TECHNOLOGY TOUCHING LIFE CONSULTATION 2015

Summary of consultation responses, BBSRC, EPSRC, MRC, September 2015

SUMMARY

Technology Touching Life (TTL) is a potential BBSRC, EPSRC and MRC joint initiative to foster interdisciplinary technology development research across the engineering, physical and life sciences (both biomedical and biological).

Earlier this year BBSRC, EPSRC and MRC carried out a short consultation on TTL to continue our dialogue with the research community as we look to develop the TTL strategy further. Key messages arising from the consultation included:

- There was overwhelming agreement among the responses that technology development was a key area where Research Councils working together could deliver major impacts.
- A wide range of technological needs and scientific opportunities for TTL were identified. These include next generation imaging technologies, novel sensors and materials, analytical technologies, innovative integration of technologies, and handling of large and complex datasets. Key challenges identified included: the resolution and analysis of biological systems across different scales; understanding the role of individual cells within populations and the role of single molecules within cells.
- A number of factors for successful and lasting multidisciplinary research partnerships were identified, including a challenge-led approach, common sense of purpose with benefits to all partners, mutual respect and effective communication, time to learn how to work together, as well as 'freedom to operate'. Proximity of research groups, shared facilities and work spaces would help to facilitate joint-working. Training could also act as a catalyst, e.g. to develop interdisciplinary scientists for the future.
- Respondents suggested that support for TTL, as a multidisciplinary area, is likely to require a range of approaches, including careful consideration of peer review, engagement with users, and partnership between Research Councils and other bodies. Funding could be provided at a range of scales, from pump-priming to centres of excellence, for discipline hopping, the development of people and skills, and engagement with users to deliver impact.

INTRODUCTION

The overarching vision for TTL is to stimulate and support interdisciplinary collaborations, promoting the co-development of novel tools that address application-driven challenges within the life sciences by harnessing cutting-edge engineering and physical sciences research.

The technologies developed through the TTL theme are expected to ensure the UK leads future waves of technology-led discovery for the life sciences and thus create new opportunities that benefit the economy

(e.g. through commercialisation of research technologies) and society (e.g. new research breakthroughs to improve for instance healthcare or agricultural productivity). To inform our initial scoping of the TTL theme we sent a short survey (see annex) to a cross-section of universities, institutes, individual researchers, learned society contacts and industry representatives to garner views from the scientific community. In total we received 48 responses and we would like to thank everyone who dedicated their time to participating in the consultation.

The purpose of this document is to provide information on the outcomes of the consultation to help continue our dialogue with the research community as we look to develop the TTL strategy further. A broad range of topics were discussed by contributors so we have not attempted to provide a detailed summary of the responses, though we will continue to draw upon this information as well as gathering further input from the research community. Instead, we aim to provide a sense of the overall scope of the information gathered and the many commonalities of opinion that were expressed by presenting some key findings.

KEY FINDINGS

1. Technology touching life is an important challenge area for the Research Councils

There was overwhelming agreement among the responses that technology development was a key area where the Research Councils working together could lead to major impacts. There was great enthusiasm for the TTL theme and recognition of the huge gains that advanced enabling technologies can bring to life sciences research, as had been noted in the EPSRC Maxwell Report.

Respondents commented that the development of 'step change' technological capabilities is intrinsically interdisciplinary and potentially crosses Council remit boundaries. A coordinated cross-Council programme would be the most effective mechanism to help engage a broad range of researchers in this challenge area and collectively the Councils could play a key role in helping to coalesce researchers from different backgrounds around key shared goals. The intrinsically multidisciplinary nature of TTL would require careful consideration of peer review to engage the best mix of scientific expertise and perspectives across fields.

2. There is a wide range of technological needs and scientific opportunities for TTL to address

The consultation highlighted a wide range of technological needs, illustrated by the word cloud in Figure 1.

