**Imperial College London response to HEFCE’s call for evidence on the BIS Science and Innovation Strategy: “What should the shape and scale of the UK’s science and innovation system be by 2020?”**

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<th>Name and role of respondent:</th>
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<td>Name of institution:</td>
<td>Imperial College London</td>
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**For each of the areas below, detail your views and any potential sources of evidence. Please also indicate if you consider that your institution may be able to provide a case study to demonstrate your argument.**

### Introduction

Key points that the College would like to make in relation to the BIS Science and Innovation Strategy are:

- In order to maintain and develop a globally leading science and innovation system, it is essential that the UK looks to the future in enabling the flexibility and interdisciplinary working required to address emerging challenges, while maintaining the health of core disciplines.
- Research-intensive universities are major drivers of innovation and economic growth locally, nationally and internationally, and hence have a crucial role to play in maintaining and developing the science and innovation ecosystem.
- It would be helpful for the Government and Ministers to work together with a high-level science advisory committee made up of expert academics to establish an agreed and common set of priorities for research funding.

### Benchmarking the UK

- What are the key challenges the UK needs to address to maintain and develop a globally leading science and innovation system?
- What indicators could be used to measure UK performance by 2020?

In order to maintain and develop a globally leading science and innovation system, it is essential that the UK looks to the future in enabling the flexibility and interdisciplinary working required to address emerging challenges, while maintaining the health of core disciplines. Research-intensive universities are major drivers of innovation and economic growth locally, nationally and internationally, and hence have a crucial role to play in maintaining and developing the science and innovation ecosystem. Such universities have the research quality, critical mass and multi-disciplinary capacity required to attract global talent and investment, to undertake and sustain large-scale research collaborations both within the UK and internationally, and to drive innovation and economic growth through the impact of their research.

Indicators to measure UK performance by 2020 should include a mixture of measures assessing the UK’s performance against previous years and measures assessing the UK’s performance against global competitors. These could include, for example, research income from external sources (including from sources outside the UK), the rankings of UK universities at the top of global league tables, and share of global research publications and citations. Measures could be normalised against UK R&D spend to allow easier comparison to other countries.

### Infrastructure

- The Department of Business, Innovation and Skills’ consultation on proposals for long-
term capital investment invites evidence to be submitted in this area. To complement that consultation, we invite any further views relating to science and innovation infrastructure that are not covered by the Department's consultation; for example, how could we make the most of existing research and technology organisations and their infrastructure, in both the public and private sectors, to strengthen science capability and support for businesses?

In order to support the infrastructure required for a globally leading science and innovation system, it is essential to ensure that capital requirements at the institutional and project level can be fully met and that national and international facilities are resourced appropriately. This will help to maintain the long-term sustainability of the UK science and research base. Capital funding is vital in attracting overseas staff and investment, and in order to compete globally the UK needs to maintain laboratories in key underlying research areas. However, universities’ future capital requirements are likely to go well beyond what can reasonably be met by Government funding. That being so, it would be very helpful for the Government to come to the table together with other stakeholders to help fulfil universities’ capital requirements from all sectors and funding sources. The College’s experience in developing Imperial West shows that the Government can play an important role in stimulating leveraged funding through schemes such as UKRPIF (the Research and Translation Hub at Imperial West has been funded partly through UKRPIF, partly by the private investor Voreda, and partly by the College).

Government science and research capital funding should not be extended to other organisations as this could have the effect of diluting the funding available to HEIs, putting at risk the sustainability of the UK research base and reducing the impact of the funding received. One way to make the most of existing research and technology organisations and their infrastructure, in both the public and the private sectors, would be to support (through incentive mechanisms such as HEFCE Business QR funding) universities in creating strong links with businesses to, for example, strengthen and develop equipment manufacturing capabilities within the UK.

### Research capability and impact

- In what key ways do the strategic principles informing UK science and innovation (such as dual support and autonomy) support the system?
- What factors are important in ensuring we have the right balance of different types of research (for example basic research, experimental research, and research directed towards application)?
- How could we further the progress already made on maximising the impact of research?
- Which models, and characteristics of models, of government support to catalyse innovation, knowledge exchange and impact work best? In what context or contexts?

