State of the Relationship 2021

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Foreword

In the global race for growth and investment, it has never been more apparent that harnessing UK science, technology and innovation is key to creating the new industries, companies and jobs of tomorrow.

We now have a historic opportunity to unleash UK science and innovation for post-Covid recovery. But we need to do more to ensure we reach 2.4% R&D investment of GDP.

The excellent research that our universities produce is being used by businesses looking to improve their productivity by adopting and adapting new technologies, including autonomous systems, robotics, artificial intelligence and remote sensors into their current operations, products and services. They are improving output, developing greener technologies and competing on the world stage.

New industries are being created for an array of new products and services, both for the UK market and for the increasingly competitive global market.

Our government demonstrated its commitment to unleashing science and innovation ideas in the summer of this year by setting out our vision to make the UK an innovation nation by 2035 turning the UK into a science superpower.

And we backed up this commitment with the promise to increase funding for research and development to record levels, putting UK R&D on the path to making this great nation a science superpower.

Delivering the ambitions of the Innovation Strategy requires collaboration, including between universities and business. It places significant emphasis on enabling the commercialisation of ideas from the UK’s world-leading research base. The research that universities and other publicly funded institutions do is a crucial part of the innovation process – from basic research through to applied and translational research. We want to build clusters of innovation and research across the UK.

That is why I welcome the National Centre for Universities and Business’ eighth annual State of the Relationship Report. It sets out the opportunities to maximise the benefits on offer and highlights where research collaboration is working well, and where there may be further challenges. An invaluable statistical barometer, the report helps us to develop policies and programmes and allocate the necessary resources where impact will be the most transformative. Importantly, the report showcases examples of the significant work already happening across the UK.

We need to move faster.

Around the world, digital technologies, climate change and the longer-term effects of Covid-19 are changing the way we live and work, in ways we could not predict just a generation ago. This report plays a valuable part in informing those of us tasked with the responsibility of creating the conditions for innovation to thrive and ideas to be built upon.

It has been a privilege and honour to take on the Minister for Science, Research and Innovation Portfolio and I look forward to being part of the UK’s great efforts to build effective partnerships between all those with a role to play in making research and innovation the drivers to making that happen.
Introduction

Throughout 2021 and as we continue to recover from the Covid-19 pandemic, a spotlight has been shone on how vital collaboration between the UK’s universities and businesses is. The introduction of vaccines, and other lifesaving treatments, has saved lives and livelihoods. Simultaneously, critical discussions on tackling climate change at COP26 in November 2021 in Glasgow centred on the importance of research, innovation and collaboration to find new and more sustainable ways of living and working.

2021 has not only demonstrated the importance of collaboration but has also renewed a sense of optimism that science can lead to solutions to pressing challenges. The UK, as well as other countries around the world, recognise that this decade should be defined by major strides in innovation. Indeed, the Government views research and innovation as the defining features of the UK’s future economy and has set a clear aim for the UK to become a science superpower.

University and business collaboration will be critical to realising this ambition. The transformative technologies of the future will not be borne out of individual experts or organisations. Rather, they will sprout out of collaboration between diverse and dynamic collaborating teams, that cut across disciplines and sectors.

To become a science superpower, links between businesses and universities will need to be further strengthened and built upon. The National Centre for Universities and Business (NCUB) was formed out of a deep belief that open, sustained, networked collaboration between universities and business is the key to prosperity and an innovative society. The State of the Relationship Report is NCUB’s flagship report and offers a comprehensive evaluation of higher education and business links.

In this year’s report, we go back to our roots. Alongside reflecting on the year past, we focus on the critical role of collaboration between universities and business. Additionally, we consider the trends in collaboration and finally take a look at what the future holds for collaboration as we continue to recover from a global pandemic. Our report showcases the strength and diversity of collaborations across the UK through a range of case studies and articles.

As with previous State of the Relationship reports, we also publish our annual Collaboration Progress Monitor. The Monitor is an updated assessment of the metrics on collaboration between universities and business, looking at skills and talent and research and innovation. In the Monitor, we analyse 25 different metrics over these two areas for 2019/20, the latest year for which most data is available and compare this to a five-year average. For the first time, the Monitor allows us to understand what the first months of the pandemic meant for university and business collaboration. Whilst this period saw some high profile and important collaborations taking place with the production of lifesaving vaccines, it also saw offices, labs, and collaborative spaces close, and many activities delayed or halted.

As ever we are hugely grateful for all the written contributions from NCUB members, businesses, universities, and other thought leaders that have made this edition of the State of the Relationship report possible.
NATIONAL PRIORITIES AND THE ROLE OF UNIVERSITY-BUSINESS COLLABORATION
Much of this report will focus on how university-business collaborations have changed and are transforming. However, before we delve into this, this section briefly considers how business-university collaborations themselves transformed 2021 and the role that collaboration will play in shaping the future.

Rosalind Lowe from NCUB offers an overview of the policy context in 2021 and the importance of research, innovation, and collaboration to the UK’s future. This is followed by a clear overview by Tomas Coates-Ulrichsen, Director of the University Commercialisation and Innovation Policy Evidence Unit, of the important role of universities in the innovation system.

Arguably, 2021 was characterised by two things. First, the UK appears to have emerged from the worst of the Covid-19 pandemic, with the development and distribution of a vaccine allowing lockdown measures to ease. Second, the end of the immediacy of the pandemic has focussed discussion on longer-term recovery and rejuvenation, with the Government publishing its Plan for Growth and turning attention to the twin priorities of decarbonisation and digitalisation.

Without universities and businesses collaborating to tackle the Covid-19 pandemic, the future will have looked very different. Universities and businesses working together, across sectors and nations, enabled the urgent development of lifesaving equipment, the rapid mobilisation of people and ideas, and revolutionised vaccine design and production. This collective response to Covid-19 bolsters confidence that cross-sectoral, transnational cooperation can help provide solutions to other global challenges, such as environmental sustainability and ageing.

**2021: The Plan for Growth, Innovation Strategy, and R&D People and Culture Strategy**

Research and innovation, underpinned by strong university-business partnerships, has a fundamental role to play in our continuing recovery from Covid-19. Equally, these partnerships are a critical part of our armory in the battle against climate change, resource depletion and other urgent global challenges that can only be solved through technologies not yet invented. The world is changing, and research and innovation will be critical for many businesses to remain competitive and successful.

Despite the disruption caused by the pandemic, in 2021 policy makers demonstrated clear recognition of how important research, innovation, talent and partnerships will be in the future. In the context of change, there is a need to support and nurture businesses across the UK to see the value and the benefit of R&D and to translate discoveries into the commercial solutions that meet the big challenges of our age.
The Government has placed research, innovation and skills at the centre of its longer-term economic plan, as laid out in its Plan for Growth. Research also plays a central role in the UK's global ambitions as set out in the Integrated Review of Security, Defence, Development and Foreign Policy. A number of strategies were published in the summer of 2021 to strengthen the UK's research and innovation system, including a new Innovation Strategy and an R&D People and Culture Strategy. The UK aspires to make the UK a global hub for innovation by 2035 and to turn the UK into a science superpower.

A critical Spending Review for UK science

It follows that to become a global science superpower and to create a world leading innovation system, the UK must invest. The scale of the aspirations set out in strategies must be matched with equally ambitious spending and policy commitments.

The Government did this in the October 2021 Spending Review. Importantly, research and innovation is to receive an important boost in funding, with total public spending to reach £20bn by 2024/25 and £22bn by 2025/26. The Government has thereby upheld and progressed its plan for higher R&D spending, sending a clear signal to businesses around the world that the UK is looking to build its research and innovation capabilities.

There is a strong focus in the Spending Review on ways to increase private R&D and innovation. Of course – private R&D investment is not determined by public R&D spending and incentives alone, though the talent, knowledge and infrastructure it supports is critical. A small number of large corporates are largely responsible for the UK’s private R&D investment, and the UK competes on a global stage for their investment.

A number of measures were announced to encourage private investment, including adjustments to R&D tax credits, greater investment tax relief, and unlocking more finance from defined contribution pension schemes. As we enter 2022, a key question is whether the targeted measures to encourage R&D investment into the UK are not offset by the cumulative impact of higher corporation tax, increased minimum wage, a proposed consultation for an online sales tax and National Insurance contributions, as well as rising energy prices and supply chain challenges.

Looking forward

As we enter 2022, UK research and innovation faces both opportunity and challenge. On the one hand, the policy environment is favourable – with new public investment and renewed commitment to supportive policies and laws. On the other, businesses and universities are facing challenging operating environments, with growing evidence that business R&D and innovation activity declined during the pandemic. This is further demonstrated in our Collaboration Progress Monitor, covered in detail in section 2, which shows a decline in the number of interactions between universities and businesses.

To realise the UK’s science superpower ambitions, discussions about how to target and optimise research and innovation spending, encourage private R&D investment and build a talented workforce must not end here. There is a need for businesses, universities and Government to continue to work together closely to shape a strong environment for research, innovation and collaboration.

This is critical. In future years we can only expect the rate of scientific process and business transformation to be even faster. The changing labour market more rapid. The need for responsiveness even greater.

The importance of collaboration is growing.

Universities and businesses working together, across sectors and nations, enabled the urgent development of lifesaving equipment, the rapid mobilisation of people and ideas, and revolutionised vaccine design and production.
The role of universities and their collaborations with partners in driving innovation

TOMAS COATES-ULRICHSEN
Director of the University Commercialisation and Innovation Policy Evidence Unit at the University of Cambridge

Collaboration will be absolutely critical to realising the UK’s ambitions for science. Universities, through their basic, use-inspired and applied research, and their varied knowledge exchange activities with partners generate and diffuse new ideas, technologies and approaches that not only have the potential to lead to ground-breaking innovations that transform the world but also help to deliver important incremental innovations that help to drive efficiency and productivity improvements.

Through their research, universities also contribute to innovation well beyond driving technological advances. For example, research helps to drive: new business models and organisational practices to create and capture value; new ways of producing and supplying products and services in more efficient and sustainable ways; insights on how individuals and populations behave, respond and adapt to new technologies; and public policies, standards and regulations, and ethics frameworks that guide the development and diffusion of innovations.

Universities leverage their expertise and infrastructure to support their partners in delivering their innovation activities. For example, they can help to understand the need for innovations and identify new opportunities. They provide services to support partners in developing, demonstrating and testing new technologies, processes and products/services, and on how to take their innovations to market.
Further, universities actively engage to provide technical assistance to partners to help solve specific problems and in adopting the latest innovations to drive efficiency and productivity gains.

Universities are also known to play an important role in strengthening the wider capabilities and infrastructure of the innovation system that shapes the ability of organisations to collaborate and innovate, and for innovations to be introduced and diffused. Examples include:

- Helping to build the necessary technical and managerial skills to innovate
- Investing in physical infrastructure that supports experimentation with new innovative ideas and very early-stage company growth
- Helping to build research and innovation networks
- Facilitating knowledge spillovers that stimulate innovation in proximity to the university
- Providing strategic insights and intelligence to inform regional and national sector and technology strategies
- Working alongside key stakeholders to provide regional leadership
- Helping to raise the public understanding around the potential opportunities and societal implications surrounding new technologies and innovations (e.g. big data and artificial intelligence driven services)

The figure below, developed by the University Commercialisation and Innovation Policy Evidence Unit, attempts to bring together the many and varied ways in which universities contribute to driving innovation within the UK innovation system.

"Research helps to drive: new business models and organisational practices to create and capture value; and new ways of producing and supplying products and services in more efficient and sustainable ways"

Figure 1: Understanding how universities contribute to innovation

EXAMINING THE STATE OF THE RELATIONSHIP THROUGH DATA
Introduction

University-business collaboration will be critical to the UK’s future success. To realise the UK’s ambition to become a more innovative, prosperous and highly skilled economy, ties between businesses and universities will need to be strengthened in the years to come.

In order to track progress against this aim, the National Centre for Universities and Business (NCUB) produces an annual Collaboration Progress Monitor (CPM). This Monitor allows NCUB, in partnership with its university and business members and stakeholders, to examine annual changes and track long-term trends. Critically, it allows us to assess whether the UK is on track to grow collaboration.

This section sets out and analyses the latest findings from the CPM as well as other sources of contextual data. A full overview of the metrics is included in annex A.

The Collaboration Progress Monitor at a glance

• 25 metrics capturing indicators of collaboration in research and innovation, and skills and talent.

• 2019/20 data, the latest year for which most data is available, analysed and compared to a 5-year average.

• Analysis for each devolved nation, recognising the importance of collaboration across all parts of the UK.

• Pulling together data from a range of sources, including: the Higher Education Business and Community Interaction (HE-BCI) survey, Higher Education Statistics Agency (HESA) records, the Office for National Statistics (ONS), Graduate Outcomes and data published by the Department for Education.
Context

Most of the data analysed in this year’s CPM is from July 2019 to August 2020. Over four months of this reporting period were impacted by the Covid-19 pandemic, during which people were required to stay at home to reduce the spread of the virus. Whilst this period saw arguably some of the most important collaborations of our lifetimes taking place, with universities and businesses working together to design and produce a lifesaving vaccine, it also saw offices, labs and collaborative spaces close and many activities delayed or halted.

The extent of the disruption caused by the pandemic is illustrated through a range of economic indicators. Between April and June 2020, UK GDP shrunk by 20%, a significantly greater and more immediate impact than that of the 2008 recession (Figure 2).

Data from universities demonstrates that the 2008 crisis had a significant impact on university-business collaboration. To investigate the impact of Covid-19 on business and university research and innovation activities, NCUB with the University Commercialisation and Innovation Policy Evidence Unit (UCI), conducted two surveys in summer 2020. In response to these surveys, universities reported that Covid-19 had disrupted almost 90% of their business partnerships. A parallel survey showed that 96% of 500 R&D active businesses in the UK reported changes to their collaborative innovation-focused activities with universities as well. This survey contributed to a growing body of evidence of the impact of the pandemic on research and innovation activities.

We anticipated that this year’s CPM would start to reveal a significant overall decline in business-university collaboration. Whilst the pandemic arguably drove some of the most important collaborations, with universities and businesses working together to design and produce a lifesaving vaccine, it also caused direct disruption to university and business operations, new challenges in the way they work together, and shifting priorities and expectations. What is distinct about the Covid-19 pandemic is that the impact of the crisis on business has not been heterogenous, and therefore its impact on collaboration will not be either. We explore this more in Chapter 4.

Last year, NCUB’s CPM broadly demonstrated a rise in collaborative activity across most indicators. However, we noted in our analysis that “the trends [identified] cannot be assumed to continue as we face the global economic effects of Covid-19 and competition from other nations to attract more foreign investment and grow technology sectors.” We therefore expected performance against some of the metrics to fall as a result of the pandemic.

Figure 2: UK GDP growth, Quarter 1 (Jan to Mar) 2005 until Quarter 2 (Apr to June) 2020

![Figure 2: UK GDP growth, Quarter 1 (Jan to Mar) 2005 until Quarter 2 (Apr to June) 2020](Source: ONS)
Summary of findings

Our analysis of the latest CPM partially matches our forecast. There were declines in the total number of interactions between universities and businesses in 2019/20 compared to 2018/19. Importantly, the CPM also reveals considerable rises in indicators of research commercialisation.

The total number of interactions fell from 112,876 in 2018/19 to 78,347 in 2019/20. This was largely due to a decline in the number of interactions of universities with SMEs. As data is only captured on an annual basis, it is not known how many interactions took place during the period disrupted by Covid-19 alone. If we assume that the number of interactions prior to the pandemic was consistent with the numbers recorded in 2018/19, approximately 8,000 more interactions with SMEs would have taken place in the four and a half months affected by the pandemic.

The CPM reveals that despite the disruption caused by the pandemic and the overall decline in the number of interactions, key research commercialisation indicators, including licenses, patents and spinouts, grew. Licenses grew particularly strongly, with a 30% increase in licenses granted by universities in 2019/20 compared to 2018/19. This suggests that research commercialisation remained a significant, and shared, commitment by universities and businesses in 2019/20, despite the disruption caused by the pandemic.

Overleaf we explore five key findings from the CPM:

- Number of interactions fell from historic high as pandemic hit
- Significant growth in commercialisation activity
- Despite turbulence of 2019/20, many indicators equaled or outperformed the 5-year average
- Broadly consistent trends are observed across the four nations
- Delivery of degree apprenticeships soared, whilst CPD and CE courses fell
Number of interactions fell from historic high as pandemic hit

The CPM captures the volume of interactions taking place between universities and businesses, including through contracted research, consultancy or sharing facilities and equipment. Last year, we reported that in 2017/18 and 2018/19 the number of interactions between universities and businesses levelled at an all-time high of approximately 113,000 interactions. As anticipated, the 2019/20 data reveals a decline in the number of interactions compared to the previous year. The total number of interactions remained high at 78,347, but fell significantly below the five-year average.

The number of interactions with larger businesses held strong, with only a small (2%) decline. This demonstrates the resilience of the longer-term, strategic partnerships often formed between universities and larger businesses. However, the CPM does reveal a greater decline in income from interaction with large business (9%). This suggests that less university income was received per interaction and may reflect postponements or scaling back of collaborative activity.

A 39% fall in the number of interactions with SMEs was largely responsible for the total decline in the number of interactions.

An important question is: why?

Covid-19 in all likelihood offers a substantial explanation. There is evidence that SMEs have often been affected more than large firms by the Covid-19 pandemic. However, as only around four months of the reporting period were affected by the pandemic, it seems unlikely that Covid-19 is the sole cause of the decline.

Another significant event in 2019/20 was the UK’s withdrawal from the EU on 31 January 2020, and business preparations during the transition period that ended on 31 December 2020. SME collaboration with universities tend to be more affected by the immediate pressures of day-to-day operations than interactions with large businesses. As a result, the focus of resource around managing the transition may have impacted on SME’s collaborations.

In previous CPM analyses, we found that SME interactions declined by 13% in one year in 2016/17, in the immediate aftermath of the EU referendum. We noted at the time that this decline may in part have been driven by the funding cycles of the EU’s European Regional Development Funds (ERDF), which often supports university-SME interaction. Indeed, in the years following 2017/18 and 2018/19, ERDF funding levels recovered and the number of SME interactions did as well despite the ongoing Brexit negotiations. In 2019/20, universities continued to receive ERDF funding, which would have supported SME interaction. However, it is possible that the nearing of the end of the transition period, and its operational impacts on SMEs in particular, would have impacted their ability to collaborate with universities.

In 2019/20, university income from interactions with SMEs fell alongside the number of interactions, but not by as much (a decline of 19%). This suggests that income per interaction with an SME was greater than in previous years.

Overall, university research income from business and overseas sources fell in 2019/20, for the first time since 2011 and 1999 respectively. We believe, based on discussions with businesses, that this reflects the impact of delays and stoppages to collaborative activity. The question of course is how long disruption to the investment decisions of businesses will remain, a topic which we will start to explore in section 4 of this report.

Significant growth in commercialisation activity

Despite a fall in both the number of interactions and external investment in collaboration, universities’ contribution to research commercialisation grew in 2019/20, with a particularly large increase in the number of licenses granted by UK universities (30%) as well as the number of patents granted (9%). This demonstrates universities’ strong commitment to post-research translation, even in the challenging context of the pandemic.