Imaging was a key area of interest, with impact across life sciences research and with the potential for significant input from Engineering and Physical Sciences (EPS) research; for example, in **developing non-invasive and *in vivo* approaches**, chemical **labelling technologies**, **label-free methods**, **multimodal or correlative systems**, enhancing **resolution** and **sensitivity**, and '**real time**' image capture methods. **Novel sensors, materials** and **miniaturisation** of technologies were identified as being needed in a variety of 'real world' contexts, including **monitoring** of health parameters (both human and non-human), **diagnostics** and pathogen **detection** (e.g. to help combat antimicrobial resistance).

The resolution and analysis of biological systems across

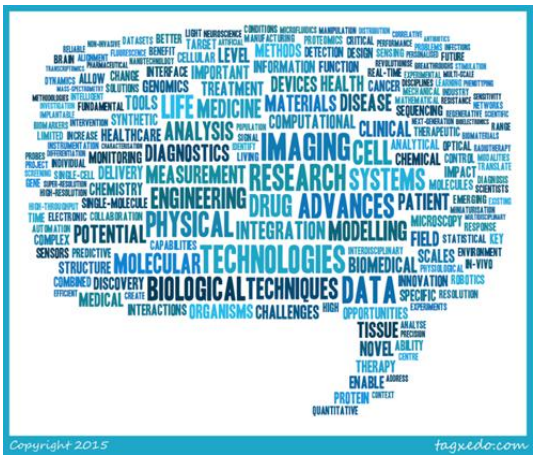

Figure 1: Word cloud based on responses to consultation questions 1-3

spatial, temporal and organisational levels (e.g. molecules to cells to tissues) was a recurring challenge where current techniques were often limiting, with a need to 'bridge' restrictions imposed by current methods. Several responses noted that life scientists needed to move away from 'average' measurements and instead understand the variation and role of individual cells within populations (**single cell approaches**), or understand how **single molecules** (e.g. drugs or receptors) operate within cells. Such insights could have significant impacts in areas such as **vaccine and drug design**, and **regenerative medicine**.

Analytical technologies were identified as another major area of need, including new –**omics methods** and **high-throughput strategies** involving **automation, robotics and microfluidics** to accelerate discovery. Innovative integration of technologies to enable simultaneous measurement of multiple parameters (**phenotyping**) was noted as enabling a more holistic view of an organism's characteristics. This could be feed into systems-level analyses and allow scientists to explore relationships between genetic makeup and measurable biological parameters, enabling biomarker identification and more **targeted and responsive treatments**, improving **screening and prevention of disease**, and fuelling **improvements to agricultural traits** or **industrial biotechnology processes**.

Finally, the management, analysis and modelling of large and complex datasets was consistently identified as a key need within the life sciences. '**Data for discovery**' is another emerging cross-Council theme and we have shared the views on data challenges with colleagues working on this area to help inform on-going thinking on 'big data'. Within TTL we recognize that supporting mathematical/statistical approaches and software tools are likely to be **integral** to the 'wet lab' technological solutions that are developed and play a key role in ensuring that researchers can analyse and interpret new forms of data they generate.

3. Many factors contribute to the development of successful and lasting multidisciplinary research partnerships, illustrated by the word cloud in Figure 2.

Motivation was frequently discussed as key to driving multidisciplinary collaboration. Experiences shared in the consultation reflected on the need for a **clear driver** coming from the life sciences which the EPS could help address, a **common sense of purpose** and sufficient **ambition** that all parties can undertake novel and interesting science. Underpinning such collaboration was **mutual respect** and **effective communication**, which can be difficult as scientific disciplines often employ different jargon and ways of working. **Workshops**, **networking**, **informal interactions** and crucially **time to learn how to work together** were all identified as ways to overcome these challenges.

