Dial-a-Molecule Response to the Department of Business Innovation & Skills consultation on the strategic priorities for science and research funding

On behalf of the Dial-a-Molecule EPSRC Grand Challenge Network, the undersigned wish to make the following statement in response to Prof. Sir John O'Reilly's invitation for comments on key priorities for the spending review FY 2015/2016 as per 23rd March 2013.

This response was prepared by the Dial-a-Molecule Executive Group in correspondence with Chemistry Innovation KTN and the Royal Society of Chemistry.

We would welcome the opportunity to discuss the points raised in this letter in further detail. Please contact the Dial-a-Molecule Network Coordinator Dr Susanne Coles with any queries.

The Dial-a-Molecule Executive Group:

Prof Richard Whitby (University of Southampton)

Prof David Harrowven (University of Southampton)

Prof Steve Marsden (University of Leeds)

Mr Simon Rushworth (Chemistry Innovation KTN)

Dr Susanne Coles (University of Southampton)

The Dial-a-Molecule Steering Group Representatives:

Dr Harris Makatsoris (Brunel University)

Prof Joe Sweeney (University of Huddersfield)

Dr Gill Smith (Gillian Smith Associates)

Dr Mimi Hii (Imperial College London)

Dr Andrew Russell (University of Reading)

Dr Robin Attrill (GSK)

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Contact

Dr Susanne Coles
Chemistry
University of Southampton
Highfield
Southampton
SO17 1BJ
Tel.: 02380596675
Mob.: 07821887382
Email: L.S.Coles@soton.ac.uk

Key Recommendations

1) Continue support for science and research through protection of the research budget and related capital spending

- Increase the Government Expenditure on Research and Development to 0.7% GDP and maintain this level of funding in real terms for the longer term

2) Strategically invest in UK research strengths

- Review priority areas and ensure resource focus to maintain technology lead

3) Review the innovation pipeline and establish effective mechanisms for open innovation

- Enhance collaboration of the research councils and the TSB to enable transitioning in cutting-edge cross-disciplinary research and innovation efforts

4) Recognise the value of chemistry and its role as a wealth generator underpinning growth in many industries

- Provide support for the Chemistry Growth Strategy and establishing of the proposed Chemicals Council

5) Maintain excellence of the research environment as the premiere training ground for the future workforce

Our comments on key priorities

Chemistry is the core science of the Pharmaceutical and Agrochemical sectors, and small molecules remain the mainstay of their product lines. These industries are paramount to UK economic growth[1]. Yet its importance also to other sectors (*e.g.* formulated products such as paints, hygiene products, solar panels, LEDs *etc.*) is often underappreciated by policy makers. For example UK chemists lead the development of both liquid crystals and Organic Light Emitting Diodes – the key current and future display technologies. In total the chemistry-using industries generate approximately £600 billion in sales and £195 billion GVA (Figure 1) per annum, a substantial contribution to UK plc.

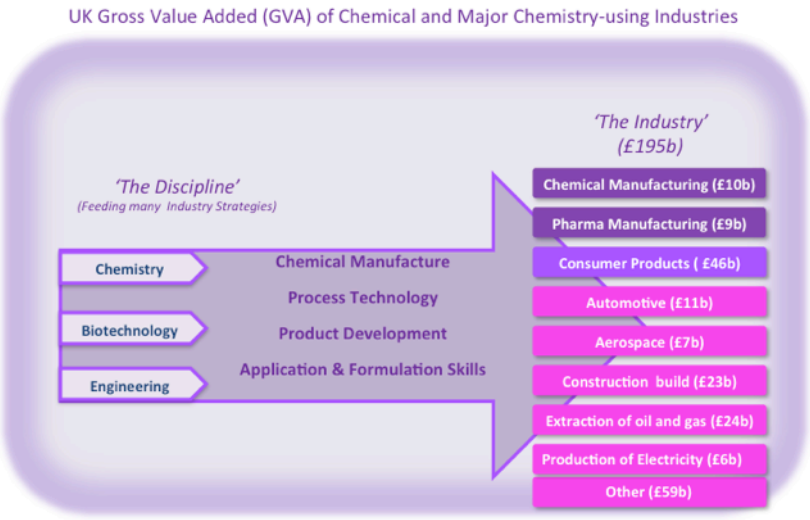

Figure 1: Value of chemistry-using industries in GVA generated per annum. Source: Office for National Statistics: Annual Business Survey - Provisional data as at 15.11.2012.