The principle of institutional autonomy is vital in strengthening UK science and innovation, as any imposition of restrictions on institutions would be likely to put at risk their ability to carry out high-quality research and achieve impact in line with their strengths and missions. The dual support system also helps to support the UK’s science and innovation system, for example through enabling institutions to carry out the type of blue skies research that is not always readily funded but can lead to significant innovation and impact. Generally, it will be important to ensure that the full economic costs of research are met under whatever mechanisms are in place. It would also be helpful for the Government and Ministers to work together with a high-level science advisory committee made up of expert academics to establish an agreed and common set of priorities for research funding.

In terms of Government support to catalyse innovation, knowledge exchange and impact, it...
should be noted that a recent research report on the economic significance of the UK science base (CaSE, March 2014\(^1\)) found that public investment in research increases rather than diminishes private sector investment (the report calculates that for every £1 spent by the Government on R&D, private sector R&D output rises by 20p in perpetuity by raising the level of the UK knowledge base), meaning that investment in science and innovation is not and should not be seen as a zero-sum game in which they are substitutes.

HEIF is vital in helping universities translate research ideas, knowledge and technology strengths into both economic and social impacts. A recent HEFCE report\(^2\) (April 2014) found that research-intensive universities are particularly effective in using HEIF to generate income; between 2003 and 2012 the top 6 most research intensive universities in England (a group that includes the College) generated £13.3 of gross additional knowledge exchange income for every £1 of HEFCE knowledge exchange funding, more than twice the sector average. The flexibility of the HEIF model is important in enabling universities to adapt their innovation systems to best suit their local environment.

Another effective mechanism for catalysing innovation, knowledge exchange and impact is the Impact Acceleration Accounts. For example, the College runs a Knowledge Transfer Secondment (KTS) programme, funded through its EPSRC Impact Acceleration Account, which is flexible, responsive, and allows for the two-way flow of individuals. This has so far funded 57 secondments involving 50 different organisations, 22 of which have been SMEs.

In the College’s experience, jobs, growth and innovation are best generated when clusters of large and small businesses together with universities form around core STEM areas with market-facing outcomes. For example, London is Europe’s major innovation hub and the College plays a central role in connecting to large and small businesses with research and venture funding around science, including in partnership with other institutions such as the Francis Crick Institute. The College engages with the London Local Enterprise Partnership (LEP), which is focusing one of its four key action areas on science and technology and has supported MedCity (which brings together the leading centres of medical research in London, Oxford and Cambridge) and TechCity (which supports the growth of digital businesses), working closely with university partners to encourage collaboration with industry.

Skills for science and innovation

- What more could be done to expand the number of people available in the UK in science, technology, engineering and mathematics (STEM) disciplines at all levels of qualification, from technician skills to graduates?
- How could we maximise the chances of people fulfilling their potential in STEM disciplines in the UK? In what ways can we raise awareness of science- and innovation-related careers and opportunities?
- Have we got the right balance between skills levels and disciplines for science and innovation? Are there particular areas where growth needs to be encouraged?
- Do we have master’s and postgraduate degrees that prepare graduates well to take up technological and managerial roles in UK businesses?

Starting from an early stage is important in expanding the number of STEM-qualified people in the UK and maximising the chances of people fulfilling their potential in STEM disciplines. For example, the College is currently working with digital education company Twig World on initiatives which will support primary school teachers to engage children in science, including

\(^1\) [http://sciencecampaign.org.uk/UKScienceBase.pdf](http://sciencecampaign.org.uk/UKScienceBase.pdf)  
\(^2\) [http://www.hefce.ac.uk/pubs/rereports/year/2014/keheifimpact/](http://www.hefce.ac.uk/pubs/rereports/year/2014/keheifimpact/)
a programme of online professional development courses scheduled to launch in autumn 2014. The College also runs a number of outreach programmes aimed at addressing the problems caused by a shortage of well-qualified science teachers in state schools and raising the aspirations of school children, towards higher education generally and science in particular, from primary education through to A-level. Examples of these activities are the College’s Reach Out Lab, which delivers practical programmes and an experience of university for pupils aged six to eighteen, particularly from schools without ready access to laboratories, and the College’s INSPIRE (Innovative Scheme for Postgraduates in Research and Education) programme, through which some of the College’s postgraduate students and post-doctoral staff spend time in partner secondary schools teaching and studying towards qualified teacher status. More generally, activities such as the Imperial Festival, an annual celebration of the sciences and arts on offer from Imperial College London, help to raise public awareness of science- and innovation-related careers and opportunities.

