STATE OF THE RELATIONSHIP 2022

Analysing trends in UK university-business collaboration
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As Minister for Science, Research & Innovation, it is more important than ever that Britain delivers a bold, optimistic and ambitious plan to realise our vision for the UK as both a science superpower and an innovation nation. We can and should be the world’s most innovative economy, inventing and adopting the new innovations and technologies that will solve the challenges of tomorrow.

The UK has exceptional strengths in research and innovation. We have some of the best universities in the world, the strongest venture capital markets in Europe and deep ranks of talented and inspiring researchers and entrepreneurs. We should rightly be proud of that. But in a globally competitive world, we must be constantly improving to keep up.

Recognising this, the UK government has put enhanced emphasis on science, R&D, technology and innovation at the heart of both our economic growth plan and our global geopolitical strategy as set out in the Integrated Review. Just over a year ago we launched the UK Innovation Strategy. This recognised that university-business partnerships underpin economic growth and fuel our future. We are leveraging public funding to encourage the development and commercialisation of revolutionary innovations, to realise the potential of vibrant clusters across the country and to train the next generation of innovators, researchers and creative disruptors.

Universities are an integral part of the value chain to companies in this effort, providing access to highly-skilled people and facilities, and a network of services and people that have the capability to support company growth and therefore drive economic prosperity. In support of this, I remain committed to confirming association to Horizon Europe or developing a comprehensive alternative science, research and innovation programme for Global Britain that can harness international collaborations, nurture top scientific talent and support innovative businesses. The launch of the Advanced Research and Invention Agency (ARIA) will be instrumental in ensuring the UK is able to seize the opportunities of transformational technologies. And finally, I am committed to improving the UK R&D ecosystem through better retainment and sourcing of top talent, and better connecting the City of London and global investors to support high growth UK technologies and scale up companies, and growing R&D clusters. As part of our overall increase in R&D in CSR21, we have made a core commitment to increase the percentage of HMG R&D outside the Greater South East to help accelerate innovation-led growth and opportunities for all.

Critical to the road ahead is understanding the immediate consequences of the pandemic and its impact on universities and businesses’ abilities to drive forward innovation and growth. I am therefore grateful to the National Centre for Universities and Business (NCUB) for once again collecting the evidence contained in this annual State of the Relationship report. To address the challenges facing our society and to realise the commercial benefits of those solutions, companies will have to invest more in research and innovation.

Universities and businesses, working together, are responding to these challenges with a range of exciting, strategic, focused, and transformational collaborations – many examples of which are set out in this report.

I hope you will join me in welcoming the insights in the State of the Relationship 2022 report and I look forward to continuing to work with NCUB and everyone across the research and innovation system to enable more of these exciting and transformational collaborations in the years to come.
Introduction

2022 has been another year of substantial challenges and pressures to businesses and universities around the UK. Just like the pandemic years, it has shown their impressive resilience and highlighted their criticality in addressing the full range of economic, societal and environment challenges – and opportunities – facing the world.

As the UK re-opened post-pandemic, many universities and businesses needed a boost in activity to regain confidence and stability. However, with changing Prime Ministers and Cabinet members, and the accession of King Charles III, 2022 has been a time of uncertainty. Through the ensuing inflationary pressures, universities and businesses have been navigating difficult waters, from rising operational costs to the financial pressures of a weakened pound and reduced GDP.

Yet, in this ninth annual iteration of NCUB's State of the Relationship report, our analysis shows that universities and businesses are resilient and innovative in the face of challenge. Last year's analysis of activities and interactions across 2019/2020 showed that through the early stages of the pandemic, despite a small decline in the number of interactions between universities and businesses, we saw sustained increases in university commercialisation activities, such as new IP licences, patents and spinouts.

This year's analysis builds on these insights to present a more complete picture of the impacts of the pandemic, covering August 2020 to July 2021. In this year's report, we update on important events in the innovation policy landscape. Against the backdrop of shifting political, economic and global contexts, we share updated insights into the state and health of collaboration between universities and businesses, reporting updated metrics from the Collaboration Progress Monitor (CPM).

Alongside reflecting on the year past, we shine a light on, and celebrate, the critical role of collaboration between universities and business. We have invited an impressive cast of expert commentators and sector leaders to analyse the most exciting new trends in collaboration and to offer their reflections on what the future holds. The report also puts a spotlight on case studies that showcase the diverse array of collaborations between universities and businesses and the strength and impact they have.

2020-21 was a period where international partnerships carried uncertainty, as Horizon Europe association remains unsecured, yet we've found domestic collaboration to be strong. There is work to do in supporting a rebound in university-SME engagement, in building and maintaining institutions’ financial resilience, and in training and supporting a workforce with the skills for the future.

In a world of financial and economic turbulence, these interactions, and the shared purpose and mission that collaboration creates, is now more important than ever.

This year's analysis builds on last year's insights to present a more complete picture of the impacts of the pandemic, covering August 2020 to July 2021.
POLICY CONTEXT: NATIONAL PRIORITIES AND THE ROLE OF UNIVERSITY-BUSINESS COLLABORATION
Setting and shaping policy direction

FREDDIE JONES
Head of Policy and Engagement (maternity cover)

Few years in recent memory have had a more dramatic economic and political backdrop than 2022. The Death of Her Majesty Queen Elizabeth II marked a historic change for the UK and much of the wider world. Russia’s war of aggression in Ukraine, alongside the unspeakable human tragedy, created significant global disruption to the supply of oil and gas, other key commodities and goods. This contributed to rising inflationary pressures, just as demand in the global economy for these very things was picking up steam after governments began to initiate ‘post-COVID’ policies on economic reopening. The year also saw major shifts in UK politics, notably the resignation of two Prime Ministers. This contributed to broad economic headwinds, affecting business investment and planning decisions, while creating doubt around government priorities and policies of vital importance to universities and businesses.

