

Introduction

The UK's global competitiveness rests on its advanced research base and capacity to innovate. These drive the productivity of the UK's knowledge economy, where 80% of new jobs are in high-skill areas¹, and attract inward investment. Therefore, levels of investment in research and innovation matter. But this investment can only be maximised if the links to, and dependency on, other drivers of productivity – a dynamic, open and enterprising economy and investment in infrastructure and skills – are recognised when deciding how to distribute funding to researchers and innovators. The UK's areas of international excellence could not survive without the broader higher education and skills environment and its complex webs of collaboration and competition.

Universities are central to the research and innovation ecosystem. Alliance universities, in particular, have much to contribute. Many Alliance universities were born out of the needs of the industrial revolution and close collaboration with industry is at the heart of our mission. Alliance universities have a significantly higher percentage of staff employed directly from industry than the sector average. We work with businesses of all sizes in all industry sectors. In particular, we use a variety of innovative engagement models to work with SMEs. Much of our research is applied and undertaken in response to a request from industry for help with a specific problem. This research contributes to improvements in services and processes as well as direct research spin-outs.

But our contribution to growth goes beyond this; our knowledge exchange activities also make a significant contribution to the absorptive capacity of the businesses in our regions. We educate the next generation of entrepreneurs and business leaders through our professionally accredited education programmes (38% of courses accredited by PSRBs), commitment to work experience and support for graduate start-ups.

As universities with a strong focus on working with business, we looked carefully at the Dowling Review of Business-University Research Collaborations. We agree with the key messages of that review and have thought about the practical implications in making our recommendations.

University Alliance argues that:

- A. Investment in the research base increases UK productivity and attracts international investment, and must be sustained;

¹ R. Wilson and A. Green (2001) *Projections of Occupations and Qualifications: 2000/2001: Research in Support of the National Skills Taskforce Department for Education and Employment.*

- B. Funding must be allocated on a competitive basis to “excellence wherever it is found”;
- C. The dual support system must be maintained – QR is particularly important and should be increased;
- D. Impact must continue to be recognized and rewarded to drive societal benefit from publicly funding research;
- E. Funding must reward and recognise collaboration in research to increase efficiency and reduce duplication;
- F. National knowledge exchange schemes must continue to be funded and should focus on growing talent and increasing mobility to improve the innovative capacity of businesses;
- G. The new science and innovation audits must include all institutions and activities that contribute to the research and innovation strength of each region, and result in targeted funding to create hubs of expertise; and
- H. Government should consider dedicated place-based funding to support universities to work with small and medium sized enterprises.

Evidence and analysis

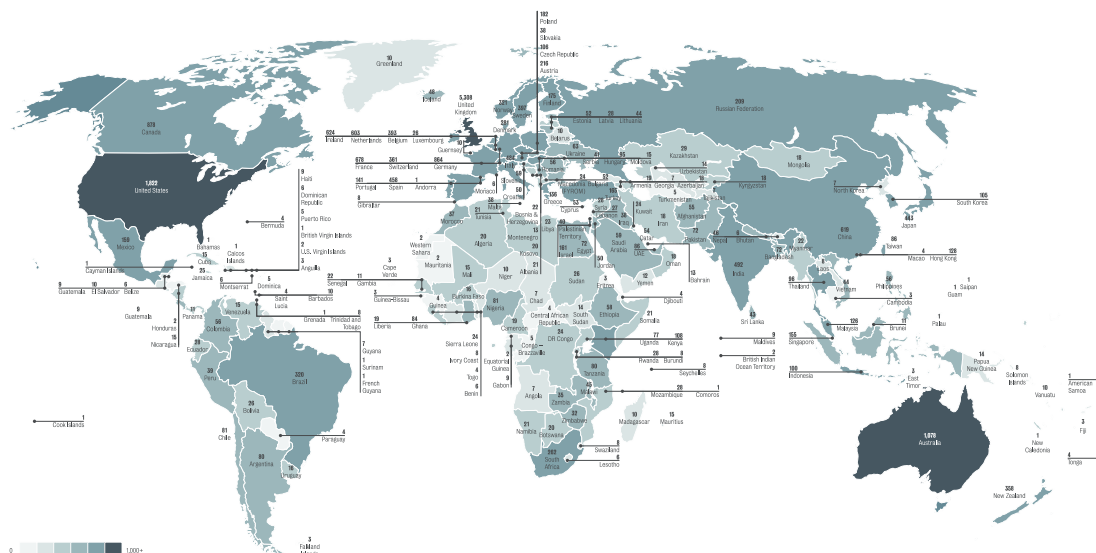
A. *Investment in the research base increases UK productivity and attracts international investment, and must be sustained*

1. The case for investment in research has been well made by many organisations. We have therefore not set it out again at length here but support the points the Campaign for Science and Engineering make in their publication “Why Champion Science and Engineering”² and that Tera Allas makes in her 2014 report “Insights from international benchmarking of the UK science and innovation system”.
2. In particular, we note that government investment in science and engineering leverages investment from industry, raises productivity and creates high-value jobs. It is a highly effective way to invest public money to drive economic growth - for every £1 spent by the government on research & development, private sector R&D output rises by 20p per year in perpetuity.³
3. Conversely, if we fail to maintain investment in research and innovation, we are at risk of losing our position as global leaders in research and innovation. Not only would we lose our own capacity to capitalise on the research and innovation generated in the UK – and the associated increase in skills – but many other countries are increasing their investment and would like to attract the globally-mobile investment and talent that currently comes to the UK.
4. The UK’s reputation as a world-class research nation brings collateral benefits. The Impact Case Studies submitted to the REF2014 show that UK research has a global significance, with benefits for international diplomacy and soft power as well as inward investment (Figure 1). 38% of Alliance research collaborations with business are with EU and international partners.

² CaSE (May 2015) <http://sciencecampaign.org.uk/Whychampionscienceandengineering.pdf>

³ J. Haskel, A. Hughes and E. Bascavusoglu-Moreau (2014). *The Economic Significance of the UK Science Base*. CaSE.

Figure 1 The global reach of impacts arising from research undertaken in UK HEIs, taken from KCL and Digital Science (2015), *The nature, scale and beneficiaries of research impact: An initial analysis of Research Excellence Framework (REF) 2014 impact case studies*, p. 41.



5. We note that, at the moment, most of the research budget sits within BIS, which is an unprotected department. As research and innovation has benefits across the whole of the government agenda, including areas that are protected, this should be taken into account when deciding departmental budgets.

B. Funding must be allocated on a competitive basis to “excellence wherever it is found”

6. The best return for investment on research funding is achieved when it is allocated competitively. There has been a notable increase in the UK’s share of world citations since the introduction of the first Research Assessment Exercise (RAE) in 1986.⁴
7. It allows universities to identify their competitive advantage and make strategic research investments. This in turn creates a rich and efficient ecosystem in the UK with institutions complementing rather than duplicating each other’s research.
8. Some have argued that preference should be given to large research units. However, there is substantial evidence that funding allocated on the basis of a research unit’s size delivers diminishing returns.⁵ Two recent studies from the US and Canada have shown that research productivity (publication levels) and reach (publication/citation impact factor) were a decelerating function of large or extra funding awards.⁶ Analysis of the REF2014 results shows that there are small and medium-sized groups of researchers that perform as well as, and often better than, the largest (Figure 2).
9. Concentrating resources on the basis of existing scale would therefore eliminate many areas of excellence and stifle the development of future niche and specialist areas.⁷ Funding in this way would also support research of varying quality, with no incentive to improve. By funding excellence wherever it exists, we will always be investing public money in the best research.