Furthermore, there exists a misconception that value in Pharmaceutical and Agrochemical industries is largely derived from the biosciences. In reality, small molecules and fine chemicals remain the primary wealth generators in both sectors (Figure 2).

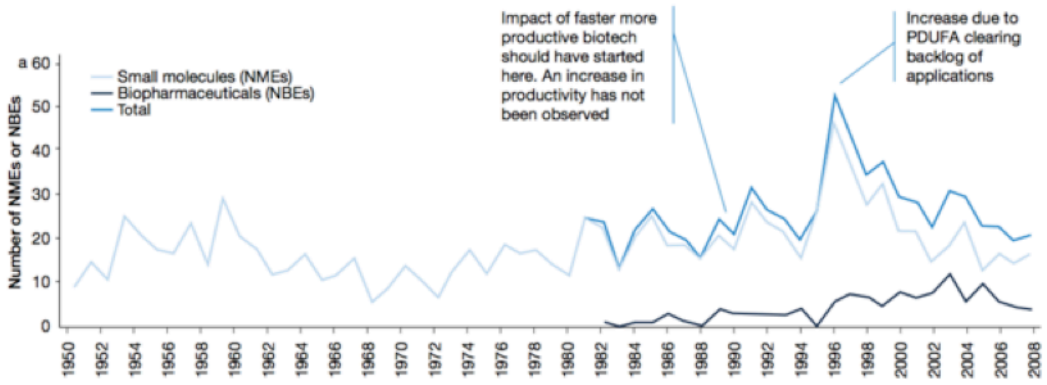

Figure 2: Number of FDA approved drugs comparing small molecule versus biopharmaceuticals in the pharmaceutical industry 1950-2008. Source: Bernard Munos "Lessons from 60 years of pharmaceutical innovation".

[1] The economic benefits of chemistry, EPSRC & RSC, Oxford Economics (2010)

Moreover, UK-trained PhD organic chemists were identified as inventors of at least 10 of the top-selling drugs worldwide generating in excess of $1 billion in annual sales at peak[2] - a strong argument for continuing investment in graduate training in this area.

It is imperative that misperceptions such as the above are corrected and that the ability of chemistry to deliver economic growth and benefit is more widely recognized.

Dial-a-Molecule seeks additionally to promote the importance of chemistry to industry and UK economy. It also seeks to improve its image within the wider community and policy stakeholders. To that end we are working with the RSC, SCI, IChemE and CIKTN and embrace the vision of the Chemistry Growth Strategy. The establishment of The Chemicals Council to drive forward that agenda is something we strongly support. Dial-a-Molecule is also playing a key role in driving innovation across a range of knowledge transfer interfaces, working with top-level organizations such as the Royal Society (Dial-a-Molecule network members chair and steer the RS Industry Fellows College) and Big Innovation Centre.

Key break-through discoveries that lead to major industries are often in areas remote from current exploitation, and serendipity often plays a role. For that reason alone, some space for exploratory research needs to found. Blue-skies research is vital for the furtherance of science and needs to be enabled through continuing public funding. The ring-fencing of the science and research budget in the last spending review was most welcome in this regard against a backdrop of spending cuts.

Solving tomorrow's problems and the global challenges we face increasingly calls for a concerted, multi-disciplinary approach with appropriate strategic investment. Networks such as Dial-a-Molecule provide a ripe seeding ground for cross-disciplinary collaborative projects, both in terms of cross-discipline academia-academia and university-industry partnerships. However, maintaining and improving mechanisms for ensuring the translation of novel IP and knowledge generated from within our Universities will be vital to ensure economic benefit is derived. Inspiration on how embracing new technologies enable economic wealth can be taken from the example of spin out companies, such as Cambridge Display Technology (OLEDs)[3], Illumina (Solexa DNA sequencing technology)[4], Nanocotechnologies (quantum dots)[5], Ingenza (biocatalysis)[6] and OxTox Ltd (electrochemical sensors)[7], to name but a few.

