

1.1.3. - supporting industry and employment, social policy and personal opportunity. Mathematical sciences enhance virtually all of these areas, and CMS believes it should be a strategic goal of the UK HE system to create structures to facilitate this. Provision in higher education for mathematical science of high and imaginative quality and well integrated into other cutting edge research areas adds substantial value. Where it is absent, it has real limiting consequences on other research areas through, for example, their limited ability to interpret and acquire interesting data. Some adjustment in dominant performance metrics may be needed, to reward constructive investments in collaborations that have other beneficial e.g. economic impacts, that are relatively poorly recognised.

1.1.4. EPSRC should attend to the balance of its support for research groups across regions, to improve the scope for diversity in research, appropriate teaching and training, and the formation of research and consultancy connections with local industry. We note that HEFCE is concerned about 'cold spots' in mathematical sciences provision across the country, so concentrating research while widening teaching would not be joined up thinking.

1.2. *Is the balance of funding well-judged between the support of individual investigators, support of teams and support of equipment and infrastructure?*

1.2.1. The mathematical sciences main infrastructure requirement is computing power. Its principal resource requirement is people's time. We will make progress in research and innovation by funding opportunities to collaborate, to compute, and to either take up studentships or post-doc opportunities, or mentor students or post-docs. The number of high quality research units needs to be increased, to underpin mathematical science across our research base. This is needed to train and retain the best researchers, and to raise the standard and competitiveness of our research base overall.

1.2.2. With regard to revenue spending should be coupled to plans for capital spending, so that spending plans as a whole can be assessed and appropriately balanced. Some of that balance is missing at the present time. For example, the relative lack of post-doctoral training and fellowship money is a serious concern in terms of bringing on the next generation of trained researchers for a wide range of disciplines and industries.

1.3. *What are the gaps or holes in the funded portfolios of the Research Councils?*

1.3.1. In 2013, the Council for Science and Technology praised the standing of UK

Institute, the Digital Economy Catapult and the Hartree Centre. They noted however

⁵ The new Alan Turing Institute, which was proposed as a means toward filling this gap, will drive forward and raise the profile of research and development in this field. However further accompanying steps are needed. UK investment in cutting edge facilities needs to be coupled to a holistic strategy to advance the mathematical sciences across our research base as a whole. To play its proper role in driving economic growth at national level and across the UK nations and regions, our intellectual capital needs to be built upon. Occupations that engage

⁵ Council for Science and Technology (CST) (2013) The age of algorithms: algorithms, analytics modeling and data for growth and public sector efficiencies. *Letter to the Prime Minister from the CST*, 6 Aut 2013. Available from: <https://www.gov.uk/government/publications/the-age-of-algorithms> [Accessed: March 2015]

in mathematical sciences research, or that directly require the use of tools and techniques derived from such research, form a highly productive sector of employment in the UK.^{6,7} We need to have the capacity to innovate, to extend and develop mathematical science, and not solely to deploy existing techniques.

- 1.3.2. The rise of the data-led economy, and the worrying existence of major skills gaps in data-led industries, have drawn further attention to the need for statistical and data analytical skills in research and in industry.^{8,9,10} recognised the need to address a deficit in data analytical skills, and commissioned a review by Universities UK on this topic.¹¹ that mathematics and statistics support centres provide students, and sometimes staff, with much-needed guidance.¹² Consultation by the Engineering and Physical Sciences Research Council (EPSRC) has also found that the use of statistics in other disciplines can be very poor, that staffing for this remains an issue, and that post-doctoral and early career fellowships are essential for retaining talent in the UK.¹³

2. Collaborations and partnerships

- 2.1. *Are the right arrangements in place to ensure optimal funding for research that crosses disciplinary boundaries?*

- 2.1.1. The recent Triennial Review of Research Councils highlighted collaboration on interdisciplinary research funding as an area for improvement. CMS is in agreement that work is needed to more widely unlock the value of research in cross-cutting disciplines and themes, among which the mathematical sciences should form a key group. Mathematical sciences are cross-cutting and it is important to recognise and build on this, to advance quantitative research and methods across a wide range of disciplines. It is important to anchor cross-disciplinary leadership on mathematical science somewhere, whether in EPSRC, or more broadly under the aegis of Research Councils UK. Wherever leadership is located, it should be well placed to be cognisant of developments across disciplines and across Councils.

⁶ EPSRC / CMS (n.d.) *Mathematical sciences research: leading the way to UK economic growth* [PDF]. Engineering and Physical Sciences Research Council. Available from:

http://www.ima.org.uk/db/documents/4_page_economic_impact.pdf [Accessed: April 2015]

⁷ Deloitte (2012) *Measuring the Economic Benefits of Mathematical Science Research in the UK* [PDF].

November 2012. Available from: <https://www.epsrc.ac.uk/newsevents/pubs/deloitte-measuring-the-economic-benefits-of-mathematical-science-research-in-the-uk/> [Accessed: April 2015]

⁸ European Commission (2015) Commission workshop identifies skills gap for big data analytics and explores possible solutions [online]. Available at: <http://ec.europa.eu/digital-agenda/en/news/commission-workshop-identifies-skills-gap-big-data-analytics->

has also been working in partnership to raise the level of quantitative skills across the social sciences, in an approach that other disciplines might also benefit from.

4.1.4. Mathematical scientists should have a wider presence in research funding panels than at present. We w

that is under-addressed at present. This would in turn send an important signal to our institutions that there is the scope for cross-disciplinary work and that applications for this will be properly assessed and valued.