SULSA response to BBSRC strategy

STRATEGY FOR UK BIOTECHNOLOGY AND BIOLOGICAL SCIENCES INVITATION TO COMMENT Introduction

The UK research and innovation landscape has changed considerably in recent years, and it continues to evolve with the creation of UK Research and Innovation. In BBSRC we are taking the opportunity to ensure the strategic direction for UK biotechnology and biological sciences is aligned with research needs, as well as with societal and economic drivers.

Between now and the end of the year, we will work with stakeholders to articulate a clear strategy and priorities for UK biotechnology and biological sciences. We would welcome your input and views to help shape the strategy.

In this document, we have set out some of our early thoughts on what might be key elements of the strategy. These are based on an initial consultation with BBSRC's strategy advisory network and Council, as well as reflecting ongoing strategy development activities across BBSRC. We pose a few questions throughout, and invite you to respond to these and provide any other comments through the online questionnaire at: https://app.keysurvey.co.uk/f/1161142/11d9/

The deadline for responses is by the end of Wednesday 11 October 2017. If you have any questions, please contact: strategy@bbsrc.ac.uk

STRATEGY FOR UK BIOTECHNOLOGY AND BIOLOGICAL SCIENCES INVITATION TO COMMENT Strong foundations - maintaining the health of the UK bioscience base

For UK bioscience to remain world-leading, and for it to be able to advance the frontiers of human knowledge and deliver economic and social benefits in the UK and beyond, it needs to be built on solid foundations. We have identified the following as key underpinning and cross-cutting capabilities that will require long-term support and integrated approaches across the bioscience research and innovation landscape:

People and talent - attracting the brightest and best into bioscience, equipping the research base with the range of skills and talent required for modern bioscience, and providing highly- skilled people for the public, private, third and research sectors.

Infrastructure - ensuring that the UK bioscience community has access to the infrastructure, facilities and resources necessary to carry out ground-breaking research, and to support the translation into economic and societal impact.

Collaborations and partnerships - enabling collaborations across disciplines and sectors, between industry and academia, and nationally and internationally.

People and talent

Attracting the brightest and best into bioscience, equipping the research base with the range of skills and talent required for modern bioscience, and providing a supply of highly-skilled people for the public, private, third and research sectors.

This will require:

- a holistic approach which considers the entire workforce needed to deliver high quality bioscience research and innovation, including postdoctoral researchers and technical specialists

- training for a depth of expertise while ensuring that researchers are also equipped with the breadth of professional and transferable skills to be able to work in multidisciplinary teams, and with a variety of partners and stakeholders

- nurturing talent at all career stages, fostering a culture of lifelong learning and development, and encouraging researcher mobility

- making strategic interventions where needed to future proof the skills base and to address emerging skills needs and / or vulnerabilities.

Q1 Are these the right foundations for UK bioscience? Are there other cross-cutting, underpinning capabilities that need to be developed and supported?

Yes, we agree that these are the right foundations for UK bioscience.

Q2 How well will this approach meet the skills needs of the research base and wider economy in the coming years? Are there other considerations?

We agree with the approach but we have reservations about how it will be put into practice. There are many areas that your strategy touches on that we believe needs reform (training, recognition of technical specialists, and strengthening underpinning knowledge in mathematics for example).

A truly integrative policy needs to stretch back to school level education. The brightest and best need to be nurtured and guided towards science at this time.

Increasingly, life sciences are based on quantitative biology, and a grounding in maths, statistics and computer sciences is now seen as a standard requirement, rather than a *luxury. Much of the research in life sciences now requires large-scale experiments that result in huge data sets that need specialist analysis – from drug screening, to microscopy to metabolomics and genomics. Bioinformaticians, who process experimental data from organism-scale projects (for example, the whole sequence of an organism), are in short supply. Bioinformatics is a shortage occupation and many researchers requiring staff with these skills are struggling to hire – as there are not enough trained bioinformaticians (there are only three Masters courses in Bioinformatics in Scotland – at Glasgow, Edinburgh and Heriot Watt Universities), and many Bioinformatics graududates are tempted away by large companies (e.g. in the financial sector) for much greater salaries. In academia, salaries are not negotiable in the way they are in the private sector, and Universities are usually not able to offer a salary that is competitive.*

In addition, the collaborative nature by which most bioinformatics work means they are often not leading grant applications or publishing as lead or senior authors, and so the traditional career trajectories that other academics follow are generally not suitable for these staff. Glasgow University is in the process of adding a new job family, Research Scientist, as part of their Research and Teaching job family, for these type of staff that are performing key, important research contributions but are not leading research. It remains to be seen if this approach is effective in rewarding bioinformaticians/ statisticians/ data analysts. We would recommend the sector follows this closely, and if shown to be effective in improving the career paths of these types of researchers, looks at widespread adoption.