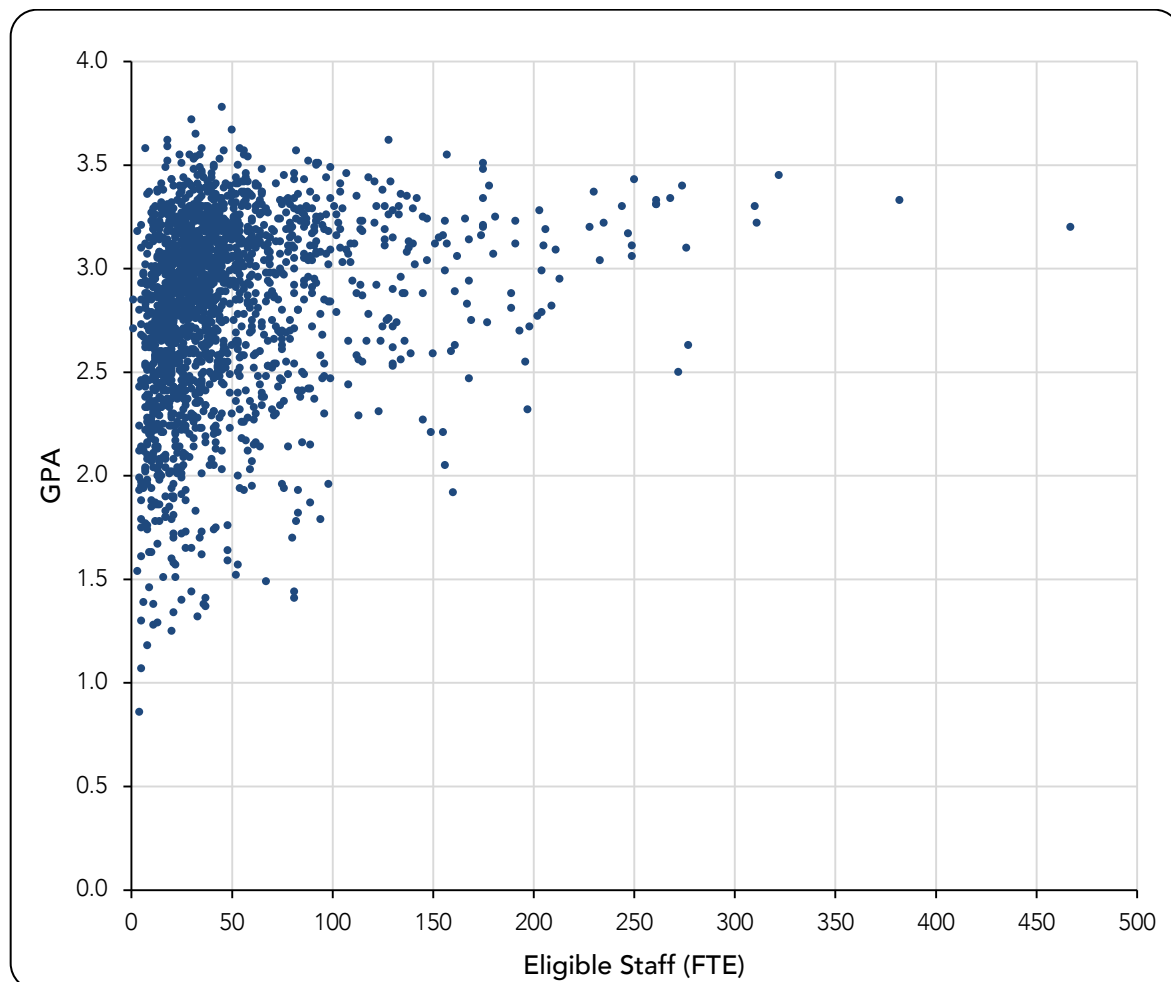
⁴ J. Adams and D. Smith (2006). Evaluation of the British Research Assessment Exercise. In: L. Bakker, J. Boston, L. Campbell and R. Smyth (eds.) Evaluation of the Performance- Based Research Fund, pp. 109-17; Wellington: Institute of Policy Studies, Victoria, cited in Libby Aston and Liz Shutt, “Concentration and Diversity: Understanding the Relationship between Excellence, Concentration and Critical Mass in UK Research,” 2009.

⁵ Faye Taylor (2015), *Evolve. Connect Succeed. Funding a Healthy Research and Innovation Ecosystem*, University Alliance, Chapter 2.

⁶ Meredith Wadman (2010), ‘Study Says Middle Sized Labs Do Best’, *Nature*, 468 (2010), 356–57; Jean-Michel Fortin and David J Currie (2013), ‘Big Science vs. Little Science: How Scientific Impact Scales with Funding’, *PloS one*, 8.

⁷ Mark Harrison, “Does High-Quality Research Require ‘Critical Mass’?,” in *The question of R&D specialisation: perspectives and policy implications. JRC Scientific and Technical Reports (EUR collection): perspectives and policy implications*. ed. by Dimitrios Pontikakis, Dimitrios Kyriakou, and Rene van Bavel (Office for Official Publications of the European Communities, 2009), pp. 53–55; Evidence Ltd (2011), *Funding Research Excellence: Research Group Size, Critical Mass & Performance* (University Alliance).

Figure 2 Small and medium size research units perform as well if not better than the largest.
Data: HEFCE, REF2014 results, all UoAs



C. *The dual support system must be maintained – QR is particularly important and should be increased*

10. In the UK, the vast majority of research is carried out within universities: 74.3% of publicly-funded Gross Expenditure on Research and Development (GERD) and 26.5% of total GERD – significantly above the OECD average. This is because universities can offer both economies of scale and connections to research excellence across the world. This may contribute to the fact that the UK’s research system is one of the most efficient in the world.⁸
11. Businesses clearly find carrying out their R&D in partnership with universities efficient. Industry invested £3.9 billion in the knowledge and expertise generated by the UK’s universities in 2013-14: an increased investment of 10.1% from the previous year, and far above the overall UK GDP growth of 2.6%.⁹
12. For smaller businesses, the fact that universities are local and can offer a range of personalized services may also be an attraction. Alliance research projects and consultancy activities are often undertaken in response to a specific request from industry –20% of Alliance research collaborations and 23% of consultancy and equipment sharing is with businesses operating in high growth areas. This reflects a wider culture of responsiveness to industry.
13. It is therefore essential that universities have predictable and targeted sources of funding to support them to develop a base capacity which grants and industry funding then “tops-up” in relation to particular specialisms. QR funding creates this base. We therefore argue that the government should consider increasing the proportion of research funding that flows through QR.
14. We also argue that this funding should continue to be used to fund 3* as well as 4* research as this will support greater diversity of subject matter in the UK research base while still targeting funds at high quality research. This will allow universities to develop areas of expertise including in new and high-risk areas, across the spectrum of research activities.¹⁰
15. Despite the current focus on devolving new powers to the English regions, which we welcome, we believe research funding should continue to operate at the

⁸ Elsevier and BIS (2013), *International Comparative Performance of the UK Research Base 2013*.