The rise in performance in research commercialisation might also reflect the heterogenous impact of the pandemic on business. Whilst interaction and investment will likely have fallen with businesses in certain sectors of the economy, new opportunities to accelerate research commercialisation in areas like healthcare and technology, will have risen too.
Headline findings for research and innovation

Collaborative activity *

78,347 interactions between universities and businesses recorded in 2019/20
The total number of interactions between universities and businesses fell by 31% between 2018/19 and 2019/20.

2% fall in the number of interactions with large businesses

39% fall in the number of SME interactions
A decline in the number of interactions with SMEs largely caused the overall decline in interactions.

Investment in collaboration

7% decline in UK business investment in university R&D

6% decline in overseas investment in university R&D
Investment by UK business and foreign sources in university R&D declined for the first time since 2011 and 1999 respectively.

812 Innovate UK grants awarded to UK universities
Over 800 Innovate UK grants were awarded to UK universities to support collaboration for the fourth year in a row.

The products of collaboration

30% Increase in the number of licenses granted
16,505 total licenses were granted. This was the second year in which significant growth was observed, after a 80% increase observed between 2017-18 and 2018-19.

1,316 Academic Spinouts existed that had survived at least three years
Increases were observed in Wales and Northern Ireland.

2,027 Patents granted
An increase of 9% from 2018/19, and the fourth year in a row with recorded growth

* includes number of contract research deals with both SMEs and large businesses
Despite turbulence of 2019/20, many indicators equal or outperform 5-year average

The last five years have seen a strong growth in indicators of research and innovation collaboration (figure 2). Overall, across the 13 research and innovation collaboration metrics measured in NCUB’s CPM, five of the 2019/20 indicators were above the five-year average, this is particularly due to the resilience of university commercialisation activity during the first four months of the pandemic. The only metrics considerably below the five-year average were the number of HEI interactions with SMEs and £ per Innovate UK academic grant.

Notably, some of the outcomes of collaboration, measured through patents, licenses, and spinouts, grew considerably against the five-year average despite the decline in the number of interactions or university income from interactions. This suggests that in 2019/20, individual interactions recorded were more likely to result in a commercialisation outcome, such as a license or patent granted, or a spinout formed.

Broadly consistent trends are observed across the four nations

Across all four nations, we see a rise in the products of collaboration compared to a four-year average, despite the disruption caused by the pandemic (Figure 3). This includes growth in patents granted across Scotland, Wales and England, as well as licenses granted in Wales, Northern Ireland and England.

Notably, interactions with large businesses grew in Wales and Northern Ireland in 2019/20 compared to the four-year average. Interactions with SMEs grew in Northern Ireland in the same reporting year. In Scotland and England, the number of interactions in 2019/20 with large businesses and SMEs both fell compared to the four-year average.

Delivery of degree apprenticeships soared, whilst CPD and CE courses fell

From the start of the pandemic, we have seen the numbers of apprentices at most levels fall across the UK; however, this does not appear to hold true for degree apprenticeships. Looking at the latest data available in 2018/19 and 2019/20, universities and businesses have remained strongly committed to delivering this collaborative pathway to a degree. There were 20,175 degree apprenticeship starts in 2019/20 in England alone, up from 13,587 in 2018/19.

In the last CPM, we found that whilst degree apprenticeship numbers rose, CPD and CE courses delivered by universities fell. Since the introduction of the apprenticeship levy, more businesses are training their teams through apprenticeship routes rather than CPD or CE routes, which we believe accounts for this change.
Skills and Talent

Joint people development

20,175 degree apprenticeship starts
A staggering increase of 114% from 2017/18. 87 UK universities now offer higher or degree apprenticeships, up from just four in 2014/15

26% of undergraduates
were on sandwich courses with an integral employment placement

20,597 CPD/CE learner days
were delivered by an average higher education institution. Down from an average of 22,714 in 2017/18
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Figure 5: CPM research and innovation indicators, 2018/19 and 2019/20 compared.
As we near the end of 2021, the UK appears to be emerging from the worst of the pandemic thanks to the design, development and manufacture of a new vaccine at record speed. The Government has set out its plans for economic recovery in a Plan for Growth, which places research, innovation and skills at its centre. To realise its ambitions, the Government has set a target for the UK’s research spending to reach 2.4% of GDP by 2027. This commitment is critical in order to bring the UK closer in line with the research spending of its competitors.

University-business collaboration is vital to recover, grow and attract private R&D investment and activity necessary to achieve the 2.4% target, as well as develop the highly skilled workforce needed in the future.

NCUB’s CPM will play an important part in monitoring trends in the years ahead. There are a number of specific trends revealed in this year’s CPM that require further review at this critical juncture of the UK’s recovery.

**Overall numbers of interactions**

This year’s CPM only partially reveals the impact of the pandemic on collaborative activities, which we believe is partly responsible for the fall in numbers of interactions.

The next CPM, which will cover data from 2020/21, will be the first to show a full 12 months impacted by the pandemic. Future CPMs will be important to determine the speed and shape and recovery of collaborative activity. Analysis of the experiences of the 2008 recession reveals that collaborative research took 2-4 years to recover to pre-crisis levels.

Our survey with UCI of around 500 R&D active businesses provided some early signs that the recovery of the Covid-19 pandemic may follow a similar pattern of slower recovery. 64% of surveyed businesses that engaged with universities and public research institutes before the pandemic did not have plans to increase their R&D and innovation activities with universities in the next 12 months (from September 2020). Amongst those businesses that engaged with universities and institutes in the period before March 2020, just over a quarter planned decreases and 3% had no plans to engage at all in the next 12 months.

The UK’s economic bounce back from the pandemic has exceeded forecasts from the Office for Budgetary Responsibility (OBR) and others. However, new economic challenges have materialised, including skills shortages, with vacancies hitting an all-time high, and supply chain issues as a result of the pandemic. This reinforces that the shape of the recovery of business-university interactions is challenging to predict. However, we forecast a further decline in the number of interactions with businesses in the 2020/21 reporting year, unless there is a significant increase in the UK’s research and innovation investment levels.

The exceptionally high levels of research commercialisation activity captured in this year’s CPM are notable, and it will be important to determine in future years whether this represented a short-term spike in activity, or a sustained and long-term increase.

**Industry-academia mobility**

The CPM considers how many people moved from industry into academia, and vice versa. In 2021, the UK Government published a new R&D People and Culture Strategy which set out an ambition for academic and industry careers to enhance mobility between sectors. Whilst this year’s CPM did not reveal a noticeable increase in mobility compared to previous years, (a small increase of nearly 10% mobility from private sector into HE) it will provide some sense in future years as to whether progress is being made.
Enhancing data on collaboration

1. Future talent collaborations
There are growing concerns about a skills mismatch, with the number of vacancies in the UK reaching an all-time high in the third quarter of 2021. The UK labour market is transforming at an unprecedented pace in the Fourth Industrial Revolution.

Collaboration between educational providers and employers are critical to forecast, adapt and deliver future talent needs; however there are very few data sources on this collaboration that enable progress to be tracked. Specifically, there are a range of ways that universities and businesses collaborate on skills that go beyond joint modes of delivery, industry placements and internships. Universities work with businesses on the design of new courses, business representatives visit classrooms and career fairs, industry leaders join universities as visiting lectures – to name but a few examples.

2. The breadth of collaboration and its impact
Knowledge Exchange covers a broad range of activities, which are not all captured by existing data sources and therefore the CPM. In a series of roundtables NCUB hosted with its members, there were concerns that existing data sources missed some of these interactions, including ‘in kind’ contributions such as donations of equipment and staff time. It should be noted that intellectual property and spinout companies are important, but small components of business relationships with universities, but are easier to access data on.

The same challenge applies to the data available on the products of collaboration. The impact of intellectual property, as an example, cannot solely be measured on the basis of income received. This misses its broader economic and societal impact.

3. User feedback
Much of the data measured in the CPM is derived from the HE-BCI survey, which universities complete annually. To fill this gap, NCUB will shortly publish a report detailing the experiences of nearly 4000 businesses and their experiences and motivations from interacting with universities. Whilst this survey offers an important overview of key metrics of collaboration from the university perspective, it does not provide data on the experiences of those interacting with universities. NCUB is working with Research England to bring the Voice of the User more to the fore in discussions about the Knowledge Exchange Framework and the Knowledge Exchange Concordat. However, more tangible feedback on the successes or challenges of collaboration from an industry perspective, would greatly strengthen the UK’s ability to monitor progress, identify challenges and anticipate opportunities.

4. Strategic partnerships
In the current HE-BCI survey, there is no way of tracking collaborations with individual businesses. For example, it is not possible to know whether interactions are typically with the same businesses year-on-year or if new businesses are being engaged. Equally, it is not possible to see whether universities engage with a business in multiple ways and across different categories through strategic partnerships.

5. Globally comparable collaboration data
Countries around the world are increasingly investing in their research and innovation capabilities. To this end, Research England have developed some useful insights into US and UK ecosystems to highlight where high level comparisons can be drawn. However, there is still a need for more comparative granular data on applied research and wider knowledge exchange activities.

To become a science superpower, the UK should strive to become the best place in the world for businesses and universities to collaborate. However, it is challenging to establish the baseline and determine progress with available data. Some comparisons can be drawn on areas related to research commercialisation like IP income, spin-offs, patents and industry research. A WEF metric based on high level survey data, ranks the UK as 11th in the world for business-university collaboration on R&D, down from 6th in 2017, but it is an imperfect subjective benchmark measure based on a comparatively small sample size of businesses.
COLLABORATION TRENDS
The Collaboration Progress monitor provides an important overview of trends in the volume and outcomes of collaboration. This section explores the critical, how, question.

**How do universities and businesses work together and is this changing? What drives collaboration?**

Since its inception, NCUB has been analysing the factors that underpin and drive university and business collaboration. Drawing on insights from our membership and stakeholders, we offer thoughts on emerging and evolving trends in how businesses and universities work together.

There are three specific trends that we investigate in the following chapters.

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### 01. The rise and rise of the innovation district

The Covid-19 pandemic has driven a rise in remote collaboration. However, in last year’s State of the Relationship report, we continued to find that geographical proximity remained important to many business and university leaders. This was illustrated particularly well when, in the midst of the pandemic, new innovation districts in places like Manchester, Cambridge and Glasgow were announced.

Successful innovation economies tend to have nodes of innovative activity that are tightly clustered in specific locations that bring together people, ideas, and facilities. It is generally understood that businesses base their R&D investments in places that meet a range of criteria, including a critical mass of talent, like-minded institutions and competitors, as well as favourable framework conditions.

Helping innovative places reach their potential is therefore critical to realising the ambitions of both the Innovation Strategy and the Government’s wider levelling up agenda. We therefore asked leaders and experts to consider the evolution of innovation in places, and particularly the growth in urban innovation hubs, such as Innovation Districts.

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### 02. Building the collaborative workforce of the future

The Government’s R&D People and Culture Strategy makes clear that building R&D talent must be an area of focus for universities, businesses, and policymakers alike in the years ahead. A more innovative, research-intensive economy will require a diverse, mobile, and dynamic R&D and innovation workforce.

The UK does not just need more people with the right skills, but also a culture of collaboration and mobility between academia and industry. Tackling some of the greatest challenges the world faces, will require new ways of thinking and new ways of working.

Universities, businesses, and policymakers will need to work together to identify and develop the talent the future needs. We explore what sorts of initiatives are already being led by UK universities and business to do this, both locally and internationally, as well as future plans in UKRI to help deliver the R&D People and Culture Strategy.

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### 03. Spin-ins spin out new opportunities

In recent years, a spotlight has been placed on university spinouts, sometimes diverting attention from other important forms of university research commercialisation activity. With the Government working up a new Enterprise Strategy, the wider involvement of universities in innovative start-ups and growing companies will continue to be critical to the UK’s science superpower ambitions.

We explore the wider role of universities in supporting innovative start-ups or growing businesses, including so-called “spin-ins”: companies that benefit from university inventions, research, technologies and/or facilities, often in return for an equity stake. Specifically, we provide some examples of spin-ins from both the university and business perspective.
3.1: The rise and rise of innovation districts

The evolution of innovation places

There is considerable policy interest in hubs of innovation, with a particular focus on how the success of innovative places like Silicon Valley in the US, may be replicated elsewhere. The UK’s 2021 Innovation Strategy states: “we need to ensure more places in the UK host world-leading and globally connected innovation clusters, creating more jobs, growth and productivity in those areas”.

Innovation hubs or clusters involve a network of companies and other innovation actors co-existing in a place, allowing each to collaborate – and compete. Many of the most successful innovation places were emergent rather than created, shaped by the specific context of their local areas, capabilities, and needs.

Today, there are a plethora of innovation places, some are concentrated around industries or sectors, others are not, some take the shape of multi-city corridors, arches and zones, others are inner-city innovation districts and quarters. Universities play an important catalytic role in many innovation places, driving talent, fundamental research, support, and advice needed to prosper.

Nicola Yates, CEO of the Connecting Places Catapult, provides an insightful overview of the evolution of innovation places, from the days when innovation places were synonymous with out of city science parks, to the range of different types of innovation places that emerged and thrive today.

A new generation of innovation places

NICOLA YATES OBE
Chief Executive, Connected Places Catapult

We are living in a period of immense change. The centralisation of past decades is giving way to multipolarity as, up and down the country, there is recognition that improving investment, productivity, and social infrastructure outside of existing centres should be a priority. This is, of course, not a new idea – recognition of regional disparity in the UK has long preceded the “levelling up” agenda – but the twin shocks of Brexit and Covid-19 have thrust into sharp relief the existing disparities between places. In this context, it becomes more important than ever before to ensure that places can attract talent and investment, develop new ideas and products, and build robust local economies that demonstrate resilience and inclusivity.

Innovation – whether it be of goods, of services, or of processes – is at the core to creating jobs, stimulating investment, and improving economic outcomes for a place.
And, of course, innovation does not happen in a vacuum: the right physical, policy, and economic inputs can together create an environment for innovation to thrive.

Places around the UK have been synonymous with innovation for more than 200 years: neighbourhoods such as Ancoats in Manchester, Hockley in Birmingham and Govan in Glasgow were global capitals of innovation during the industrial era. They pioneered locally – in tight networks of cotton spinners, medical scientists, shipbuilders, and metal producers - many of the inventions, processes, and ideas of the Enlightenment and the Industrial Revolution. Places in London, Edinburgh, Cambridge, Liverpool, Sheffield and around the UK have been home to Nobel Prize-winning discoveries and numerous other inventions that shape our lives today.

In the modern era, the UK is now entering its fifth cycle of innovation places, since the first organised science parks took hold in the 1960s and 1970s. In the first cycle, science parks and business centres were established outside of cities to enable tech transfer. Many gravitated around large government R&D facilities. Incentivised by the efficiencies of selling space to larger businesses, these commercial locations tended to achieve a high level of occupancy, and many have endured successfully. However, most did not consciously specialise and their long-term effect on innovation and place development has been limited. Many of these places now confront dilemmas around connectivity, porosity, and appeal to drive the talent, profile and collaboration they depend on.

In the second cycle, the growing imperative faced by universities to commercialise saw more campus and incubator initiatives established. At the same time, sector-specific hubs were created in newly emerging sectors such as media, life sciences and advanced manufacturing. The approach to innovation was typically more network- and services-based, rather than strongly place-based.

In the third cycle, from the late 2000s, the UK saw the rise of innovation triangles and corridors, motivated by the perceived need for places to compete on scale in a much larger international investment market. These larger locations have required a different scale of convening, planning and branding, creating significant impacts on place in the process.

The fourth cycle, beginning in the mid-2010s, has featured a wave of innovation districts and quarters, underpinned by a new capital investment cycle in larger cities and growing demand for their dense labour markets. With more of the low hanging fruit having been picked, more of these locations are in areas of historic deprivation or under-investment. Many of these innovation districts are governed by cross-sector partnerships or coalitions, including involvement from the academic sector, local businesses or BIDs, local government, and other institutions with significant local presence (e.g. NHS).

Now as we enter our fifth cycle of innovation places, there continues to be a role for all types of innovation hubs. Buildings and infrastructure, whether in science parks or innovation districts, will have to evolve from passive workspace provision into an active canvas for discovery. More places have recognised the need for partners with longer-term horizons, and for collaboration that hinges on greater frequency, quality, and purpose; increasingly, places seek to learn from and work with each other – for example, via the UK Innovation Districts Group. Success, more than ever, relies on a clear common identity and co-ordination.

We also see the rise of dedicated civic innovation and mission-driven hubs designed to use place and infrastructure as a catalyst for new ideas, solutions and policies directed at larger societal challenges. Knowle West, Barking Riverside, and Perth West are just three among many places being reimagined as test beds, whether for modern technologies, new kinds of civic participation, or new modes of carbon mitigation.

This new generation of innovation places has the potential to deliver long term economic and social impact, both through supporting an ecosystem of innovation via SMEs and spinouts, and through their potential to reconfigure city systems on a macro scale to drive innovation. Governments at all levels are seeking to deliver whole place return; by growing innovation places across the UK and fostering innovation’s social license to operate, we will start to see these returns materialise.

"Innovation – whether it be of goods, of services, or of processes – is at the core to creating jobs, stimulating investment, and improving economic outcomes for a place."
Business-university links in innovation places

Universities can play an important catalytic role in innovation places through the knowledge they create, the talent they build, their facilities and space, and routes to finance. These places can help foster multiple types of interaction between businesses and universities to drive research translation, application, innovation, and skills.

The following examples of Nexus in Leeds, the Manchester Innovation District and the KQ Liverpool exemplify the collaborations that can be unlocked within innovation places. We asked contributors to consider the aims of innovation places, as well as the wider contribution they make to the economy and society.

The critical importance of innovation ecosystems

Universities and their innovation communities play a vital role in an innovation ecosystem (IE), acting as a magnet to attract the entrepreneurs, companies, and investors, which will generate a beneficial economic and societal impact – locally, nationally, and internationally.

A powerful catalyst for collaboration, they bring together the brightest minds and most inspiring business concepts. The benefits of a successful IE can be measured both economically, through markers such as capital investment, inward investment, creation of highly skilled jobs and on a societal level by promoting inclusive growth - creating educational and employment opportunities to improve social mobility.

At Nexus, we have been privileged to host and support many inspiring fast growth businesses since our launch in May 2019 and our focus has always been to enhance and create a thriving community that is rich in opportunity and addresses the real needs of member businesses.

The many challenges posed by the pandemic acted as an accelerator for innovation as many of the Nexus community used creative problem-solving either to pivot or rapidly grow their businesses. Itecho Health, developed a dedicated healthcare platform, Ascelus, for patients with long-term health conditions, enabling them to connect with their clinicians via their smartphones and devices. During the pandemic they increased from an initial two to now cover 22 disease areas supported by medical student placements, whilst continuing to grow their team.

About Nexus:

Nexus brings together the brightest minds from business, technology and academia. Our community of high growth businesses is located across the globe but has its physical base in a state-of-the-art innovation hub on the University of Leeds campus.
We know from our members that innovation ecosystems and the investment they attract are a major draw for international companies seeking to work with leading academics, optimise their innovation, scale fast and generate products and services which deliver real impact.