Compared with 2021, there were few new major government strategies impacting on university-business collaboration. Instead, the policy focus was on delivering against the major proposals set out in the Plan for Growth, the Innovation Strategy and the R&D People and Culture Strategy – all published in the previous year. UK funders were also focused on developing their allocation plans following the 2021 Spending Review, which made historic commitments to public R&D spending – increasing to a record £20bn by 2024-25 with plans to increase this further to £22bn in the following two years.

The UK government continues to weigh up a final decision on association to the European Union’s Horizon Europe programme. UK researchers and innovative businesses have long made the case for accessing not just the €100 billion funding pot, but the network of international collaborations that the European programme supports across a range of critical societal and economic challenges. As we await a final decision, the UK government is rapidly developing proposals for a ‘Plan B’ domestic alternative programme in the event that a positive association decision cannot be reached. The UK is also adjusting to the transition away from European Union Structural and Investment Funding towards the new UK Shared Prosperity Fund. The EU funds were an important source of income for UK universities’ regional development activities, particularly important in supporting collaboration with local SME communities. There is widespread worry across the university system about the less prominent role that universities are likely to play in delivering the new domestic funding.

In May, the results of the Research Excellence Framework 2021 were published – the first comprehensive assessment of UK universities’ research excellence and impact since 2014. Notably, for the first time, the exercise considered all staff with major significant responsibility for research, helping to build an even more comprehensive picture of the breadth of university research activities across the UK. It also saw an even greater emphasis on the impact of universities’ research – increasing the weighting from 20% to 25% compared with the last exercise. The results demonstrate
that UK research remains globally significant – with 84% of all assessed activity judged as world-leading or internationally excellent, with exceptional breadth in our areas of disciplinary strength. Through impact case studies, the exercise also shone a light on the treasure trove of societal and economic outcomes that UK research capabilities are delivering, in partnership with businesses and others.

2022 also saw the development of three important independent reviews. The Tickell Review of Research Bureaucracy in July made recommendations to government, funders, universities and regulators to reduce low value bureaucracy in the research system. The Grant Review of UKRI examined the context, structures and performance of the major R&D funder after its first four years of operation, identifying recommendations around efficiency, governance, accountability, and efficacy – while highlighting many early successes for the organisation. Finally, Sir Paul Nurse – the original architect for the reforms that led to the creation of UKRI – has been undertaking a review of the organisational landscape for research, development and innovation, which – at time of writing - is expected imminently.

Looking forward

As the UK continues to emerge from the economic turmoil of the last two years, the political agenda will be dominated by how we build a stable fiscal platform while pursuing economic growth policies that start to put pounds in the pockets of people across the UK. At the Autumn Statement in November, it was very reassuring to see the Chancellor honour the previous Spending Review commitment to increase public spending on R&D to £20 billion by 2024/25. This shows that the government recognises that research and innovation will be a fundamental tool in driving a modern UK knowledge economy. Economic growth can only come from people and ideas. Sustained public investment and clear government leadership, working in lockstep with industry and the university sector, are essential factors in training and attracting a new generation of highly skilled people and empowering them to develop the ideas that will transform society and the global economy over the coming decades.

Our Collaboration Progress Monitor (CPM) shows some positive trends in collaboration between universities and businesses, but there are also challenges we need to respond to. The last two years of data show a drop in SME-university engagement in particular. SMEs are not only the engine of the UK economy, they are also typically the major disruptors that enable paradigm shifts in existing sectors creating entirely new sectors. They do this while often spinning out of or engaging with the world class research and technologies in university labs. As the Government looks to aim the UK economy away from crisis and towards growth, we should explore how we can use every tool in the box to enable smaller businesses and universities to work closely together.

As the UK’s economic strategy develops, there is an opportunity to align this explicitly to the major societal and economic challenges that the UK and the world face. Universities and businesses have an impressive array of expertise and capabilities that can help address climate change, energy security, emerging health threats, and more – and there is a time-bound opportunity to anchor much of the global economic advantage that can come from new technological solutions and innovations to these issues here in the UK. Making decisive choices that map clearly against global market potential and UK strengths should be an important feature of our future science and technology policy framework.

This advantage will only be secured by continuing to support the growth of strategic collaborations between universities and business.

“The UK is also adjusting to the transition away from European Union Structural and Investment Funding towards the new UK Shared Prosperity Fund.”
EXAMINING THE STATE OF THE RELATIONSHIP THROUGH DATA: NCUB COLLABORATION PROGRESS MONITOR
Introduction

Impactful collaborations between universities and businesses are critical to the UK’s future success. However, these collaborations themselves are not impervious to the impacts of external uncertainties and changes. NCUB produces and analyses an annual Collaboration Progress Monitor (CPM) to track trends and monitor progress in university-business collaboration. This chapter examines the main findings from this year’s CPM, which tracks 25 metrics of collaboration from 2020-21. It explores what the CPM indicates, but also considers what might be driving these trends. The CPM aims to help policymakers shape and define new initiatives and programmes that can ultimately enhance the ways in which universities and businesses work together and contribute to the UK’s economic and social growth. 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.
- 2020-21 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

With data from 2019-20, last year’s CPM began to reveal the impact of the COVID-19 pandemic on university-business collaborations. This year, it offers a more complete picture of the impacts of the pandemic, covering August 2020 - July 2021.