Institutions and individuals were also viewed as being important in helping catalyse and maintain multidisciplinary interactions. **Proximity** of research groups, **shared facilities and work spaces** (e.g. common faculty buildings) were useful for helping to facilitate joint-working, challenging traditional disciplinary silos and establishing a **melting pot culture** focused on problems. There was also support for institutions to encourage **joint appointments** between departments and many responses identified a need for **mentoring** and **support for the career progression** of interdisciplinary scientists, noting that **recognition and reward** is sometimes focused within rather than across

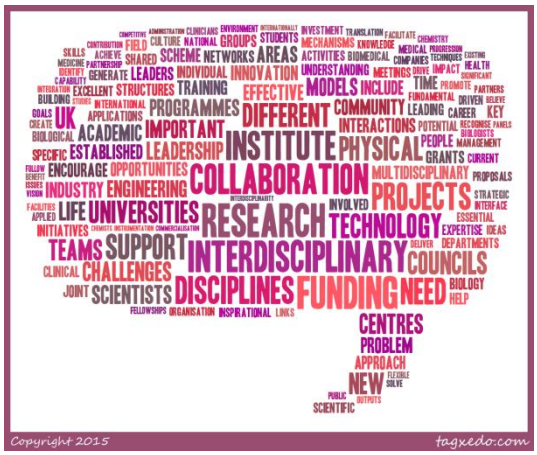

Figure 2: Word cloud based on responses to consultation questions 4-6

research fields. **Flexibility** and 'freedom to operate' were key enablers, as was **supportive leadership** and a clear strategy that had senior management 'buy in'. **Training** could also act as a catalyst, not only to develop young scientists who are comfortable working in an interdisciplinary environment but also to foster cross-faculty coordination.

4. Support for TTL is likely to need a range of approaches

We received a range of comments about ways the Research Councils encourage and support technology development at the EPS/life sciences interface, with **funding** and **peer review** as common themes. Several responses commented that **centres of excellence** (Institutes, Centres, hubs, platforms) which bring together life scientists and physical scientists in close proximity were important to establish long term **critical mass**. However, there was also a strong message regarding the need to provide funding across a **range of** scales, in particular smaller **pump-prime funding** for exploratory **high risk/high reward projects** that test out radical new ideas with high potential. Research Council schemes to promote **discipline hopping**, the **development of people and skills**, and **collaboration with industry** were also cited as of particular relevance to TTL.

To deliver **impact**, mechanisms such as workshops and networks that promote **engagement with users** (e.g. industry, clinicians and other communities of practice) were felt to add significant value in bridging the gap from 'proof of concept' to 'real world' use of new technologies, in both academic and non-academic settings. **Coordination** and **partnership** between the Research Councils and other bodies, such as **Innovate UK**, to help support the technology development pipeline and aid dissemination were also viewed as crucial to ensuring effective routes to translation.

NEXT STEPS

We will continue to progress with TTL strategy development between the Councils, engaging with the research community as our work progresses.

We plan to hold a follow up workshop in early 2016 once the Spending Review has concluded and our plans are further developed.

CONTACT DETAILS/FURTHER INFORMATION

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ANNEX: '*TECHNOLOGY TOUCHING LIFE*' CONSULTATION QUESTIONS

CURRENT AND FUTURE RESEARCH OPPORTUNITIES AND TRENDS

Within the broad scope of '*Technology Touching Life*':

1. What are the 'sweet spot' areas where there is high potential for closer alignment across physical sciences and life sciences to lead to major advances?
2. What trends or developments in engineering and physical science technologies are already emerging which you think will have impact in the life and biomedical sciences?
3. What important areas in the life and biomedical sciences are currently limited by existing technologies and require new technology developments to 'unlock' discovery opportunities and deliver a 'step change' in understanding?

INTERDISCIPLINARITY

4. What do you see as the key features of successful models of close working between physical sciences and life sciences in fundamental discovery research? Please use specific examples, national or international, where possible. Your views on unsuccessful as well as successful models are welcome.
5. What structures, activities and mechanisms help establish a culture of interdisciplinary research and strong interdisciplinary leadership in universities, institutes and centres?

   Please comment of the role that effective and inspirational leadership plays, giving examples where possible.

STRENGTHENING SCIENTIFIC PERFORMANCE AND IMPACT

6. How might the Research Councils working with research organisations (e.g. universities and institutes), industry and other stakeholders help address the issues raised in response to the questions above? Please provide examples of successful approaches (both national and international) where applicable.

WRAP UP

7. Finally, we would welcome any other comments you have on developing the 'Technology Touching Life' theme.