Betalin Therapeutics, biotechnology specialists based in Israel, chose Nexus as its UK base to develop revolutionary treatment for diabetes, supported by funding from the Leeds City Region Enterprise Partnership. We also recently attracted US cloud-based software multinational, Snowflake, on the strength of our talent proposition – they have a major recruitment focus on software engineers.

Innovation is very much a ‘contact sport’ – the more diverse the people and the experiences, perspectives, and technologies they bring, the newer and more creative the thinking allowing entrepreneurs to think beyond traditional solutions. That is where innovation hubs play a fundamental role, not least because they enable those precious ‘water cooler moments’ by creating spontaneous, random connections. We are proud to be able to say that over half of our member businesses at Nexus are currently exploring opportunities to innovate with each other, illustrating the power of a close-knit community.

But more importantly, we facilitate curated collaboration – our latest Innovation Cluster Challenges Workshop, for example, hosted with our strategic partners KPMG, attracted over 40 entrepreneurs, businesses, funding providers and advisers.

Innovation ecosystems are a catalyst for creativity, collaboration and community – as we enter a post-pandemic recovery period, their role has never been more important.

“Innovation ecosystems are a catalyst for creativity, collaboration and community – as we enter a post-pandemic recovery period, their role has never been more important.”
Building a successful innovation district: the case of Manchester

Established in 2004, Manchester’s Oxford Road Corridor innovation district, one of the UK’s earliest and largest innovation districts, is on target to become one of the top 5 in Europe by 2025. When it was created, many of the country’s universities were focused around spinouts, and their business collaborations were almost entirely forged with international companies. The digital dot.com era provided new opportunities for places like Manchester and in particular universities, to establish new relationships with local businesses. Being the forward-thinking and innovative place Manchester is, partners from across the city came together to establish a triple helix partnership model; bringing together public – both clinical (Manchester University NHS Foundation Trust) and governmental (Manchester City Council), academic (University of Manchester, Manchester Metropolitan University and Salford University) and private commercial partners (Bruntwood) together to grow the knowledge economy. The triple helix has subsequently evolved into a quadruple helix with arts, culture and the local community playing an increasingly important role in the placemaking that’s necessary to create a rich, vibrant and ever-evolving innovation district.

Today, the Oxford Road Corridor is home to 42,000 residents, 8,800 businesses, 74,000 students and 79,000 employees. The area accounts for 20% of Manchester’s economic output and is accessible to over 3 million people via public transport, boosting both productivity and reducing inequalities.
The success of the Oxford Road Corridor and vision for ID Manchester have been driven by several factors:

- **Local government involvement** - We work very closely with the local council who have been supportive from the beginning. They are incredibly forward-looking and wanted to do something that would generate value for the city.
- **Connectivity** - The opportunity to continue developing an innovation district in the heart of Manchester is already proving attractive. The city is thriving, offering a high standard of living with great transport links both locally and nationally. It will be the most connected area of its kind outside of London.
- **University strengths** - We built our model on the strengths of our city’s internationally-regarded universities where there are existing strong collaborations between businesses. These themes include: innovation engines (advanced materials), industrial biotechnology, applied healthcare (made easier by a devolved healthcare budget in Manchester), clean growth and a green economy, and digital and data. These themes will be agile and flexible but provide us with a vision for where we can target our efforts.
- **Access to a diverse range of skills and talent** - The University of Manchester has the highest graduate retention rates in the UK so we will not struggle to attract or retain the best talent at ID Manchester. We have worked on creating and building opportunities for student placements but also graduates to live and develop their careers locally. We are now seeing more graduates move back to Manchester because of the thriving economy.
- **Access to capital** - Crucial to the success of any innovation district is its ability to attract investors. The investor to startup ratio is much better in the North West because there are less investors but more high value startups to choose from. Access to Northern Gritstone funding has also been a game changer.

Innovation Districts can thrive or fail due to a multitude of reasons but with the right partners and vision, businesses will see the potential.

The proximity, density and collaboration of the partners in the quadruple helix act as catalysts for future partnership, research and innovation opportunities. The success of the Oxford Road Corridor innovation district sparked discussions around its growth, expansion and other similar opportunities in the city.

The University of Manchester’s 18 acre North Campus, the site of the former UMIST, located to the east of the Oxford Road Corridor, close to the city centre and immediately next to the city’s mainline railway station - Manchester Piccadilly, is one such opportunity. The University’s world class research strengths and undeveloped land made ID Manchester ripe for investment and growth. The University of Manchester set out a clear vision for ID Manchester - one of inclusive innovation - a fairer economic model, powered by Manchester’s productive and progressive spirit, shaped by creativity and invention, and working to deliver a healthier, happier, greener future for all. Based in the heart of the city of Manchester and set over 4m sq ft, the £1.5bn ID Manchester is Europe’s most ambitious innovation district. ID Manchester will be a new kind of place - an innovation platform, home to the most exciting new ideas and ventures, addressing some of humanity’s greatest challenges and opportunities.

Bruntwood SciTech, the UK’s leading property provider dedicated to the growth of the science and technology sector, was selected by the University of Manchester as their chosen partner in June 2021.
Fuelled by culture and powered by knowledge: Knowledge Quarter Liverpool

EMILY COOK
Policy Assistant, Knowledge Quarter Liverpool

About KQ Liverpool

Knowledge Quarter Liverpool (KQ Liverpool) is a 450-acre innovation district which spans more than half of Liverpool City Centre. KQ Liverpool links up like-minded cultural and commercial organisations, academics, clinicians and scientists, to promote the world-class innovation that exists within the Liverpool City Region and to create the conditions for collaboration, commercialisation and business growth.

Why KQ Liverpool?

Liverpool has long been known for its visitors and cultural economy. Its cultural offer in particular is something which has enabled the city’s universities to attract ever-growing numbers of students year on year. However, despite its thriving cultural scene and healthy talent pipeline, Liverpool was often overlooked for investment opportunities with its strengths within the knowledge economy relatively unknown nationally and globally. Liverpool had a poor track record in attracting inward investment and, excluding fractional sales, commercial development in the city had stood still for over a decade.

Therefore, KQ Liverpool came into being in 2016. The KQ Liverpool Board was created, and is led, by Professor Dame Janet Beer, University of Liverpool’s Vice-Chancellor, with the aim to create a world-leading innovation district by harnessing the power of partnerships and attracting national occupiers to Liverpool. It was formed with the strategic vision to disrupt the market; challenge the norm, combining place making with targeting key occupiers to generate investment opportunities of international importance; increase university spin outs and to enable Liverpool to better compete with neighbouring cities.

From the beginning KQ Liverpool focused on Liverpool’s strengths in infectious diseases, materials chemistry and digital health and technology, and what was unique within the HE ecosystem in Liverpool. It worked to reposition Liverpool to consolidate it as one of the UK’s most successful locations for knowledge creation and innovation.

Demonstrating capabilities

It was by playing to the city’s proven world class specialisms and through collaboration, that KQ Liverpool was an almost immediate place making and strategic success in disrupting the status quo.

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“...
Shortly after its formation the KQ Liverpool team led and helped win the bid for the Royal College of Physicians to establish its new northern home in the city. KQ Liverpool also fought off competition from the Midlands to attract one of the UK’s first four proton beam cancer centres to Paddington Village and worked with Liverpool John Moores University to secure the Manufacturing Technology Centre (MTC).

Most recently Liverpool’s capabilities were demonstrated in the Covid-19 mass testing pilot, the first of its kind anywhere in the world. The pilot demonstrated the city’s strengths in infectious diseases to a global audience, which in turn facilitated significant inward investment into the city from overseas. This investment culminated in the newly formed Pandemic Institute, which has been established with the ambitious vision to ensure the world is better prepared for future pandemics.

Key features of KQ Liverpool

Paddington Village
Paddington Village is the £1bn flagship KQ Liverpool expansion site that sits at the eastern gateway to the city centre. Once completed, Paddington Village will be a 30-acre urban village with a focus on life sciences, technology, and education. The campus is home to The Spine which opened in May 2021 and is the new £35m northern hub of the Royal College of Physicians.

Sciontec Developments Limited
Sciontec is the spin out development company from KQ Liverpool which is jointly owned by Liverpool City Council, the University of Liverpool, Liverpool John Moores University and Bruntwood SciTech. This unique combination of partners brings together the key elements of the city, its universities, a developer and a leading UK financial services provider – thus creating a development company like no other seen in the UK before.

Sciontec aims to create an innovative ecosystem that is connected at all levels, to promote the commercialisation of research and encourage more university spinouts and start-ups. It focuses on expanding and modernising KQ Liverpool’s existing assets and works to develop new world-class business space and labs across the region to facilitate the collision of minds and to house innovators. Since taking over Liverpool Science Park, Sciontec has turned a loss into a profit, is undertaking a £1m refurbishment and is home to over 60 thriving start-ups and SMEs.

KQ Liverpool 2025 Vision
Where Sciontec focuses on creating and developing the right property, KQ Liverpool focuses on place making and strategy. In July 2020, KQ Liverpool launched its five-year vision setting out a roadmap for ambitious yet sustainable, inclusive growth for the innovation district and beyond. The Vision focuses on five strands: Creating a Smarter Greener City, Growing Businesses and Attracting Inward Investment, Attracting and Retaining Talent, Collaborating with Purpose and Being a Better Neighbour.

The five strands reflect the opportunities and also the challenges that we anticipate over the coming decade. From the race to absolute zero carbon, to supporting post-pandemic economic recovery. Innovation districts and clusters have a key role to play in ensuring that innovation is not restricted to certain areas but instead crosses geographical boundaries, helping to tackle local inequalities.

“Most recently Liverpool’s capabilities were demonstrated in the Covid-19 mass testing pilot, the first of its kind anywhere in the world. The pilot demonstrated the city’s strengths in infectious diseases to a global audience, which in turn facilitated significant inward investment into the city from overseas.”
Covid-19, net zero, and ongoing regional inequality in the UK: it’s quite a list of challenges, and together they provide a compelling set of reasons to focus harder than ever on what it takes to really marry innovation with a mission for a place. Innovation districts, while by no means a panacea, can help to drive local economic growth, generate new ideas, and build links between communities. Why?

Innovation districts are built with proximity in mind. Often at the heart of urban development or regeneration programmes, they are designed not just to be spaces for offices and labs, but to be places explicitly created to welcome the communities they are based in. We know that “friction” is at the heart of creativity: we are inspired through interaction with the people and spaces around us. Successful innovation districts build in this “friction” as a feature rather than an add-on: through place-making that creates interaction between those you wouldn’t otherwise encounter, through programmes which actively include participants from across backgrounds, and through engagement with local communities to foster a shared sense of ownership and drive unexpected exchanges of ideas.

Contributions to the economy and society

There has been a proliferation of research into innovation places, hubs and clusters, including substantial debate about the frameworks that can help an innovation place establish, succeed and grow. Proponents of innovation places argue that they increase the productivity of companies in the area, drive innovation with substantial spill-over benefits and stimulate the formation of new businesses.

In addition to the critical mass and interaction unlocked within innovation places, there is increasing interest in how a range of additional fiscal and regulatory levers can be pulled to make innovation places more attractive and more successful. New initiatives like Freeports create new opportunities to think differently about innovation places and to further enhance their impact.

The following contribution by Claire Eagle from the UK Innovation Districts Group reflects on the ways Innovation Districts contribute to inclusive growth.

CLAIRE EAGLE
Manager, UK Innovation Districts Group

How innovation districts drive inclusive growth

Covid-19, net zero, and ongoing regional inequality in the UK: it’s quite a list of challenges, and together they provide a compelling set of reasons to focus harder than ever on what it takes to really marry innovation with a mission for a place. Innovation districts, while by no means a panacea, can help to drive local economic growth, generate new ideas, and build links between communities.

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As those of us working in innovation districts can testify, it is an art more than a science to continually bring forward the right pro-innovation physical spaces with the networks, tailored support, services and amenities to match.
At the same time, the task is to inspire institutional buy-in and the confidence and involvement of communities. The rewards are tangible – more capable clusters of mixed organisations, better-defined start-up ecosystems with more diversified investment, new solutions and services, opportunities to ‘grow-your-own’ talent, and more of a lasting sense of local pride and belonging to a place.

Driving these economic and social returns can take a number of forms, and innovation districts can implement a range of programmes depending on local objectives. These can include:

- Develop a skills pipeline for current and future businesses: While many innovation districts are formed in partnership with local universities, it is also crucial to create opportunities for communities outside the academic sector. Innovation City Belfast recently partnered with TechTalent Academy and Amazon Web Services to offer a free, 12-week, full-time skills development programme on cloud computing. This had the dual objective of providing entry-level talent for local employers, while providing job opportunities in tech for under-employed or unemployed residents – both critical for the long-term growth of Belfast’s digital economy.

- Support early-stage SMEs in growth: Innovation districts can create an ecosystem of start-ups and spinouts and provide support at scale for them to grow. The BUILD programme in Leeds City Region invited entrepreneurs with ideas to address pressing challenges (e.g. clean energy, financial inclusion) to join a 12-week programme, where they learned core skills to build and scale a business. Participants were also given access to the broader business community in Leeds, ranging from later-stage start-ups to corporates and investors.

- Provide infrastructure for businesses to test new technologies: Innovation districts can provide a unique opportunity for companies to trial emerging products. The Queen Elizabeth Olympic Park in London has thousands of people living and working on-site, ranging from schools to shopping centres to head offices, and as a result is well set-up to act as an urban test bed. Trials have ranged from early-stage deployment of e-scooters, which influenced the regulatory framework governing e-scooters in the UK, to testing how the gamification of fitness via an app changed people’s physical activity and health.

The rewards are tangible – more capable clusters of mixed organisations, better-defined start-up ecosystems with more diversified investment.
Delivering an R&D people and culture strategy

In 2021, the Government published an important R&D People and Culture Strategy. This Strategy recognised that growing the UK’s research and innovation capabilities will require not just a bigger R&D workforce, but also a more diverse and collaborative workforce in which researchers are better equipped to commercialise their ideas and transition between academia and industry.

Businesses, universities and policymakers agree that remaining with the current system will mean that R&D careers will remain too siloed, homogenous, unrewarding and potentially unattractive. The strategy therefore outlines the ambition to move to “dynamic, varied and sustainable career paths that allow movement across the system – especially between academia and other sectors, including business, the third sector and public sector.”

In this section we asked Rory Duncan from UKRI and Clare Viney from the Careers Research and Advisory Centre (CRAC), to comment on the Strategy and what their organisations are doing to deliver it. We also share the reflections of Professor David Bogle from University College London on how researchers can be better equipped to contribute to innovation.

Why skills, talent and people matter to the UK’s science superpower ambition

A few weeks ago, the Chancellor announced he was increasing the amount the government spends on R&D to £20 billion per year by 2024-25. Public investment in research and development generates excellent returns, leveraging additional business and overseas investment – it drives economic growth, boosts productivity, leads to high value jobs and is key to the UK’s future prosperity. This requires talented people – lots of them – inspired to dedicate their careers to research and innovation in the UK, with a system and a supportive, welcoming ethos that allows people to envisage and enjoy flexible, dynamic careers. We have a vibrant research and innovation sector already, so building on this can cement the UK’s position as a leading research nation that can drive a high-skill, research and innovation-led recovery.

The publication of the government’s R&D People and Culture Strategy in July 2021, following from its conception a year before in the R&D Roadmap, is therefore an essential part of the new policy landscape. The People and Culture Strategy sets out for the first time the government’s plan to ensure that research and innovation careers are as attractive as they can be.

RORY DUNCAN
UKRI Director of Talent and Skills
There are challenges to address: people might grapple with unclear pathways, barriers and costs that hinder cross-sector, -organisation or international mobility, and variable leadership quality. Some parts of the research and innovation system can exhibit unhealthy cultures, including evidence of bullying, harassment, and discrimination. We will not achieve the aspirations in the strategies unless these weaknesses are tackled. This recognition, set out by the government, is a positive step.

Change requires whole sector collaboration. It is essential to appreciate that these areas are connected and inter-dependent, so the People and Culture Strategy is a call to action for us all in the research and innovation system to work together, build upon and celebrate things that are going well, learn from, and change things that aren’t and help contribute to lasting change. UKRI already has an ambitious portfolio of work that we look to strengthen and mature, and a role to play in helping convene the right groups of experts to support the delivery of the strategy. The future we want will only be secured with ownership of the challenges and solutions from all parts of the sector.

We need to plan, attract and prepare for enough people to meet growing demand for research and innovation. UKRI will ensure that we have a competitive offer for researchers, including how to address the precarity that is a severe disincentive for many, especially at the early stages of a research career.

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Continuing to incentivise and enable university and private sector collaboration and co-design of training and development is important here. Fostering a positive, inclusive and respectful culture that supports richer, more productive and sustainable ways of working is inarguably the right thing to do, and there are well-established business reasons for doing so: diverse workforces and teams are more productive and creative and the UK, with its remarkable research and innovation history, foundation and future, can lead the way.
The launch of the Research and Development People and Culture strategy has brought a new urgency to the need to rethink research careers and the support we provide to our research talent at all career stages. Vitae is committed to enabling researchers and those who support them to fully articulate the value of researchers, both in R&D and beyond.

In 2020 Vitae embarked on a series of projects that aim to revisit and test the initial guiding principles of the Researcher Development Framework (RDF), taking into account the ways in which the RDF is currently being used, changes to the way research is done, and increased focus on the research environment and culture over the past 10 years. A key question informing our approach is: How has the environment for doing research changed and what might that mean for the RDF?

The RDF (2010) maps researcher competencies across four domains, providing a holistic view of how to develop effective researchers. It is the framework for planning, promoting and supporting the personal, professional and career development of researchers and, along with the accompanying Researcher Development Statement (RDS; 2012), it underpins policy and practice relating to the professional development of researchers at all levels, including:

- Researchers throughout their research careers
- Researchers preparing for careers beyond academic research
- Institutions and staff supporting researchers
- Employers of researchers within and beyond academia
- Policy makers and funders of research
As part of our recent work, we’ve looked at the adoption and use of the RDF by postgraduate researchers (PGRs) as a career and professional development tool. The project examined the experiences and perceptions of RDF users through a series of in-depth interviews focused on how PGRs were introduced to the RDF, their experiences of using it, and the institutional support they received.

PGRs’ first impressions of the RDF were varied and linked to the amount of support they received from their institutions and supervisors, which varied widely. PGRs who had received training were more likely to use the RDF as a tool to support their career and professional development. PGRs wanted further integration of the RDF into doctoral programmes and more emphasis on the importance of professional and career development.

Supporting researchers to prioritise their professional and career development and use the RDF as a tool for evaluating their competencies will support the development of researcher skills and behaviours of the future, including openness, inclusiveness, adaptability, collaboration and cultural competence. Signposting clear pathways to careers beyond academic research will address the mismatch between the supply of researchers and their career aspirations, ensuring researchers can have rewarding careers and realise their potential in all sectors.

Enhancing the value of the RDF to employers

Having just reached an important milestone following an internally-focused RDF research project and community consultation, Vitae is currently focused on how the RDF can more fully meet the needs of researchers doing research within and beyond academia and those who go beyond research into other parts of higher education or other sectors. As part of this, we will work with employers to further understand the future researcher skills, knowledge and behaviours they need.