The pandemic, and the measures taken to prevent further spread through lockdowns and travel restrictions, had a profound impact on UK society and economic activity. In 2020, the UK economy experienced the largest hit to economic output in one calendar year since the deep recession that followed the First World War. UK GDP fell by an estimated 9.3%. Figure 1 shows monthly changes to UK GDP growth, with falls corresponding to months spent in lockdown and increases reflecting easing of restrictions. The rapid development and deployment of vaccines enabled the lockdowns to be lifted, and the economy reopened in the first half of 2021. In 2021, the UK’s economy grew by 7.5%. Globally, trends in economic growth during 2020 and 2021 are broadly similar to the UK (See Figure 2).

Figure 1: Contributions to UK’s monthly GDP growth

Source: ONS, GDP monthly estimate, 2022

Figure 2: GDP growth, UK and selected economies, quarterly (Jun 20 – Aug 21)

Source: OECD, economic outlook, 2022
The pandemic caused direct disruption to university and business operations, created new challenges to the way they work together, and led to shifting priorities and expectations. Offering early insights into the impact of the pandemic on collaboration, last year’s CPM – covering 2019-20 data – reported significant declines in the number of interactions, driven specifically by declines in interactions with SMEs. It also reflected a growth in commercialisation activities.

The CPM this year covers a full 12 months of data on collaboration, wholly affected by the COVID-19 pandemic, compared to the five months reflected in last year’s CPM. We therefore expected this year’s CPM would reveal deeper declines in the number of university-SME interactions compared to the previous year. We also reflected in last year’s report that “next year’s CPM will help to determine whether the strong levels of interaction with large businesses were upheld throughout the pandemic or whether disruptions to these partnerships just took longer to materialise.”

Of course, the actual impacts of the pandemic are complex. Whilst there was operational disruption, the world also saw a significant improvement in automation and digitalisation, allowing firms to innovate and become more globally connected. Innovation investment arguably thrived at the height of the pandemic and boomed in 2021. OECD analysis of R&D investment over time suggests that business R&D investment continued to grow in 2020, although at a significantly lower rate than in 2019 and with striking differences across countries and industries (OECD, 2022).

According to the WIPO (2022), intellectual property filing activity and international trademark filings grew during the pandemic. The world also saw the biggest boom in venture capital investment (VC) in 2021, recording levels comparable to the internet boom years of the 1990s. All of this arguably created a positive environment for collaboration, despite the practical disruptions and uncertainties.

1 OECD. (2022). Main Science and Technology Indicators.
Summary of findings

The CPM shows collaboration activities exceeding our forecasts. Whilst the number of interactions between universities and businesses did fall slightly in 2020-21, this was a smaller drop than we would have anticipated given the significant disruptions of the pandemic. This reflects that universities put significant effort into supporting and maintaining collaborations with business partners and their wider communities. Importantly, they were also able to pivot those partnerships to respond rapidly to the needs that arose during the pandemic, building on a long history of prior research and expertise to develop vaccines and treatments, support policy development through data and knowledge, and provide advice and guidance.

Additionally, whilst the number of collaborations declined, universities’ commercialisation activities grew. The CPM shows a significant increase in the number of newly registered spinouts and a positive growth in the number of patents and licences granted compared with the previous year. Overall, this demonstrates universities’ ability to adapt at speed and build resilience to large external shocks such as the COVID-19 pandemic. That adaptability and resilience will continue to be important in the months and years ahead, as the UK and the world face new challenges.

Universities put significant effort into supporting and maintaining collaborations with business partners and their wider communities.
University income from knowledge exchange activity with businesses showed a decline, reflective of disruption during the pandemic.

During 2020/21, universities reported a decrease of 10.1% in industry income from knowledge exchange (KE) activities (including consultancy, contract research, facilities and equipment and Continuing Professional Development (CPD), and excluding KE income with non-commercial organisations), falling from £1.1b to £991m. This contraction was especially driven by a decline in CPD activity (down by 21.3% in real terms), facilities and equipment-related activities (down by 11.4%), and contract research (down by 11% in real terms). These elements were particularly affected by lockdowns rather than by long-term changes in market demand. We might anticipate that future data will show these fields gathering pace and recovering throughout the second half of 2021 and onwards, reflecting the end of lockdown restrictions and rapid economic recovery over that period.

According to latest ONS data, the share of universities’ investment in R&D from overseas sources was 5% in 2020. The share of universities’ R&D funded by businesses recorded 8.8% in 2020. Due to changes in Higher education R&D data methodology, data for years prior to 2020 is yet to be available.

The number of university interactions with businesses saw a marginal decline over the last year, but these were not as deep as anticipated.

The CPM shows a decline in the total number of interactions between universities and businesses in 2020/21 compared to 2019/20. The total number of interactions fell marginally by 2%, from 78,449 in 2019/20 to 76,952 in 2020/21. The decline in the overall number of interactions was mainly driven by a decrease in the number of interactions with SMEs: a fall of 2.5% from the previous year (from £3,390 in 2019/20 to £2,032 in 2020/21). Overall, we see that levels of engagement with SMEs are still below the five-year average and were behind the volume of interactions registered before the pandemic. However, it is important to note that the fall between 2019/20 and 2020/21 was quite small, despite the fact that this corresponded with a series of COVID-19 lockdowns and other disruptions caused by the pandemic. This provides a promising sign that levels of university-SME interactions have stabilised. Importantly, the Monitor also shows that the value per interaction peaked in 2020 and remained high in 2021. This suggests that whilst fewer SME interactions took place, those that did were of a larger scale and more strategic.

During 2019/20, universities reported that large business interactions held

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3 Changes in methodology in HE R&D investment are due to new methodology adopted by the ONS: the Transparent Approach to Costing (TRAC). The new methodology uplifted universities’ R&D by £4.8bn (from a previous estimate of £9.1bn in 2019 to a revised figure of £13.9). This approach records full economic costs of all activities, including self-funded R&D of HE, which previous estimates did not consider. We will follow this data closely in the coming months to understand the differences in methodological and economic terms.
relatively steady, but that analysis of 2020/21 data would be needed to understand whether disruption to large business interactions just took longer to materialise. The CPM shows that even in 2020/21, the number of interactions with large businesses held strong, with only a marginal decline of 0.6% from 25,059 to 24,920.