⁹ HEFCE (2015), Report on Higher Education – Business and Community Interaction survey, 2013-14

¹⁰ PACEC and Centre for Business Research at the University of Cambridge (2014), A Review of QR Funding in English HEIs: Process and Impact. Report to the Higher Education Funding Council for England (HEFCE).

national level. This is the best way to ensure that limited funds are allocated to the best research giving us the best chance of maintaining our global standing as a leading research nation.

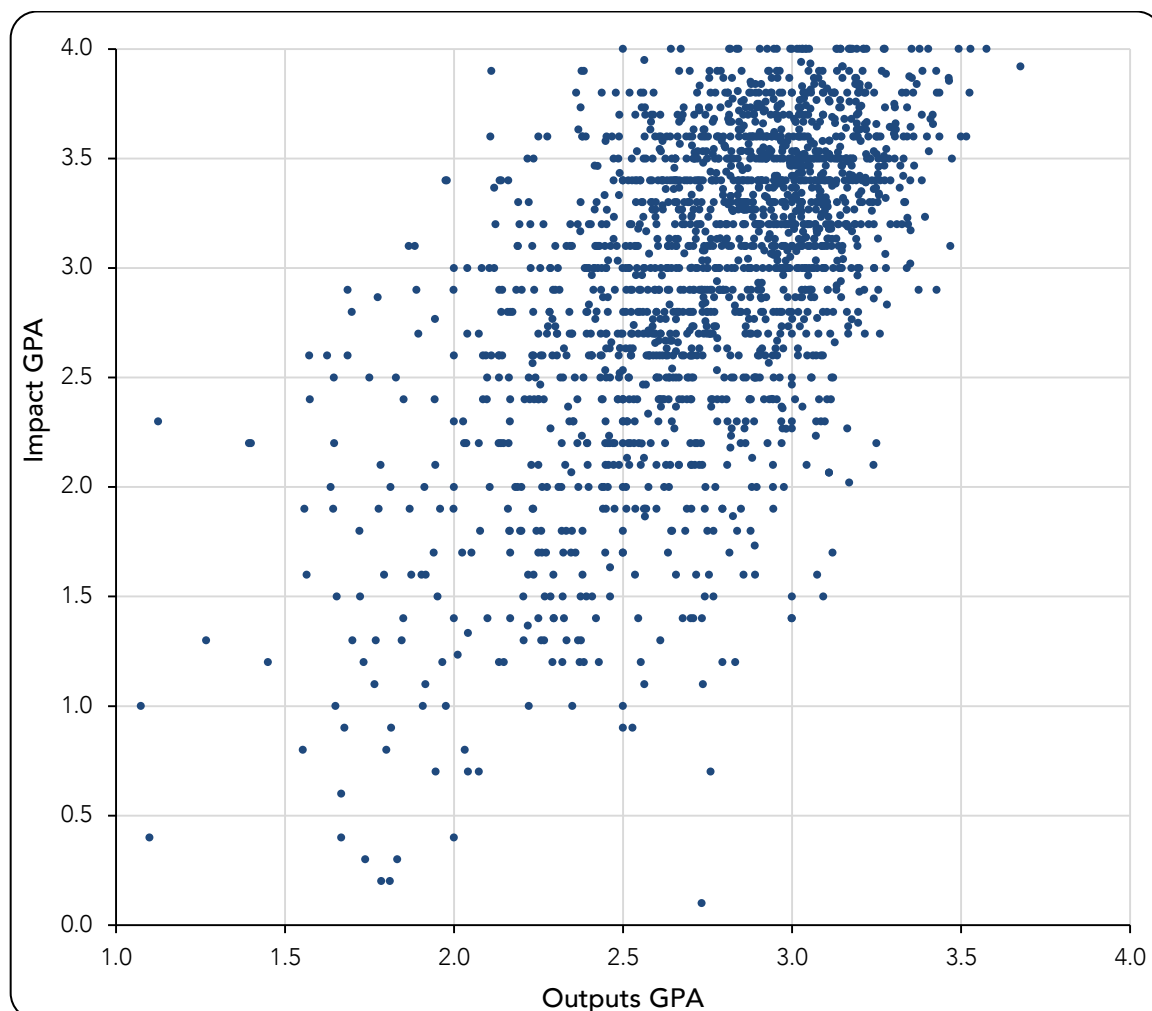
D. Impact must continue to be recognized and rewarded to drive societal benefit from publicly funding research

16. Publicly funded research should justify its value to society. Of course, some impacts of research are long-term and difficult to predict. But research can and should contribute a huge amount to our world, today. This requires researchers to engage with the users of research and help them exploit new knowledge. We therefore welcome the increased focus on impact in funding decisions.
17. Impact requires a separate recognition/reward system from scholarly publications because – although both activities are important – output/publication-based excellence is a poor predictor for impact excellence and the value of that research for society (Figure 3). Analysis of REF2014 results shows that around two thirds of variation in impact quality is not explained by output, with the coefficients of determination ranging from 0.235 to 0.404 depending on which panels were analysed.¹¹ Likewise, collaborative research with business is not always recognised in a scholarly output (often due to business sensitivity) but can have significant economic and societal outcomes.

¹¹ The coefficients of determination (R^2) for a simple linear regression of outputs on impact in Panels A-D are, respectively, 0.361, 0.404, 0.393, 0.235.

Figure 3 Outputs are a poor predictor of impact - many high impact ratings have low output ratings and vice versa.

Source. HEFCE REF2014 results data – all UoAs



18. For the next REF, we recommend that the current 20% weighting for impact case studies should be retained and that the impact template should be moved into the environment section, which should retain its 15% weighting. This would recognise that impact should be ‘fully embedded’ within the research environment, and would further increase the value of impact within the research assessment process.

E. Funding must reward and recognise collaboration in research to increase efficiency and reduce duplication

19. Funders should encourage collaborations both between academics within the UK and overseas and between academics and industry. Collaboration delivers cost

efficiencies by reducing duplication and allowing latent capacity to be exploited in new ways.

20. Elsevier analysis suggests that UK researchers are 'highly collaborative' but that the country fits a pattern of 'high and rising rates of international co-authorship with moderate and falling institutional co-authorship rates'.¹² One way to encourage more collaborative and interdisciplinary modes of working between researchers in the UK would be to remove current disincentives in the system. One example is that most Research Councils do not recognise the contributions of co-collaborators. As this contribution is not considered in future funding rounds that are based on previous award levels, this acts as a disincentive to operate as a Co-Investigator. To address this, all Research Councils should track 'pass through' funds and recognise the input of Co-Investigator. (The Arts and Humanities Research Council already do this.) They should also encourage multi-partner bids for funding to encourage new collaborations.

F. National knowledge exchange schemes must continue to be funded and should focus on growing talent and increasing mobility to improve the innovative capacity of businesses

21. We will only make the most of university research and teaching if we also support knowledge exchange. As Dowling recommends, the government should make a long-term commitment to maintaining a form of flexible public funding for knowledge exchange.¹³ We argue that the Higher Education Innovation Funding (HEIF) should remain flexible and stay within HEFCE's national portfolio. There is, however, a good case for a more place based dimension to some of the knowledge exchange and innovation funding administered by Innovate UK and the Research Councils.
22. HEIF is a success story. It leveraged over £6 for every £1 invested¹⁴ and has achieved its original remit to build knowledge exchange capacity in universities. It is now a good time to think about refocusing this funding stream. We think that a new fund should focus on two areas: improving the innovative skills of each generation of students and academics; and supporting proof-of-concept testing.