The RDF needs to be useful for future employers of researchers within and beyond academia, and to help researchers make sense of new environments, whether a new institution, sector or country. This can be achieved not by fundamentally changing the RDF but by thinking about how it connects with the wider environment, including the changing priorities of government, funders and publishers and expectations of employers across all sectors.

Feedback from Vitae Members and the wider community has shown that there is scope for the RDF to be further mapped and connected to HE policies, agreements and frameworks at local and national levels. This enables the RDF to continue to provide a universal language that describes the competencies of effective researchers – a feature that is highly valued by current users – while also aiding all stakeholders to make the most of the RDF in their more specific contexts.

Moving beyond HE, there is a potential opportunity to map the researcher competencies described by the RDF to competency frameworks and associated professional development frameworks and policies across sectors. It is anticipated that this work would provide researchers and those who support them with clear guidance on the skills valued by employers of researchers in a variety of sectors beyond academic research and, at the same time, enable employers to reach potential employees with high level competence in areas that are particularly relevant to their sector.

UKRI will ensure that we have a competitive offer for researchers, including how to address the precarity that is a severe disincentive for many, especially at the early stages of a research career.
Early career researchers driving innovation: let’s allow them to grow independence

PROFESSOR DAVID BOGLE
Pro-Vice-Provost of the Doctoral School and Professor of Chemical Engineering at University College London

There is increasing awareness of the wide range of career paths for researchers beyond academia. Many early career researchers aspire to academic careers but without really knowing what that entails or sufficient knowledge of other career paths. The pipeline of skilled researchers is a vital part of the impact that researchers make as they take their well-honed skills as ‘creative critical autonomous and responsible intellectual risk takers’ into the workforce, within and beyond academia. The connections between the research system and the wider labour market need to be more porous, both ways.

Are they sufficiently well prepared for this? Universities do train researchers well for their individual research as Doctoral candidates are required to prove and defend their own original ideas. However, postdoctoral research staff are more likely to be employed on a grant that already proposes ideas and the plans necessary to prove them. Research staff need time for themselves and their own independent ideas: training, independent project work, consultancy, internships and teaching. This requirement for 10 days training was recently included in the new Concordat together with further time to develop ‘research identity’.

While individual research training is strong what is missing is consistent training on innovation in the broadest sense. This includes entrepreneurship which is increasingly available, but more broadly how to take really novel ideas, one’s own or other peoples’, into organisations and make them happen. Employers often say they
need change managers and, if we are to make the best use of research investment, the best research ideas, wherever they come from, need to be taken forward. Our researchers should develop an understanding of the barriers to innovation (financial, human, legal, organisational etc.) and how to overcome them.

 Universities as the employers of researchers are primarily responsible for the training of their researchers but we need to work together with funders and with employers to achieve this.

To do this:
- Funders can make clear their expectations in grant conditions and;
- Universities should work more closely with employers to clarify employment pathways, to identify internship opportunities for postgraduate and postdoctoral researchers, and to draw from expertise in innovation and research-based change management.

I believe in this way all stakeholders in research impact will understand better each others’ different positions and provide more exposure of the exciting and challenging opportunities for employment beyond academia.

The pressures on researchers have become intense with many being generated by the research system itself and this is discussed widely in the recent BEIS R&D People and Culture Strategy. We want to ensure that being involved in cutting edge research remains an attractive choice wherever it leads to in longer term career choices – and this should include having a satisfactory work life balance.

The early career researchers that we train in our research system are the drivers of innovation in our society.

“...The early career researchers that we train in our research system are the drivers of innovation in our society.”
Creative Destruction Lab (CDL) is a nonprofit organisation that delivers an objectives-based mentoring programme for massively scalable, seed-stage, science and deep tech ventures. It creates a marketplace for judgment to guide companies on their commercialisation journey and in order to create the lowest possible barriers to the highest quality scientist founders, it takes no fees and no equity from participating ventures.

Since its inception in 2012 at the Rotman School of Business, University of Toronto, more than 4000 founders representing over 1700 companies have participated in the global CDL programme and have gone on to create over £8.5 billion in equity value. The CDL network has grown to ten sites worldwide, offering 16 different programme streams including Space, Oceans, Computational Health, Quantum, Energy and AI Supply Chain.

CDL-Oxford launched in the Fall of 2019 as the first CDL site in Europe. Based at Oxford Said Business School, CDL-Oxford harnesses the convening power of a world class University to bring together a leading community of mentors, scientists and postgraduate business students.

Following the success of CDL-Oxford’s first Artificial Intelligence cohort, the programme expanded in 2020 to include a stream in Health involving 47 ventures sourced from across the UK, Europe and beyond. Over 60 University of Oxford students participated in the programme, delivering 31 consulting projects to augment their classroom education with real life entrepreneurial experience alongside the venture founders.

CDL-Oxford will be expanding again in this, its third programme year in the Fall of 2021, to run four streams: AI, Climate, FinTech and Health. Over 130 mentors have committed their time to guide 80 ventures, who have been accepted from over 500 applications onto the programme along with 100 University of Oxford MBA and postgraduate students.

Case studies

The role of university and business collaboration for the future workforce

There are a wide variety of collaborative initiatives led by universities and businesses to build an effective R&D and innovation workforce, including to improve mobility between academic and industry careers, encourage greater diversity and collaboration, and enhance the attractiveness of researcher careers.

By working together, universities and businesses can anticipate, identify and respond to talent needs, learn from shared experiences and challenges, and drive genuine change in researcher careers in academic and private sectors.

The following section includes a number of examples of university and business-led initiatives in the UK that pre-date the publication of the Strategy. The examples may stem from teaching, research and/or knowledge exchange. This means that some models come out of deep pedagogic and curricula insights. Some out of research into entrepreneurship or technology development processes, and others out of deep experience with partners – investors or technology experts. Some originate from all of these.

Many initiatives are new. In the years to come, it will be important for universities and businesses to share their experiences and consider whether lessons learned may be applicable, and initiatives translatable, to other institutions.
The worlds of ‘research’ and ‘innovation’ remain hugely siloed, to the detriment of both. Zinc responds to this with a focused approach to R&D which connects and advances research and innovation in four broad mission areas: to improve mental health, the quality of later life and the future of work, and to help reduce negative impacts on the environment. We achieve this principally through a venture-builder programme bringing together 70 people from different backgrounds and helping them build highly scalable, mission-focused businesses from scratch. Our current programme aims to improve the mental and emotional health of children and young people.

Zinc has a focused approach to R&D on:

1. Ensuring that our start-ups use existing research to develop more effective and engaging products and services. Our in-house R&D team supports engagement with research and helps develop partnerships with researchers.

2. Foregrounding and enhancing the capacity for high-quality research in and with ventures.

Excellent research doesn’t - and shouldn’t - only happen in universities. Researchers and scientists are increasingly working in a variety of sectors and settings. We see early-stage commercial innovation as particularly fertile territory for research, given its focus on rapid, iterative, real-world experimentation. We will soon start work on a new project to explore effective ways to better connect the ‘applied’ social science happening in service sector start-ups with the academic social science carried out in universities.

Creating opportunities for ambitious researchers to pursue problem-led, cross-sector, cross-disciplinary research and development in and with our ventures.

We provide a growing range of opportunities for researcher engagement. Some researchers join us as Foundations or provide advice to Founders as Visiting Fellows. Our start-ups might host MSc students or hire researchers. We will soon be launching 3-month PhD placements, shorter placements for mid-career researchers, and 12-month postdoc Fellowships. We recently launched the first of these with the AHRC, which is funding two R&D Fellowships awarded to ECRs from Arts and Humanities backgrounds who want to explore opportunities to apply and conduct research in a commercial setting. We plan to increase the number and breadth of these Fellowships to allow researchers from a range of disciplinary backgrounds to spend up to 18 months immersed in the world of early-stage innovation.

Ultimately, we are working towards building a new environment that connects and advances research and innovation through connecting talented researchers and through taking a dynamic approach to producing, sharing and linking scientific knowledge to impactful innovations.

Prosper, funded by Research England and based in The Academy at the University of Liverpool, is a new approach to career development that unlocks postdocs’ potential to thrive in multiple career pathways. Working jointly with our stakeholders, our ultimate goal is to open up the huge talent pool that exists within the postdoctoral community, to the benefit of postdocs themselves, Principal Investigators, employers and the wider UK economy.

Prosper is being co-created in partnership with employers. If we are to ensure that the Prosper approach equips postdoctoral researchers with the understanding of how best to discover and exploit the vast range of career opportunities available to them then we need the expertise, networks and “insider knowledge” of a representative range of employers beyond academia. The project also aims to build employers’ knowledge of this group of highly talented potential recruits.

Our co-creation to date with over 91 employer stakeholders ranging from multinationals to SMEs, Government Departments to charities and third sector organisations has been invaluable in providing a rich employer perspective, from helping to create our first set of resources on our prototype portal currently available at the 3 partner institutions of Liverpool, Lancaster and Manchester, to developing a set of 12 career clusters intended to represent the key areas of the economy which can benefit most from the qualities and attributes postdocs can offer. We are now intensifying our co-creation with employers creating targeted career interventions based around the career clusters which are currently being piloted with a cohort of 52 postdocs at the University of Liverpool. Learnings from this will inform a second cohort of up to 90 postdocs across the 3 partners before eventual roll out of the Prosper approach and portal across the sector in March 2023.

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Achieving societal and economic impact is one of the benchmarks of successful research, however, changing policy, practice or creating a desirable asset for commercialisation can often take years. While the destination may be the goal, the journey is just as important.

Universities are encouraged to be proactive when priming their innovation pipeline by creating the right environment, training staff and students to develop an innovation mindset and ultimately, fostering a culture of innovation throughout the organisation.

Skillfluence is a training company established in 2016 with the goal of designing and delivering transferable skills training that equips Researchers to work productively with others, both inside and outside of academia. The aim of any of our programmes is to grow confidence, capacity and ultimately activity to increase collaboration with the ‘end users’ of research in external organisations – i.e. public, governmental, private and third sector enterprises. We also seek to empower Researchers to realise how portable and desirable their skills and expertise are to organisations and in society.

At Skillfluence we recognise the need for transferable skills, particularly skills that give researchers a better understanding of business and how they can engage, communicate and connect whether they want to pursue a career in industry or collaborate with business as part of an academic research career.

For researchers, there’s a need to be able to respond to a fast-changing research and work landscape. We’ve had more than 700 researchers attend our Connecting with Industry programme, the top reasons they note for taking part in the programme are learning to communicate with business (19%), networking (12%) and building confidence (7%). Researchers note the obstacles they feel prevent them from building stronger links with industry include their understanding of industry (25%), poor network (17%) and lack of previous experience (10%).

**Spotlight on Collaboration Skills**

Connecting with Industry is a 6-week masterclass series, which equips researchers with the tools, skills and confidence required to work more effectively with businesses and organisations. The programme is suited to those who want to work in industry and those who want to stay in an academic career and seek funding and knowledge exchange opportunities with external partners. The programme is brought to life through facilitated group conversations with professionals experienced working in, or with, industry. The ‘Conversations’ are live interactive forums with diverse guests who provide context, inspiration and real-world stories. They also offer the opportunity for participants to expand their network and build relationships with key external contacts.

**Spotlight on Innovation Skills**

Future Innovators is a 6-week masterclass series, which equips researchers with the tools, skills and confidence to help them lead, facilitate and enable innovation. Participants learn how to clearly define problems, create a large volume of possible solutions, select top ideas, reduce risk, test assumptions and present ideas clearly and concisely to gain buy-in. The programme is facilitated by group conversations with Innovators who work in academia, in public or private sector organisations or in roles that support the innovation pipeline. They also offer the opportunity for participants to expand their network and build relationships with key external contacts.

**What is success to us?**

We’ve worked with over 10,000 participants and 60 universities and organisations in the UK, Europe and beyond. Our programmes have led directly to job offers, funding, consultancy, collaboration, work placements and evidence of significant growth in confidence. We have qualitative participant feedback, months or years down the line that can be triangulated by feedback from our customers and expert trainers. Ultimately, it’s the lightbulb moments participants experience that have the potential to create new opportunities for impact.
Learning lessons from overseas

There are valuable examples of collaborative initiatives led by universities and businesses to build the R&D workforce, as well as new UK-wide initiatives aligned to the R&D People and Culture Strategy. Countries around the world face similar challenges related to the R&D workforce, with similar initiatives and strategies being produced everywhere. The question is how to drive the genuine step-change that will deliver the research and innovation talent needed in the future.

For this year’s State of the Relationship report, we have started a dialogue with other organisations around the world to better understand what other nations and organisations are doing to tackle similar problems. Below we have collated examples of initiatives from the US, Germany, Australia, Korea and Japan.

International case studies

EXIST Business Start-up Grant, Germany
Postdocs to Innovators (P2i) Network, Europe
ACT-I, Japan
Degree and Research Centre Support Program, Korea
Translating Research at the University of Melbourne (TRAM), Australia
Entrepreneurial Training Program, Australia
National Science Foundation Convergence Accelerator, U.S.
National Science Foundation I-Corps Program, U.S.
John Hopkins University, U.S.
EXIST Business Start-up Grant, Germany

EXIST is a funding programme set up by the German Federal Ministry for Economic Affairs and Energy (BMWi) and co-financed by funding from the European Social Fund (ESF). It was set up to fund early-stage start-ups from universities and other research institutions. The programme provides funding for the development of an idea for a product/service, as well as the business plan, right through to company launch.

The programme provides funding to both innovative and technology start up projects but also to innovative services that may offer a substantial benefit to the client based on a unique selling point in the market. Funding is available to current students as well as academics and non-university researchers, graduates and former research assistants and start up teams of up to three people provided at least one of the applicants is within five years of graduation or leave of university.

Success story
Celonis SE is the first EXIST unicorn. Following consistently profitable growth after being spun out of TU Munich in 2011, Celonis received $50 million in Series B investment round funding from investors Accel and 83North in 2018 at a valuation of $1 billion. Another round of funding in 2021 led to a valuation of $11 billion and thus to decacorn status.

National Science Foundation Convergence Accelerator, U.S.

The NSF Convergence Accelerator is a newer U.S. National Science Foundation programme that requires industry participation with academic researchers on projects that can be translated into innovative products. The programme model includes three phases: topic identification and convergence research phases 1 and 2. Teams that complete the convergence research phases are expected to deliver high-impact solutions that meet societal needs and continue to have an impact after NSF support ends. The model includes a period of hands-on researcher training with an innovation curriculum.
Johns Hopkins University, U.S.

Johns Hopkins Technology Ventures was built to assist researchers to maximise their impact through the translation of technologies, formation of start-up ventures, and collaboration with industry. We see ourselves as “agents” for the faculty, representing and advising them as they turn science into products and services. To capitalise on the commercial potential of academic science, it is critical that academic innovators have foundational knowledge of intellectual property, product development, and business planning. In that spirit, we have an array of programs and resources designed to equip and educate researchers:

- **ICorps**: Several times a year, we run a campus programme based on the National Science Foundation I-Corps curriculum. This abbreviated version of the national course teaches researchers how to refine their value proposition by conducting 40 interviews with customers. We find that the process of actually speaking to potential users of a product makes a big difference in how researchers develop their products and approach their business plans. Last year, we took 38 teams through this curriculum over the course of 3 cohort sessions.

- **The 7 Questions**: We have developed a set of key questions that we ask all researchers to answer when they have a discovery they wish to patent/commercialise. The idea is to help them communicate not just the incredible novelty of the science, but also the commercial potential and ultimate product that will result from the technology. Our licensing team uses the answers to these questions to design the licensing strategy (who to license to, how to structure the agreement, etc). The 7 Questions can be found [here](#).

- **Lab-to-Market Bootcamp**: In 2020, we ran the inaugural iteration of an 8-week Lab-to-Market bootcamp course last year, where 18 faculty teams participated. The curriculum covered topics such as: IP, building a team, venture funding, regulatory process, etc. Each participant brought a current discovery that they hope to commercialise and was able to get feedback on their business plans.

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**National Science Foundation I-Corps Program, U.S.**

The U.S. National Science Foundation I-Corps Program works across several NSF directorates to train researchers towards an innovation mindset, with a focus on translation of research thrusts to development of products and services. Through I-Corps, NSF addresses four urgent national needs: training an entrepreneurial workforce, translating technologies, enabling economic impact, and nurturing an innovation ecosystem. Over the course of seven weeks, seasoned entrepreneurs teach I-Corps participants how to test the market through customer discovery and how to create a business strategy. They participate as a team of three (technical lead, entrepreneurial lead and mentor) with other teams in an I-Corps cohort. To qualify, participants must have been funded by NSF as a faculty member, student or researcher in the preceding five years, or have participated in a regional I-Corps program. Some NSF-funded small businesses also participate in I-Corps. The programme is open to all disciplines.

Since the NSF Innovation Corps (I-Corps™) programme launched in 2011 as a pathway to translation for NSF’s basic research investments, more than 5,700 people have participated in the training that teaches NSF-funded researchers the entrepreneurial skills necessary to identify market opportunities for the discoveries that emerge from their research. More than 1,000 start-ups have been launched because of I-Corps, and these start-ups have cumulatively raised $760+ million in subsequent funding.
Translating Research at the University of Melbourne (TRAM), Australia

TRAM runs a comprehensive suite of four programs that enable researchers to have greater impact with their research. They help individual researchers or teams of researchers to understand their target market, assess the viability of commercialisation opportunities and successfully bring them to market. TRAM is open to all researchers from the University of Melbourne and the Melbourne Biomedical Precinct. Their programs are designed to quickly develop entrepreneurial thinking within proven frameworks to maximise the real-world impact of research-based projects. TRAM programs are designed to be matched to how advanced teams are along their research impact and/or commercialisation journey and is open to early stage or new research teams. Over 250 researchers, collaborators from nine faculties and five medical research institutes from across the Melbourne Biomedical Precinct have graduated from TRAM programs.

Postdocs to Innovators (P2i) Network, Europe

The postdocs to innovators (p2i) Network was created to develop entrepreneurial mindset and skills in the postdocs at seven p2i partner organisations - University of Cambridge; Freie Universität Berlin, Universität Innsbruck, PSL Université Paris, Edinburgh University, AstraZeneca and BP.

The p2i programme builds upon already existing innovation and entrepreneurial training programmes at the partner organisations, by focusing on raising awareness of the importance of an entrepreneurial mindset and entrepreneurial thinking and skills for any successful career as an innovator; by sensitising researchers to the idea that they could start their own venture based on their research or ideas and supporting those already on the journey to setting up a venture.

Our p2i online course: Empowering researchers to innovate and our p2i In Action events familiarise postdocs with the language, concepts and processes used in the entrepreneurial world and teaches them how to apply these to their ideas and build their confidence and credibility to discuss their (business or research) ideas with various stakeholders. Our p2i Network app connects budding entrepreneurs with an international network of domain experts, providing a low threshold channel for networking and knowledge exchange.

p2i is listed as an innovative approach for university-industry relationships according to the League of European Research Universities (LERU).
Two training programmes were developed in Korea aimed at developing researchers’ transferable skills. The first, the Degree and Research Centre Support Program (DRC) was introduced more than a decade ago to bridge universities and government-funded research institutions and enable staff exchange between the two sectors. Doctoral candidates (as well as Master’s students) can undertake six months of coursework (designed for specific research areas and incorporating transferable skills training) and two months of site work (for practical training), with the government funding. The programme targets interpersonal, organisational and communication skills, as well as research competencies and cognitive abilities and around 150 researchers participate each year.