At school level, ensuring that STEM A-Levels and GCSEs are challenging and globally competitive would certainly help to expand the number of suitably-qualified people in STEM disciplines in the UK. At university level, one of the key factors in maximising the chances of people fulfilling their potential in STEM disciplines is the provision of an excellent intellectual and physical environment for both teaching and research in STEM subjects. Enabling institutions to recover the full costs of teaching and postgraduate research in STEM disciplines, and thus ensuring the financial sustainability of these courses, is essential in achieving these aims. The College’s Home/EU undergraduate students were taught at a loss in 2012-13, and with tuition fees not rising with inflation this deficit can only increase.

There are a substantial number of Master’s and postgraduate degrees available that prepare graduates well to take up technological and managerial roles in UK businesses. For example, many of the College’s courses (such as the MSc in Systems Engineering and Innovation and the MSc in Innovation, Entrepreneurship and Management) are tailored closely to the skills required by industry and business. In 2011-12, the latest year for which data is available (Destination of Leavers from Higher Education survey 2011-12), over 90% of the College’s postgraduate leavers were in work or further study 6 months after graduation.

Research-business interface

In responding to the questions in this area, institutions may want to reflect on how their relationships with businesses relate to the issues raised.

- What prevents businesses in the UK from investing in research and development as much as businesses do in other leading economies? What more could be done to catalyse business investment in the system?
- How could we ensure that more small and medium-sized enterprises develop new products and services to bring business innovation performance at the level of other leading economies? How could the science and innovation system better support some of these enterprises?
- How could the science and innovation system better contribute to supporting innovation in services, a large part of the UK economy? Are there areas that would require further consideration?
- How should Government and partners regularly identify the technologies in which the UK should prioritise investment, and what evidence should that be based on?

It should be noted that BIS research has shown that whilst the UK’s share of national income in R&D investment is relatively low compared to other leading industrialised nations, this is largely due to the UK’s industrial mix; UK companies generally show similar R&D intensities.
to others in their sectors, but the UK is also specialised in less R&D intensive industries\(^3\). Innovation is much broader than just R&D. It should also be noted that making a distinction between manufacturing and services is misleading because many manufacturing firms provide and use services. The main impediment to catalysing business investment is short-termism; longer-term investment is needed to support university-business collaboration and the Government needs to encourage businesses to invest longer-term by setting out a stronger long-term vision itself.

In the College’s experience, supporting SMEs to develop new products and services is best done as part of an ecosystem which includes both universities and large and small businesses. Such collaborative clusters provide opportunities for networking and interaction between entrepreneurs, innovators, and researchers, encouraging them to combine their complementary strengths. For example, the College is a core partner in the London Node of the European Institute of Technology ICT Lab together with BT, IBM, the Institute for Sustainability, Intel, Vodafone, University College London and the University of Edinburgh.

Innovation in services has the potential to be one of the UK’s major strengths and there is already considerable activity in this area. For example, the College’s Brevan Howard Centre for Finance (funded by a gift of £20.1M from the hedge fund Brevan Howard) aims to advance the economic understanding of financial market behaviour, develop a greater understanding and more efficient management of risk, and improve policy-making around this crucial field. There are also key opportunities in fields such as “smart cities”, emergency and healthcare services, and cognitive computing. It should be noted that a major contributor of STEM to services innovation is via the recruitment of STEM-trained personnel, representing STEM knowledge embedded within an institution. Between 1994-95 and 2006-07, 82% of university leavers with a “core STEM” first degree who were in full-time employment six months after graduating were working in the services sector (as were 90% of leavers with a non-STEM first degree)\(^4\).

Technologies should be prioritised for investment based on regular consultation with the sector and expert advice from researchers, including mechanisms such as the high-level science advisory committee proposed above.