To fully unleash such potential greater collaboration between the research councils and TSB is required to ensure the seamless passage from innovation in the research base to the market place. The significant investment in Higher Education Innovation Funding by HEFCE is a crucial additional resource that should be maintained.

Our comments on interactions between the research base and the wider innovation ecosystem

The ring-fence of the current science budget has provided welcome stability in a tough economic climate through strategic government investment in a vital contributor to UK plc. The protected budget, together with capital investment, has allowed longer-term initiatives to be sustained, maintaining the UK's national capability and international competitiveness. However, the flat-cash ring-fence represents an effective reduction in investment in real terms and if the UK is to retain its international excellence we have to compare this against the strategies adopted by competing nations.

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[2] http://www.rsc.org/chemistryworld/Issues/2008/December/OrganicChemistryRisesToTheHealthcareChallenge.asp
[3] http://www.cdtltd.co.uk/
[4] http://www.illumina.com/technology/solexa_technology.ilmn
[5] http://www.nanocotechnologies.com/
[6] http://www.ingenza.com/
[7] http://www.oxtox.com/

With economies such as Germany and the U.S., as well as the BRICS countries, increasing projected spending in science and research for 2015[8], there is the danger that the UK will start to lag behind. It is essential for the prosperity of the UK that support for science and research is strengthened. The UK's thriving research base provides a gold-standard training environment for our future workforce. This needs to be recognized and protected to ensure a continuous flow of relevant skills and expertise to the industrial sector.

We would therefore strongly support the inflationary increase in the budget to 0.7% of GDP, as suggested by the "Science is Vital" campaign[9] and the Royal Society of Chemistry.

Government has recognized eight great technologies[10] in which the UK excels internationally and recent capital investment in these areas is welcomed. In order to escape the 'Valley of Death' it is important that momentum is maintained and continuity is provided through sustained strategic investment in the sectors covered by the Growth Review[11].

The molecular sciences including synthetic chemistry have been identified as a key strength for UK manufacturing (with organic chemistry mentioned explicitly as Revealed Technological Advantage)[12,13], yet appear to have received little in terms of strategic investment. As they underpin much of the chemistry-using industries both in manufacturing and discovery, we believe that such science needs to be recognized as a strategic pillar for investment by RC-UK in line with stated government priorities. Dial-a-Molecule and the UK academic chemical community is zealously committed to working with growth leading industry end-users to help connect and extrapolate manufacturing supply chains (for instance, through multidisciplinary research collaborations focused on translational catalysis which brings together Tier 1, medium and small businesses).

Internationally, the UK ranks as one of the lowest in terms of gross investment in research & development (GERD as % of GDP)[14], yet return on that investment is staggering (£6.71 GVA value generated per £1 investment)[15]. The UK is a truly great place to do science – UK research excellence is rated highly and in terms of citations the UK is second only to the United States[16]. Strategic investment in our most competitive and wealth-creating research areas, coupled with an appropriate immigration policy for scientific workers, will ensure that the UK continues to draw exceptional talent to the country.

Recent studies from the World Economics Forum place the UK at the forefront of academia-industry collaborations (2nd only to Switzerland)[17]. However, the report identified insufficient capacity to innovate as one of the most problematic factors for doing business in the UK. The establishment of the Technology Strategy Board in 2007 and the recent investment in the seven Catapult Centres[18] are welcome steps in the right direction towards addressing this problem. The investment in centres of excellence, such as the EPSRC Centres for Innovative Manufacturing[19], provide further platforms for innovation and uptake of new technologies within businesses maximising economic benefit for the UK. However, exploitation of emerging technologies is an area requiring improvement. Excessive protection, the over-valuation of early stage intellectual property and technology and the aggressive behaviour of research