The Japanese Agency for Science and Technology (JST) funds several strategic professional development programs for young researchers aimed at enhancing the research productivity of Japan. It supports universities and research institutions that promote the strategic development of excellent researchers. The purpose of ACT-I is finding and developing superior young researchers to address important problems facing the country. Under the management principles of the Research Area defined by the Research Supervisor, they accept researchers who have challenging ideas and support their research aimed at creating new values that lead to scientific and technological innovation. With advice and guidance from the Research Supervisor and Research Area Advisors as well as industry, young researchers advance based on their unique ideas. In advancing the research project, the researcher can gain various types of advice and guidance from the Research Supervisor and Research Area Advisors in Research Area Meetings (meetings for research report presentation), and in addition, researchers will be strongly supported with an Advisor Assignment System outside of the university.

Australia offers a new Doctor of Philosophy (PhD) training programme in Technology Innovation, delivered in the context of the Australian Medical Technology industry. The programme is administered by the Australian Research Council Training Centre in Biodevices and Diagnostics “BioReactor” at Swinburne University of Technology in Australia. The programme provides a paradigm shift from traditional PhDs to industry-oriented PhDs by integrating multidisciplinary research, entrepreneurship education, design-led innovation training, mentorship, industry partners, collaboration and a unique and innovative stage-gate programme structure. The PhD recruitment programme features an associated entrepreneurship and innovation curriculum, that weaves through the programme structure, activities and timeline over the duration of PhD study. The programme overall provides a contextual approach that can be adopted by other programme designers and educators not only in Australia but also more broadly in other countries and locations, especially in areas of biomedical engineering.
3.3: Spin-ins spin out new opportunities

The role of ‘spin-ins’ in commercialisation strategies

Research conducted in universities and institutes unlocks many of the world’s greatest innovations, from recombinant DNA technology to superconducting magnets and from voice recognition technology to GPS. These innovations can bring significant benefits to the economy as well as society, driving growth and productivity, creating jobs, and solving problems.

Spinouts, licensing, and patents are important channels of research commercialisation. Importantly, our Collaboration Progress Monitor reveals a significant growth in these activities in 2019/20, despite the disruption of the pandemic. However, it is important to observe that universities support the commercialisation of research in other ways too, such as student and faculty mobility, consulting, collaborative research, and student entrepreneurship. So-called “spin-ins”, whereby companies previously unrelated to a university benefit from university inventions, research, technologies and/or facilities, often in return for an equity stake, can also be important components of universities’ commercialisation strategies.

In the following pages, Dr Rebeca Santamaria-Fernandez at Imperial College London and Tim Brundle at the University of Ulster, set out how spin-ins fit into their commercialisation strategies, and what they aim to do. Suzanne Safie-Sibert, Chief Executive of Sisaf also gives the business perspective about what her business has gained through their spin in partnership with Ulster University.

Spin ins at Imperial College London

One of the many ways in which Imperial creates innovation is through start-up companies - maximising impact from research activities and contributing to the enterprising ecosystem that encourages and rewards the generation of new inventions and knowledge. Whilst this is one of the traditional and well-known approaches to technology transfer and knowledge exchange, it is increasingly the case that “external start-ups” and SMEs from outside the Imperial innovation ecosystem seek engagement with Imperial’s tech transfer offer to commercialise existing inventions and translate these into solutions and/or services to tackle societal challenges.

Companies can ‘spin-in’ to Imperial to access our inventions, research, technologies and facilities to develop a commercial opportunity through a collaborative approach in return for an equity stake and/or a commercial agreement. This is an attractive proposition in areas where the existing company has obtained exploitation rights to IP complementary to Imperial’s and the rights to Imperial’s technology and/or access to research capabilities will help accelerate impact and enable translation of the IP portfolio to the market at pace.
The key criteria for assessment of the spin-in opportunity are:

- alignment with the key research and impact objectives of the College
- an opportunity for collaborative research with the Imperial inventors to achieve integration of expertise and resources into the spun-in company.

This approach is a great addition to the existing collection of tech transfer methods: it diversifies routes to impact and leverages expertise, talent and facilities whilst assisting existing start-ups and SMEs. It also often uses less resources than would typically be invested in organic start-ups and can bring in revenue via licensing and acquisition – though that is not its primary purpose.

Imperial has developed bespoke start-up/SME programmes for collaborative projects where a College research group partners with a young start-up or SME. We have also signed - and are working - on a number of Commercialisation Agreements (Data, Software, Patents) in return for equity and/or royalties often connected to future research collaborations.

Some recent spin-in examples at Imperial:

- **AI**: Ariel AI is a UK tech start-up recently acquired by Snap (parent company of social media app Snapchat). Ariel AI was founded in 2018 and licensed IP from Imperial in 2020 in return for equity, becoming an Imperial start-up. The company use computer vision to build augmented reality features.

- **MedTech**: A young SME supplying instrumentation for studying molecular and cellular binding mechanisms to enable a better understanding of disease causes and optimisation of drugs approached Imperial with an interest in ongoing Imperial research resulting in complementary Imperial technology being licensed and a multi-year research collaboration being developed.

- **Creatives Industries**: A young start-up developing innovative biocomposite solutions for the fashion industry. Their initial interest in Imperial research in the synthetic biology field has led to interest in both commercial and research agreements with Imperial.

Companies can 'spin-in' to Imperial to access our inventions, research, technologies and facilities to develop a commercial opportunity through a collaborative approach in return for an equity stake and/or a commercial agreement.
Spin ins at Ulster University

TIM BRUNDLE
Director of Research and Impact, Ulster University

Ulster University enjoys a broad and vibrant research base and its knowledge has been put to work on behalf of business and wider society through the combined innovation and entrepreneurship actions taken across the University. Innovation Ulster Limited (‘IUL’) is Ulster University’s wholly-owned technology commercialisation company, managing an evergreen investment fund, a portfolio of technology company investment and commercialisation of the University’s intellectual property portfolio. The Northern Ireland business community, including the technology startup scene, is highly integrated into the local University system, with the region recording the highest percentage of R&D active firms engaged with HEIs. In supporting such partnerships between entrepreneur and academic, Ulster University has invested in the people and programmes that enable innovation.

Over a decade ago IUL adopted a new investment ethos, balancing investments into Ulster’s University spin out companies with investments in graduate start-ups and into ‘spin in’ companies. The University was observing increases in the levels of technology venturing in Northern Ireland, with requirements from our partners for lab space, research assistance, technology validation and information on the sources of capital. The capital for startups was in short supply, particularly for those companies and entrepreneurs that were commercialising longer-term knowledge-based products and services. The University decided to back both a graduate with a highly scalable business idea and a startup company that was collaborating with one of our research teams. Both investments found early success and follow on investment and the strategy of balancing investments was adopted.

Today, IUL generates economic value and enables research and civic impact from the University’s knowledge base through:

- Licensing Opportunities – companies of all sizes and individual entrepreneurs can access an extensive portfolio of Intellectual Property (IP), technologies and early-stage concepts that have been developed by Ulster researchers and are available for licensing and collaborative development;
- Portfolio Companies – it encourages, supports and invests in the commercial advancement of new inventions and ideas developed by Ulster academic staff and students into fully commercial enterprises; and
- Spin Ins – it provides opportunities for companies to partner with the university and access Ulster inventions, research, technologies and facilities to develop a commercial opportunity through a collaborative approach, in return for an equity stake in the partner’s business.

The first company to benefit from the University’s focus on spin in investments was SiSaf, led by Dr Suzanne Saffie Siebert. SiSaf is the creator of Bio-Courier®, technology, a non-viral, hybrid carrier system which enables the safe and efficient targeted delivery and transfection of therapeutic small interfering Ribonucleic acids (siRNA). Suzanne’s original plan was met with great excitement with IUL and by Ulster’s prospective partner academics. Seed funding and lab space was provided to enable early proof of concept studies, Ulster’s commercialisation team helped source substantive follow on investment and the company has worked closely with the University on the development and commercialisation of new IP.

IUL’s balanced investment policy has proven successful, not only for SiSaf, but also with over $150m USD of acquisitions of companies in the portfolio over the past five years. These transactions have not only spurred economic activity in Northern Ireland but have also enabled IUL to make a substantive financial return to Ulster University and provided the capital for IUL to embark on the establishment of a new private venture capital fund, Énbarr. Énbarr is Northern Ireland’s first fully private technology investment fund and its investment policies are mirroring IUL’s approach of balancing its funds between spin out, spin in and graduate startup companies. This balance has also brought benefits to Ulster’s portfolio of investments with the spin outs providing the highest return on investment, the student startups moving quickest to market and the spin ins providing both talented management teams and faster scaling. The investment ethos has also brought a deeper working relationship with technology-based companies and entrepreneurs, advancing our mission to operate as Northern Ireland’s civic University.
Dedicated to transforming the treatment of genetic diseases, SiSaf is a UK-based company founded by entrepreneur and leading nanoparticle scientist Dr Suzanne Saffie-Siebert PhD. SiSaf has pioneered the development of Bio-Courier® technology, a patented next-generation silicon stabilised hybrid lipid nanoparticle (sshLNPTM) that enhances the stability, targeted delivery, and protection of RNA therapeutics.

The company is currently applying its technology to advance an in-house pipeline of RNA therapeutics for rare and therapeutically neglected Genetic Skeletal Disorders, which account for 5% of all birth defects and are an important cause of disability worldwide. In partnership with Avellino Lab USA, SiSaf is also developing the world’s first topical siRNA therapy for a rare ophthalmic disease.

Following SiSaf’s original approach, Ulster University (UU)’s Innovation & Impact team made an initial introduction to Professor Jim McLaughlin, then Head of Nanotechnology at the (UU)’s Nanotechnology and Integrated Bioengineering Centre (NIBEC), and Tim Brundle, UU’s Head of Innovation.

Having reviewed the potential of the technology, the group decided that NIBEC could act as an incubator. UU provided the facilities and expertise that allowed the company to generate essential data in its early technology development and validation phase through cost effective access to state-of-the-art labs. It continued to support the company as it expanded, responding to its growing needs with the required resources and facilities. The University also provided seed funding that enabled the company to generate the data required to attract prominent VC investment.

UU continued to facilitate networking and contacts with academic thought leaders, including a key collaboration related to RNA therapeutics. Professor Tara Moore, Director of the Biomedical Research Institute at UU, required a delivery platform to permit, patient friendly, topical siRNA treatment for corneal dystrophy. This relationship was pivotal in building SiSaf’s early approach to applying its platform technology to RNA therapeutics. The spin-in with UU also promoted a valuable information exchange on drug delivery technologies between Dr Saffie-Siebert and NIBEC, and during this time she was appointed Visiting Professor.

Today, SiSaf has built a unique pipeline of first-in-class RNA therapeutics, all enabled by its Bio-Courier platform. The latest addition to the company’s portfolio of proprietary Bio-Courier technologies is a technology that helps resolve the restrictions of ultra-cold chain storage for RNA vaccines and therapeutics, an issue that has become widely recognised throughout the COVID-19 pandemic. The company has raised over £30M to date from grant funding and renowned investors and has built a world-class team. The connections, relationships and investment provided by UU continue to play a key role in the company’s value development.

“I think SiSaf’s relationship with UU and how it matured could be a good blueprint for other spin-ins. It has provided unrivalled access to research, technologies and facilities that has helped SiSaf develop an important medical breakthrough and a significant commercial opportunity through this collaborative approach.” Dr Saffie-Siebert, CEO, SiSaf Ltd
Case studies

Opportunities and benefits
Successful examples of spin-ins can be found across the UK at a wide range of different institutions. These case studies represent but a small selection of these important university-business partnerships.

- The University of Exeter and Intelligent AI
- Heriot-Watt University and Celestia UK
- The University of Cambridge and Better Origin
- The University of Cambridge and Cambridge Engineering Analysis and Design
- The University of Birmingham and Nonacus Ltd
- Loughborough University and Foster + Freeman
- Cardiff University and Ship Shape
- The University of Nottingham and Footfalls & Heartbeats
The University of Nottingham and Footfalls & Heartbeats

The University of Nottingham has a long history of working with local SME, Footfalls & Heartbeats. The company has developed unique patented technology to measure pressure and movement in textiles enabling fabrics themselves to become sensors. This technology is being applied to a wide range of exciting applications including those in sportswear, healthcare and automotive. Footfalls & Heartbeats engaged with the university due to our expertise in fibre optics. A collaboration began in 2016 to examine the potential to integrate optical technology into textiles to broaden the functionality of their product offering. The university subsequently licensed intellectual property to the company and invested in the business in return for an equity stake establishing Footfalls & Heartbeats as a ‘spin-in’. The company has gone on to successfully raise funding from the Midlands Engine Investment Fund managed by Foresight.

The University of Birmingham and Nonacus Ltd

Nonacus Ltd, developer and manufacturer of innovative genetic testing products based in The BioHub Birmingham, has partnered with the University of Birmingham’s Bladder Cancer Research Centre to develop a test for bladder cancer that will detect tumour DNA in urine.

The project draws on the unique capabilities of both partners. Nonacus has developed methods that allow confident and sensitive calling of mutations from small amounts of DNA and is experienced in rapid commercialisation. The University brings expertise in ‘deep sequencing’ of tumour DNA, and ready access to bladder cancer biospecimens specifically collected for such biomarker research.

The research was funded by Cancer Research UK and an MRC Confidence in Concept grant, and the relationship was brokered by CRUK and University of Birmingham Enterprise.
Loughborough University and Foster + Freeman

Foster + Freeman are innovators in the design and manufacture of systems for the examination of questioned documents, latent fingerprints, trace evidence and shoe prints. Established in 1978, the company is one of the foremost forensic science equipment suppliers in the world. It began working with Loughborough University in 2017, to commercialise RECOVER – a cutting-edge chemical vapour fuming process which provides unrivalled fingerprint development capabilities on even the most difficult surfaces.

Having worked with the Defence Science and Technology Laboratory and the Centre for Applied Science and Technology to maximise the potential of the process, Foster + Freeman was the ideal commercialisation partner for the University, with its global track record of developing and exporting market leading products. RECOVER was launched in 2018, marking a step change in crime detection and security and it is now used by police forces worldwide.

Foster & Freeman has since established a laboratory on Loughborough University Science and Enterprise Park, which employs former University researchers in work that underpins the ongoing commercialisation process.

The University of Cambridge and Better Origin

Globally, a third of all food produced goes to waste, much of which ends up in landfill or outdated composting plants. If food waste were a country, it would be the world’s third largest emitter of greenhouse gases. Insects could be a big part of the solution, with the potential to decarbonise food supply chains by recycling waste into valuable nutrients. Cambridge-based technology start-up Better Origin has developed a platform to harness black soldier fly larvae to process waste into animal feed. It has been working with University of Cambridge researchers on a range of projects, including genetic engineering, genome sequencing and the characterisation of antimicrobial peptides from the larvae.

The University of Cambridge and Cambridge Engineering Analysis and Design

Family-owned technology business Cambridge Engineering Analysis and Design (CEAD) has been collaborating with the University since 2008, helping it to solve a number of thermodynamic and fluid flow problems. More recently, it has been working with the University to develop a new, low-energy, polymer-based carbon capture technology for use particularly in biogas upgrading plants. The University tested and measured the physical properties of the materials and, by helping CEAD understand the underlying science of the production process, has enabled it to scale its manufacturing.
Heriot-Watt University and Celestia UK

In 2020 Celestia UK, specialists in the advancement of state-of-the-art antenna systems, used for tracking satellites, made the Heriot-Watt University Research Park its permanent base in Scotland after a successful five-month residency at the University’s Global Research Innovation and Discovery (GRID) facility.

Establishing the business at the Research Park, enabled Celestia to embark on its next development phase, which encompassed setting up a new bespoke lab and assembly facilities, as well as providing a larger base to deliver cutting-edge innovation in satellite-on-the-move user terminals and gateway systems.

A £2.5 million R&D award from Scottish Enterprise earlier this year allowed Celestia, with continued academic support from the University, to develop a new electronic scanning antenna and subsequently create 25 new jobs in Scotland.

Our Research Park is recognised internationally as a centre for high calibre science and engineering research and in their new facilities, Celestia UK will also design and produce a flat panel satellite antenna for aircraft, pioneering a next generation satellite link for enhanced in-flight connectivity.

Cardiff University and Ship Shape

Ship Shape is building the search engine for Venture Capital, enabling brilliant businesses to find relevant investors.

Critical to their current and future success in doing this is making the most of advances in Data Science. They have partnered with Cardiff University’s Data Science Academy and have three MSc students work with them on building pioneering capabilities involving Artificial Intelligence.

This knowledge exchange has made real impact already, enabling them to build up their in-house skillset, shorten time to market and deliver greater value to our customers. They are delighted to be collaborating with industry experts Dr Fernando Loizides and Professor Irena Spasić on an upcoming Innovation Programme of work.

Ship Shape’s research partnership with Cardiff University is a force-multiplier for the UK, enabling them to catalyse more investment in the innovation economy.

The University of Exeter and Intelligent AI

Intelligent AI are an insurtech start-up bringing together global location data, using AI, IoT open data and satellite data. Intelligent AI has been awarded a grant through the Sustainable Innovation Fund, to work together with the University of Exeter. Together they are hoping to develop an online insurance surveying tool for insurers to gather risk information without having to travel to sites, reducing their carbon footprint.

The company are piloting the first iteration of their product with customers, and all are in commercial discussions about SaaS licences and long term licencing. They are also in the process of writing grant application for the European Space Agency. Going forward, the team are working on obtaining Series A investment and will prove sales of the platform licenses and demonstrate market need. In the longer term, they plan to expand sales across Europe and Asia.
A LOOK TO THE FUTURE
The UK is at a critical juncture. Decisions made in the years to come, by government as well as senior leaders in business and universities, will determine the shape of the future economy and the UK’s global competitiveness.

Covid-19 brought unprecedented disruption. Although national economic recovery has outpaced expectation, the impact of Covid-19, as well as the journey to recovery, has been far from heterogenous. Some industries and some types of businesses have benefited from new opportunities during the pandemic, others have seen fundamental changes and declines in customer demands.

Beyond the immediacy of the Covid-19 pandemic, there are other drivers of change. 2021 saw the UK publish its Net Zero Strategy and host the major COP26 conference to tackle climate change. The Net Zero Strategy rightly recognised the importance of research and new technologies, with a Net Zero R&D Framework published beside it. A low-carbon economy will require fundamental transformation in business models, operations and skills requirements. Equally, the rapid pace of technological advancements and the transformative impacts of digitalisation under the Fourth Industrial Revolution continues to accelerate.

The twin priorities of decarbonisation and digitalisation drive and demand change.

What is clear to us is that collaboration between businesses and universities will only become more important as they each tread transformative paths.