The UK has a significant skills shortage in the life sciences, which we believe stems from school years. With maths now underpinning the majority of life sciences disciplines, we suggest that maths should be a requirement for entry into University life sciences courses. It has recently been published that in England, 24.6 % students fail GCSE maths. In Scotland at Higher level there were 18,861 mathematics candidates this year compared to 18,868 in 2016, with an A-C attainment rate of 74 % compared to 73.5 % in 2016. Students from an early age need data training as well as being taught the latest advances in the life sciences – this may help alleviate the stigma associated with STEM subjects. In addition, it is imperative that teachers are trained properly in these new advances so they feel comfortable and capable of delivering this updated information to students. Whist these are not areas under direct BBSRC control we believe that the BBSRC has an important role to play in informing policy around these areas. RCUK generally should do more to influence what is taught in schools (and how that teaching occurs).

A key issue to address with the skills shortage will be that of migration (via Brexit). 16 % of academic staff at UK higher education providers are from EU countries, while 12 % are from non-EU countries, and if the ability of these skilled workers, and their families, to live and work in Britain is threatened, the skills shortage will amplify.

It is important to emphasise the importance of active interactions between different disciplines to train highly skilled researchers. It is crucial to invest more in interdisciplinary projects. Occasionally supporting a single skilled researcher (PDRA level) is not enough, rather it will become important to invest in projects which will create a research environment where two skilled researchers will actively interact with each other.

Finally, on the issue of researcher mobility – we believe that while it is often important and provides researchers with new experiences, it must also be recognized that researchers often have family commitments that may prevent them from moving (and the perception – perceived or real – that this is not a good enough reason not to move). We believe that this particularly has an impact on the lack of progression of female researchers beyond postdoctoral level, and that there should be some recognition that not every researcher is in a position to move to a new city every few years. In addition local infrastructure (plus support – monetary or otherwise) may mean remaining where they are is the best option for developing their research and their team more quickly.

Infrastructure

Ensuring that the UK bioscience community has access to the infrastructure, facilities and resources necessary to carry out ground-breaking research, and to support its translation into economic and societal impact.

Cutting-edge bioscience is dependent on the availability of modern and sustainable research infrastructures, from essential bioinformatics and biological resources such as databases, genetic resources and culture collections, to state-of-the-art instrumentation and facilities such as high-throughput platforms for genomics, and advanced bioimaging technologies. Infrastructures that support innovation, for example by enabling users of research to access advanced research capabilities, are also crucial to the competitiveness of UK bioscience.

We recognise the need for the UK to take a more strategic approach to the sustainable provision and use of infrastructures for bioscience research and innovation, that encompasses different types of infrastructures, at local, regional, national and international scales. Within this, long-term support for the development and maintenance of reliable and sustained data infrastructures are expected to be a high priority as bioscience becomes an increasingly data-intensive discipline.

Collaborations and partnerships

Enabling collaborations across disciplines and sectors, between industry and academia, and nationally and internationally.

Tackling complex economic and societal grand challenges requires the integration of research across multiple disciplines. Furthermore, exciting developments in research and innovation often occur at the interfaces between disciplines. While ensuring the continued health of the discipline, our strategy for UK biotechnology and biological sciences must also promote and enable multi- inter- and trans- disciplinary ways of working.

Bioscience underpins a wide range of established and emerging industry sectors, and national and international policy areas. Partnerships with the users and beneficiaries of research (e.g. industry, policy-makers, charities, society) are important in shaping research agendas through better understanding of users' needs and aspirations. Similarly, the realisation of economic and societal benefit from the ideas, knowledge, skills and technologies that arise from bioscience research, relies on a deep, discipline-specific understanding of the diverse and diffuse routes to application, effective knowledge exchange, and partnership approaches that bring together companies and other research users with the academic research base in ways that are appropriate for the sector.

International partnership helps sustain the vibrancy of UK bioscience, promoting the free flow of ideas and researchers, delivering 'best with best' scientific collaboration that advance the frontiers of human knowledge, capitalising on complementary research and technology capabilities, and contributing to the development and delivery of international research priorities.

Q3 What are the biggest gaps in UK infrastructure for bioscience research and innovation?

Support for data science (and data storage) is becoming a massive problem, with many universities not having the capabilities or expertise to handle the explosion in big data.

More generally, there are limited opportunities to secure funding for equipment, and we applaud the BBSRC's mid-range equipment grants (and similar) as they provide a very welcome means of buying new equipment. In addition, the tradition of funding only 50% of equipment on many grants means that Universities are having to co-fund much equipment (and are often not able/willing to do so).

Q4 How could the UK take a more strategic approach to the provision and use of infrastructures that are required for bioscience research and innovation?

