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Scoping exercise to develop a new cross-sector mobility programme in the biomedical sciences

The Academy of Medical Sciences

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Executive Summary

Background

A vibrant, robust life sciences ecosystem requires strong collaboration across academia, the NHS, industry and research funders, as recognised in the Life Sciences Industrial Strategy (2017). The smooth mobility of researchers between sectors is key to delivering such a vision. This report presents evidence and insights to support the development and implementation of a new cross-sector mobility programme.

Landscape

- Current UK strategy in the Life Sciences, combined with cultural shifts to promote 'open science', 'team science' and 'open innovation' highlight that there is a need and a strong desire to encourage greater cross sector mobility of researchers.
- A recent analysis reports that about 1.4% of all UK university researchers had direct links to the private sector during the years 2009-2015, which is much lower than levels recommended by organisations such as the European Commission.
- In recent years, declines have been reported in the number of undergraduate industrial placements, collaborative PhD studentships and collaborative postdoctoral researchers in pharmaceutical R&D.
- Certain universities, such as Cambridge, demonstrate particular strengths in researcher mobility, through tripling the number of collaborative PhD studentships supported by the pharmaceutical industry between 2015 and 2017, and having the highest proportion of researchers who publish with a university and business sector affiliation.
- Whilst many initiatives exist to encourage and support cross-sector collaboration, there is a real lack of more targeted funding to directly support researcher mobility.

Challenges to cross sector mobility

- Several challenges to cross sector mobility exist, some of the most significant being:
    - Low awareness of role models and few exemplars of effective cross-sector working to highlight the importance and impact of such approaches
    - Lack of appreciation for the skills and infrastructure that can be accessed
    - Cultural gaps between research environments in industry, academia and the NHS
    - Unrealistic expectations and incompatible objectives e.g. freedom to publish
    - Few opportunities for early career researchers to engage with industry
    - Lack of incentives and little recognition for mobility in career progression appraisals
    - Backfilling positions to enable exchanges, particularly in SMEs and the NHS
    - Technology Transfer Offices can stifle collaboration and impair trust-building between organisations
    - Bureaucracy in negotiating contracts and establishing joint appointments
    - Lack of appropriate cross-sector knowledge, awareness and skills
    - Inconsistent project supervision or lack of supervisory engagement

Facilitators for cross sector mobility

- Several facilitators to cross sector mobility are described in this review:
    - Promotion of achievements delivered through cross-sector mobility to influence researcher and funder activity
    - Illustration and recognition of incentives: access to pre-competitive space e.g. datasets, compounds and technologies; access to 'in kind' consultancy

- Increased recognition and reward for cross-sector mobility using appropriate appraisal metrics
- Access to transferable skills in e.g. project management, entrepreneurship
- Environments that co-locate industry, academia and the NHS
- Access to existing infrastructure such as AHSNs, Experimental Medicine Centres and Academy networks
- Creation of opportunities for cross-sector networking and partnering – regionally and nationally
- Inclusion of bespoke educational modules in undergraduate and postgraduate courses
- Awareness of cultural differences across sectors and adapting behaviour
- Develop a portfolio of activities, tailoring support for different career stages and sectors

Deeper insight on selected schemes

- Several existing programmes have been assessed to obtain further insight on the approaches used, challenges experienced and impacts delivered. These are:
  - MRC's Proximity to Discovery Scheme
  - Royal Society Industry Fellowships
  - BBSRC Industrial Partnership Awards
  - BBSRC Flexible Interchange Programme
  - NHS Clinical Entrepreneur Scheme
  - Wellcome Trust Collaboration in Experimental Medicine at Newcastle University
  - Innovate UK – Knowledge Transfer Partnerships

Gaps in the provision of support for researcher mobility

- Specific gaps identified in this landscape review are:
  - Low uptake in cross-sector mobility from industry, particularly SMEs and Clinical Academics
  - There exist very few schemes targeting the early stages of researcher mobility, which could lead to new collaborations or projects
  - There is a lack of
    - career development support – such as training, mentoring or coaching – available to researchers, to help them overcome challenges of cross sector mobility
    - provision for brokering – at a national level – between early career researchers and smaller biotech companies
    - formal recognition – in all sectors – of the contribution that cross-sector mobility can make
    - training – in undergraduate and postgraduate programmes in medicine and the life sciences – for skills and knowledge required for effective industry engagement

Thematic scope

- A wide thematic scope would enable outstanding researchers from diverse fields of bioscience to be supported. However, during this review, the following themes emerged as potential priorities:
  - Digital pathology and diagnostics
  - Data analytics and artificial intelligence

- Medicinal chemistry and drug development
- Gene therapy design and manufacturing
- Genomics
- Regenerative medicine
- NHS improvement through process engineering / logistics
- Improve research translation pathways – share skills and insight to improve understanding and streamline translational development

Key principles to inform scheme design

- Increase awareness of impact and unmet need
- Develop tailored approaches for targeting specific career stages and sectors
- Create more incentives for cross sector mobility
- Support networking and partnering between sectors
- Reduce bureaucracy and provide advice on terms for collaboration
- Support researcher mobility in priority and emerging areas
- Provide funding continuity (for access to follow-on funding and career progression)

1. Introduction and Objectives

1.1. Background

The Academy of Medical Sciences has taken a leading role in developing and delivering innovative programmes for early career biomedical and health researchers. Their portfolio of activities includes the Future Leaders in Innovation, Enterprise and Research (FLIER) programme aimed at emerging leaders who can create collaborations across academia, industry, the NHS and government to drive innovation. In addition to FLIER, the Academy has initiated scoping work on potential programmes that aim to facilitate academe-industry-NHS mobility and stimulate permeability across traditional boundaries. The scoping work described here will inform the development of a potential new programme that would facilitate cross sector interactions and mobility.

1.2. Aims of this scoping exercise

The overall aim of this scoping exercise is to generate an evidence base to support the development and implementation of a new cross-sector mobility programme. Specifically the objectives are:

- Review current UK and international trends in mobility/porosity of researchers across the academe, preclinical, clinical (NHS) and industry interface;
    - Identify parameters that facilitate successful 'bridge-crossing'
    - Understand what are the inhibitors to cross sector working
- Review current mobility and permeability programmes delivered across different sectors and countries (particularly the UK, US and Europe) and explore whether there are any evaluations of these programmes that provide helpful data and insights.
- Identify gaps in the current provision of mobility programmes.
- Ascertain areas that might benefit most from engaging in mobility between these sectors.
- Identify group(s) of researchers who would benefit from a cross-sector mobility programme.
- Suggest elements of wider career support that have been offered with other schemes and which the Academy might consider offering alongside a new programme.
- Synthesis of key elements or principles that would inform design of a scheme.

A survey will also be developed to gather information and views from the research community.

2. Background

2.1. Definition of cross-sector 'mobility'

Distinct from collaboration, we consider mobility as being the frequent and fluid interaction of researchers across sectors. Just as Clinical Academics demonstrate a high degree of mobility across the boundaries of academia and the NHS, we are seeking a new cadre of 'Industrial Academics' with equally fluid and regular interactions across the sector boundaries of academia, industry and the NHS.

We would also like to identify an alternative descriptor to 'mobility', encapsulating the following themes:

- Porosity / Permeability of Researchers across Bioscience sectors
- Crossover Researchers in Bioscience
- Cross sector Team Science

2.2. Rationale for promoting cross-sector mobility

A vibrant, robust life sciences ecosystem requires strong collaboration across academia, the NHS, industry and research funders, as recognised in the Life Sciences Industrial Strategy (2017). Fluid interactions between these sectors are required to drive the cross-fertilisation of ideas and translation of research to benefits for health and national wealth. Such interactions support the better use of resources, and access to specialist facilities, knowledge and expertise.

The Dowling Review of business-university research collaborations (2015) found that businesses reported numerous challenges in working with the research base to develop and commercialise ideas. These included intellectual property arrangements, identifying partners, funding to support collaborations and perceived cultural differences.

The Government's Industrial Strategy (2017) set an ambition for R&D spending to reach 2.4% of GDP by 2028, which could see health R&D spending hit £14 billion. The NHS Long Term Plan emphasises government's ambition to treble industry contract and R&D collaborative research in the NHS over ten years, to nearly £1 billion. The UK's capabilities and assets for research and innovation, combined with better data infrastructure, have the potential to strengthen further the UK's position as a global force in data driven scientific advances in healthcare.