¹² Elsevier and BIS p. 59.

¹³ Dame Ann Dowling (2015) *The Dowling Review of Business-University Research Collaborations*

¹⁴ couldTomas Coates Ulrichsen, *Knowledge Exchange Performance and the Impact of HEIF in the English Higher Education Sector*, Report for HEFCE (April 2014)

It should still be allocated to universities, because they have the knowledge, scale and connections to provide the best support to these activities.

23. Innovation requires highly-skilled and innovative people. The most recent Global Innovation Index report found that tertiary education, student and professional mobility, and original R&D (as opposed to technology transfer) improve innovation performance. Embedding enterprise education in the curriculum and providing support for start-ups can support this. Movement of people between academia and industry is also important as it supports absorptive capacity and knowledge exchange.¹⁵ This is therefore a good use of government funding – and better than rewarding large research contracts that bring their own financial reward. The fund should support movement in both directions – facilitating both placements from industry to academia and for students and university staff into industry.
24. Knowledge exchange funding should also be used for proof-of-concept funding for collaborations between industry partners and universities. This would provide students and academics with enterprise and commercial experience.
25. Knowledge exchange funding should be applied across all disciplines. The recent Global Innovation Index recognised that an over-focus on STEM would be misguided, since “graduates of tertiary arts programmes are among the most likely to contribute to product or service innovation”. Innovative societies above all require “creativity, critical thinking, and communication skills”.¹⁶ Likewise, we could make more use of our business schools in addressing the management weaknesses that contribute to the UK’s productivity puzzle.¹⁷
26. The Innovate UK portfolio should continue to recognise the importance of investing in people. **Knowledge Transfer Partnerships** provide high returns on investment. They develop expertise and close relationships which often lead to longer and larger research and skills partnerships.

¹⁵ D. Tzabbar, B. S. Aharonson, and T. L. Amburgey (March 2013). “When Does Tapping External Sources of Knowledge Result in Knowledge Integration?,” *Research Policy* 42, no. 2, pp. 481–494; Vitae, RCUK, and CBI, *The Future of the UK Research Base and Implications for the Professional and Career Development of Researchers*; H. Bakhshi, P. Schneider and C. Walker (2008), *Arts and Humanities Research and Innovation*. AHRC and NESTA.

¹⁶ Global Innovation Index (2014), chapter 3.

¹⁷ REF2014 showed that Alliance Universities accounted for 9% of the research power in Business and Management studies.

27. We also recommend that staff who have spent a significant amount of time in industry should not be penalised in research funding allocation processes, as this disincentivises an activity that supports collaboration and innovation. We support Recommendation 2 in the Dowling review, for the next REF 'to provide more explicit recognition for staff who have moved between industry and academia in either direction, or 'discipline-hopped'; and to consider universities' industrial collaborations, including the exchange of people the success of their translation activities, as an important part of the 'Environment' component.' We would also urge Research Councils to ensure these activities with and in industry are recognised and rewarded when making funding decisions.

G. *The new science and innovation audits must include all institutions and activities that contribute to the research and innovation strength of each region, and result in targeted funding to create hubs of expertise*

28. As Tera Allas argued in her 2014 report: "Science and innovation ecosystems are complex and made up of a number of complementary elements. Their effectiveness is crucially determined by how well the elements interact within, and respond to, the demands of the broader economic and societal system."¹⁸

29. The government's Summer Budget outlined plans to audit excellence in science and innovation across the UK.¹⁹ We welcome these - especially because there is a commitment to identify excellence of different kinds. We believe there is significant collaboration and activity that is currently under the radar. The aim of these audits should be to incentivise new forms of collaboration, as well as to reward existing networks. Following the audits, we would like to see funding directed towards both supporting existing activity and pump-priming new activity.

30. To achieve this we need the audits to take account of excellence across the full range of research and innovation activities – and in all institutions. They must avoid a methodology that reinforces current misconceptions and instead uncover new information that helps to improve our understanding. REF results and funding data can tell us to some extent about the spread of excellence. But, of course, innovation is more than direct spin-outs and licensing of research. We urge audits to consider the full range of knowledge exchange activities that

¹⁸ Tera Allas (2014) *insights from international benchmarking of the UK science and innovation system* p.5

¹⁹ [HM Treasury, Summer Budget 2015.](#)

contribute to productivity and growth. We have included analysis of HE-BCI²⁰ data in Annex A. This shows that expertise in a range of knowledge exchange and innovation activities is spread across the country.

31. Likewise, different types of higher education institutions make disproportionate contributions in various parts of the ecosystem. As KCL/Digital Science analysis of REF impact case studies showed, 'Group II' and 'Group III' universities, although less research-intensive, make disproportionate contributions of research impact in vital subjects. For Group II universities, these include 'Marine and Ocean Science' and 'Work, Labour and Employment' subjects. Group III universities make a disproportionate contribution to nine vital topics: Schools and Education, Community and Local Government, Innovation and Business, Women, Gender & Minorities, Asia (China and India), Religion (Christian faiths), Arts and Culture, Music, Dance and Performance and Sports.²¹
32. It is therefore essential that a wide range of data sources should be used to determine the full spread of research and innovation activities and excellence in institutions across the UK. In addition to REF data, we suggest further data sources should underpin the audits, including:
 - **Granular level Research Council funding data.** This should not be limited to information about Principal Investigators on successful funding bids (where the money goes), but should also take into consideration Co-Investigators and other collaborators (where the money is spent) to give a fuller picture of the spread of excellence.
 - **Private investment.** National Audit Office data and Innovate UK funding data, including collaborative R&D, showing where private investment is spent on R&D gives an open market dimension on the spread of excellence.
 - **HE-BCI data.** As the maps in Annex A show, the contributions of universities to business productivity come through a variety of activities above and beyond direct linear commercialisation of research, including collaborative and contract research, CPD courses, graduate start-ups and the sharing of facilities – all highly valued by businesses and trackable through HE-BCI data.
 - **Alignment with local innovation plans.** Local clusters of expertise already exist, as demonstrated through LEP Strategic Economic and Smart Specialisation

²⁰ HEFCE, Higher Education Business-Community Index Survey.

²¹ King's College London and Digital Science (2015), *The nature, scale and beneficiaries of research impact: An initial analysis of Research Excellence Framework (REF) 2014 impact case studies*, p. 36.

plans. Alliance universities have strategically aligned research strengths with local innovation plans. These are listed in Annex B.

33. It will also be critical that any calls for expressions of interest to report back on joint areas of strength have sufficient lead times. Otherwise the information collected will be skewed towards existing groups that do not cover the diversity of institutions from across the sector. For example, N8, M5 and GW4 are exclusive groups only catering for research intensive universities. If we really want to know how the eco-system is working, we will need to dig deeper.
34. These audits should inform competitions for innovation funding from the Research Councils and some of Innovate UK's portfolio, which could be used to create hubs based around complementary research and innovation expertise. These funds should be targeted at innovative small and medium-sized enterprises which stand to gain more from public support than large businesses, as expanded below.