With the rapid pace of technology development, it is imperative that the UK keeps up and as a sector can have access to the latest equipment. For example, in Scotland, SULSA is supporting many facilities (for example the National Phenotypic Screening Centre in Dundee, and the newly funded Scottish Macromolecular Imaging Facility in Glasgow), and central to this is the requirement that access is equitable to all Scottish researchers. We also help to coordinate bids to ensure there is no duplication amongst Scottish Universities (if possible), and with that comes support from many universities. With more agreement across universities on large equipment usage, we can maximize the possibilities of these *technologies. However, it will be necessary to be careful that the major research centres are not the only ones to benefit from coordinated access, as this may leave smaller, less well-funded and/or isolated institutions without any significant technology and large/expensive travel times (for example) or lack of access (perceived or real). In the longer term this will widen the gulf between the successful and the less successful, which is not helpful in generating a thriving and innovative bioscience sector.*

Regional sensitivity and strategic considerations are needed too. For example, caps on investment in the South East of England (so called-golden triangle) and commitments to minimal investment limits in other regions would help redress an imbalance in resource spread across the UK. Not only would this help enhance research beyond the golden triangle, it would also drive increases in efficiency within it.

The strategy for UK biotechnology and biological sciences must be set in an international context, and should seek to strengthen the UK's position as a global partner of choice for bioscience research and innovation.

Pushing the frontiers of bioscience discovery

BBSRC's strategic plan The Age of Bioscience describes the revolution that is taking place in bioscience, driven by new tools, technologies and approaches that enable researchers to explore key fundamental questions about living systems and how they function (the 'rules of life'). For example, understanding how cells communicate with one another, or how the interplay between an organism's genetic make-up and its environment will affect its physical characteristics. For the UK to remain at the forefront of this revolution, it is essential that we continue to promote creative, curiosity-driven 'frontier bioscience' research that advances the boundaries of knowledge and delivers high-impact discoveries.

Advances in both fundamental and challenge-led research often involve the development or application of new tools and technologies and, increasingly, data-intensive and predictive approaches to biological discovery. Similarly, the emergence and exploitation of disruptive platform technologies can open-up transformative new opportunities for research and business innovation. The future strategy for UK biotechnology and biological sciences must support the synergistic relationship between research, innovation and technology development.

Strategic challenges - building a more resilient, productive and secure future

In the coming decades, bioscience will be at the heart of providing solutions to major challenges facing society, while simultaneously acting as a driver for innovation and growth in the bioeconomy by transforming traditional industries and creating new ones.

BBSRC's strategy identifies three challenge areas for particular focus, where bioscience can have the most impact, nationally and internationally:

Agriculture and food security - sustainably enhancing agricultural productivity, food security and resilience in the face of population growth, changing diets, climate change and other pressures

Industrial biotechnology and bioenergy - developing renewable bio-based feedstocks and processes for low carbon manufacturing of chemicals, materials, biofuels, helping to meet international emissions targets and reducing dependency on fossil fuels

Bioscience for health - improving health across the lifecourse, reducing the need for medical and social intervention

Q5 How might opportunities for collaboration and partnership change in coming years, and how can UK bioscience make the most of these?

Collaboration among biologists, physicists, engineers, and data scientists/informaticians will become a key to solve complex biological issues. Investing such true multidisciplinary research will become extremely important. To make the most of these opportunities, the UK bioscience sector needs to ensure that researchers are being appropriately trained, so that we have the right mixture of skills to advance bioscience research.

We believe that collaboration will become more widespread and will require links with researchers in countries outside of the UK, and of course the aftermath of Brexit will affect this (both positively and negatively). In particular, the Global Challenges Research Fund will encourage partnerships with OED countries.

New ways to peer review interdisciplinary research should be developed to deal, explicitly, with the multidisciplinary challenge. Expert review for each discipline accompanied by an overarching view from someone with a strategic view of promoting innovation in spite of risk. Deeper review of fewer proposals (increased triage before that stage), for example, might help.

Q6 What are likely to be the 'next generation' of breakthroughs that will revolutionise bioscience research, or open up new opportunities for innovation?

Nanotechnology (diagnostics)

Genomics (mass sequencing) and other omics profiling (metabolomics, proteomics) – implications for cancer, dementia, food security etc.

3D printing improvements

DNA editing (food security, health)

Precision medicine

Machine learning

Neuroscience

Q7 How can the UK foster an environment in which creative, curiosity-driven research can thrive and advance the frontiers of bioscience knowledge?