21st century science is becoming increasingly 'borderless', with knowledge being shared across geographical, disciplinary and sector boundaries more easily than ever before. Whilst 'open science', 'team science' and 'open innovation' initiatives promote such interactions, it is acknowledged widely that major challenges remain that hinder effective engagement between academia, industry and the NHS. Furthermore, with high rates of phase II candidate compound attrition, closer collaboration between industry, academia and the NHS is essential to tacking the challenges of delivering precision medicine.

Numerous benefits arise from effective cross sector engagement e.g.

- Companies profit from the skills of highly qualified researchers or students
- Researchers gain greater skills, knowledge and develop application-oriented goals
- Researchers gain access to technology, knowledge and expensive research infrastructure

- Universities benefit from additional funding provided, through grant funding, access to industry equipment or from licensing or patenting income

The Academy, and other funders, have identified a need to increase the funding opportunities available to researchers – from PhD to senior levels – to improve academia / industry / NHS interactions. Key priorities for the Academy are to engage more clinicians with industry to align industry programmes with patients' needs.

2.3. Goals for a new cross-sector mobility scheme

Efforts for supporting researchers to work across sectors more effectively could be channelled in a range of different ways, informed by the Academy's overarching goals for such a scheme e.g.

- Develop a dedicated funding scheme, supporting more researchers to work across sectors and making it easier to do so
- Develop the skills of researchers to work across sectors effectively, supported by mentorship from Academy Fellows
    - improve relevance of teaching and research to commercial outputs
    - improve the cross-sector employability of researchers
- Promote dialogue to facilitate cross-sector porosity between academia, NHS and industry
- Facilitate the identification of potential research partners between researchers and industry

3. Trends in researcher mobility

For the last two decades, UK Science and Innovation Strategy has prioritised the increased translation of research to commercial application through closer links between academia and industry. European Commission strategy has also placed high priority on supporting cross sector research, through programmes such as the Marie Skłodowska-Curie Actions, launched in 1994.

3.1. Pharmaceutical industry – academia R&D links

The ABPI's Industry Academia Links Survey reports encouraging industry-academia relationships in the UK, with the pharmaceutical industry and academia collaborating on over 16,000 publications between 2006 and 2015. Their survey captures information from member companies on their interactions with the academic sector, from undergraduate placements to large-scale collaborative projects, which bring together industry, academia, charities and the NHS. Interactions are not solely limited to R&D, including also manufacturing, IT and finance, for which there is a trend for increasing interactions.

The ABPI reports that between 2007-2017, there was a decline in the number of undergraduate industrial placements (IPs) in R&D and collaborative PhD studentships, although slight increases were observed between 2015 and 2017 (figure 1). The number of postdoctoral researchers who are collaborating with the pharmaceutical industry has fallen by 11%, from 500 in 2015 to 447 in 2017.

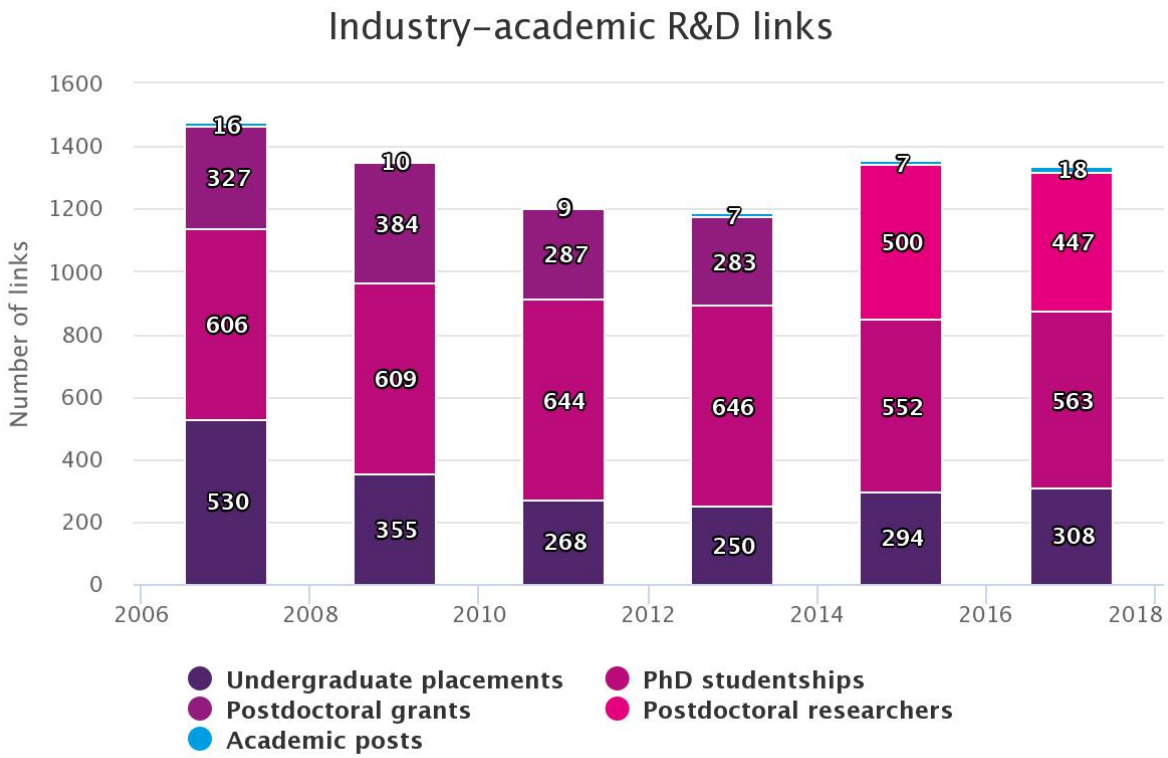

Figure 1 – Trends in industry – academia interactions between 2007-2017. N.B. since 2015, companies were asked to provide information about the number of postdoctoral researchers they had links with, rather than postdoctoral grants supported. Source: ABPI

The ABPI also reports that in 2017, 30% of collaborative PhD studentships in the pharmaceutical industry were co-funded by the BBSRC and 25% supported by the EPSRC (figure 2). There was an increase in the number of studentships funded in part by a university partner, from 35 in 2015 to 60 in 2017, while companies were also funding 93 studentships without any other co-funder, a similar state to the 85 fully funded PhDs seen in 2015. After several years of the MRC co-funding a decreasing number of PhD studentships, there was a slight increase in 2017, from 19 in 2015 to 26.

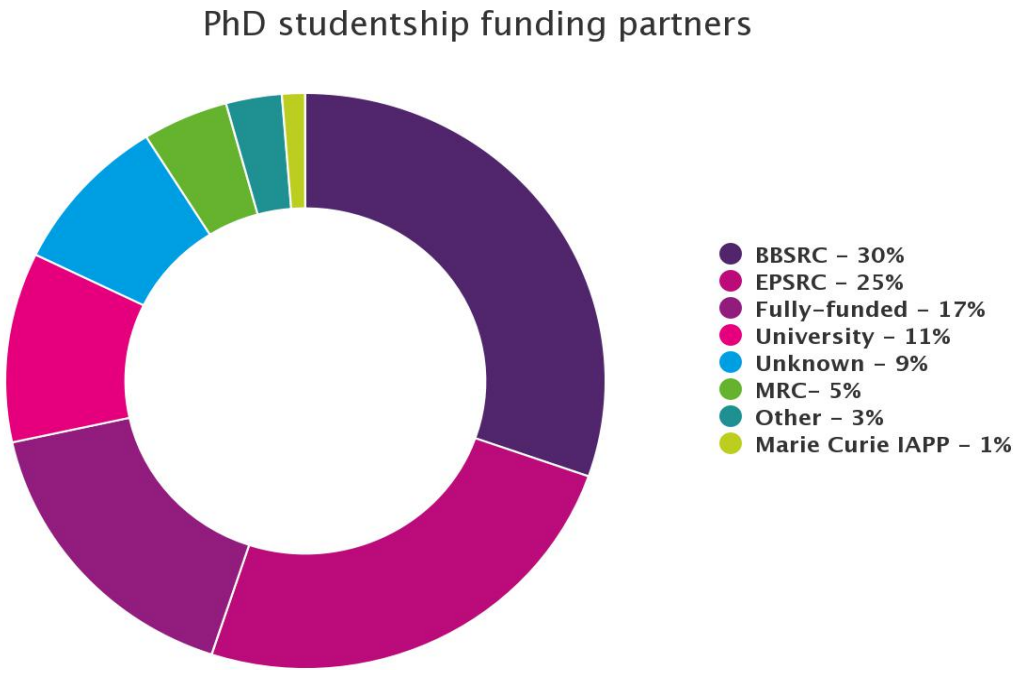

Figure 2 – PhD studentship funding partners in 2017; source ABPI.