H. Government should consider dedicated place-based funding to support universities to work with small and medium sized enterprises

35. British SMEs with product or process innovations have declined in recent years and are an underperforming aspect of the UK's research and innovation ecosystem.²² Small businesses are often constrained by limited resource and time and are often unable to capitalise on the knowledge and research that is available to them. Absorptive capacity and lack of leadership and management skills act are also barriers to innovation in SMEs.
36. Universities provide vital business and innovation support to SMEs and act as a hub around which specialist groups of SMEs and supply chains cluster. Universities can match projects and use supply chain knowledge to link up innovative businesses. They are already ensuring their significant capital research assets are available to a wider cohort of users, including industry of all sizes.
37. Interactions with SMEs are often on a project by project basis, rather than part of a more strategic, cross-institutional partnership. Engaging with numerous SMEs therefore uses more resource than contracts with large businesses. The impacts of engaging with small businesses (in terms of human resource, percentage increases to profits, etc.) may not equal those on large corporations in purely financial terms. Currently, high levels of engagement and innovation with SMEs

²² European Commission, Innovation Union Scoreboard 2014.

does not necessarily translate into measures like HE-BCI with associated funding implications. Some measure (and recognition) of levels of SME engagement in quantity, for example number of interactions and/or number of individual SMEs engaged with – given that this is a policy priority at all levels – would be extremely useful and a strong indicator of how universities are actively engaging with LEP and local growth agendas.

38. University-SME interventions provide a shop window and go some way to hiding the wiring behind the complex funding system for innovation. However, we recognise the key message of the Dowling Review that current funding for university-business engagement is too complex. We risk further complexity through the mooted regional allocation of funding. One way to help simplify this landscape would be to bring several of the existing funds together into two regionally-sensitive funds: one administered by Innovate UK and focussed on co-locating business and research expertise, and one administered by the Research Councils and focussed on creating knowledge exchange hubs.
39. Place-based funds must recognise that innovation is complex and different interventions are needed to target different market failures – which may present differently in different parts of the country. The science and innovation audits should help us understand these.

Place-based Innovate UK funding should cover:

- Support for place based clustering of SMEs through incubation hubs, science parks and university enterprise zones.
- Pump priming funding for commercialising research developed jointly by universities and SMEs.

Research Council place-based funding should cover:

- Multi-institutional partnerships (a similar models to the AHRC's KE hubs).
- Partnership formation in order to bid for funding sources e.g. from the EU.

40. We believe HEIF funding should be channelled nationally through HEFCE because this will allow universities to develop different forms of expertise which can be made available to businesses across the country. Universities can also help businesses work across artificial LEP boundaries. They can act as “connectors”, able to draw collaborative links across borders and to pull national and international research through to the local business base. An over-focus on

regional innovation networks may prevent the identification of truly transformative or disruptive knowledge/technology being developed elsewhere.

Annex A: Supporting Examples from Alliance Universities

The quality of Alliance research draws businesses to the UK and improves local business expertise

- The **engineering multinational BorgWarner** and the **University of Huddersfield** have developed a new partnership to improve turbo-charged engine technologies. Huddersfield University has invested more than £3.5 million in facilities and in developing research expertise, and has attracted £5 million inward investment from BorgWarner. The partnership has established bespoke turbocharger research and test facilities, co-developed a Masters' course for training the next generation of turbocharger engineers and has created and safeguarded jobs at the BorgWarner Bradford site.
- A new £15M 4-metre class robotic telescope ("Liverpool Telescope 2", LT2) at **Liverpool John Moores University (LJMU)** will be the world's largest robotic telescope dedicated solely to scientific work. The original LT1 project created jobs and drove upgrades in skills and machinery for local precision engineering SMEs in the Merseyside region. The increase in LJMU's capability through LT2 will enable the UK to take a leading role in big data, robots and advanced materials.

Alliance research is driving the productivity of high-potential mid-caps

- In 2014, the **University of Portsmouth** and **Entec International Limited** were awarded an Innovate UK Knowledge Transfer Partnership. Together they will take and analyse data for engineering departments and make predictions of future planned and unplanned maintenance demand. This will help avoid unscheduled maintenance, reduce downtime and increase productivity and profitability.

Alliance universities' work with large businesses and their supply chains strengthens the local economy

- The **University of Lincoln's** £37.5M collaborative venture with the international giant **Siemens** and their supply chain demonstrates the large financial benefits of a university-coordinated research strategy with local and industry partners. The partnership resulted in the building of a new Engineering School, generated a wide portfolio of research projects (over £2M since 2010) with immediate commercial benefit, retention of over 1,000 jobs in the UK and further expansion of Siemens' business with the creation of a further 50 jobs. As well as leveraging investment from Siemens, the collaboration

brought in £3.2M of public grant, £1.8M ERDF and £1.4M Single Programme funding. The School, and the activity around it, will help deliver the Greater Lincolnshire LEP's ambitions to grow the engineering sector in Lincolnshire. It also provides a centre around which research and business throughout the supply chain can cluster.

Alliance research impact is felt across the globe

- Research from the **University of Greenwich** applied in collaboration with local partners is transforming the tropical root crop, Cassava, into safe, cheap and valued products for food and industrial use in Africa. Collaboration with university and research institute partners in Ghana, Nigeria, Uganda, Tanzania and Malawi increased the incomes of 90,000 farmers who are estimated to have benefitted by \$33 million, and has the potential to reach 250,000 people within 8 years. 24,000 tonnes of high quality flour was processed and 300 village processing groups and 50 enterprises were supported. Last year Greenwich handed over leadership to the Nigerian Federal University of Agriculture, Abeokuta (FUNNAB). It is expected that the partnerships formed during the project – and the associated benefits – will continue. The Bill & Melinda Gates Foundation were so impressed by this project that they have invested \$18.8M in a follow-on project – CAVA2. Greenwich will continue to support CAVA2 and is leading or contributing to several other Foundation initiatives.

Alliance expertise leads to business investment

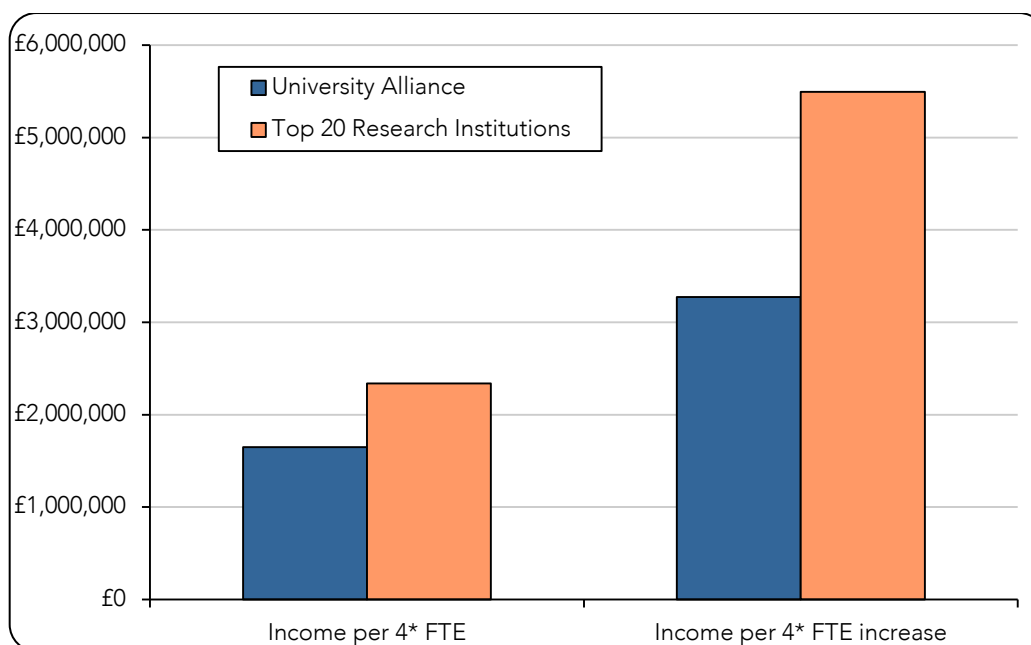
- Innovative techniques developed at **UWE Bristol** for measuring the dimensions of difficult solid objects automatically in challenging environments caught the attention of US company Quantronix. The resulting collaboration led to the creation of a system that could rapidly capture any 3D object up to 3m³. Having been successfully patented, it was developed into a full commercial product, the Cubiscan 1000-VS, which has since been sold to organisations around the world, including FedEx and the UK's Ministry of Defence.