During 2020/21, universities reported that total university income from interactions with SMEs and large businesses fell by 9.6% and 8.2%, respectively. Data from the Centre for Business Research/NCUB’s Business Interactions Survey shows that more than 40% of UK R&D active businesses surveyed indicated that COVID-19 led to delays and stoppages to existing projects. The survey also shows that 40% of businesses reported that COVID-19 had impacted their interactions with universities. The level of disruption was higher for innovators and companies in high-technology sectors.

Universities reported a 26.6% decrease in the number of Innovate UK grants from 2019/20. After reaching a peak in 2019/20, there was a significant decrease (38%) in the size of the average grant, now at £195k.

Commercialisation in UK universities continues an upward trend.

Despite the levels of economic disruption, universities reported significant commercialisation activity between 2020 and 2021.

Although real income from intellectual property activity with businesses decreased in 2020/21 by 13.2%, the volume of activity was encouraging. Universities issued 4.6% more licences, totalling 18,396 licences, the highest number ever registered in the HE-BCI data records since 2014/15. This increase was especially driven by a 9% increase in the number of non-software licenses and a 16% growth in the number of licenses issued to SMEs. However, income from licensing activity fell in real terms by 13%, from £198m in 2020 to £172m in 2021. The decline in 2020/21 was mainly driven by a 14% reduction in non-software licences and a 25% drop in other IP income. Despite the decrease in 2020/21, income from licensing remained aligned with the broader trends observed over the last five years.

Universities reported 2,078 patents granted, up by 8.8% from 2019/20. This number of patents exceeded the five-year average, as did the previous year’s total of 2,027. Universities also saw an increase of 4.5% from 2020 in the number of spin-out companies that had survived at least three years – suggesting that universities continue to mature effective institutional policies and approaches to establishing spin-outs and supporting them to attract the investment they need to survive and thrive. The University Commercialisation and Innovation (UCI) evidence unit based at the University of Cambridge recently completed a project exploring how to improve the data, evidence and insights available to policymakers on issues related to university spinouts, including university equity stakes policies.

Looking at the dynamics of these indicators over time, commercialisation activity has shown trends upwards since 2018 and all indicators have been markedly above the five-year average. All in all, a steady increase in the ability of universities to capture and sustain the level of interaction during periods of extreme economic conditions evidences the resilience that universities have to ride out the storm. This also shows that research commercialisation activities were pivotal and prioritised during the COVID-19 pandemic.

Knowledge flows between universities and businesses showed strong resilience.

Contrary to the evolution of apprenticeship starts at intermediate and advanced levels, the number of UK apprenticeship entrants at higher levels surged in 2020/21 by 29%. This is the fourth consecutive year where there has been recorded growth. In 2020/21 there were 39,200 degree apprenticeships starts in England alone, whereas in 2018/19 (pre-pandemic) there were 22,480. Total learner days of CPD/CE courses for business and the community offered by universities have also continued to increase to...
almost pre-pandemic levels. However, the UK average number of CPD/CE courses per university has continued to decrease. Both are strongly driven by trends in England.

The CPM shows the mobility of people between academia and industry fluctuated over the pandemic, with declines in the number of staff leaving academia for industry and the other way.

There is variation in findings across the four nations

All nations show a decline in the number of interactions with SMEs, while the number of interactions with large businesses rose in all nations except for England, which saw a 6.5% drop from 2019/20. The volume of interactions with SMEs are significantly below the 5-year average in England and Scotland, whereas for Northern Irish and Welsh universities, these figures are in line with the 5-year average.6

There is also considerable variation between the four nations on commercialisation. In 2020/21, the number of patents granted dropped by 40% in Wales, and 7.7% in Scotland, while a 4.3% and 90% increase was observed in English and Northern Irish universities respectively. Patenting activity is below the five-year average in all nations, except for English universities.9

Spin out measures fell across all nations of the UK, with the exception of England which reported a 13.4% increase in the number of spinouts that had survived at least three years. This field has remained aligned with the broader trends observed over the last five years, with the exception of Scottish universities, where 195 academic spinouts existed in 2020/21, down by 17.7% from 2019/20 and almost 14 percentage points below the five-year average. High levels of university spin out activity in English universities in particular may be, in part, due to the maturity of university commercialisation activities supported through increases since 2016/17 to Research England knowledge exchange funding streams, in particular Higher Education Innovation Funding and the Connecting Capability Fund.

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**Source:** NCUB based on HESA (2022), ONS (2022) and Innovate UK funded projects. *Five-year average set to a value of 1 with individual averages scaled.*

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4 This includes income from contract research, facilities and equipment and consultancy services.
5 The business interaction survey was commissioned by NCUB in collaboration with UKRI and was undertaken by the Centre for Business Research at the University of Cambridge and included a survey of almost 4,000 businesses from across the UK. The report can be read at [https://www.ncub.co.uk/wp-content/uploads/2021/07/5334_NCUB_Changing_State_of_Business-University_Interactions-FINAL.pdf](https://www.ncub.co.uk/wp-content/uploads/2021/07/5334_NCUB_Changing_State_of_Business-University_Interactions-FINAL.pdf)
6 A breakdown of this source of income by type of business partner shows that 73% of the total license income comes from large businesses and remaining from SMEs. Both types of partners contribute to the overall fall in income from licenses.
7 Ulrichsen, T., & Kelleher. (2022), Busting myths and moving forward: the reality of UK university approaches to taking equity in spinouts. University of Cambridge, UCI Policy, NCUB.
8 Data submitted to the Scottish Funding Council through the KE metric return also showed the volume of interactions with SMEs to align with the five-year average, similar to Wales and Northern Ireland.
9 It is worth noting that numbers on certain indicators, including patenting activity and IP licenses, in Wales and Northern Ireland should be interpreted with caution as they have a natural tendency to fluctuate significantly annually, due to small overall volumes. Therefore, a small number variation year-on-year will present as a significant percentage change.
Figure 5. CPM indicators for 2020/21 against a five-year average, by nation