The University of Cambridge receives the highest number of collaborative PhD studentships supported by the pharmaceutical industry (figure 3), growing substantially from 37 in 2015 to 109 in 2017. These figures may be explained by initiatives such as the GSK-Cambridge strategic alliance, as well as the move of AstraZeneca to the Cambridge Biomedical Campus, highlighting the opportunities and benefits afforded by such co-location. Universities at Bath and Loughborough attract a high number of Undergraduate industrial placements (IPs).

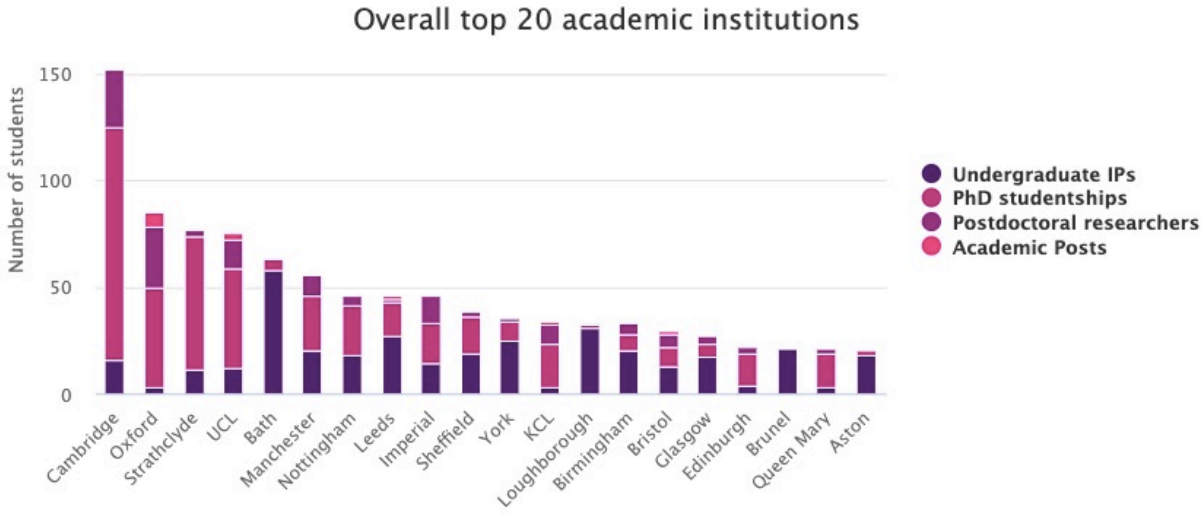

Figure 3 – Top academic institutions for collaborative academic placements; source ABPI

3.2. UK universities interacting with industry

- Patterns of research collaboration and inter-sector mobility of academic researchers ("crossover researchers")

Tijssen et al (2017) have analysed patterns of research collaboration and the inter-sector mobility of academic researchers in the UK, across all fields of academia / industry. In particular, they measured university-industry co-authored publications (UICPs), and university-industry crossover researchers (UICRs) - individuals who have (or had) one or more UK university affiliation as well as one or more affiliation in the business sector in recent years.

Publication patterns

Analysing over 100,000 research publications from UK research universities in 2016, the group identified 5.4% of research publications with an author affiliate address from industry. The seven universities with the highest publication output co-published with industry on 5-7% of all papers. Universities that are active in 'industry relevant fields' (like engineering and computer sciences, or medical and life sciences) tend to be much more UICP-intensive.

Universities and industry based in the same UK region accounted for 11% of UICPs (figure 4). 28% were from partners in separate regions of the UK, 24% were with industries based in the EU and 37% with industries based further afield. The universities of Cambridge, Edinburgh and Aberdeen had the highest levels of co-publishing with industry located in the same region. Universities at Cranfield, Loughborough and Bath were more likely to co-publish with industry located elsewhere in the UK. In contrast, 88% of the London School of Hygiene and Tropical Medicine's UICPs included at least one company outside the UK, with 40% of these involving a company in the EU. Overall, across all 47 research intensive UK universities included in this analysis, 1.5% of research publications were co-produced in collaboration or association with an EU-based company. The authors note that, "With this level of dependency on European industry for industrial relevant research, Brexit may have significant implications".

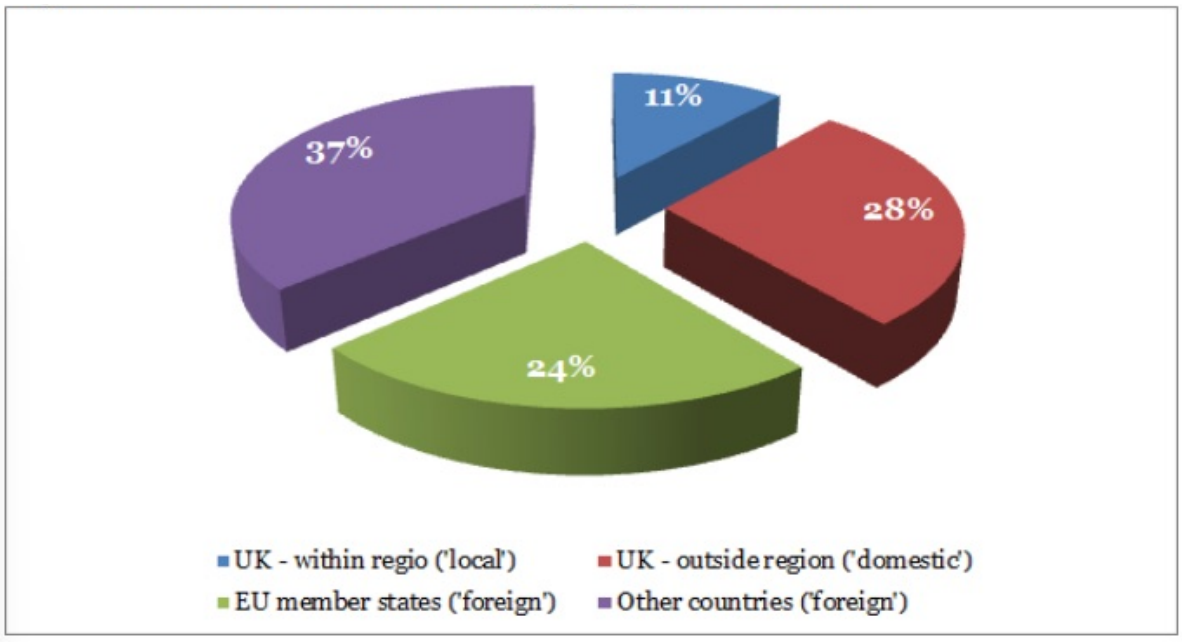

Figure 4 – Geographic distribution of university-industry co-authored publications (UICPs); source: Tijssen et al (2017), who obtained data from the Web of Science, selecting 47 research intensive UK universities in the 2016 Leiden Ranking.

It has also been reported that publications arising from university-industry collaborations are, on average, more highly cited than outputs from single university or university-university collaborations (Hicks and Hamilton, 1999).

University-industry researcher mobility

Tijssen et al (2017) also measure the levels of academics moving to or from industry according to their author affiliate addresses on published scientific papers. This group of crossover researchers includes those who (most likely) had – or still hold – dual appointments, as indicated by a university affiliation and one at a business enterprise on the same publication.

The authors reported that, "About 1.4% of all UK university researchers were linked to the private sector during the years 2009-2015". This is much lower than the levels recommended in the EC report on Mobility of Researchers between Academia and Industry (2006), proposing that "ten per cent of the workforce in each year should be moving" between both sectors.

Tijssen et al (2017) reported that, "Some of the UK's largest universities (in terms of publishing academic staff) are also those with the highest UICR shares, like the University of Cambridge (2.4 per cent) or Imperial College London (2.1 per cent). But size is not the only factor. Much smaller universities, such as Heriot-Watt, Edinburgh or the University of Surrey, also have high shares (2.1 per cent and 2.0 per cent, respectively). Many universities with UICR levels less than 1 per cent tend to have fewer researchers, like the University of Exeter, the Open University or Bangor University."

The authors also reported that universities exhibited varying mobility patterns for crossover researchers: Cambridge (52% local; 16% domestic); Imperial College London (33% local; 31% domestic). The London School of Hygiene and Tropical Medicine had 60% of UICRs with foreign partners and the University of Oxford had 48%.