Strategic investment in Alliance strengths delivers best value for money

- Comparing University Alliance with the top 20 research intensive universities (ordered by number of 4* FTEs from REF2014) shows that world leading

research is significantly more cost-effective at Alliance institutions.²³ Figure 4 shows that world-class research in the top 20 research-intensive universities required 42% more income than the equivalent volume of world-class research in Alliance institutions (£2.3m per 4*FTE compared with £1.6m). Likewise, the increase in world-class research in the top 20 the research-intensive universities between 2008 and 2014 was underpinned by 65% more research income than in Alliance institutions (£5.5m per additional 4*FTE compared with £3.3m).²⁴

Figure 4 Research funding per 4* FTE and increase in 4* FTEs between 2008-2014
Data: HESA, RAE 2008, REF 2014



Alliance universities work with complementary research partners to innovate

- **Manchester Metropolitan University** researchers collaborated with partner laboratories at Bath, Edinburgh, Hull, Lancaster, Manchester, Oxford, Plymouth and Queen’s Belfast universities, to develop and deploy technology to push the boundaries of wave energy generation. This work is helping the

²³ Using RAE 2008 and REF 2014 outcomes, research income and QR funding, it is possible to determine the amount of funding per submitted 4* researcher, as well as the amount of resources required to produce additional researchers.

²⁴ Analysis conducted by Richard Bond, Head of Research Administration, and Jennifer Quah, Research Information Officer, UWE Bristol

UK to meet ambitious government targets to deliver 15% of energy from renewables by 2020

- **Jaguar Land Rover (JLR)** explored with **University of Salford** researchers, in collaboration with colleagues at University College London, and the Universities of Reading and Roehampton, how virtual reality technology could be used in the automotive industry. The results of this research were used to design a Virtual Reality Centre and a Virtual Innovation Centre (VIC). Employees use the virtual reality tools to work faster and smarter, achieving higher levels of quality, durability and reliability in their vehicles with less reliance on expensive and time consuming prototypes. This has played a crucial role in the delivery of the Range Rover Evoque – internationally acclaimed as one of the most exciting design concepts of its age – the new Range Rover and Range Rover Sport, and the Jaguar F-Type sports car.
- **University Alliance** has created a new Doctoral Training Alliance building on its collective strength in Applied Biosciences for Health and its multiple partnerships with business. 13 universities will deliver a high-quality shared training programme for a cohort of 100 students over the next five years. As well as increased opportunities for students, research and research support staff to collaborate, the Doctoral Training Alliance will bring efficiency savings. University Alliance are also undertaking and supporting efforts at the national level to improve the sharing of resources amongst universities and the wider research ecosystem.

Alliance education is enhancing the UK's innovation capacity

- Alliance members use a mixture of embedded and extra-curricular approaches to enterprise learning, offering support through competitions, mentoring, funding opportunities and workshops. This is successful – Alliance universities are responsible for 21% of all turnover and 30% of all jobs from UK graduate start-ups. 31% of start-ups that have survived three years or more were created by Alliance University graduates.

Alliance universities use HEIF to upskill people and develop networks

- HEIF funding supported the Research Business & Innovation department at the **University of the West of England (UWE Bristol)** to work with management from flooring company **Dycem** to develop and get approval for a KTP to help the company overcome business stagnation. Dycem's business is in two distinct product areas: contamination control flooring and non-slip 'grip'

products. Having previously doubled their sales within contamination control flooring, the company had reached the limits of expansion in this market and overall sales were stagnating. The non-slip products side of the business was ripe for development, but the company lacked the expertise and knowledge to develop new products. The University is helping Dycem to collaborate with commercial partners to develop new products to boost sales, exports and profits. A graduate will be appointed to the project, mentored and supported by the University's Applied Marketing Group and this group will also analyse and write up the collaborative development process for publication to add to knowledge on co-creation in innovation.

Alliance universities develop KTPs that increase the innovative capacity and productivity of businesses

- **Oxford Brookes University** reviewed the market position for Webmart, a print management company, and identified areas for corporate development and investment through a KTP. Webmart's sales doubled to £37 million over the course of the project and achieved a further £30 million in the two years after the project.
- Materials research at the **University of Hertfordshire** enabled tool accessory manufacturer C4 Carbides to improve quality and consistency in their products saving the company around £100,000 a year since 2010. Improved product performance has also increased sales of the company's premium ranges and contributed to it winning a major Technology Strategy Board (now Innovate UK) award that has fundamentally changed the company's profile, repositioning it from a niche SME into a mainstream player.

Alliance universities operate free accessible hubs that provide general business support to local SMEs

- **Sheffield Hallam University's** Fix It Fridays²⁵ provide drop-in sessions to give local SMEs free advice and expertise to help them manage their problems. Similarly, Growth Acceleration and Investment Network (GAIN) network²⁶ run by **Plymouth University** and **Coventry University's** Knowledge Exchange and Enterprise Network (KEEN) network²⁷ both provide one-stop shops for SME

²⁵ <http://www.shu.ac.uk/ad/fix-it-friday/>

²⁶ <https://gaininbusiness.com/dashboard>

²⁷ <http://www.cwlep.com/database/meet-the-university--sme-drop-in>

advice. **Nottingham Trent University** is placing over 300 graduates into SMEs, some benefitting from financial support through ERDF. Demand is currently outstripping funding.