Source: NCUB based on HESA (2022), ONS (2022) and Innovate UK funded projects
Headline findings for research and innovation

Collaborative activity

76,952
interactions between universities and businesses were recorded in 2020/21. University engagement with businesses saw a marginal decline of 2\% between 2019/20 and 2020/21.

2.5\%
fall in the number of interactions with SMEs.

0.6\%
fall in the number of large business interactions.

The marginal decline in the number of interactions demonstrates the resilience of collaboration during the pandemic.

Investment in collaboration

10.1\% decrease
in industry income from knowledge exchange activities (excluding licencing). A contraction that was especially driven by a decline in CPD, facilities and equipment, and contract research, all down in real terms by 21\%, 11.4\% and 11.0\%, respectively.

8.8\%
UK share of investment funded by business in 2020.

5\%
UK universities share of foreign R&D investment in 2020.

The products of collaboration

COMMERCIALISATION ACTIVITIES CONTINUED TO SOAR.

4.6\% increase
in the number of licenses granted. 18,396 software and non-software licenses were granted in 2020/21. A 45\% increase relative to 2019-20. This increase was largely driven by a 16\% growth in the number of licenses issued to SMEs.

1,379 academic spinouts that had survived at least three years. A 4.5\% increase from 2020 and a 34\% increase in the last 5 years (between 2016-17 and 2020-21).

2,078 patents granted. This represents a 2.5\% increase from 2020 and an 11\% increase on pre-pandemic levels.

Joint people development

39,200 degree apprenticeships starts in England alone. An increase of 29\% from 2019/20. This is the fourth year in a row with recorded growth.

19,418 CPD/CE learner days were delivered on average by universities. This represented a 5\% decrease from an average of 20,510 and 15\% against the average observed during the last 5 years.

24\% of undergraduates were on sandwich courses with an integral employment placement in 2020/21.

19\% increase in UK domiciled undergraduates undertaking an internship in the UK.

32\% increase in UK domiciled postgraduates undertaking an internship in the UK.
Observations

The CPM offers important insights into UK-wide and national trends. For this year’s CPM, we delved deeper into the data to consider variations by type of interaction, type of institution and university location. Whilst the CPM offers insight into trends, it does not necessarily explain them. This section draws on wider evidence, consultation with universities and businesses, and a wider set of data and evidence.

The trends observed in university-business engagement for 2020/21 reflect both changes in market opportunities and business strategy (demand), and universities’ KE operations (supply). The pandemic likely challenged both sides of the equation.

On the demand side, an NCUB-UCI survey last year showed 64% of R&D active businesses engaged with universities before the pandemic did not plan to increase R&D and innovation activities in the months from September 2020 to August 2021. The report also highlights that more than a third of companies reported that COVID-19 had impacted their interactions with universities. The most prevalent impacts were difficulty in forming new interactions with universities, delaying existing projects, and stopping existing ones.

On the supply side, NCUB and UCI published a report on the ongoing effects of the pandemic on universities. The report shed light on how universities navigated the crisis and showed that the response was heterogeneous across the university landscape, with some universities more severely affected than others. On the operational side, universities saw the most challenges coming from recruitment and retention of qualified staff, the ability to access necessary facilities and the ability to cover the full economic costs of projects and activities. Research also revealed that universities saw a decrease in levels of innovation-focused activities across their portfolio over March-July 2020 (down 6%) and August 2020-July 2021 (down 7%) (NCUB & UCI, 2021). This demonstrates the challenges faced by universities’ Knowledge Exchange departments and researchers.

Observation 1: University consultancy interactions with SMEs became more important as the pandemic progressed

Figure 6 shows income from consultancy with SMEs increased significantly (up 18%) between 2019/20 and 2020/21. This suggests that while consultancy activity dropped off significantly in the early days of the pandemic and as we observed in last year’s CPM it is likely that the five-months of pandemic disruption does not account for the full scale of this drop, it gained...
greater importance in 2020/2021. This warrants further investigation in next year’s CPM.

**Observation 2: English university interactions with businesses varied across different university clusters.**

To understand whether collaboration varied by type of university, the CPM analysed English universities by Knowledge Exchange (KE) cluster. Universities in devolved nations are grouped into one cluster, as they were not included in the KE clustering exercise which was done for England only. Figure 7 shows that SME interactions declined across most university types, however, certain types of universities saw larger declines than others. Notably, universities in KE clusters J and M, which capture mid-sized universities with more of a teaching focus, although research is still important, saw the greatest reduction in the number of SME interactions (down by 16.5% and 7.2% from 2019/20 to 2020/21, respectively). Data from a University Commercialisation and Innovation Policy Evidence Unit UCI/NCUB report shows that the decrease in activities in the smaller and less research-intensive universities was more significant across almost all partner types, and in particular with small and medium-sized partners.

Universities in clusters V, X and Arts specialist institutions also reported a decline in SME interactions, but these were smaller. Small and specialist STEM institutions reported a total growth in SME interaction of 15% during the pandemic.
The CPM shows that even in 2020/21, the number of interactions with large businesses held strong, with only a marginal decline of 0.6% from 25,059 to 24,920.