4. Barriers and facilitators for researcher mobility

4.1. Challenges and barriers

Several challenges and barriers to effective cross-sector mobility have been identified from a number of sources:

- A dinner discussion hosted by the Academy in 2017
- New Concepts of Researcher Mobility (ESF, 2013)
- Report on Mobility of Researchers between Academia and Industry (EC, 2006)
- Rybnicek and Königsgruber (2018)
- Successful Engagement in Open Innovation (NCUB, 2014)
- Interviews undertaken as part of this review (see appendix 1)

General

- Low awareness of role models and few exemplars of effective cross-sector working to highlight the importance and impact of such approaches
- Whilst secondments and fellowships are good for learning, they are less good at embedding individuals in partnering organisations

Cultural

- The cultural gap between research environments in industry, academia and the NHS
- Reconciling the different drivers and ways of working across the fast paced, risk-taking technology sector and the slower, risk averse nature of the healthcare sector, where the primary concern is patient safety
- Mistrust of industry (e.g. profit over patient benefit)

Timescales and Deliverables

- A different understanding of timescale issues i.e. a greater emphasis on short-term deliverables in industry versus longer term outcomes in academia
- Unrealistic expectations of the partners; incompatible objectives e.g. publish or not publish

> "Over 65 per cent of surveyed firms saw the greatest hindrance to open innovation as being the long-term nature of academic research" Survey of KTP partners (NCUB, 2014)

Career

- The majority of existing schemes are targeted at established mid career or senior investigators, with fewer opportunities for early career researchers to engage with industry
- Career progression: lack of clarity in having a clear route back to the primary employer or forwards to a new position

Recognition

- Lack of incentives; perceptions that cross sector working does not contribute to career progression
- Inter-sectoral mobility is frequently not taken into account during appraisal, and in some circumstances can even have an unfavourable impact

Resource

- Backfilling positions – challenging for all sectors, particularly SMEs (lack of resource) and NHS (lack of available clinical expertise)
- Informal networks between SMEs and academia are difficult to create because SMEs have scarce financial and human resources to identify research contacts in academia

Bureaucracy

- Some researchers consider that university TTOs can act as barriers rather than facilitators of knowledge transfer. They can have unrealistic expectations of the economic value of the research and hinder the trust-building process.

> "55 per cent of surveyed firms cited regulations regarding confidentiality or intellectual property as being a hindrance to open innovation. Between 2004 and 2008, the proportion of businesses citing barriers arising from unrealistic expectations of the university technology-transfer offices (TTOs) increased from 24 per cent to 49 per cent." Survey of KTP partners (NCUB, 2014)

- Bureaucratic procedural and legal barriers, at the institutional level, where rules and regulations may hinder joint appointments or placements
    - In general, universities are perceived to be more bureaucratic and hierarchical than the more flat structure of company management

Applying to schemes

- Scheme application formats and timescales:
    - Preferences for academia tend to be for more detailed applications with a longer timescale to apply
    - Industry tends to prefer less detailed applications with shorter application timescales
    - Establishing appropriate collaboration agreements can also take time, covering: visiting workers, data sharing and IPR

Practicalities and locality

- Practical arrangements: travel time to partner organisations; access to partner facilities, data and IT systems can sometimes be problematic
- Geographical proximity – accessing funding to support interactions with organisations in other regions of the UK can be challenging

Training and supervision

- Researchers are generally trained for a career in academia and do not always possess the necessary skills for industry:
    - Research skills and techniques; communication and interpersonal skills; awareness on IPR; entrepreneurship; career management; project management; leadership
- Lack of robust supervision or engagement by doctoral supervisors from academia and industry. Lack of clarity in co-supervisor responsibilities.

Academia to Industry

- Perceived risks of losing contact with academic networks by moving to industry
- Managing appropriate academic freedom with the business needs of industry – can lead to reduced publication output for academics
- Pressure on early / mid career academics to consolidate publication output and secure funding versus perceived 'time out' for industry experience and establishing new collaborations; often coinciding with plans to start a family
- Academic recognition incentivises mono-disciplinarity, with few people willing to work across disciplines or sectors
- Identifying companies that are able to provide both an adequate environment for training and the prospect of professional development for researchers
- Researchers are focused on achieving results that are robust and repeatable although business "can cope with 80 per cent solutions"
- A lack of experience in dealing with external partners
- A higher level of reactive working in industry and NHS compared to academia

- Low engagement from industry; tokenistic participation from industry or 'tick box' attitude to industry participation from academia
- Perception from academics that quality of research is inferior in industry

Industry to Academia or NHS

- Lack of appreciation for industry experience in academic or NHS reward structures
- Fewer opportunities for mobility from industry to academia or NHS than vice versa
- Over-long timescales are often required to set up placements or exchanges

NHS to Industry

- Heavy clinical workloads, insufficient time and lack of resource for backfilling roles
- Negative perceptions of industry (openness, transparency, freedom to publish)

4.2. Facilitators

Several facilitators of effective cross-sector engagement have been identified by others and in interviews and are summarised below.

Leadership and awareness of impact

- The presence of 'translators' i.e. experienced researchers who are able to understand the aims, drivers, expectations, and culture of the two sectors
- Identify and promote cross-sector exemplars, highlighting their achievements and impact to influence the engagement of other researchers
- Better recognition of respective strengths and synergies across all sectors
- Demonstrate importance and impact to influence more funders to support research in this way

Create incentives

- Access to pre-competitive space in the NHS
- Access to datasets; early access to industry compounds and technologies
- Increased recognition and reward for cross-sector mobility
- Increased availability of funding opportunities to support cross sector mobility

Transferable skills

- Increasingly, students and early career researchers are looking for transferable skills such as project management, entrepreneurship
- Broaden scientific expertise to support multidisciplinary and trans-disciplinary working
- Improved awareness and recognition of complementary resources and skills, where sectors can learn from each other:
    - Academia: access to patients samples & data; flexibility for riskier, blue-sky thinking
    - Industry: infrastructure to deliver at scale; rigour & reproducibility; project management and leadership skills.

Reward structures

- Embed an appropriate range of recognition metrics in appraisal systems, applicable across academia, industry and NHS, to assess progress, success and impact. Such metrics are also important facilitators of 'Team Science', advocated by the Academy through its influential work.
- Recognition: ensure that hosting organisations have appropriate appraisal systems in place to recognise the diverse outputs of cross-sector working:

    - Access to data sets, expertise, 'in kind' consultancy, technologies, infrastructure;
    - Increased knowledge, confidence, networks;
    - Leveraging research and commercial outcomes along the translational pathway.
- Organisations (academia, industry and NHS) to provide CPD accreditation for relevant experience.

Landscape / strategic investment

- Creation of environments that encourage the co-location of industry, universities, interface organisations and advanced service suppliers e.g. science parks
- Strategic investment in cross-sector working by some centres (e.g. Cambridge, Birmingham) is proving successful
- Use existing infrastructure Academic Health Science Networks (AHSNs), Clinical Research Facilities (CRFs) for Experimental Medicine and Experimental Cancer Medicine Centres (ECMCs)

Funding models:

- Creation of large projects and consortia that concentrate multi-disciplinary, cross-sector capacities around strategic research.
- Joint appointments: Senior, cross-sector joint appointments, whilst costly, have been successful in building critical mass and increased awareness of the importance of working across boundaries. The Academy's report on the future of artificial intelligence in health explained that:
    - "Joint appointments between academia and industry could be a mechanism to enable cross-sectoral mobility, and provide links between the sectors while helping to retain talent in academia. These opportunities are highly valued by the industry and it was agreed that funders could play a role in recognising the value of such cross-sectoral appointments."
- Sandpits: engaging researchers from different sectors in an intensive workshop, with speedy movement to funding decision

Career stage

- Facilitate access by people with unconventional careers, or who may be returning to research from industry or NHS, or who may have taken a career break

Networking and partnering

- Create opportunities for cross-sector networking – regionally and nationally
- Partnering activities, matching appropriate expertise across sectors
- Promote and support collaboration between the NHS and technology companies (e.g. data analytics, AI, imaging)

Training

- Supervision for doctoral candidates: Provide two supervisors, or a supervisor from academia and a supporting mentor from industry, with clear responsibilities
- More flexible medical training: embed cross-sector learning in training programmes e.g.
    - Increased awareness, bespoke modules and lectures from industry
    - Introduce BSc intercalated degree or Foundation programmes with industry placement opportunities
    - Include industry engagement in the Academy's INSPIRE programmes

Financial support

- Financial support for national mobility: funding for travel to interact with partners in other UK regions
- Unforeseen costs can arise where complex partnerships are being established. A new mobility scheme could retain a contingency budget for release to candidates in exceptional circumstances.