Alliance universities act as hubs, drawing in and developing local SME populations around their research expertise

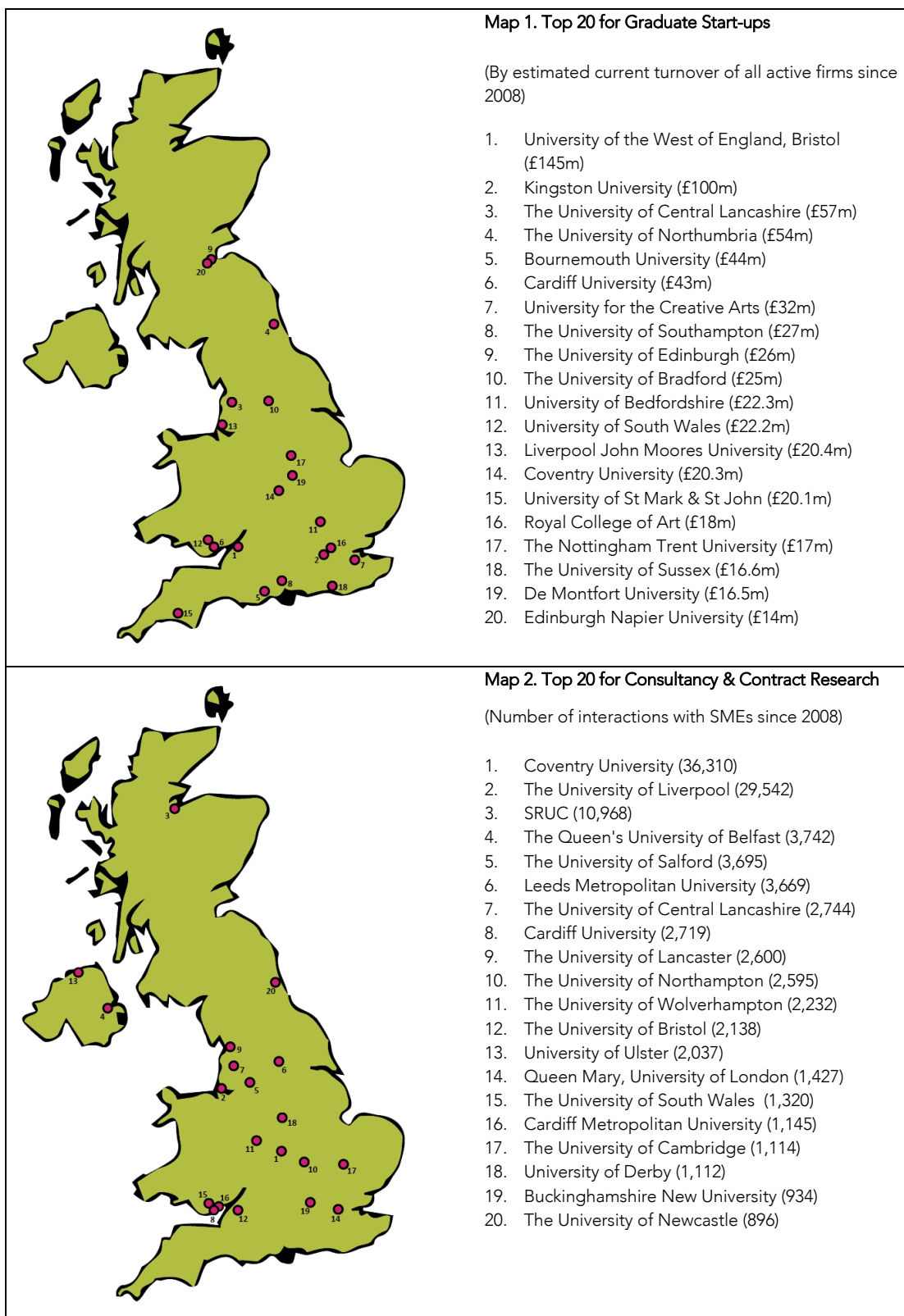
- As part of the **University of Salford** the major research facility in MediaCity UK connects the BBC and the Digital and Creative Industries sector to international academics and industry research specialists with the aim of generating £25m investment in research over the next eight years. Salford also runs the ERDF Energy Hub, a unique project allowing regional SMEs to engage with leading academics and state-of-the art world class facilities, aiming to support 140 regional SMEs in the development of new technology, products and systems that reduce the carbon emissions from existing properties.
- The **University of Plymouth** three Innovation Centres in Cornwall have won UK Business Incubation (UKBI) status in 2014, and are home to 139 businesses in total, employing around 480 people. An estimated 216 gross Full Time Equivalent jobs have been created in Cornwall amongst innovation centre clients since they were set up. Gross Value Added amongst clients for two of the innovation centres has increased by an estimated £9.3 million since the innovation centres were open, while Net Value Added has increased by £7.8 million.