Observation 3: The diversity and breadth of knowledge exchange strategies helped universities maintain engagement with businesses.

Universities engaged in broader knowledge exchange (KE) activities before the pandemic appear to have been better positioned to redeploy and focus resources to keep up collaborations with large businesses. Data shows that the volume of interactions with large companies during the pandemic is positively explained by universities having more than one element of comparative advantage in their KE portfolio. In other words, universities with a higher weight of income than the average managed to keep up their levels of interactions with large businesses during the pandemic.

The same is not true for SME interactions. Data suggests instead that sustaining SME interactions was mostly determined by university capacity (size, funding) rather than their pre-pandemic KE strategies.

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10 NCUB and UCL (2021), Innovation and Resilience in a Crisis
11 Ulrichsen, T., & Kelleher. (2022), Through Crisis to recovery: The ongoing effects of the COVID-19 pandemic on universities and their ability to drive innovation. University of Cambridge, UCI Policy, NCUB.
13 Ulrichsen, T., & Kelleher. (2022), Through Crisis to recovery: The ongoing effects of the COVID-19 pandemic on universities and their ability to drive innovation. University of Cambridge, UCI Policy, NCUB.
14 Following a previous report – Day, A., & Fernandez, R. (2015), Strategies For Sustaining Growth Of Income From Knowledge Exchange Across Higher Education Institutions (HEIs) In The UK. NCUB. We evaluated 4 out of the 7 KE elements: 1) Consultancy; 2) contract research; 3) Facilities and equipment; 4) continuous development programmes (CPD). Regression analysis was performed on the number of interactions and universities’ comparative advantage in all four elements for the period 2019/20 and 2020/21.
As we near the end of 2022, the COVID-19 pandemic has gradually become more endemic. However, its long-term impacts are still being felt and new challenges are emerging. Next year’s CPM will cover 2021/22 data, and will therefore start to show the journey out of the pandemic but also the start of the war in Ukraine. Next year, we will keep a close eye on the following trends.

**Reaching pre-pandemic SME interaction levels**

Even though SME interactions saw a marginal decline over the last year, there is a way to go to reach – and ideally exceed – pre-pandemic levels. At the time of writing this report, the UK economy is observing early signs of cooling in private sector activity, increasing uncertainty about the recovery of SME university interactions. Inflation levels – driven partly by soaring energy costs – may also have an impact of SMEs’ decisions to engage with universities and recent announcements to decrease levels of R&D tax reliefs available to SMEs may also impact their engagement. This may however, have a varying effect and could drive some SMEs to engage with universities as they explore innovation projects to increase their efficiency, while others may recede into a more protective position, which could shelve collaboration plans. On top of the economic conditions, the loss of key European funding streams, in particular the European Regional Development Fund and the European Social Fund, will place significant pressure on universities, particularly those in the nations and regions of the UK that have particularly benefited from larger allocations.

Although the UK Government has replaced these funding streams with the new UK Shared Prosperity Fund, this is expected to have less focus on innovation and university-led initiatives. This dynamic could have a negative impact on future SME-university collaboration data trends.

**Resilience in large business interactions**

The CPM shows the number of interactions with large businesses held strong, testing the resilience of interactions with large businesses. However, new challenges have materialised and the risk of entering a recessionary period could generate significant disruptions to these partnerships.

These factors will again test the resilience of businesses and universities to sustain collaboration.

**Continued high performance in university commercialisation**

The last few years saw consistent growth in key measures of university commercialisation – including patent activity, licensing and the creation and survival of university spinouts. As university initiatives continue to mature, it will be interesting to observe if this trend continues to grow - which will provide stronger evidence that consistent, and well-coordinated university sector investment in commercialisation activities is bearing fruit.

We may also expect to see certain commercialisation indicators in Wales grow in future years, following the introduction of the Research Wales Innovation Fund in 2020/21.

**Innovate UK grants and business-university collaboration**

Over recent years, the number and value of Innovate UK grants supporting university activity (a useful measure of business-led innovation collaborations with universities) fell. In the Spending Review 2021, Innovate UK received a significant multi-year uplift to its core budget, and in its recent Plan for Action committed to strengthen programmes and simplify its mechanisms that support business-university collaboration. With this in mind, in future years we might expect to see an upward turn in the trends for both number and average value of Innovate UK grants supporting university activity.

**Sustaining the increase in apprenticeships**

The CPM shows apprenticeships continue to increase at a significant pace. Apprenticeship numbers would continue to grow at a considerable pace if funding created through the Apprenticeship Levy is sustained and used effectively across the UK.
Enhancing data on collaboration

Case study: konfer

A central question for many universities and policymakers is: how can the UK science base be more responsive to business needs?

We can start with the dynamic presentation and easy access to latest research and expertise. Simplifying access to innovation opportunities and potential partners will increase collaboration with universities that is central to the UK vision of being a global hub for innovation by 2035.

To help, NCUB developed konfer, to connect businesses and universities. It gives both businesses and universities an open front door to experts and opportunities that might otherwise be difficult to find. It enables the creation of new coalitions of experts to work together on research and development projects.

To date, konfer has successfully drawn on publicly available data. Now, City, University of London is improving representation of their expertise and capability by feeding their data directly into konfer. This has improved visibility of experts at City by a factor of 30 – the number of academics profiled on konfer has grown from 23 to 678, and now includes over 11,000 research publications.

A complete picture of their experts and research in konfer will support new and existing collaboration partners to find and connect with academic staff and research centres across the university. It shows the innovation community, at home and abroad the latest expertise at City. They also use konfer internally to connect academic teams to support interdisciplinary collaboration.