Collaboration agreements:

- Provision of template agreements and advice from sources such as the Lambert Toolkit for University and business collaboration agreements

Behaviours:

- Adapting to different circumstances and cultures, being open to listening and managing corporate changes
- Learning about each other in order to find the best way to collaborate
- Find an appropriate 'language' suitable for both partners
- Mutual commitment, trust and loyalty
- Individual responsibility for projects and engagement

The report of a workshop (MRC, NIHR) looking at Academic – NHS – Industry Collaboration in Experimental Medicine (2011) highlighted a number of complementary strengths and resources that facilitate cross sector collaboration.
• The pharmaceutical, biotechnology and medical technology industries could adopt more informed approaches to drug, device and diagnostic design and development through collaboration. UK academia hosts a strong cohort of investigators with innovative discoveries and ideas arising from detailed explorations of specific diseases. • Accurate disease biomarkers developed and validated by academia can improve study protocols, stratify patient populations and ultimately ensure therapy development is more targeted and efficient. • Partnering with the UK's world class NHS, including its clinicians, healthcare professionals and dedicated experimental medicine research infrastructure, fosters engagement with patients and their carers. Operating in the context of a unified care system ensures product design is better informed and potentially stratified by patient disease. • Early access to industry compounds and technologies presents academics and clinicians with the opportunity for unique first-in-human clinical research studies. • These provide a platform for further research and development, as well as expand the knowledge base and publication record. Industry can also share its wealth of experience in negotiating the regulatory pathways to first-in-human studies.

In its report, New Concepts of Researcher Mobility, the ESF highlights the value of combined / part-time positions, where a researcher is engaged in two institutions simultaneously, facilitating knowledge transfer in person. Such joint appointments tend to be more common in senior positions, however the ESF recommends that corresponding schemes should also exist for earlier academic levels. "Such schemes should be introduced as part of ordinary employment conditions (not limited to project duration) as well as in scholarships and grants both nationally and in EU instruments (Marie Curie Actions and other European support instruments). Combined/part-time positions could be established at all levels in the hierarchy to stimulate 'double careers'. They are effective initiatives for direct knowledge transfer by bridging institutions, disciplines, sectors and countries, stimulating new knowledge through diverse careers and, as they often include teaching, strengthen the Knowledge Triangle."

5. Insight from research programmes that promote sector engagement

There are a wide range of schemes available, in the UK and internationally, aimed at supporting research engagement between academia and industry. The Academy has compiled a summary of such schemes, which has been updated and refined as part of this review (appendix 2). The schemes have been organised into ten different groupings, based on their design and aims:

1) Placements, secondments and short-term fellowships
2) 'In residence' programmes
3) Joint appointments
4) Partnering programmes
5) Centres and networks
6) Industry-led
7) Skills and training
8) Technology transfer and commercialisation
9) Fellowships with training and career development support
10) Project-based collaborative grants

Current schemes provide a range of support to researchers, as illustrated in figure 5.

		Direction of exchange, from:			*Funding*			
Funder	*Scheme*	*Academia*	*Industry*	*NHS*	*Salary*	*Research*	*Travel*	*Career Dev*
BBSRC	Flexible Interchange Programme							
BBSRC	Industrial Partnership Awards							
NIHR	Development and Skills Enhancement Award							
Royal Society	Industry Fellowships							
RAEng	Industrial Fellowships							
MRC	Proximity to Discovery							

Figure 5 – Range of support provided by selected schemes that support research engagement between academia, industry and the NHS.

Several programmes have been selected and assessed to obtain further insight on the approaches used, challenges experienced and impacts delivered. These are described below.

5.1. MRC Proximity to Discovery Scheme

Scheme	**MRC's Proximity to Discovery Scheme (P2D)**
Aims	P2D provides flexible funding to research institutes, supporting innovative ways to enable the initial development of academic-industry collaborations. It is less about project-specific support and more about informal engagement between academia and industry.

Funding	Up to £250k over 18 months. Funding can be used to support two-way people exchange between academia and industry, including Technology Transfer Offices in universities and Business Development teams in industry.
Background	P2D was set up in 2014 as part of a wider translational strategy that recognised a gap in exchange opportunities between academia and industry.
Scheme value	Forms an important, early step in the translational pathway: i) P2D to build academic-industry relationships, ii) Confidence in Concept (CiC) scheme to support generation of preliminary data, and iii) application for a translational project grant.
Most helpful aspects	Use of funding is devolved to the HEI, which helps flexibility and agility to support interactions; no career stage restrictions.
Examples of use	○ 274 exchanges have been supported, the majority from academia to industry ○ Early Career Researchers (ECRs) seconded to industry pick up technical skills, experience how industry pipelines work (most common use) ○ Supported Mid Career Researchers to engage with companies about potential collaboration ○ Workshops and networking events
Outputs	○ Securing CiC funding to advance collaboration and generate preliminary data ○ Follow on project grant / fellowship applications ○ ECR secures a position in industry
Challenges	○ Several HEIs misinterpreted what the scheme is for, seeing it as project support rather than for engagement and skills ○ SMEs find it quite hard to second people into academia; lack of funding to support such a scheme ○ Very low engagement from clinical academics
Future	The P2D scheme is being merged with the CiC scheme. Rationale: The same centres tend to apply for P2D and CiC, therefore they are being consolidated into a single scheme.

5.2. Royal Society Industry Fellowships

Scheme	**Industry Fellowship (IF) and Short Industry Fellowship (SIF)**
Aims	Enhance knowledge transfer in science and technology (within RS remit of natural sciences).
Background	For academic scientists who want to work on a collaborative project with industry and for scientists in industry who want to work on a collaborative project with an academic organisation. SIFs were established more recently to target earlier career, postdoctoral researchers and encourage SME engagement.
Duration	IF: Secondment; 2 years full time or 4 years pro-rata (split between both organisations) SIF: Secondment; 3-6 months full time or up to 12 months pro-rata (split between both organisations)
Funding	IF: Fellow's basic salary plus up to £2k research expenses pa SIF: Fellow's basic salary plus up to £1k research expenses pa
Demand	Overall, there is a much greater demand from academia than from industry. Of applicants from industry: ○ IFs – 60% of companies applying are large ○ SIFs – 60% of companies applying are SMEs

Scheme value	○ Enables fellows to develop industry-academia collaborative projects, offering flexibility ○ Shorter fellowships are more attractive to ECRs and SMEs ○ Companies see IFs as valuable for career development of scientist employees, facilitating more interesting career pathways from academia / industry interactions
Most helpful aspects	○ The offer is flexible (secondment or part-time), however most fellows opt for the part-time, pro-rata option, splitting time between academia and industry ○ Access to RS Industry Fellows college: training events (leadership, entrepreneurship, public engagement); networking and conferences ○ Not many schemes exist in the natural sciences (excluding clinical medicine) where industry can apply
Examples of use	○ Development of a wide range of industry-academia collaborative projects
Evaluation / design	○ 2016 review of IFs recommended establishing SIFs for ECRs and SMEs ○ Introduced inclusion of research expenses in the scheme offer
Challenges	○ Reaching out to engage industry is a big challenge; general awareness of the scheme can be quite low. RS would recommend concerted efforts to target relevant schemes to industry. ○ SMEs are not as well supported; with less publications they experience fewer opportunities, or are less able to set up collaborations

5.3. BBSRC Industrial Partnership Awards

Scheme	**BBSRC Industrial Partnership Awards**
Aims	To encourage and support collaboration between academic research groups and industry.
Background	Academic-led, responsive mode grants that have significant industrial involvement. Industry partner(s) contributes at least equivalent to 10% of the full project costs.
Funding	Up to £550k with 10% coming from industrial partner and 10% from Host Institute.
Scheme value	○ Provides training opportunities for postdoctoral researchers and other staff beyond typical responsive mode funding ○ Provides training in strategic and applied research
Most helpful aspects	○ Researchers benefit from access to industry expertise, facilities and resources, and gain greater insights into industry approaches to research
Examples of use	○ Collaborative research to generate constructs, datasets, formulations, genetic stocks, kits, methodologies, processes, reagents and tools
Evaluation / insight	○ There is a mixture of passive and active involvement which may reflect the different culture of particular industry partners and the contrasting ease with which individual academic research groups are able to build relationships with industry ○ Academic awardees were primarily researchers who had previously conducted collaborative research with industry ○ The IPA scheme is currently most suited to larger companies, rather than SMEs ○ Require industry partners to provide an annual, light-touch report about their research project, to enable review of progress, successes, benefits and any concerns ○ Encourage grant holders to establish collaboration agreements as early as possible
Challenges	○ The lack of a formal agreement between partners can be a barrier in the

	collaboration o The level of industry participation in individual IPA and 'stand-alone' LINK projects can be varied o For a small number of projects, the interaction with the industry partner was less successful than anticipated because their priorities changed, they merged with another company or they went out of business o Barriers to industry participation: - Difficulties in identifying academic partners with shared research interests - Lack of awareness of the scheme - SMEs or companies with low profitability experience barriers to engage
Outputs	o 81% of IPA grant holders stated that the research supported by their grant had or could result in a novel product, process, resource, tool or technology o A variety of measures highlight industrial co-authorship on publications, further funding from the industry partner, industry involvement in the exploitation of the research, and the maintenance of the partnership after the grant ended