It is vital that the BBSRC supports innovative, risky basic research in as wide a variety of research areas as possible, as no one can predict when the next breakthrough will occur. This should occur alongside support for translational research and commercialisation of the outputs (probably funded by others). In addition, the current focus on challenge-led funding minimises the possibilities of step-change research outcomes because funding is focused on a defined need. Moreover, the challenges laid out may not have identified key issues that may yet come to light in the future.

It is key that the BBSRC invests in truly multidisciplinary projects, and we hope that the formation of UKRI will assist with this, as there are many challenges to addressing this properly (specialist reviewers in multiple areas for example, or sub-projects sitting outside BBSRC remit). Successful collaboration with biologists, physicists and data scientists will revolutionise the way to solve issues.

Our engagement activities have indicated that these remain the right areas of focus for UK bioscience, recognising that they are long-term challenges requiring sustained and concerted effort across the research and innovation ecosystem, and involving multiple disciplines.

Any other comments?

Q8 Are these the right strategic challenges for UK bioscience to focus on? Are there others?

We agree that these are important strategic challenges. For bioscience for health, novel technologies are still required. Therefore, "Technologies for Bioscience" is also an extremely important area.

Q9 What do you see as the greatest opportunities for UK bioscience research and innovation to effect a step change in how these challenges are addressed?

International, creative and cross-disciplinary collaborations are important (and must be maintained/generated after Brexit). Computing science, physics and engineering are becoming more critical to bioscientific advances, and we need to ensure these relationships are nurtured.

Improving academic links with Industry and the NHS will be vital as they are key "endpoints" to deliver new innovations into practical reality. Whether the formation of UKRI helps with this remains to be seen. The injection of funds into R&D via the Industrial Strategy Challenge Fund is a welcome advance. Whilst many SULSA academics would love to have industry connections, many researchers believe they are unable to access the Industrial Strategy Challenge Fund either because their research is "basic" (and they can't see a translational aspect, or it is not ready to translate), or they don't have the industrial contacts required to apply for the funding. A disconnect between milestone driven, timeline constrained research required by industry and a culture of blueskies research in academic also acts as a barrier between industry-academia collaboration/service. Dedicated expert training may catalyse a step change. In Scotland, Interface, and the Innovation Centres are going some way to address this issue, but more could be done. However, we observe that the Innovation Centres (and particularly the Industrial Biotechnology Innovation centre, has made great strides in bringing productive collaborations between Industry and academia, and looking carefully at the ways by which this has been achieved is recommended.

Clinician scientists are vital for our translational research agenda. Clinicians with research experience will be better able to engage with academics and have fruitful collaborations. Recent findings show that major barriers to career progression are lack of funding and support and greater guidance about their career options. Going further with additional funding schemes that link NHS and academia should be considered too. One good example has been the MRC-EPSRC Molecular Pathology Nodes, where groups consisting of researchers, the NHS and industry partners, are working on novel routes to diagnosing disease (not just biomarker discovery through genomics etc. but also designing new engineered devices e.g. microchip based immunoassay, application of machine learning algorithms to pattern search micrographs of diseased tissue etc.).

In terms of career progression in academia, the current system is set-up to support the brightest and most successful early career researchers – those that publish numerous high-impact papers during their PhD and first postdoc, who secure personal fellowships before gaining independence. In reality this is not the path that most researchers take. Some have an unproductive project that doesn't give interesting results and may leave a PhD/postdoc without any publications. Or they may take longer to publish. Whilst eligibility restrictons on post-PhD years are now being lifted, those researchers who may have more experience (but have been less "productive") will still be expected to have more mesures of success (e.g. publications) than a ECR directly out of their first postdoc. We think that this attitude may result in "missing" some fantastic researchers that are either not supported to independence or leave academia as they believe they will not be successful in today's highly competitive *climate. Giving researchers the opportunity to have a couple of missteps in their career – taking a risk on "unproven" researchers may produce the greatest innovations.*

Q10 Is there anything else that BBSRC should consider in developing a strategy for UK biotechnology and biological sciences that is not covered in the previous sections, including, for example, any particular risks or threats you see for UK biotechnology and biological sciences over the coming years?

Most obviously, Brexit has the potential to strongly impact on the Life sciences sector, particularly via the issues of research funding and immigration. It appears that Life Sciences research is already suffering following the Brexit referendum. The risks associated with removal of the UK from the European Research Area are very substantial with a potential loss of annual research income running into the hundreds of millions of pounds. Beyond that, because of possible immigration policies (and the perception that the UK is not a welcoming country anymore), a diminished pool of talented research workers to drive an active research agenda and potential loss of highly skilled non-UK citizens from key positions in the research community, risk diminishing the UK's Internationally recognised reputation and exceptional outputs in the Life Sciences. Removal of UK scientists from broad EC wide groupings will also present the risk of diminishing interdisciplinary research and lessen access to important large equipment that might be found only in a few European laboratories.