Recognising the importance of easy access to their capabilities, City is embedding konfer in their business innovation strategy, to ensure they engage more nimbly with business opportunities by matching their experts with opportunities while aiding their understanding of the relevance of their own skill base.

This is the first time a UK university internal data repository has been made available, and fully searchable, to an external audience with an added simple connect function. This is a powerful resource to support truly open innovation.

Collaboration between universities and businesses underpins our knowledge economy and future aspirations for research, innovation and talent development. Growing the scale and impact of collaborations will require effective, evidence-based policy, which is strengthened by better data.

In the UK, we are fortunate to have the Higher Education Business and Community Interaction (HE-BCI) Survey. The survey provides rich data to measure “interactions between UK HE providers and business and the wider community”.

Nevertheless, there are gaps in the current data available that if addressed could greatly enrich our ability to monitor trends and design effective policy.

1. The richness and breadth of interactions

Knowledge Exchange covers a broad range of activities, which are not all captured well by existing data sources and therefore the CPM. Advances such as the Knowledge Exchange Framework in England have put a spotlight on the challenges of capturing and valuing non-commercialisation interactions with business. We know that businesses value a breadth of interactions with universities.

A more systematic approach is needed to capture the full breadth of interactions and for the system to recognise and reward these based on the ultimate economic and societal outcomes and impacts they deliver.

2. Collaboration to develop future talent

A gap in the evidence base relates to, arguably, universities’ most impactful contribution to UK knowledge generation and dissemination: teaching. Whilst there is some data

16 Available at: Hughes, A. et al. (2021), The Changing State of Business-University Interactions in the UK 2005 to 2021. NCUB, CBR.
Growing the scale and impact of collaborations will require effective, evidence-based policy, which is strengthened by better data.

3. Talent flows between industry and academia

The UK Innovation Strategy includes an ambition to support, ‘the mobility of skilled personnel between business and academia to facilitate knowledge sharing’. However, there is very limited data on the extent to which talent flows between industry and academia.

4. Contextual data on the businesses involved in interactions

Whilst the detail of universities involved in interactions is known, there is very limited data on the businesses involved in interactions. Collecting data on, for example, business location would allow for a more comprehensive understanding of the complex relationship between collaboration and place, and offer new insights into internationalisation. Equally, data on industrial sectors would enable analysis of where collaborations are strongest and on growth potential.

5. Repeat interactions

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. Equally, it is not possible to see whether universities engage with a business in multiple ways and across different categories through strategic partnerships.
COLLABORATION TRENDS IN 2022
Introduction

The previous section covering the Collaboration Progress Monitor sets out a range of important data points that together measure trends in university-business collaboration up until 2020-21. Collaboration trends in 2022 asks how university-business collaboration is changing, exploring qualitative trends in how collaboration modes and methods are evolving and what is driving this change.

We draw on insights and perspectives from our diverse membership and stakeholder networks to identify three ‘Collaboration Trends’, and then ask a series of experts to share their views on those trends, alongside illustrative case studies.

The three trends we are exploring in the 2022 State of the Relationship report are:

1. Innovation at pace: reducing timescales to do applied research and development

The commercialisation of research, innovation and new ideas can be a complex and lengthy process that brings in funding, people and expertise from a range of actors. However, the COVID-19 pandemic demonstrated it is possible to move from lab to market at pace, e.g. the vaccine development and rollout.

A series of factors affect this: strong backgroind research capabilities, strategic partnerships between academic groups and industrial interests, a clear and upfront understanding of the contributions of and benefits to each party, and – when there is a public policy imperative – appropriate mechanisms and support from government and the wider public sector.

For this section, we asked senior leaders to consider recent developments in the landscape contributing towards accelerating innovation, and where this might be strengthened in the future.

2. Drivers of change within the R&D workforce

Skilled people are the foundation of any research and innovation system. As the UK seeks to achieve innovation-led growth by expanding our R&D-active sectors and supporting all sectors to innovate, we need to make sure we have a clear strategy for training and attracting the right people to power our future knowledge economy.

There are a number of challenges facing the UK. We are still developing our approach to supporting and encouraging the best talent from overseas to relocate to the UK within the context of wider immigration policy post-Brexit; there are still reported misalignments between the skills the future economy will need and the training provided at all levels of the education system. There is further to go in supporting the effective movement of people across traditional academic-industry boundaries.

For this section, we asked experts to comment on the challenges and opportunities facing the UK skills landscape and the impact these could have on university-business collaboration and the wider R&D system.

3. Innovation-led local growth: zones, clusters and institutions

Over the last few years, the UK government has been experimenting with new spatial economic policies that use co-location, tax incentives and other benefits to encourage enterprise, innovation, and economic activity in specific, geographic areas.

Boris Johnson’s government introduced Freeports, and Liz Truss through the Growth Plan in September announced an intention to establish new ‘Investment Zones’ across England, with an aim to work with the Devolved Administrations to extend these to Scotland, Wales and Northern Ireland. Rishi Sunak has chosen to reformulate these zones around universities, recognising the knowledge-intensive pull for innovative businesses.

For this section, we have asked academics and local leaders to comment on the role these new economic geographies – or alternative models – could play in supporting UK growth and where there is potential for university-business collaboration to support their implementation.
3.1 Innovation at pace: reducing timescales to do applied research and development

A major focus for research and innovation policy over the last decade was on improving the commercialisation of ideas, knowledge and capabilities emerging from the UK’s world class research base. This year’s CPM points towards exciting upward trends across a range of metrics – spinout creation and survival, new patents, and IP licensing. This progress is recognised by policymakers, with the 2021 Innovation Strategy noting “in recent years, UK universities have become more effective at attracting investment and bringing ideas to market” and UK institutions’ performance is now “competitive with the USA in terms of patents, spinouts, income from IP and proportion of industrial research”.