5.4. BBSRC Flexible Interchange Programme (FLIP)

Scheme	**BBSRC Flexible Interchange Programme**
Aims	Supports the movement of people from one environment to a different one to exchange knowledge/technology/skills, developing bioscience research/researchers and addressing BBSRC strategic priorities.
Funding	o Up to 24 months o Provide up to £150k in total at 80% fEC o Can be undertaken on a full-time, part-time or intermittent basis o Cover a contribution to the salary of the interchangers, reasonable travel, subsistence and costs associated with the interchange
Scope	o Enhance opportunities for the exchange of knowledge, technology and people between the research base and user communities and vice versa for economic and/or societal benefit o Facilitate the development of partnerships to foster longer-term collaborations, thereby maximising the impact of previously-funded BBSRC research o Allow for an expansion of the skill base of individuals, particularly in emerging, niche and vulnerable areas alongside BBSRC strategic priorities
Eligibility	Each FLIP proposal will only have one lead academic applicant. **Lead applicant** must: o satisfy standard eligibility criteria as described in BBSRC grants guide o be a named investigator on the awarded BBSRC research grant connected to the proposed interchange **Interchanger** must: o have a PhD (or for non-academics the equivalent professional experience) o upon commencement of the FLIP award, be employed by one of the organisations participating in the interchange, such as a research organisation, UK industry, policy making or charitable organisation
Outcomes	Development of a new diagnostic test for Human African Trypanosomiasis, or sleeping sickness. The prototype tests are currently undergoing clinical trials, and will contribute to World Health Organisation (WHO) efforts to control the disease and

	provide access to treatment. Enabled a researcher from industry (GSK) to progress aspects of research in an academic setting (University of York) that normally would be regarded as high value, high-risk work and of low priority in an industry-based R&D programme. Enabled identification of entirely new opportunities from within the university and new R&D collaborations with GSK and across industry sectors. https://bbsrc.ukri.org/documents/flip-case-studies-2014-pdf/

5.5. NHS Clinical Entrepreneur Scheme

This scheme offers healthcare professionals who would otherwise leave the NHS, opportunities to pursue entrepreneurship at work, whilst training the workforce in the skills needed to deliver digital health, genomics, data analytics, advanced technology and social networks. The scheme consists of training and a professional placement. It is open to all healthcare professionals with an interest in entrepreneurship.

Scheme	**NHS Clinical Entrepreneur Scheme**
Aims	To provide healthcare professionals with opportunities to pursue entrepreneurship at work.
Background	Candidates have access to educational days, networks, coaching, mentoring and placement opportunities. Began in 2016 and the fourth round is underway in 2019.
Funding	No funding is awarded to successful candidates; Travel, accommodation reimbursed
Eligibility	Doctors, dentists, healthcare scientists, AHPs, nurses, midwives, pharmacists
Added value	The Clinical Entrepreneurs are seen as "agents for change", transforming healthcare through raising awareness and changing culture to pursue entrepreneurship at work.
Examples of use	Time for entrepreneurial activity; education; mentoring and coaching; access to entrepreneurial placements/internships; signposting for funding; networking events – regional and national events coordinated through AHSN and other organisations.
Challenges	"One of the biggest barriers I have seen facing companies is that they may have a great product/service but have not tried to understand the clinical/provider problem. You need both: a good product and an understanding of pain points in a clinical/provider environment. To overcome this, you need to think: 'what is the problem, and how do I solve it'."*
Approach	"We don't spoon-feed the entrepreneurs but we do give them: a 'badge of permission' to be an entrepreneur in the NHS; a commercial coach; an individually-chosen mentor; a connection to customers; and funding. We arrange networking and educational events across the year. Effectively, we present a range of opportunities on the table and the entrepreneur can pick and choose. It is self-directed learning. We facilitate group learning and ensure resources and facilities are available."*
Outputs	By September 2019, the following outputs have been identified (see figure 6): ○ 175 start ups and 1,047 jobs created ○ Raised £164m funding ○ 12,000 CPD points awarded to CEs ○ 106 clinicians retained or returned

*Quotes from Dr Tony Young (National Clinical Lead for Innovation at NHS England); source: interview with doctorpreneurs.

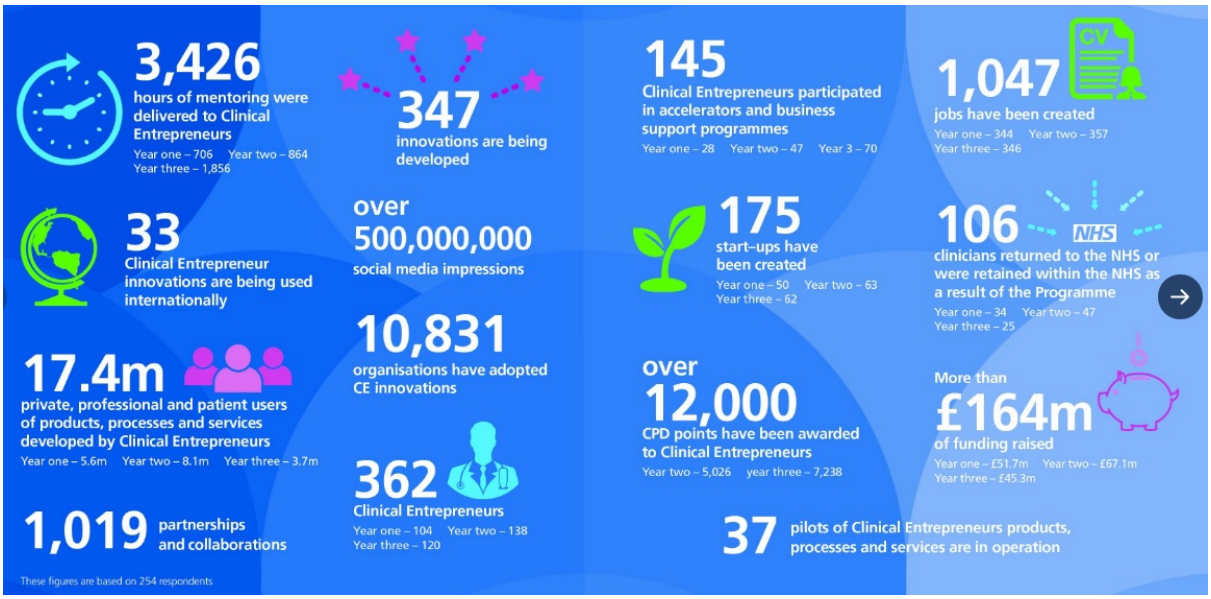

Figure 6 – Outputs from the NHS Clinical Entrepreneur Scheme; source Dr Tony Young (National Clinical Lead for Innovation at NHS England) talk at Health and Care Innovation Expo, September 2019

5.6. Academic / NHS / Industry Collaboration in Experimental Medicine (2011)

About ten years ago, the Wellcome Trust supported a training programme developed collaboratively between Newcastle University and several industry partners. An evaluation of the programme was conducted, which was reported here.