If businesses are changing the ways in which they are working, it is critical that universities and policy makers adapt to these too. In a rapidly transforming world, the UK must work hard to ensure that it remains globally competitive and continues to develop, attract and grow businesses that improve our economy and society. To do this, it must keep up with the pace of change. ONS data reveals £900bn of pent-up corporate cash reserves stand ready to be invested. To capture a share of this investment, the UK must create and promote an excellent investment environment.

The Plan for Growth, as well as commitments made at the 2021 Spending Review, send important signals that the Government wants to do this.

The following section looks towards the future. We start by delving deeper into some of the drivers of change, particularly considering the heterogenous impact of the Covid-19 pandemic and the role of university-business collaboration in recovery. We then ask a number of contributors to consider the specific role of collaboration in tackling some of the greatest challenges of our time. Finally, we asked business and university leaders to consider how collaborations are evolving.
There are a range of drivers of change for businesses. This includes the far-reaching and varied impacts of the Covid-19 pandemic, the need for greater environmental sustainability, as well as the challenges and opportunities of new technologies and big data. The end of 2021 saw further challenges for many businesses, with the rising cost of energy, emerging supply chain challenges and a record number of job vacancies.

Whilst summarising the drivers of change at a national level is relatively straightforward, it does not necessarily capture the variety of impacts felt across different industries. Neither does it consider the varied ways in which different businesses are responding to change, and the implications for their research, innovation and collaboration activities.

Arguably, different industries’ R&D and innovation activities are driven by different factors and are evolving in different ways. From computer game developers, where rapid development cycles are core to their survival, to big pharma which underwent a major strategic shift with the decline of blockbuster drugs and a shift to personalised medicine, to the energy sector which is having to pivot into renewables while continuing to meet global energy needs.

NCUB is planning a number of projects to build a better understanding of the varied impacts of change and their implications for university-business collaboration.

To start this discussion, Wendy Atkins, a frequent contributor to the Financial Times, offers analysis of the varied impacts of Covid-19, Phil Clare, from the University of Oxford, offers his thoughts on the life sciences specifically, and Ian Robinson at HSBC shares his insights into how the finance industry is helping innovative companies to tackle climate change through access to finance.

Covid: a catalyst for change?

WENDY ATKINS
Freelance contributing editor with fDi Magazine and Senior Content Editor with FT Live

The Covid-19 pandemic has trained a spotlight on business – from how firms collaborate with stakeholders, to how responsible and agile they are. Coming at a time when a wider tech revolution was already underway, many organisations have used the pandemic to accelerate their digital and ESG strategies.

But not all firms have had the same pandemic experience. While some have weathered the storm well, responding quickly to the challenges of social distancing, others have had a torrid 18 months dealing with plunging incomes and reduced access to finance.

As we approach 2022, businesses are increasing their focus on improved resilience, sustainable recovery and greater productivity. At the same time, they’re coping with supply chain issues, labour shortages and inflationary pressures.

Turbulent times for aviation

The aviation sector has endured the worst crisis in its history. While some of the larger airlines have been able to raise funds to shield themselves from the downturn, regional players, such as Stobart Air, have become casualties of the crisis.
Although green shoots of recovery are starting to emerge – IATA says net industry losses are expected to fall to US$11.6bn in 2022 after a US$51.8bn loss in 2021 – Heathrow Airport has revealed that it does not expect passenger numbers to recover fully for five years.

The wider aviation industry has also felt the pain of the decline in passenger numbers. Aircraft deliveries dropped and maintenance checks plummeted as demand for air travel fell in 2020.

However, in July 2021, Airbus announced a surge of deliveries in June, notching up a total of 297 aircraft handed over in the first half of 2021.

Sustainable post-pandemic recovery and innovation are driving much of the sector’s collaboration efforts, with major firms, start-ups and universities looking to address these issues through projects aimed at cutting carbon emissions, experimenting with composites, increasing automation and developing sustainable aviation fuels. For example, the new Digital Aviation Research and Technology Centre (DARTeC) at Cranfield University will enable researchers to work with established industry partners and SMEs to advance the application of digital technologies in the air transport sector.

**Collaboration between industry and academia has long been important to the fintech sector and these opportunities continue.**

**Banking on change**

The financial services sector responded quickly to Covid-19. The rollout of digital technologies and the rise of fintech firms was well underway before the pandemic and there have been opportunities to intensify deployments in this area since then. However, both KYC and cyber-security challenges have had to be addressed.

Capital markets firms experienced higher trading revenues as markets rallied after the volatility of the early days of the pandemic. However, insiders say the financial services sector will likely be hardest hit by second-order effects caused by the deteriorating credit quality of customers and the after-effects of the pandemic being felt throughout the real economy.
Collaboration between industry and academia has long been important to the fintech sector and these opportunities continue. In October, NatWest and the University of Warwick opened a new business accelerator hub to support students and local entrepreneurs and company owners to grow their businesses in industries such as fintech. And in Scotland, the University of Edinburgh is involved in the Global Open Finance Centre of Excellence (GOFCoE) – a collaboration between the university, the Financial Data and Technology Association (FDATA) and FinTech Scotland – to build a data-driven research and innovation hub for financial services and fintech, serving the public, private and third sectors.

Healthy future?

The life sciences sector is in a unique situation in which it is able both to provide solutions to the pandemic and be subject to some of the shocks of the past 18 months.

Its ability to roll out rapid diagnostic testing and treatments as well as develop vaccines is providing opportunities to boost revenues and collaborate with stakeholders from universities and businesses. The opportunity to combine leading life science expertise with the global development, manufacturing and distribution capabilities of major firms was a key feature of the high-profile UK collaboration between AstraZeneca and the University of Oxford which resulted in the development and distribution of one of the first Covid-19 vaccines.

The sector is continuing to accelerate telehealth plans, expedite trials for treatment and deploy digitisation, robotics and AI technologies to assist with diagnostics and treatment. An easing of competition rules and greater flexibility from regulators has helped life science firms to cooperate and secure the supply of medicines and equipment during the pandemic as well as achieve more rapid drug and vaccine approval processes.

In the longer term, the sector needs to ensure it has sustained funding for research and innovation as public debt could put pressure on government funding for universities and research institutions.

The pandemic has certainly acted as a catalyst for change for businesses and academia. Investments in IoT, blockchain, 5G and automation technologies are helping to boost productivity and cut costs. Likewise, digital tech offers more chances to collaborate, providing opportunities to work with a broader range of partners.

The global nature of the pandemic has highlighted the importance of robust international relationships in dealing with the twin challenges of Covid-19 and the climate crisis. However, while there is going to be an increasing need for international collaboration between public and private sector partners, this is likely to be tempered by public budget constraints and geopolitical tensions.

“The global nature of the pandemic has highlighted the importance of robust international relationships in dealing with the twin challenges of Covid-19 and the climate crisis.”
A look at the life sciences sector

DR PHIL CLARE
Director of Innovation and Engagement, University of Oxford

Business partnerships have been a crucial part of Oxford University’s life sciences research and innovation for many years. We recognise the important role they play in exchanging knowledge and harnessing expertise to efficacy and ultimately expedite solutions to world health challenges.

Developing a vaccine for Covid-19 was a huge challenge of global significance to which the University proved itself particularly well-placed to respond. Thanks to years of research, Oxford's scientists in the Jenner Institute and Oxford Vaccine Group had already developed the vaccine platform, which was then rapidly adapted to protect people against Covid-19. The University also has a great deal of manufacturing expertise and its own Clinical Bio Manufacturing Facility, so were able to produce the initial quantities of vaccine required for such a global test. These elements were attractive to an industrial partner.

The University’s existing partnership with Astra Zeneca was not well established prior to the vaccine development. We knew we needed to partner with a company with the right skills and resources but what really sealed the deal, and fortified our relationship, was our shared values and desire to commit to global distribution at cost in the pandemic and in perpetuity to low-and-middle income countries.

Thanks to years of research, Oxford’s scientists in the Jenner Institute and Oxford Vaccine Group had already developed the vaccine platform, which was then rapidly adapted to protect people against Covid-19.

Our partnership with Astra Zeneca has shown how agile thinking and action can achieve huge impact.

We achieved in 10 months what would normally have taken 10 years by normal R&D standards because there was enormous sense of urgency, and trust, and all the steps had to happen in parallel. Clinical trials were organised, manufacturing was organised, contracts were drafted, and partners were approached. Failure to agree was unthinkable for everyone, the work went on at pace even before the details had been worked out.

Of course the circumstances were extraordinary and such relentless operations cannot be sustained on an ongoing basis. However, strong partnerships and establishing clear, shared goals from the beginning can allow for developing contracts and starting work in parallel, and high levels of trust can move projects along at much greater speed.

Our partnership with Astra Zeneca has shown how agile thinking and action can achieve huge impact. These are principles we aim to foster across all our partnerships such as our pioneering work with Ineos on antimicrobial resistance; developing cutting edge genomic sequencing tools with Oracle; and producing groundbreaking diabetes research with Novo Nordisk. Industry partnerships will also be integral to the establishment of Oxford's new Pandemic Sciences Centre, helping to give it the capacity for rapid decision-making and intervention on a world stage.
Beyond Banking – how the finance sector is helping to accelerate the transition to net zero

As we move beyond the broad commitments and into the detail of what net zero really means for the UK, all sectors will need to think carefully about their climate impact and introduce measures to reduce their emissions.

Financial institutions have a unique role to play not just in how they operate their facilities but in the ways in which they can influence the decarbonisation of other sectors through the capital they provide.

Innovation to decarbonisation

Solutions will differ widely for every sector facing their own decarbonisation challenges. Energy companies will need to consider investing in solar and wind technology, for example, while shipping companies are looking to design vessels that are more fuel-efficient or powered by alternative fuels such as electricity or liquid natural gas.

To make an effective transition to net zero, many businesses will need access to finance. Shifting strategy to develop cleaner, healthier products, will require major shifts in business’ manufacturing processes, new innovative technologies, access to artificial intelligence or simply new business models to reduce their emissions - all of these will require new and innovative solutions - often enabled through capital.

Businesses that are primarily service providers, like banks, are becoming increasingly aware that they have effective levers they can pull in order to reduce their emissions.
Beyond just seeking to minimise and disclose the carbon emissions they generate by running their business, financial services companies also exercise considerable influence over the carbon footprints of the companies that they lend to or invest in. Cutting these Scope 3, or “financed emissions,” is recognised as the biggest contribution that the financial services industry can make to reaching net zero.

Growing numbers of financial institutions are committing to delivering net zero financed emissions. They aim to achieve this through applying their capabilities and networks of relationships to support customers in their own transitions towards net zero. For example, HSBC is working with customers to facilitate more sustainable ways of doing business through innovations in financing, with plans to deliver between USD750 billion and USD1 trillion of finance and investment by 2030 to enable customers to achieve net zero in their own businesses.

For clients in ‘hard-to-abate’ sectors where emissions are heaviest and reducing them most difficult, banks are adding to the transition finance solutions they offer. Transition finance can enable companies in these sectors to progress toward net zero in a stable manner over time. Banks are also increasingly opting to factor climate considerations into all financing decisions, which should accelerate progress towards net zero in financed emissions.

One way in which HSBC is committed to helping the UK reach net zero by 2050 is through its work with Imperial College London, the University of Birmingham and the National Trust.

One way in which HSBC is committed to helping the UK reach net zero by 2050 is through its work with Imperial College London, the University of Birmingham and the National Trust.

HSBC UK partnered with Imperial College London and the University of Birmingham to accelerate the growth of clean tech start-ups. The two accelerator programmes will provide businesses with research expertise, intensive coaching to help redesign business and technology models, grant funding and will run educational workshops to attract commercial investment for ventures to scale. 150 UK start-ups are expected to participate over the next four years.

To further the focus on innovation and nature-based solutions to tackle the climate crisis, HSBC UK have also partnered with the National Trust to create carbon rich habitats. Together, they will plant two million trees across 2,000 hectares of new woodland habitat over the next four years, locking in 1.25 million tonnes of carbon. The partnership aims to open the door for National Trust to explore new areas of agroforestry management and how nature-based solutions are being scaled and delivered to tackle climate change internationally. The programmes are part of a global Climate Solutions Partnership led by HSBC, WRI and WWF, backed by $100 million of philanthropic funding from HSBC over five years.

Transition is hard but every sector has its own role to play. Through developing effective sustainable finance programmes that offer companies wishing to innovate to cleaner, healthier products and processes, financial institutions are playing their part in enabling an easier transition.
4.2: Building more sustainable and equitable societies

In last year’s State of the Relationship report, we set out that whilst businesses and universities were impacted profoundly by the pandemic, their continued collaboration was critical to recovery. The pandemic shone a spotlight on what collaboration can achieve, with the important collaboration between the University of Oxford and AstraZeneca generating a Covid-19 vaccine that is saving and changing lives around the world.

Now, as we refocus other global challenges and opportunities, it is critical to maintain momentum. The global impacts of UK science have never been so clearly on display, and there are many more opportunities for groundbreaking collaborations to help build more sustainable, healthy, and equitable societies.

We asked a number of contributors, including Cisco, Huawei and NCUB’s Strategic Advisor, Bob Sorrell, for their thoughts on the innovations and collaborations that they thought would really shift the dial on some of the greatest challenges facing the world today. This section also offers a number of inspiring case studies of business-university collaborations, enabled through NCUB’s konfer brokerage tool, that are leading to groundbreaking innovations.

Climate change – A critical driver for innovation

**DR BOB SORRELL**
Strategic Advisor to NCUB and Chair of the Campaign for Science and Engineering (CaSE)

Multifaceted challenges like climate change require a systems-based approach which allows point solutions to be assessed in the context of their impact on the overall ecosystem. This can potentially identify unintended consequences of actions taken which limit solutions to single pathways or block off or dismiss options at too early a stage. At the end of the day there is no silver bullet for climate change, and we will need all the options available if we are to successfully address this challenge. The selection and deployment sequence of these options will have a critical impact on the timescale and cost in which the challenge is addressed.

Circularity arguments are important such as materials re-use, for example recycling of RSJs in the building industry into new structures or recovering precious metals from catalytic convertors; the principles behind which will be critical for future energy needs from batteries to hydrogen production. There is an opportunity to think beyond the operational lifetimes of the hardware and to design things for ease of raw materials recovery at end of life. Repurposing of existing infrastructure will also offer significant savings in terms of energy and cost; the repurposing of the gas networks from natural gas to hydrogen being a case in point.

The question then is how to access, develop and implement the innovative solutions needed to address the challenges we face. A regulatory framework that supports implementing innovative solutions and the ability to prototype and scale at pace will play a key role in enabling the UK to lead in this field.

A key challenge for small energy technology companies is to gain market access, often they need either a first customer or access to large scale physical (hardware) or data sources. Here the Government and hard-fought lessons from Covid-19 can help.
During Covid-19 the Government acted as the first customer for vaccines, ventilators, and a whole raft of other technologies. At the same time, it enabled the creation of a more flexible regulatory framework to accelerate bringing innovative solutions to market. Businesses can develop new technologies, what they need is market access and assurances of a supportive regulatory framework. Sometimes unintentionally, existing, and often outdated regulations remain on the statute book and act as unintended barriers. During Covid-19 the Government by acting as first customer and providing market access did a huge amount in accelerating the delivery of innovative solutions to the market. The challenge now is how do we continue on the same footing to meet challenges like climate change without reverting back to the way things were before and losing momentum and the opportunity for the UK to lead in many areas. Work processes like “agile” attempt to create the sense of urgency needed and focus on the critical items rather than trying to solve everything simultaneously. Digital is also radically reshaping the way we work and there is a need to take time out to invest effort in understanding what it can deliver as many companies are doing today. Universities have a key role to play in providing people with the necessary skills and businesses can help by communicating the practical examples of where the impact of digital technologies can be felt.

Digital tools are revolutionising the way we work. The trick here is not to simply create better digital versions of what we already have but rather use these tools to create innovative out of the box type solutions to the challenges we face. Digital tools, combined with new ways of working such as using agile methodologies, are helping to create innovative solutions and drastically reduce the product development cycles enabling these solutions to be realised in the marketplace much faster.

The challenges we face combined with the techniques we now have at our disposal make this an extraordinary period of innovation. What sits at the heart of enabling this to flourish is collaboration between government, academia, and business. Bringing together innovative ideas within a supportive regulatory framework and the ability to scale and deploy the solutions at pace will enable innovative products and services to be brought to market in a timely fashion. There is a significant role for public private partnerships to drive innovative solutions for the future and put the UK at the forefront of developments.

There is a significant role for public private partnerships to drive innovative solutions for the future and put the UK at the forefront of developments.
A focus on future trends in technology and innovation: Huawei’s perspective

MICHAEL HILL-KING
UK Collaboration Director, Huawei Technologies

Over the past few centuries we have experienced industrial revolutions. Well-known examples include the mechanisation in textile industries which reduced the amount of human effort required for production. Alongside that came technological changes in handling raw materials such as iron and developments in the steam engine. Each of these innovations led to a change in labour and skills requirements and to land use, the extractive industries and transportation, and importantly, urbanisation.

Later innovations brought grid electrification that enabled mass adoption of new machines in businesses and homes. Electrification also prepared the ground for the use of computers, telecommunications, broadcast and other changes to how life was lived. Achievements in flight and propulsion, as well as automotive technology led to mass travel and large public investment in transport infrastructure. Technology has been at the root of industrial revolution and in each case new possibilities for humanity are afforded by technological advances.

There is expectation that technological advances will continue to be developed, but the boundaries for such development and the limits to growth are becoming more apparent. Historically, technological innovation could be viewed as progress. Over recent decades we have become more aware of global resource finitude and the long term effects of greenhouse gas emissions.

"Historically, technological innovation could be viewed as progress. Over recent decades we have become more aware of global resource finitude and the long term effects of greenhouse gas emissions."
Public consciousness of the role that technological advances have played in acerbating these issues is elevated. Technological innovation is more complex and relies, to an increasing extent, on the skill of highly educated scientists and engineers.

Huawei has identified several directions for future development. Now, as a technology leader, the company has to look further ahead. Across the information and communications technology (ICT) industry global trends are towards convergence — convergence of networks and of information storage and information processing in the cloud. Huawei employs over 100,000 R&D staff to bring the best products to customers; that includes product innovation, technology innovation and basic science and engineering.

The past decade has seen a growth in Huawei's investment on basic science and engineering, now reaching around 10,000 researchers and scientists with an annual budget of $3bn. Increased focus on basic technologies has led to increased interaction with universities and other research organisations. That interaction takes the form of sponsored research to explore topics beyond the state-of-the-art pushing the frontiers of discovery.

Thinking ahead, Huawei has identified eight strategic research initiatives to enable and support future technological innovation. These eight strategic research initiatives are

(1) hyper reality;
(2) connectivity beyond 5G;
(3) photonics;
(4) new internet protocols;
(5) smart edge as a service;
(6) next AI;
(7) neo-computing;
(8) trustworthy world.

These fully support Huawei's corporate vision to bring digital to every person, home and organisation for a fully connected, intelligent world. At its essence that vision can be represented as all things sensing, all things connected and all things intelligent.