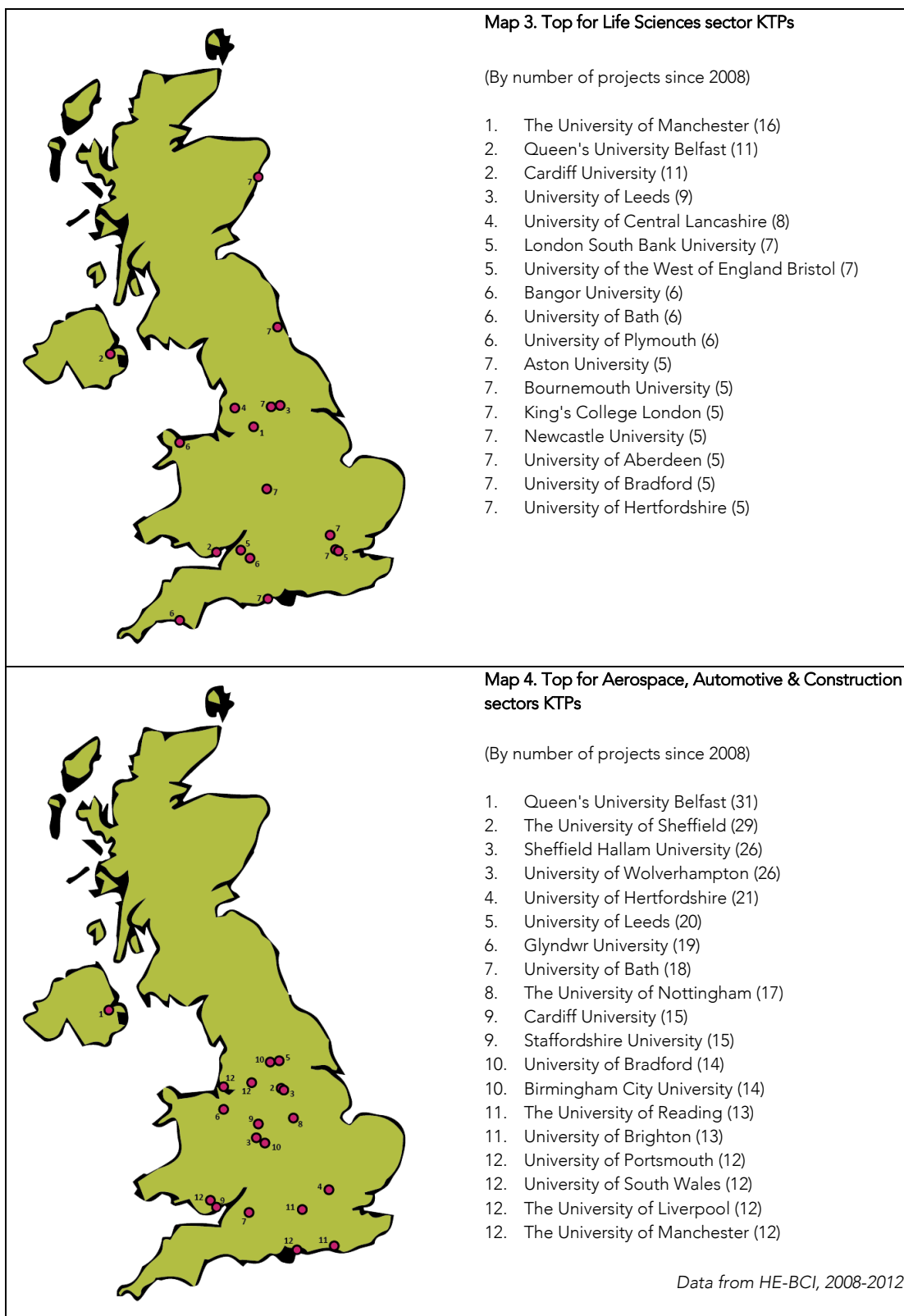
Annex B: Analysis of HE-BCI data

Analysis of HE-BCI²⁸ data shows expertise in a range of knowledge exchange and innovation activities (particularly involving SMEs) is spread across the country. This includes creating new businesses through graduate start-ups, consultancy and contract research interactions with other economic stakeholders, and knowledge transfer partnerships in key sectors including life sciences and aerospace, automotive & construction. Peaks of excellence in societal and economic contribution also exist throughout the sector, as they do in research: increases in knowledge exchange income are due to strategies of diversification and specialization.²⁹ This is why HEIF needs to remain a national fund to allow universities to develop expertise which they can funnel to their local economy.

²⁸ HEFCE, Higher Education Business-Community Index Survey.

²⁹ Adrian Day and Rosa Fernandez (2015), *Strategies for Sustaining Growth of Income from Knowledge Exchange across Higher Education Institutions (HEIs) in the UK*, National Centre for Universities and Business.





Annex C: University Alliance local R&D strengths aligned to LEP Strategic Economic Plans

UA LEP representatives

Local Enterprise Partnership	HE representative on the LEP Board
Coventry and Warwickshire	John Latham, Vice-Chancellor of Coventry University
Dorset	Jim Andrews, Chief Operating Officer Bournemouth University
Hertfordshire	Professor Quintin McKellar CBE VC University of Hertfordshire
Leeds City Region	Professor Bob Cryan - Vice-Chancellor, University of Huddersfield
Greater Lincolnshire	Professor Mary Stuart VC University of Lincoln
Liverpool City Region	Professor Nigel Weatherill, VC LJMU
Oxfordshire	Paul Inman, PVC Oxford Brookes
Sheffield City Region	Professor Philip Jones, VC Sheffield Hallam University
Tees Valley	Professor Graham Henderson CBE VC Teesside University
West of England	Professor Steve West, VC UWE Bristol

Coventry University – Coventry and Warwickshire

SEP	ESIF
<ul style="list-style-type: none"> • Utilisation of advanced materials • High value manufacturing 	<ul style="list-style-type: none"> • High-tech manufacturing • Advanced materials • Robotics and autonomous systems • Automotive R&D • Low carbon vehicles

Nottingham Trent University – D2N2

SEP	ESIF
<ul style="list-style-type: none"> • Life sciences • Food and drink manufacturing • Construction • Visitor economy • Low carbon goods and services • Transport and logistics • Creative industries 	<ul style="list-style-type: none"> • Life sciences • Food and drink manufacturing • Construction • Visitor economy • Low carbon goods and services • Transport and logistics • Creative industries

Teesside University – Tees Valley Unlimited

SEP	ESIF
<ul style="list-style-type: none"> • The process industry • Advanced manufacturing • Digital • Health 	<ul style="list-style-type: none"> • Process innovation • Advanced manufacturing • Digital and creative industries • 3D animation • Art and design • Health and social care

University of Portsmouth - Solent

SEP	ESIF
<ul style="list-style-type: none"> • Marine • Advanced manufacturing • Transport and logistics business • Low carbon • Digital and creative 	<ul style="list-style-type: none"> • Marine engineering • Advanced manufacturing • Transport and logistics • Low carbon technologies • Digital/creative industries

Sheffield Hallam University – Sheffield City Region

SEP	ESIF
<ul style="list-style-type: none"> • SHU's Centre for Excellence for Food Engineering • The National Centre for HIPIMS 	<ul style="list-style-type: none"> • Food & drink

Huddersfield University – Leeds City Region

SEP	ESIF
<ul style="list-style-type: none"> • 3M Buckley Innovation Centre • Centres of medical research & life sciences • Digital expertise and enterprise • Institute for rail research • Cross-LEP collaboration – digital 	<ul style="list-style-type: none"> • 3M Buckley Innovation Centre • Medical technologies • Digital and creative industries • Institute for rail research • LEP employment and skills collaboration

Plymouth University – Heart of South West

SEP	ESIF
<ul style="list-style-type: none"> • Agri-tech • Digital Economy • E-health • Marine technology • Space and aerospace assets • Environmental Futures • Healthy Ageing 	<ul style="list-style-type: none"> • Rural development • Digital and mobile skills • Healthcare • Marine renewables • Aerospace • Environmental sustainability

<ul style="list-style-type: none"> • Agricultural science • Nuclear 	<ul style="list-style-type: none"> • Agriculture activities • Nuclear
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Manchester Metropolitan University – Greater Manchester

SEP	ESIF
<ul style="list-style-type: none"> • Low carbon technology • Innovation and digital innovation 	<ul style="list-style-type: none"> • Low carbon economy • Innovation (social) • Digital manufacturing technologies • Digital/creative sector

Oxford Brookes University – Oxfordshire

SEP	ESIF
<ul style="list-style-type: none"> • Business support programmes • Social enterprise partnerships • Low carbon 	<ul style="list-style-type: none"> • Supporting innovation • Development of social enterprises • Low carbon technologies • Automotive/advanced Engineering • 'Big Science' research institutions

Hertfordshire – Enterprise M3

SEP	ESIF
<ul style="list-style-type: none"> • Global excellence in science and technology • Bioscience, life science and pharmaceuticals • Film, digital animation and creativity 	<ul style="list-style-type: none"> • Life sciences • Agri-science and agri-tech • Advanced engineering

Liverpool John Moores – Liverpool City Regions

SEP	ESIF
<ul style="list-style-type: none"> • Health and allied health • Biosciences • Nanotechnology • Materials chemistry • Astrophysics • Advanced computing • Engineering 	<ul style="list-style-type: none"> • NHS, business and Third Sector interaction • Open innovation access – between private R&D and Universities/ science campuses

Lincoln University – Greater Lincolnshire

SEP	ESIF
<ul style="list-style-type: none"> • Applied agricultural science and technology • Manufacturing and engineering 	<ul style="list-style-type: none"> • Research supporting key sectors • Effective knowledge transfer • Good quality education and skills

<ul style="list-style-type: none"> • Low carbon economy • Health and care • Innovation 	development
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University of Salford – Greater Manchester

SEP	ESIF
<ul style="list-style-type: none"> • MediaCity UK 	<ul style="list-style-type: none"> • Innovation • Low carbon/environment economy

University of the West of England, Bristol – West of England

SEP	ESIF
<ul style="list-style-type: none"> • Advanced engineering and Aerospace • Biotechnology • Robotics • SME innovation 	<ul style="list-style-type: none"> • Robotics & autonomous systems • Bio-technology • Health and wellbeing • Architecture and built environment • Geography and environmental management • Business • Aerospace and engineering • Innovation networks