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[8] OECD Science, Technology and Industry Outlook 2012

[9] http://scienceisvital.org.uk/

[10] https://www.gov.uk/government/speeches/eight-great-technologies

[11] The Plan for Growth, BIS (2011)

[12] Manufacturing in the UK: An economic analysis of the sector, BIS Occasional Paper No. 10A (2010)

[13] Industrial Strategy: UK Sector Analysis, BIS Economics Paper No. 18 (2012)

[14] OECD Economic Surveys United Kingdom (2013)

[15] Evaluation of the Collaborative Research and Development Programmes (2004-2011), TSB

[16] Benchmarking UP Competitiveness in the Global Economy, BIS Economics Paper No. 19 (2012)

[17] The Global Competitiveness Report 2012-2013, World Economic Forum

[18] https://www.innovateuk.org/-/catapult-centres

[19] http://www.epsrc.ac.uk/research/centres/innovativemanufacturing/Pages/centres.aspx

institutions in respect of IP[20] need to be evaluated along with the issue of 'Dark IP'[21]. We recommend a review of the current situation to identify and establish effective mechanisms for early-stage innovation and the establishment of mechanisms to enable the rapid commercialisation of emerging and dormant technologies.

The mind set has to be changed towards open innovation. Often the researcher is not the limiting factor. The Dial-a-Molecule Grand Challenge provides a unique opportunity for both academics and industry to innovate in collaboration at the early stage by focussing on each other's requirements and priorities. The initiative has started to attract wide interest from Europe, Asia and the U.S. with a drive for interactions on the global level. Support through government recognition and greater publicity of such mechanisms would add substance to this course and would help us to overcome the barriers associated with high-risk high-return investments by instilling trust at the highest level in all parties in the wider innovation ecosystem.

Dial-a-Molecule

In 2010, the EPSRC-funded Dial-a-Molecule[22] Grand Challenge for the Chemical Sciences and Engineering[23] was born out of a recognition that the current bottleneck in the production of high value chemicals is frequently chemical synthesis. If this could be addressed, the UK would remain competitive on the international stage and at the forefront of wealth-generating chemical research with high social and economic impact.

A step change in our ability to make complex molecules can impact positively on chemical producing and using industries in three ways: (i) the time-to-market is reduced (and thus lifetime of high value goods under patent protection is increased); (ii) the cost of manufacture and hence ultimately cost of goods is reduced; and (iii) innovative new products are facilitated. Thus, as a matter of urgency we need to develop economically viable and sustainable protocols that are time and cost efficient, and it is our belief that this can only be achieved by a cross-disciplinary, application-driven approach. The community led Dial-a-Molecule Network has developed as its vision the goal of enabling the production of any fine chemicals on a timescale that is useful to the end-user (days rather than years).
The Dial-a-Molecule network has over 460 members including chemists, chemical and process engineers, mathematicians, statisticians, computer scientist and synthetic biologists. Industrial and end-user requirements are key drivers, with a business-led perspective providing essential guidance in the short to medium term. Indeed, 38% of participants in Dial-a-Molecule events are from industry (mainly from the Pharmaceutical, Agrochemical, SME and Consultancy sectors). The remainder are academics from more than 40 UK universities and representatives from organisations and learned societies such as the Chemistry Innovation KTN, the RSC, SCI and IChemE. As the primary funder of the network, EPSRC is critical to our mission and its investment in the Grand Challenges provides a huge incentive for the community to work towards our long-term vision.

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[20] Collective view of all industry perspectives presented at PraxisUnico event "What industry want from academia" at GSK Stevenage on 8th May 2013

[21] David Docherty (Director of the National Centre for Universities and Business) coined the term 'Dark IP' during his presentation at the PraxisUnico event "What industry want from academia" at GSK Stevenage on 8th May 2013. Approximately only 5% of university research IP is protected through patents and easily accessible to the commercial sector via patent databases.

[22] http://www.dial-a-molecule.org

[23] http://www.epsrc.ac.uk/research/ourportfolio/themes/physicalsciences/introduction/Pages/chemscieng.aspx