All things sensing - includes enhanced human experiences, sensing through the digital world. Two strategic research initiatives are strongly related to this vision: advances in hyper reality and; connectivity beyond 5G. Hyper reality is the concept of enhanced virtual experiences to immerse people in places and situations for a better experience of gaming or video calling for example. 5G has been with us for a few years and the pathway for the evolution of future generations of mobile connectivity is beginning to emerge. Both of these technological fields can reduce the need for travel and bring people closer together for work and social interactions.

All things connected - speaks of data going online with ubiquitous connections and connectivity. For that scientific breakthroughs are needed in three key strategic research initiatives. Photonics forms the backbone of the internet and is a field that is constantly developing with new discoveries in materials, optical fibres and coding. The data that travels across the internet follows protocols that were developed long ago, designed for application scenarios very different from today's internet traffic. So, new, and better, internet protocols will be welcomed. As the internet of develops, many services will be brought to the edge to reduce both response time and energy dissipation, so future plans include edge related technological advances and standards.

All things intelligent - unleashes the potential of big data to enhance experiences, add value, reduce costs and diminish energy dissipation. Three strategic research initiatives align with the vision for all things intelligent. Machine learning and artificial intelligence technologies have advanced much in recent decades and are beginning to disrupt many industries, just like the way that previous technological innovations have led to industrial revolutions. Computer architecture is based on concepts that have served us well for a long time, but we seek new designs that can run efficiently and quickly on neuromorphic platforms. In this intelligent, connected and sensing world, the requirement for trustworthiness is poignant, so fair, fast, robust, reliable and economical solutions will need to be found. Trustworthiness engineering is a key strategic research initiative and underpins the future of ICT.

Each of these eight strategic research initiatives not only builds upon but will rely on new academic theories, new materials, and new designs from scientific breakthrough. Working with our universities partners can accelerate those discoveries and train students for working with us to create the future.
Climate change and sustainability have become key global topics in recent years as the world tries to mitigate the potentially disastrous consequences of global warming and the over-consumption of precious raw materials on the planet. The scientific community have provided sufficient evidence around the severe consequences of continuation of existing economic models and living norms. The criticality around this issue is demanding a change to how businesses operate, how people live their lives, how food is produced and how we make products. Protecting the planet for future generations is paramount as a species.

Many people will be familiar with topics such as global warming and climate change. There is less familiarity with concepts such as the ‘circular economy’ and the implications for existing business models and living norms as the world transitions to circularity. The existing linear model of ‘take, make dispose’ which is prevalent in nearly all existing product value chains will require substantial change towards a circular model that makes better use of our limited natural resources.

Legislation and policy makers around the globe have made significant progress in laying the groundwork for nations, businesses and citizens to reduce greenhouse gas emissions and adopt more sustainable practices. Despite this, significant challenges remain in executing on the ambition and direction of climate related legislation and policy decisions. The challenges are clear and the ambition is clear. Successful transformation will require the transformation of economic systems and living norms that have existed on a linear model for centuries.

The circular concept starts with circular design, an approach to ensuring any product design utilises materials that can be ultimately decomposed back into raw materials for future use and not sent to landfill. In addition, longevity of the useful product lifecycle of a product is supported by easy repair, easy upcycling and commercial models that allow product consumption in a sustainable manner.

“

The critical role of co-operation among all stakeholders, including academia and industry, is very clear.

“
Many large corporations will have the resources to execute on these principles, engage the design expertise, manufacture or procure product from a sustainable supply chain, introduce repair, return and recycle services while ensuring a profitable transition. The journey for the SME type company is more arduous. Bridging this gap will be one of the world’s biggest obstacles to overcome on the transition to a circular economy.

Knowledge institutions and universities carry out critical research, provide education and training on many areas and their role in the transition to a circular economy is on the critical path for success. There are many key research areas required across all verticals, for example:

• Production process analysis to assess opportunities for energy reduction and sustainable material substitution
• Circular product design including packaging
• New sustainable material efficiency & safety
• Business model analysis for circular products & services
• Circularity approaches in priority sectors such as construction, fashion, agriculture
• Sustainable sourcing & economic models

The challenges are clear and the ambition is clear. Successful transformation will require the transformation of economic systems and living norms that have existed on a linear model for centuries.

Collaboration of academia and industry will also be critical to pilot new business models, new production processes, implement traceability solutions for product takeback of high value items, optimise supply chain procurement and logistics. In addition to the extensive research required, new technology innovations will be required especially around the sourcing and procurement of reusable raw material. In most countries and industries, this secondary market does not exist to any extent. Complete value chain analysis is required on a verticalized basis to guide the development of these technology platforms for sustainable material sourcing.

Currently, a lot of fragmentation exists in coordinating the sustainability activities of industry, not for profits, research institutes and policy makers. National coordination is required with guiding principles and common objectives. According to the OECD, a national strategy should encompass:

• An analysis of stocks and flows to identify key sectors that can generate economic benefit along with good social and environmental impacts.
• Mapping of existing circular economy related initiatives
• Setting of clear and actionable goals with expected outcomes
• Allocation of budgets and resources
• A shared understanding and co-creation with stakeholders to build consensus and vision

The critical role of co-operation among all stakeholders, including academia and industry, is very clear.
Making connections to help change the world

SHIVAUN MEEHAN
Stakeholder and Communications Manager, konfer

The National Centre for Universities and Business (NCUB) developed the digital collaboration tool, konfer, to provide simple, unified access to research and innovation opportunities in the UK and around the world, supporting the translation of discoveries into commercial solutions.

Konfer harnesses AI-powered, “smart-matching” technology to rapidly connect universities with relevant businesses and other organisations, making it easier and quicker to develop research and innovation partnerships.

After categorising open access data from 153 UK universities, NCUB developed a konfer directory of thousands of ‘innovation-ready’ UK SMEs, including details of research projects undertaken and intellectual property developed. Konfer showcases international challenges and commercial opportunities across a wide range of sectors. The platform matches relevant UK experts and businesses, both with each other and with innovative organisations around the world.

We illustrate how companies, using konfer, are making connections with universities, to develop innovative ideas and drive forward their R&D programmes.

Konfer at a glance

153
Universities and institutions connected to our platform

151k+
Academics are part of Konfer

1.6m+
Research publications and projects

15.9k+
Facility and equipment listings available

46k+
Businesses
Cornerstone/ Antser
Antser, through the Cornerstone Partnership, a konfer-featured company, are using virtual reality to tackle a range of issues affecting children and families. Their pilot scheme produced startling results in a groundbreaking pilot scheme addressing domestic abuse. konfer connected the business with a team of VR specialists from a leading UK university, who are now helping them develop new offerings which they believe will be truly groundbreaking. Serena Hadi, Antser’s Head of Service, said: “Our experience with konfer has been excellent. The connection we’ve made with a leading university couldn’t be more right for us. We’re now working with some truly innovative academics and we’re really excited about the project.”

National Nuclear Laboratory- BEIS
The Advanced Fuel Cycle Programme (AFCP) is part of the BEIS £505m Energy Innovation Programme. AFCP is led in partnership with the National Nuclear Laboratory (NNL). Working with the Game Changers innovation programme, NNL used konfer to promote a research funding opportunity. This research relates to coated particle fuels, a prospective advanced nuclear fuel technology that has the potential to accelerate transition to a ‘net zero’ carbon emission future. Through konfer, funding has been offered to support feasibility and proof of concept projects to a research team at University of Sheffield.

Science and Technology Facilities Council
The Science and Technology Facilities Council (STFC) supports research in astronomy, physics, space science and operates world-class research facilities for the UK. They used konfer to find collaboration partners in the fields of miniaturised, high performance gas sensors, including for the purposes of real-time monitoring ammonia emissions from agriculture. This would enable real-time early warning systems to flag rising levels of this significant global pollutant. konfer’s smart-matching technology enabled the organisation to rapidly engage with three businesses, including two UK SME’s. STFC is now actively working with one of these SMEs, Protea Ltd, with a view to co-developing a completed, cutting-edge product suitable for commercial application.

Teesside University and Nova Q
Through konfer, Teesside University is working with Nova Q a leader in the fields of agriculture, aquaculture, disinfection, renewables, and wastewater to demonstrate the potential of their micro-bubble aeration technology to drive sustainability. Dr Faik Hamad, Associate Professor in Thermofluid Engineering at Teesside University, said: “Water is essential to everything from agriculture to industrial processes; as the issue of pathogenic micro-organisms becomes more prevalent, micro-bubble aeration technology has the potential to tackle this issue in a way that is sustainable and safe. We are delighted to be working with konfer, who have provided us with simplified access to a network of thousands of businesses.”

Digital Catapult/ Babcock BAE
Run by Digital Catapult, in partnership with tech sponsors and funded by UKRI, the Made Smarter Technology Accelerator gives Industry Challenge Owners the chance to bring in start-up expertise to fuel innovation, boost productivity and accelerate the fourth industrial revolution. Digital Catapult used konfer to reach out to businesses and universities working with industrial partners, including GAF, Nothumberian Water, O’Neills, Safran, Babcock and BAE Systems. Two of the SMEs that konfer connected to the Catapult were selected as part of the first stage of the programme. Both have now succeeded in reaching the second (MVP) phase, out of four companies to reach this stage.

Machine Intelligence Ltd (BAE Systems, the scalable artificial intelligence for visual inspection challenge): the MVP will use machine learning to identify defects in manufacturing, improve the quality of the end product, reduce waste and save money.

JetSoft (Babcock International Group, Warrior base overhaul challenge): This solution both reduces reliance on paper-based reporting to improve shop floor efficiency and utilises existing equipment to create automatic 3D inspections improving understanding of faults and operating performance.
4.3 The changing shape of partnership

University partnerships at Thales

DR MATT BALL
Chief Scientist/Head of Academic Liaison, Thales

In the UK, Thales has a wide range of academic partnerships that support the full spectrum of a diverse research agenda that underpins our future product and service offering into the breadth of our markets. We operate a flexible engagement strategy that delivers both corporate partnerships alongside capitalising on our geographic spread across the UK to leverage local relationships. The focus of these partnerships varies depending on the maturity of the science and nature of the technology.

For example, our strategic partnership with the University of Bristol sees us joining forces on an ambitious, EPSRC Prosperity Partnership, the Thales – Bristol Partnership for Hybrid Autonomous Systems Engineering (T-B Phase) which is advancing our understanding of the complex engineering challenges involved in deploying systems of human and autonomous machines to deliver particular mission objectives. Here we bring together leading academic insight into novel approaches to multi-agent system design with Thales engineers working at the forefront of our autonomous systems research programme. This provides a powerful co-creation environment to develop a high-quality fundamental research programme directly informed by the real-world constraints and requirements often missing from academic research in this area.

Our partnership with the University of Southampton has a core focus on Maritime Autonomy mission planning and heterogeneous asset management. This enables us to combine the rich Maritime expertise and range of surface, sub-surface and aerial platforms of the university with our delivery experience and Maritime Autonomy Centre at Turnchapel Warf in Plymouth, where real-world trials and demonstrations of the academic work were carried out.

We have argued in this chapter that the world is experiencing a wave of change, characterised as much by its pace as by its scale. Policy makers and strategic leaders are grappling to understand the varied impacts of this change, as well as anticipate further drivers of change in future.

Universities and businesses are not passive participants in this process. We know that many university and business leaders are responding – changing the ways in which they work together to tackle challenges and unlock opportunities. In the summer of 2021, we launched a research project with the University Commercialisation and Innovation (UCI) Policy Evidence Unit to explore how the Covid-19 pandemic has impacted universities and their innovation-focused activities. As part of this, we are also investigating whether universities are changing their approaches to knowledge exchange in this context of change.

Below, we share reflections from Tomas Coates-Ulrichson at the UCI who sets out how universities contribute to innovation, and include contributions from Dr Matt Ball from Thales, Professor Simone Buitendijk, Vice Chancellor at the University of Leeds and Emma Flynn from Queen’s University Belfast on the future and the changing shape of partnership.
In order to shape the future of unmanned aircraft systems and their deployment at scale in this country, we are working closely with Cranfield University and other technology partners. Physical demonstration is crucial to unlocking the complex safety, regulatory, engineering challenges involved, and we are investing to capitalise on the unique research facilities and local infrastructure at Cranfield and collaborating with an ecosystem of technology providers to advance national industrial capability through the Industrial Strategy Future Flight Challenge project, Airspace of the Future.

The impact Covid-19 has accelerated many technological and societal trends and we all quickly learned how to effectively communicate and collaborate remotely which has many upsides, not least reducing the cost overheads involved in such partnerships. Also, the established familiarity with video conferencing and virtual collaboration tools, while by no means perfect substitute for face to face working, does mean we are able to access a broader range of experts from the our business to engage with research projects. Colleagues that previously would not have been able to justify the time to travel to meetings, can easily, for example, form a broader audience for our PhD presentations or now easily provide a remote briefing to the university research team.

The Thales UK corporate research programme forms a key part of a global R&T network, connecting to our research centres in France, Canada, Netherlands and Singapore. Again, the adoption of remote working practices greatly increases the efficiency of collaboration across this network and we have recently delivered successful remote placements for two of our EPSRC ICASE PhD students with our Canada Research and Technology Centre.

Looking to the future, the impacts of Artificial Intelligence, Autonomous Systems and Quantum Technologies will be far-reaching and comprehensive across all markets in which Thales operates.

The scale, pace and complexity of such technology developments means that to maintain a competitive edge in the global marketplace, the UK must get better at capitalising on the world class academic capability we rightly celebrate.

The complexity and interrelation of such cyber-physical and socio-technical systems and their impact on society and our infrastructure, means that simulation, test and validation facilities will continue to be vital to accelerating the journey to safe and trusted operation. As the examples describe, whether it is exploiting unique industry test and Digital Twin environments to simulate, validate and iterate university research outcomes or clustering with partners around unique university facilities such as the Digital Aviation Research Technology Centre at Cranfield University, each partner can provide capabilities that would not be economically viable for the other partner to develop.

Only through connecting these respective capabilities in a network of research and innovation assets, will we make the rapid progress and reduction in costs we need to overcome some of the key science and engineering challenges of our time.

Our strategic partnership with the University of Bristol sees us joining forces on an ambitious, EPSRC Prosperity Partnership, the Thales – Bristol Partnership for Hybrid Autonomous Systems Engineering (T-B Phase)
Collaboration over competition – unlocking symbiotic potential

PROFESSOR SIMONE BUITENDIJK
Vice-Chancellor, University of Leeds and Professor Nick Plant,
Deputy Vice-Chancellor: Research & Innovation, University of Leeds

The world is facing many complex, interconnected challenges. Tackling these is going to need collaboration on an unparalleled scale across institutions and nations.

As researchers, we often talk about ‘wicked problems,’ so-called because of their complexity. They include the climate crisis, maintaining health and wellbeing across an ageing population, food and energy security, and emergent pathogens, such as Covid-19 and SARS. These problems are further exacerbated by increasing inequalities across the globe.

Universities and businesses have a long history of innovation and entrepreneurship based on collaboration, but there’s never been a more important opportunity for us to step up and make a big impact on society by tackling these issues together.

We are perfectly placed to explore, innovate, and deploy solutions to these problems. To do this, we need to make it easy to work together, engage effectively to identify the problems that need solving, and use digital technology in innovative ways, making it available and accessible across our workforces, locally, nationally and globally. This is consistent with the thrust of our new strategy at the University of Leeds Universal Values, Global Change.

Collaboration starts by connecting people. To do so, universities must make it easier for businesses to access facilities, training, and talent. There must be clear entry points that can signpost businesses to the appropriate contact for specific enquiries. Alongside this, we need themed networking events that allow more ad hoc exploration of collaborative opportunities.

To make sure we’re asking the right questions before we even start to explore solutions, universities and businesses must engage deeply from the beginning. It may seem an obvious thing to do, but in the past, we may not have always done this in the research community. It is critical to making sure we use resources in the most effective way, delivering novel solutions that target key problems.
At the University of Leeds, collaborations such as the Future Fashion Factory with the UK textile industry or GCRF-AFRICAP with all components of the food system in Africa are taking this approach. These projects have created diverse networks with industry, policymakers and other universities, which are crucial to making sure we understand the problems and find solutions that work for everyone, whether that’s using digital technologies to make the fashion industry more sustainable, or helping farmers adapt to climate change.

The Covid-19 pandemic has undoubtedly forced an acceleration of the digital transformation that was already underway within many universities and businesses. The need to move from in-person to virtual operations has created a step-change in how we collaborate. By removing geographical boundaries through digital transformation, it has become easier than ever to bring together collaborating teams.

We need to keep this momentum and seize opportunities to facilitate more accessible and diverse ways of working together, enhancing the development of ideas and delivery of collaborative projects. The use of immersive technologies, for example, allow pseudo-physical interactions between people, whether they are in different rooms or on different continents. For instance, Virtuocity at the University of Leeds supports collaboration between automotive manufacturers, government agencies and academics. Through immersive, human-in-the-loop simulation and visualisation, we can develop and prototype solutions to future challenges, such as urban mobility and urban dynamics.

Alongside this, we must ensure the people working in our organisations are supported with the skills to thrive in this new digital era by upskilling current staff and preparing the future global workforce. Collaborating with businesses helps tailor our curriculum to equip students with the knowledge and skills that meet the needs of society and employers. Likewise, continuing professional development of the current workforce is most effective as a collaborative effort: responding to business need and benefiting from the skills, experience and mentorship of business leaders on programmes.

The future of collaboration also has a significant role to play in reducing local and global inequalities, creating a more diverse and inclusive workforce. For example, in the Leeds City region, a range of partners have been supporting entrepreneurs from underrepresented groups to develop their businesses through the BUILD programme.

Of course, collaboration won’t only be virtual in the future. Indeed, we are already seeing an increased demand for spaces that connect, inspire, and facilitate physical interaction and innovation. Innovation hubs such as Nexus at Leeds bring together SMEs, large corporates, regional entrepreneurs, students and academia, driving innovation and entrepreneurship through collective support and collaboration.

Through collaboration, universities and business have a unique opportunity to respond to our world of complex and evolving challenges. If we remove barriers through digital transformation, move towards more agile, collaborative working in the pre-competitive space, and make sure all voices have an equal opportunity to engage in this journey, we can help shape a better and fairer future for all.

Collaborating with businesses helps tailor our curriculum to equip students with the knowledge and skills that meet the needs of society and employers.
Agile and integrated partnerships between industry and academia provide the foundation of a successful innovation economy

PROFESSOR EMMA FLYNN
Pro-Vice Chancellor for Research and Enterprise, Queen’s University Belfast

Much has been written about the changing shape of partnerships between universities and businesses. The traditional understanding of this relationship was that the university serves as a centre of knowledge for research and development alongside developing the future skilled workforce, with the outcome being the delivery of short-term solutions to meet a business’ objectives.

Increasingly, we are seeing an evolution from this linear transaction of knowledge to a model characterised by circularity and long-term partnerships involving a broader ecosystem across public and private sectors and multiple industries to meet longer term goals for the benefit of wider society. The most successful examples of this model demonstrate that the investment of time, effort, and commitment to establish such partnerships is repaid through the creation of an innovation ecosystem that is characterised by agility and enabled by a mutually understood shorthand in the exchange of information across parties. This means that not only are long term goals achieved in less time, but also that solutions to unexpected or urgent challenges are found faster.