Aims: To improve the translational knowledge of clinical academics		
Academia	Initiation	Industry
There was a mutual realisation between industry and academia that, although many people discussed the topic of 'translational research', few within academia actually understood how to effectively develop the results of research into therapies and technologies for patient benefit.		
Offer		
• NIHR Biomedical Research Centre with dedicated infrastructure funding to support research translation • An experienced group of clinical academics		• Updated 'Real World' course content • PhD programmes in translational research hosted at industry sites • Expert experience in therapy development
Collaborative functions		
• Newcastle University engaged multiple industry partners • Collaborative development of a first year Masters course entitled 'MRes in Medical and Molecular Biosciences' • Partners agreed to use real experimental data to enrich the course content		
Outcome		

• The scheme has proven very popular with both clinical fellows and industry, and acted as a catalyst for greater industry engagement at Newcastle • University, NHS and industry partners found themselves on the same side of the table when designing and delivering the training programme • University-NHS-industry interactions in Newcastle are more common, rich and diverse as a result of this collaboration
Key Success Factors
• Senior industry figures from the partner companies work alongside academics to deliver the Masters programme • A strong translational research environment within the Newcastle NIHR Biomedical Research Centre • The course tackles a very real gap in translational knowledge within the clinical academic community • Broad profiles of the companies involved, which include Sanofi-aventis, Roche, AstraZeneca, PTC Therapeutics, Sirtris and GSK

5.7. Innovate UK – Knowledge Transfer Partnerships

Innovate UK runs several programmes that support the interface between university research and business innovation, enabling ideas to flow both ways. Knowledge Transfer Partnerships (KTPs), which have existed for over 40 years, build partnerships between businesses looking to address specific problems or opportunities and researchers in academia with the skills and expertise to help.

Scheme	**Knowledge Transfer Partnerships**
Aims	○ Improving the competitiveness, productivity and performance of UK businesses ○ Increasing the commercial relevance of UK academic research and teaching ○ Enhancing the personal skills and commercial awareness of recently qualified people entering the workplace
Background	KTPs help businesses in the UK to innovate and grow. They do this by facilitating connections with an academic or research organisation through support for a graduate – a 'KTP Associate'. This enables the business to bring in new skills and academic expertise to deliver a specific, strategic innovation project through a knowledge-based partnership.
Funding	Each project receives up to £100k pa over 2-3 years. £35m is available each year.
Eligibility	Any business, higher education institution or research organisation. Public sector bodies (e.g. NHS) are not eligible.
Added value	Companies – particularly SMEs – can often find it difficult to maintain the skills, knowledge and equipment necessary to support the introduction of a new product or service. KTP can help by providing businesses with access to knowledge, skills, equipment and partners. KTPs can also help embed an ongoing new strategic capability within the business, developing a long-term collaborative working relationship with academic teams at the forefront of their discipline offering further innovative possibilities.
KTP model	Cross-sector expertise combines to advance open innovation, overcoming the barriers that arise – see the KTP "5Cs" model below (figure 7).
Challenges	○ Whilst open to all scientific areas, KTPs are generally perceived as being for

	engineering or manufacturing programmes. Indeed, in 2014, 42% of KTPs were in engineering (chemical, electrical and mechanical), with only 3% in biology and 3% in medicine. ○ All Research Councils, except MRC, contribute to KTPs, which hinders their reach into the biomedical sector ○ Biomedical product development timelines are considered to be long-term and expensive compared to other areas: KTPs seek a faster return on investment ○ KTPs don't engage with NHS or other public sector bodies – not considered to be good places for innovation
Inputs	In 2012-13: ○ KTP supported UK business by drawing on the expertise of 98 higher education institutions across nearly 350 departments ○ Nearly £82m was committed to new KTP partnerships in the shape of grant support and company contributions
Outputs	○ Achievements and outcomes (2014) for KTPs report that for every £1m of government money invested in 2012-13: - 44 new jobs were created - 366 staff were trained - £1.6m was invested in plant and machinery - £1.18m was invested in R&D - The one-off increase in profit before tax achieved during the course of KTP projects increased to £780k from £480k - The anticipated annual increase in profit after project completion increased to £6.95m from £4.79m ○ An evaluation of the KTP programme, published in 2015, estimates the Return on Investment (ROI) to be approximately £7.5-£8 of net additional Gross Value Added (GVA) generated for every £1 of KTP grant funding invested by sponsors through businesses and KTP Associates participating in the programme.

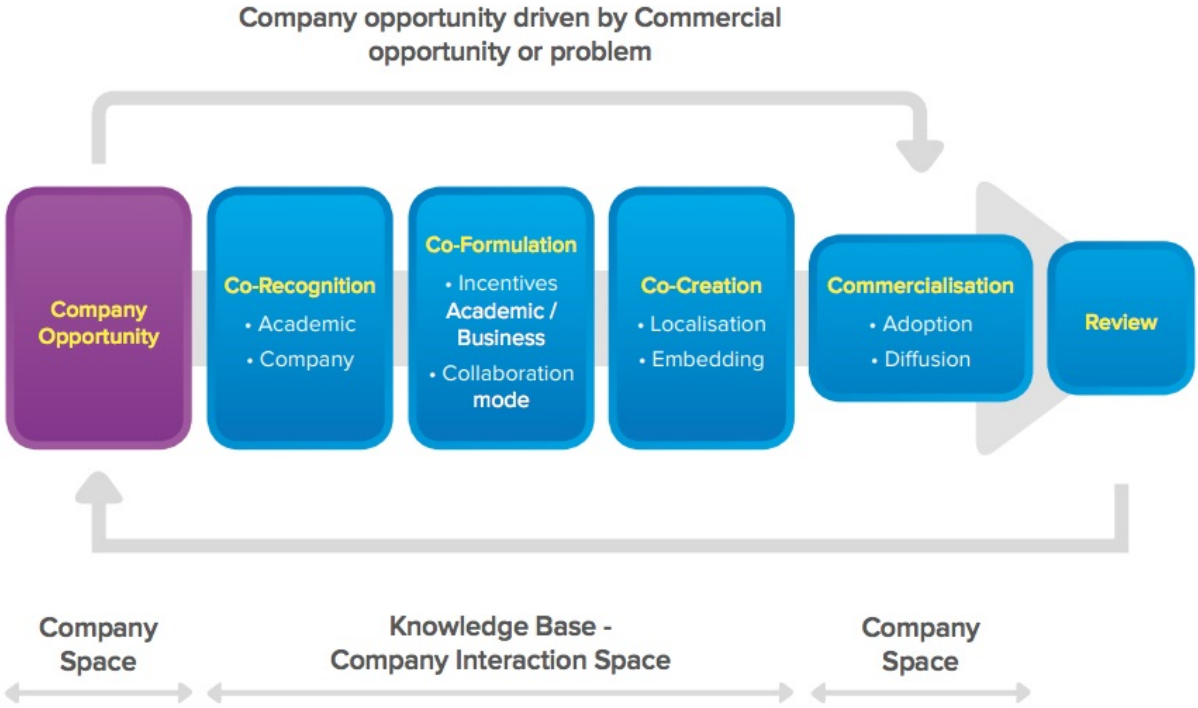

Figure 7 – Generic '5C' model for knowledge transfer in open innovation; source: KTPs - A best practice approach to open innovation (2013)

The report, KTPs - A best practice approach to open innovation (2013) highlights key barriers in the open innovation pathways that KTPs are designed to tackle (table 1).

Stage in the open innovation pathway	*Barrier*
1) Company Opportunity - A business recognises that there is an opportunity or a problem that it could address if it had access to the necessary knowledge, skills and expertise.	• Lack of awareness of opportunities and issues facing the business • Lack of awareness of new knowledge • Lack of understanding of the potential of universities to provide relevant information and knowledge • Weakness in networks and information, and difficulties in finding the right partner within a university
2) Co-recognition - The partnership begins with a joint analysis of needs and solutions, appropriate research and willing researchers within the institution.	• Different incentives and objectives • Unrealistic expectations on either side • Legal formalities
3) Co-formulation - The researchers' generic knowledge is adapted or 'localised' to meet the specific needs of the business. The knowledge from the academic and business domains is synthesised. This requires collaborative working and the building of trust amongst the partners.	• Differences in 'language' and timescales • Issues of relationship management and trust
4) Co-creation - As the project develops, the partners create the opportunity for innovation in process, product or markets. This depends on the firm's ability to absorb new knowledge ('absorptive capacity') and also on its ability to deliver.	• Lack of absorptive capacity and effective internal structures and communications in the business • Difficulties with change management and organisational learning
5) Commercialisation - Success in the market place and adoption by end users is the mark of successful innovation.	• Access to finance • Lack of Intellectual Property Rights (IPR) clarity

Table 1 – Barriers to the '5Cs' of open innovation, where KTPs are designed to facilitate progress; source: KTPs - A best practice approach to open innovation (2013)

6. Future development of a scheme to promote cross sector mobility

6.1. Gaps

Particular gaps identified in this landscape review are:

- Low uptake from industry, particularly SMEs, in schemes aimed at promoting cross-sector collaboration.
- Very low uptake from Clinical Academics in schemes aimed at promoting cross-sector collaboration with industry.
- The majority of existing schemes focus on supporting placements to develop collaborations on a specific project. There exist very few schemes targeting earlier stages of mobility, which could lead to new collaborations or projects.
- There is a lack of career development support – such as training, mentoring or coaching – available to researchers, to help them overcome challenges of cross sector mobility. Opportunities exist for senior researchers from academia, industry and the NHS to support and mentor researchers to move across sectors.
- There is a lack of provision for brokering – at a national level – between early career researchers and smaller biotech companies. A resource to help find experts in academia who wish to collaborate with industry would be valuable for SMEs.
- There is a lack of formal recognition – in all sectors – of the contribution that cross-sector mobility can make. Appraisal systems should be improved to recognise formally the range of contributions from people who work across sectors, as enshrined in Team Science.
- There is a lack of training – in undergraduate and postgraduate programmes in medicine and the life sciences – on skills and knowledge required for effective industry engagement.

