategy and the work of the Industry Strategy and other sectoral Councils. It can be shown that the development of high level engineering skills has a significant and positive contribution to make to all of them[8] and the task groups established as a result of the Perkins Review of Engineering Skills embraced this. That said, it was clear from the work that the EPC led on the postgraduate skills task group that industry sought financial incentives from Government to facilitate engagement with academic institutions. The small amount of pilot funding announced in the Science and Innovation Strategy[9] to support more non engineering graduates transitioning to a career in engineering is welcome but more is needed, possibly in the form of tax breaks to incentivise industry investment in training and continuing professional development in priority industries and/or loan repayment forgiveness for those embarking on degree level/postgraduate training in priority discipline areas.

4. Determination of 'resource' and 'capital' allocations and the current distribution of the budget between particular types of expenditure and between different organisations. Achievement of the appropriate balance between pure and applied research.

4.1 In many areas, particularly high-performance computing, big data etc, it seems there is a willingness to make capital investment but a reluctance to balance this with investment in the people needed to run the equipment and other running costs. The traditional model of having fixed term contract postdoctoral staff develop and maintain equipment and software is unsustainable. Skilled software developers and technicians are crucial to modern scientific endeavour so developing appropriate and appealing career paths and incentives and allocating appropriate operational budgets, taking these into account at the investment decision stage are essential. We are becoming increasingly short term in outlook and a more holistic and longer term approach to return on investment calculations needs to be taken: "holistic" in that greater effort needs to be made for reflecting the need for on-going upgrade and articulating and taking account of the economic, social and other impacts of the investment. We also need to bear in mind that these impacts may only be felt by the next generation rather than in five years' time. Provision of running costs linked to new facilities will make the most of public capital investment.

4.2 In respect of achieving the appropriate balance of expenditure between organisations, we would draw on the work of the HEFCE/UUK Review of Quality-Related Research Funding in English Higher Education Institutions[10] which finds widespread support for the dual funding system, with the two elements, project based Research Council funding and block grant quality-related (QR) funding being seen as complementary rather than as substitutes when reviewing any possible changes in the balance between them.

4.3 The report also noted that third stream income (TSI) is used as a proxy for the impact accruing to external organisations and measures the willingness of these organisations to pay for a range of research-related activities and commercialisation derived from research in HEIs and that there is a statistically significant and positive relationship between research funding (both QR and Research

[8] https://www.gov.uk/government/publications/engineering-skills-perkins-review-progress-report
[9] https://www.gov.uk/government/publications/our-plan-for-growth-science-and-innovation
[10] http://www.hefce.ac.uk/pubs/rereports/Year/2014/qrreview/Title,101530,en.html

Council funding) and the generation of TSI. In this way, the Higher Education Innovation Fund (HEIF) is shown to make a positive impact in enhancing the role of these funding streams, at all levels.

4.4 The willingness of industry and other stakeholders to pay for the research-related activities generated by this investment in the block grant would be further enhanced by providing enhanced support for university-industry collaboration and in this regard, we commend the recent work of Professor Dame Ann Dowling of the Royal Academy of Engineering[11] who said:

"It is clear that the UK has played host to many successful business-university collaborations but that….the UK is not reaping the full potential provided by the opportunity to connect innovative businesses — from the UK and overseas — with the excellence in the UK's academic research base. Government has a crucial role in fostering the conditions under which these collaborations can happen at scale and deliver enduring impacts for all parties involved".

4.5 More specifically, she called for:

- Simplification of the innovation system
- Support for activities that help seed collaborations.
- Pump-prime funding to stimulate the development of high quality research collaborations with critical mass and sustainability.
- Better co-ordination and visibility of Government strategy on innovation.

To this, we would add:

- A reduction in tax on sharing of R&D equipment and facilities to foster innovative collaboration

5. Summary

5.1 The more than 90 engineering faculties in universities across the UK are playing leading roles in educating the engineers of the future and working with businesses of all sizes: in doing so, ensuring enduring economic resilience through their regional spread and provision of talent and cutting edge research to both innovative firms and the public services. This work is underpinned fundamentally by the dual support system of research funding which itself leverages industry and other stakeholder funding. This industry and stakeholder funding would not, however increase to fill the gap if public funding were reduced or withdrawn. (See the Department for Business, Innovation and Skills' 2013 report illustrating examples of successful leveraging and the consequences of withdrawal of public funding from areas of research[12]). In our own report, Ingenious Resilience[13], we cite some excellent examples of good practice but more needs to be done. We need:

- To deliver the EU target of investing 3% of GDP in R&D by 2020 as a long term commitment to a vibrant industrial strategy
- Tax breaks to incentivise the sharing of R&D equipment and facilities
- Investment in operating costs to ensure the long term viability of R&D facilities and an appropriate return on the capital investment
- Investment in high level/advanced employee skills development, particularly in shortage skills areas, through tax breaks and/or loan repayment forgiveness

[11] http://www.raeng.org.uk/policy/dowling-review
[12] http://www.rcuk.ac.uk/media/news/130715/
[13] http://epc.ac.uk/ingenious-resilience-messages-for-a-new-government/

- Transparency in departmental budgets and arrangements for academic institutions to access R&D funding allocated to other Government departments (such as DEFRA, Ministry of Defence, Departments of Health and Transport etc).
- To maintain the dual support system to enable our universities to maintain a flexible, strategic and collaborative approach to their research.
- To sustain the regional spread of university engineering departments by investing in excellence in skills development and innovative research, wherever it may be found.
- Continuation of the contribution to the costs of teaching high cost subjects like engineering which are not currently met by the capped undergraduate tuition fee to secure the ability to fill this critical skills gap in the economy.

We would be delighted to elaborate further on this submission if called upon to do so.

Yours sincerely

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