The Covid-19 pandemic has provided a profound global example of not just the benefits, but perhaps the necessity, of interconnected ecosystems, shared knowledge and a common objective across institutions, industries and indeed nations. In Northern Ireland we can illustrate this developing
relationship through our partnership with Seagate Technologies. We first collaborated with Seagate Technologies on data storage materials research in 2005. The initial success of this collaboration meant that in 2010 Seagate established a £7.5m advanced material research and development hub in Queen’s, leading to the 2013 launch of the Photonic Integration and Advanced Data Storage (PIADS) EPSRC Doctoral Training Centre as well as collaborations on other initiatives from undergraduate placements through to funded Chairs. The partnership culminated in the award of a £42.4M UK Research and Innovation’s Strength in Places grant for ‘Smart Nano NI’ in 2021, a nano technology project focused on developing world-leading innovative technology for medical devices, communication, and data storage. The Smart Nano NI consortium demonstrates the complex ecosystem, including Ulster University, Northwest Regional College, three highly specialised technology-led spinouts from Queen’s University; Analytics Engines, Causeway Sensors and Cirdan Imaging, the innovation agency Digital Catapult NI, and test equipment manufacturer, Yelo. This

Higher Education-Industry collaboration presents benefits and opportunities on multiple fronts. It is estimated that the project could lead to the creation of over 500 jobs, a £250m increase in exports and the injection of around £100m in Foreign Direct Investment over the next 10 years.

This agile and integrated partnership is further illustrated by the Innovation City Belfast project which brings together industry, academia, policy, and civic leadership to identify and support the innovative potential of the Belfast Region through initiatives such as the £1bn Belfast Region City Deal (BCRD). BCRD’s mission is to deliver the necessary infrastructure and transformative projects that are designed to position the region as a globally competitive destination for digital and innovation investment, securing future prosperity and growth. Smart Nano NI forms part of the Photonics strand of the Advanced Manufacturing Innovation Centre, which is itself one of the innovation pillars of the Belfast Region City Deal, demonstrating the interconnectivity of the objectives and ecosystem that we are leading and developing in Northern Ireland.

As the Government’s levelling-up agenda and post-pandemic recovery plans kick in to action, now more than ever universities serve as a linchpin between society and industry.

As the Government’s levelling-up agenda and post-pandemic recovery plans kick in to action, now more than ever universities serve as a linchpin between society and industry. The partnerships between academia and industry, alongside civic and political leadership, will continue to adapt rapidly to a new way of working for the benefit of wider society at a local, national, and global level.
Report conclusions

We have set out in this report that in the years to come the UK faces two seismic challenges. The first is how to adapt and remain competitive in a world changing at an unprecedented rate in the Fourth Industrial Revolution. The second is responding to the urgent climate change crisis.

Responding to these challenges requires the same collaborative, systemic approaches taken in response to the pandemic. Universities, businesses and government – whilst weathering the storm of change themselves – must be bold in their endeavor to recover, discover and collaborate.

Unlocking innovation is critical too so that UK businesses remain resilient and can grow in a changing world with difficult trading conditions, whilst also boosting productivity, generating high-value jobs, becoming greener and driving further advances in technology, medicine and energy.

This year’s State of the Relationship report demonstrates the critical contribution that collaboration makes to the UK’s economy and society. In the years to come, many of the business and university leaders who contributed to this report recognise that collaboration will be of critical importance.

However, NCUB’s latest Collaboration Progress Monitor, set out in section 2, signals potential challenges ahead. Although important indicators of research commercialisation, including patents and licenses, grew, the number of interactions between universities and businesses, particularly SMEs, fell. There is a need to better understand the reasons and consequences of this decline, and to monitor future trends. In particular:

1. Whether the overall number of interactions recovers and grows, in particular the number of interactions with SMEs
2. Whether the increase in research commercialisation is sustained in future years
3. Whether the UK succeeds in growing mobility between industry and academic careers

The CPM offers important insights into the scale of collaboration in the UK, as well as its outcomes. Beyond this, this report, as well as others in the State of the Relationship series, demonstrates that the ways in which businesses and universities work together is ever evolving. We draw on three particular trends.
The first is the changing shape of innovation and places and the rise of innovation districts. We observe that despite the rise of engaging and collaborating online during the pandemic, geographical proximity remains important for collaboration, with the emergence of many new urban innovation places that aim to drive inclusive growth.

The second trend identified is a commitment to new, collaborative initiatives to build a more dynamic and diverse researcher workforce. We demonstrated a number of different national and institutional initiatives, as well as examples from abroad. Finally, we recognised the important breadth of university commercialisation activities, shining a spotlight on the important role universities play in supporting so-called “spin-ins”.

As well as looking at recent trends, the report also looks forward. In section 4, several business and university leaders provide their thoughts on wider changes around the world, and their implications for business-university collaboration.

What is clear is that to become the science superpower that we aspire towards, the UK should not simply grow each individual part of the innovation system. The UK must also strengthen the interconnectedness of the system, such that the sum becomes much stronger than the parts. That is why becoming the best place in the world for research and innovation, also requires becoming the best place in the world for collaboration.
Annex A: collaboration progress monitor data tables

Table 1: Collaboration Progress Monitor on Research and Innovation: Collaborative activity, investment in collaboration, and products of collaboration, UK-wide

<table>
<thead>
<tr>
<th>Indicator</th>
<th>5 Year Average 2016-2020</th>
<th>2020 Actual</th>
<th>5 Year Average 2015-2019</th>
<th>2019 Actual</th>
<th>Difference from 2019 to 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>HE income from business collaboration (excluding IP)</td>
<td>37.8%</td>
<td>36.0%</td>
<td>38.1%</td>
<td>39.7%</td>
<td>-3.7%</td>
</tr>
<tr>
<td>Business Funds in HE</td>
<td>4.4%</td>
<td>4.0%</td>
<td>4.5%</td>
<td>4.5%</td>
<td>-0.5%</td>
</tr>
<tr>
<td>Overseas funds in HE</td>
<td>17.2%</td>
<td>16.2%</td>
<td>17.3%</td>
<td>17.9%</td>
<td>-1.6%</td>
</tr>
<tr>
<td>HEI interactions with SMEs</td>
<td>77,909</td>
<td>53,329</td>
<td>83,122</td>
<td>87,266</td>
<td>-33,937</td>
</tr>
<tr>
<td>Total income from interactions with SMEs (£000s)</td>
<td>£241,961</td>
<td>£218,682</td>
<td>£242,290</td>
<td>£270,366</td>
<td>£-51,684</td>
</tr>
<tr>
<td>HEI interactions with large business</td>
<td>26,056</td>
<td>25,018</td>
<td>25,884</td>
<td>25,610</td>
<td>£-592</td>
</tr>
<tr>
<td>Total income from interactions with large businesses (£000s)</td>
<td>£722,893</td>
<td>£690,107</td>
<td>£726,265</td>
<td>£759,979</td>
<td>£-59,972</td>
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<tr>
<td>Innovate UK academic grants</td>
<td>802</td>
<td>812</td>
<td>801</td>
<td>813</td>
<td>-1</td>
</tr>
<tr>
<td>£ per Innovate UK academic grant</td>
<td>£239,236</td>
<td>£194,988</td>
<td>£229,858</td>
<td>£262,039</td>
<td>£-67,051</td>
</tr>
<tr>
<td>Licenses granted</td>
<td>10,194</td>
<td>16,505</td>
<td>7,874</td>
<td>12,719</td>
<td>3,786</td>
</tr>
<tr>
<td>Income from licensing (£m)</td>
<td>£159.95</td>
<td>£186.36</td>
<td>£143.66</td>
<td>£198.98</td>
<td>£-12.61</td>
</tr>
<tr>
<td>Patents granted</td>
<td>1601</td>
<td>2027</td>
<td>1390</td>
<td>1,867</td>
<td>160</td>
</tr>
<tr>
<td>Academic spinouts</td>
<td>1181</td>
<td>1316</td>
<td>1120.6</td>
<td>1,316</td>
<td></td>
</tr>
</tbody>
</table>

Sources: HESA, Innovate UK

Table 2: Collaboration Progress Monitor on Research and Innovation: Collaborative activity, investment in collaboration, and products of collaboration, by UK country

<table>
<thead>
<tr>
<th>Indicator</th>
<th>4 Year Average 2017-2020</th>
<th>2020 Actual</th>
<th>4 Year Average 2016-2019</th>
<th>2019 Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ENGLAND</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HE income from business collaboration (excluding IP)</td>
<td>37.3%</td>
<td>35.3%</td>
<td>37.8%</td>
<td>39.2%</td>
</tr>
<tr>
<td>HEI interactions with SMEs (£000s)</td>
<td>56,941</td>
<td>38,446</td>
<td>64,177</td>
<td>71,822</td>
</tr>
<tr>
<td>Total income from interactions with SMEs (£000s)</td>
<td>£194,369</td>
<td>£169,421</td>
<td>£198,040</td>
<td>£217,455</td>
</tr>
<tr>
<td>HEI interactions with large business (£000s)</td>
<td>19,877</td>
<td>18,069</td>
<td>20,281</td>
<td>19,657</td>
</tr>
<tr>
<td>Total income from interactions with large businesses (£000s)</td>
<td>£507,352</td>
<td>£573,332</td>
<td>£616,387</td>
<td>£632,633</td>
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<tr>
<td>Innovate UK academic grants</td>
<td>683</td>
<td>663</td>
<td>651</td>
<td>656</td>
</tr>
<tr>
<td>£ per Innovate UK academic grant</td>
<td>£231,633</td>
<td>£203,449</td>
<td>£265,660</td>
<td>£266,239</td>
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<tr>
<td>Licenses granted</td>
<td>10029</td>
<td>15225</td>
<td>7530.25</td>
<td>11469</td>
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<tr>
<td>Income from licensing (£m)</td>
<td>£146.33</td>
<td>£177.00</td>
<td>£133.38</td>
<td>£182.30</td>
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<tr>
<td>Patents granted</td>
<td>1431</td>
<td>1763</td>
<td>1190</td>
<td>1530</td>
</tr>
<tr>
<td>Academic spinouts</td>
<td>827</td>
<td>900</td>
<td>776</td>
<td>908</td>
</tr>
<tr>
<td>Indicator</td>
<td>4 Year Average 2017-2020</td>
<td>2020 Actual</td>
<td>4 Year Average 2016-2019</td>
<td>2019 Actual</td>
</tr>
<tr>
<td>-----------</td>
<td>--------------------------</td>
<td>-------------</td>
<td>--------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td><strong>N. IRELAND</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HE income from business collaboration (excluding IP)</td>
<td>26.9%</td>
<td>28.2%</td>
<td>27.0%</td>
<td>31.1%</td>
</tr>
<tr>
<td>HEI interactions with SMEs (£000s)</td>
<td>1,163</td>
<td>1,044</td>
<td>1,110</td>
<td>1,072</td>
</tr>
<tr>
<td>Total income from interactions with SMEs</td>
<td>£5,582</td>
<td>£5,652</td>
<td>£5,246</td>
<td>£6,506</td>
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<tr>
<td>HEI interactions with large business (£000s)</td>
<td>401</td>
<td>355</td>
<td>447</td>
<td>416</td>
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<tr>
<td>Total income from interactions with large businesses</td>
<td>£9,920</td>
<td>£8,752</td>
<td>£8,697</td>
<td>£11,213</td>
</tr>
<tr>
<td>Innovate UK academic grants</td>
<td>29</td>
<td>24</td>
<td>31</td>
<td>44</td>
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<tr>
<td>£ per Innovate UK academic grant</td>
<td>£204,760</td>
<td>£204,031</td>
<td>£234,141</td>
<td>£337,317</td>
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<tr>
<td>Licenses granted</td>
<td>99</td>
<td>118</td>
<td>85</td>
<td>104</td>
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<tr>
<td>Income from licensing (£m)</td>
<td>£6.41</td>
<td>£0.41</td>
<td>£8.54</td>
<td>£4.98</td>
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<tr>
<td>Patents granted</td>
<td>29</td>
<td>10</td>
<td>34</td>
<td>29</td>
</tr>
<tr>
<td>Academic spinouts</td>
<td>62</td>
<td>77</td>
<td>56</td>
<td>63</td>
</tr>
<tr>
<td><strong>SCOTLAND</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HE income from business collaboration (excluding IP)</td>
<td>45.5%</td>
<td>43.3%</td>
<td>46.7%</td>
<td>46%</td>
</tr>
<tr>
<td>HEI interactions with SMEs (£000s)</td>
<td>1,639,660</td>
<td>1,308,000</td>
<td>1,766,500</td>
<td>1,338,100</td>
</tr>
<tr>
<td>Total income from interactions with SMEs</td>
<td>£38,530</td>
<td>£36,832</td>
<td>£38,448</td>
<td>£40,287</td>
</tr>
<tr>
<td>HEI interactions with large business (£000s)</td>
<td>4,961</td>
<td>5,826</td>
<td>4,600</td>
<td>4,566</td>
</tr>
<tr>
<td>Total income from interactions with large businesses</td>
<td>£90,994</td>
<td>£90,900</td>
<td>£91,897</td>
<td>£96,688</td>
</tr>
<tr>
<td>Innovate UK academic grants</td>
<td>90</td>
<td>96</td>
<td>83</td>
<td>84</td>
</tr>
<tr>
<td>£ per Innovate UK academic grant</td>
<td>£189,917</td>
<td>£167,391</td>
<td>£177,317</td>
<td>£235,851</td>
</tr>
<tr>
<td>Licenses granted</td>
<td>524</td>
<td>461</td>
<td>522</td>
<td>516</td>
</tr>
<tr>
<td>Income from licensing (£m)</td>
<td>£8.33</td>
<td>£6.49</td>
<td>£8.80</td>
<td>£8.75</td>
</tr>
<tr>
<td>Patents granted</td>
<td>261</td>
<td>209</td>
<td>234</td>
<td>256</td>
</tr>
<tr>
<td>Academic spinouts</td>
<td>228</td>
<td>237</td>
<td>216</td>
<td>244</td>
</tr>
<tr>
<td><strong>WALES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HE income from business collaboration (excluding IP)</td>
<td>31.0%</td>
<td>35.7%</td>
<td>29.0%</td>
<td>35.3%</td>
</tr>
<tr>
<td>HEI interactions with SMEs (£000s)</td>
<td>998</td>
<td>759</td>
<td>1,103</td>
<td>991</td>
</tr>
<tr>
<td>Total income from interactions with SMEs</td>
<td>£5,253</td>
<td>£5,777</td>
<td>£6,047</td>
<td>£6,119</td>
</tr>
<tr>
<td>HEI interactions with large business (£000s)</td>
<td>883</td>
<td>768</td>
<td>987</td>
<td>971</td>
</tr>
<tr>
<td>Total income from interactions with large businesses</td>
<td>£15,281</td>
<td>£17,123</td>
<td>£14,109</td>
<td>£19,445</td>
</tr>
<tr>
<td>Innovate UK academic grants</td>
<td>33</td>
<td>29</td>
<td>35</td>
<td>29</td>
</tr>
<tr>
<td>£ per Innovate UK academic grant</td>
<td>£122,325</td>
<td>£85,418</td>
<td>£140,486</td>
<td>£128,656</td>
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<tr>
<td>Licenses granted</td>
<td>553</td>
<td>701</td>
<td>480</td>
<td>630</td>
</tr>
<tr>
<td>Income from licensing (£m)</td>
<td>£2.67</td>
<td>£2.45</td>
<td>£2.62</td>
<td>£2.95</td>
</tr>
<tr>
<td>Patents granted</td>
<td>42</td>
<td>45</td>
<td>36</td>
<td>52</td>
</tr>
<tr>
<td>Academic spinouts</td>
<td>101</td>
<td>102</td>
<td>100</td>
<td>101</td>
</tr>
</tbody>
</table>
Table 3: Collaboration Progress Monitor on Skills & Talent: joint people development, employment levels, and readiness for work

<table>
<thead>
<tr>
<th>Indicator name</th>
<th>Description</th>
<th>2019-20 (or 2018-19, marked *)</th>
<th>5-Year Average</th>
<th>Previous Year (2018-19 or 2017-18)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degree apprenticeship starts</td>
<td>Number of degree apprenticeship starts (level 6 and 7) in England.</td>
<td>20175</td>
<td>8502</td>
<td>13587</td>
</tr>
<tr>
<td>Higher apprenticeship participation</td>
<td>Number of Higher Apprenticeships provided by Universities in England, by apprenticeship participation.</td>
<td>26221*</td>
<td>8085</td>
<td>10497</td>
</tr>
<tr>
<td>CPD/CE courses for business &amp; the community</td>
<td>Total learner days of Continuing Professional Development (CPD) and Continuing Education (CE) courses for business and the community, provided by HEIs in the UK. Total learner days</td>
<td>4,016,338</td>
<td>3,994,423</td>
<td>4,373,625</td>
</tr>
<tr>
<td>Source of salary of HE staff: HE provider</td>
<td>UK Industry (in %) Percentage of all academic staff whose basic salary is ‘Wholly general financed by the HE provider’</td>
<td>75.96%</td>
<td>76.80%</td>
<td>78.22%</td>
</tr>
<tr>
<td>Graduate Employment (in %)</td>
<td>Percentage of UK-domiciled Undergraduate leavers who are in employment (full-time or part-time) in the UK, as a share of all Undergraduate leavers in the UK.</td>
<td>66%*</td>
<td>NA</td>
<td>69%</td>
</tr>
<tr>
<td>Postgraduate Employment (in %)</td>
<td>Percentage of UK-domiciled Postgraduate leavers who are in employment (full-time or part-time), as a share of all Postgraduate leavers in the UK.</td>
<td>78%*</td>
<td>NA</td>
<td>78%</td>
</tr>
<tr>
<td>PhDs in employment (in %)</td>
<td>Percentage of UK-domiciled PhD graduates entering employment: working in HE</td>
<td>TBA</td>
<td>NA</td>
<td>43.1%</td>
</tr>
<tr>
<td>HE leavers running own business</td>
<td>Number</td>
<td>Percentage of UK-domiciled HE leavers that run their own business as an activity.</td>
<td>5315</td>
<td>1.6%*</td>
</tr>
<tr>
<td>Private Sector Staff Inflow and Outflow</td>
<td>Number of HE academic staff (research and teaching) by previous employment vs. leaving destination: UK private sector inflow</td>
<td>7270</td>
<td>750</td>
<td>5934</td>
</tr>
<tr>
<td>HE leaver satisfaction</td>
<td>Percentage of HE leavers who are full-time employed and agree or strongly agree that they are currently utilising what they learnt during their studies: Undergraduate</td>
<td>68%</td>
<td>80%</td>
<td>NA</td>
</tr>
<tr>
<td>HE leavers on an internship in the UK</td>
<td>Number of UK-domiciled HE leavers undertaking an internship in the UK.</td>
<td>1050</td>
<td>155*</td>
<td>NA</td>
</tr>
<tr>
<td>Undergraduate students on a sandwich course</td>
<td>Percentage of Undergraduate sandwich student enrolments in the UK as share of all Undergraduate student enrolments.</td>
<td>25.7%</td>
<td>25.17%</td>
<td>25.9%</td>
</tr>
</tbody>
</table>

Sources: HESA, Department for Education
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