6.2. Thematic areas that would benefit from an initiative to stimulate cross-sector mobility

Developing a scheme that is open to applicants from a wide range of disciplines would enable the Academy to cast its net wide, attracting outstanding individuals from diverse fields to progress research in the life sciences of relevance to improving human health. However, in the early years of a new scheme, it may be practicable to highlight priority topics, encouraging applications in these areas and creating more clarity in purpose for the scheme. A focus on emerging technologies could be of particular interest, with widespread appeal. Topics that have been suggested during this review are:

- Digital pathology and diagnostics
- Data analytics and artificial intelligence
- Medicinal chemistry and drug development
- Gene therapy design and manufacturing
- Genomics
- Regenerative medicine
- NHS improvement through process engineering / logistics
- Improve translation pathways – share skills and insight to improve understanding and streamline translational development

6.3. Groups of researchers who would benefit from access to a cross-sector mobility initiative

A wide range of students and researchers would benefit from support tailored to their career stage, discipline and sector (table 2).

Career stage	Potential activities and benefits
Undergraduate and postgraduate students (medicine and life sciences)	○ Educational modules ○ Industrial placements ○ Effective cross-sector supervision
Early career researchers	○ Educational modules ○ Industrial placements ○ Networking opportunities: - to identify potential partners - for peer-to-peer support ○ Effective cross-sector supervision ○ Mentoring and coaching
Mid career researchers	○ Flexible funding to support cross-sector working ○ Networking opportunities: - to identify potential partners - for peer-to-peer support ○ Mentoring and Leadership coaching
Senior researchers	○ Access to funding to facilitate cross-sector interactions and initiatives ○ More showcasing of "role models" ○ Provision of mentoring

Table 2 – Summary of tailored support for research mobility required at different career stages

6.4. Elements of wider career support

A new scheme should place particular emphasis on providing support for the career development of crossover researchers. This should include opportunities for education, training, networking and partnering. Further elements of a new scheme that would be attractive to researchers would be:

- Mentoring from senior cross sector researchers
- Leadership coaching to understand styles and behaviours for effective cross sector working
- Access to the Academy's extensive networks, including fellows and peer researchers
- The hosting organisations should demonstrate their commitment to the candidate's career development, through:
    - Conceiving an appropriate supervision plan, with clear responsibilities from partner organisations
    - Backfilling and departmental support for organisational commitments such as teaching, clinical practice and project management
    - Protected time for mobility and research
    - A career development plan, with clear sight of career progression avenues to future roles and funding channels

6.5. Other schemes in development

UKRI Innovation Scholars Programme

The UKRI Delivery Plan (2019) made a commitment to, "Pilot a new Innovation Scholarship scheme, with the dual objectives of providing courses / training to meet industry demand and funding individual secondments between sectors, particularly academia and industry, to increase mobility and facilitate exchange of ideas and skills."

This scheme is at a very early stage of development, however a key goal will be to increase porosity between academic, industrial and NHS sectors. A particular focus will be about developing workforce skills through short secondments and possibly short modular flexible training in topics such as bioinformatics. It is likely to be piloted in 2020, in the biomedical field.

NIHR

NIHR's Strategic Review of Training (2017) highlighted the need for greater engagement with industry. They are developing opportunities for working with, and meeting the needs of, the life science industry through future funding partnerships. The NIHR will present ideas to the Department of Health later this year and is holding a session on engagement with industry at its annual conference (November 2019).

6.6. Survey

Following the Task Force meeting on 18 September, we will be launching a survey to obtain further insight from the research community on barriers and facilitators for effective cross sector mobility. We will reach out to researchers working in Academia, NHS and Industry through the Academy's networks, other funders' networks (MRC, NIHR, BBSRC, Innovate UK) and organisations such as ABPI and BIA. The survey will also be promoted through social media. The findings of this survey will be presented to the Task Force at their meeting in November.

7. Key principles and future considerations

7.1. Key principles to inform scheme design

A set of key principles has been developed to inform scheme design, based on the barriers, facilitators and gaps identified through this scoping exercise.

Increase awareness of impact and unmet need

- Identify and promote cross-sector exemplars – role models – highlighting their achievements and impact to influence the engagement of other researchers
- Demonstrate importance and impact to influence more funders to support research in this way

Develop tailored approaches for targeting specific career stages and sectors

- A portfolio of educational modules, flexible placements, training, networking, partnering and mentoring to engage undergraduates, postgraduates, early career, mid career and senior researchers from academia, industry and the NHS
- Attractive and flexible funding opportunities that can be accessed at pace and which support backfilling for researcher movement
- Clear commitment from all partners to the career development of crossover researchers
- Prioritise uptake and engagement from clinical academics, SMEs and early career researchers

Create more incentives for cross sector mobility

- Improve access to attractive funding packages
- Greater recognition in appraisal systems for the expertise and tools acquired, in cash and in kind contributions, and the skills developed through cross sector mobility
- Partners should provide evidence of their commitment to the career development of crossover researchers
- Apply the principles of Team Science, Open Science and Open Innovation

Support networking and partnering between sectors

- Develop informal regional and national networks engaging academia, industry – particularly SMEs – and the NHS
- Engage existing infrastructure: Experimental Medicine Centres, AHSNs, Academy networks

Reduce bureaucracy and provide advice on terms for collaboration

- Develop and enable access to guidance on how to set up transfer agreements and contracts for collaboration
- Encourage a stronger culture in industry of publishing research, whilst protecting IPR
- Develop a streamlined funding application process

Support researcher mobility in priority and emerging areas

- Digital pathology and diagnostics; data analytics and artificial intelligence
- Medicinal chemistry and drug development; gene therapy design and manufacturing
- Genomics and regenerative medicine

Funding continuity

- Ensure there is adequate provision of follow on funding programmes for 'mobile' researchers to develop their ideas and collaborations

7.2. Programme management

Candidate or Organisation-led selection

Different models for selecting candidates exist (table 3). A candidate-led model is essentially an open competition for individuals to apply from across the UK, where they meet specified criteria. An organisation-led model places more emphasis on pre-selecting specific organisations to select candidates in a subsequent stage.

Candidate-led	Applicants from any eligible organisation submit their applications, informed by the criteria as set out in the guidance.
Pros	Wide, open, national competition to select the most suitable candidates Simultaneous appraisal of candidate, goals and partners Open to all organisations from academia, industry and NHS
Cons	Demand could be very high Substantial cost and time required for managing the programme and selecting candidates
Examples	Majority of national fellowship schemes e.g. the Academy's Starter Grants for Clinical Lecturers
Organisation-led	Any organisation can apply, based on specified criteria. Candidate selection is delegated to successful organisations.
Pros	Offers successful organisations flexibility to move rapidly when selecting candidates Reduces programme management costs for the funder Helps to manage overall demand, by restricting the number of applications
Cons	Limits the direct engagement between Academy and awardees Could limit the ability for smaller organisations e.g. SMEs to apply
Examples	MRC's Skills Development Fellowships programme MRC's P2D and CiC programmes (see 5.1)

Table 3 – Consideration of a Candidate or Organisation-led selection process

Funding panel

A standard research review committee would not be suitable for such a scheme. Instead, a standalone committee should be convened, with relevant cross-sector expertise, to assess applications based on e.g. hosting arrangements and commitment, candidate strength, relevance to priority areas.

8. References

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Appendix 1 – Interviewees

Organisation	*Name*	*Role*
NIHR	Dr Peter Thompson	Assistant Director, Personal Awards
MRC	Dr Agnes Leong	Programme Manager, Translation
BBSRC	Dr Adam Bowen	Joint Head, Knowledge Exchange and Commercialisation
Royal Society	Dr Kelly Makarona	Senior Manager, UK Grants
Royal Academy for Engineering	Dr Andrew Clark	Director of Programmes
Innovate UK	Richard Lamb	Knowledge Transfer Partnerships (KTP) Programme Manager