Beyond the headline figures, the COVID-19 pandemic showed the art of the possible for collaborative innovation and commercialisation at pace. Responding to a clear societal imperative, universities, businesses and government worked seamlessly together to produce much-needed vaccines, treatments, and other solutions – all at unprecedented speed.

Dr Tony Soteriou, Director of Commercialisation at UKRI, provides an insightful overview of the challenges and opportunities facing the UK’s research translation and commercialisation ecosystem – and sets out the steps that UKRI is taking to respond positively to these. Susan Rienow, UK Country President at Pfizer UK, also offers her reflections on what is needed to accelerate innovation in pharmaceuticals and Life Sciences in the UK. Finally, Professor Michael Lewis, from the National Institute for Health and Care Research, sheds light on an innovative funding model designed to determine the feasibility of health research translation projects quickly and effectively.

Accelerating the pace of research commercialisation to drive forward growth and societal impact

The UK has a world class research, commercialisation and innovation system with some of the world’s best universities, research institutes, global R&D-intensive prime businesses, world-renowned strengths in services and creative industries that have strong potential to undertake and benefit from R&D; and a vibrant start-up ecosystem in emerging areas of technology such as quantum.

Indeed, in the 2022 Global Innovation Index, the UK ranks 4th among the 132 economies featuring in the index behind only Switzerland, the USA and Sweden. Furthermore, recent Research England analysis demonstrates that the UK university sector is broadly comparable to the US with regards to the commercialisation of university research, when normalised for research funding; and that the UK university sector is relatively efficient in generating patents and spinouts. UK universities also compare favourably with their US counterparts at engaging with industry: with 8.1% of income from industry contribution in the UK compared to 6.5% in US.

Successive UK governments have set the ambition to grow the economy. As the UK’s largest public R&D funder, with cross-disciplinary and cross-sector reach, UKRI has a pivotal role in supporting economic growth and societal impact. This is at the heart of our UKRI 2022-27 Strategy “transforming
tomorrow together», which includes the objective: World-class Innovation - Delivering the government’s vision for the UK as an innovation nation, with the priorities to deliver the skills, finance and collaboration opportunities needed to boost private sector investment, and to accelerate translation, commercialisation and knowledge exchange.

To achieve this, the UK research commercialisation system needs to work even more effectively and efficiently. Previous reports have highlighted that R&D and innovation support in the UK is often complex, and while the ‘system is not broken’ it can be improved and be more efficient. Therefore, in delivering our strategy, UKRI is implementing a programme of work to help speed up commercialisation including:

- Implementing a new model for harmonised Impact Acceleration Accounts to fund institutions to develop impact from research including through early commercialisation
- Implementing a new UKRI Commercialisation Funding Framework to improve research commercialisation outcomes
- Further incentivising business and university collaboration by harnessing the learning from the success of programmes such as Higher Education Innovation Funding (HEIF) through Research England’s review of their knowledge exchange (KE) policies and funding (also taking account of relevant developments in Scotland, Wales and Northern Ireland).
- Delivering new strategic partnerships between Innovate UK, Research England and Research Councils to drive economic growth through business-led innovation and commercialisation, and address some of the most pressing UK/global challenges.
- Supporting businesses to access specialist facilities and provide Business Incubation Centres, and maximising the role UKRI campuses have in local economies
- Working with local partners to maximise the opportunities to embed research commercialisation within the new UK Innovation Accelerators, focussed on Greater Manchester, the West Midlands and Glasgow City-Region

As the UK’s largest public R&D funder, with cross-disciplinary and crosssector reach, UKRI has a pivotal role in supporting economic growth and societal impact.

It is widely commented that concerted actions across sectors in response to Covid-19, including rapid funding of research; development, regulatory approval and deployment of vaccines, diagnostics and medtech, led to many examples of accelerated commercialisation and innovation.

There is a need to consider how UKRI and partners across the Research, development and innovation (RD&I) ecosystem come together to address other key challenges where accelerated commercialisation and innovation would benefit society and the economy. Obvious areas include building a greener future, tackling infections, securing better health, ageing and wellbeing, and building a secure and resilient world.

21 Rees, M., & Sweeney, D. (2019), Advice on university-investor links: independent advice from Mike Rees for David Sweeney, Executive Chair, Research England, NCUB.
25 Chinnery, P., et al. (2021), How COVID-19 has changed medical research funding. The Royal Society.
Our collective experience through COVID-19 demonstrated innovation could take place at a speed that may have previously been thought impossible. At Pfizer, we have recognised the importance of collaboration across industry, academia, the NHS, and beyond throughout our 70+ years in the UK, and through over 100 UK R&D collaborations in 2022.

The UK Vaccine Taskforce (VTF) was an exemplar of public-private partnership, where a clear central mission, an end-to-end approach to innovation, and the involvement of expertise from all sectors were critical to the pace and success of the UK’s COVID-19 vaccination programme.

The UK has set out similarly ambitious goals for life sciences in other areas. As we move to the next phase of the pandemic, will the UK successfully expand and embed the lessons from the VTF to strengthen UK health, prosperity and resilience?

Life sciences is the largest contributing sector to UK R&D, with the industry investing over £5 billion in 2020. Yet this has remained relatively flat over time, and when seen as share of global pharmaceutical R&D investment, represents a fall from 7.7% in 2012 to 4.2% in 2020. Other countries are taking significant end-to-end action, from early discovery to adoption of innovation, to incentivise life sciences R&D, and the UK cannot afford to stand still if it is to maintain or grow its global position.

This is clear in specific areas such as clinical research, where the potential to build on major successes in UK COVID-19 clinical trials is under threat from wider system challenges. The number of industry clinical trials initiated in the UK fell by 41% between 2017-21, with a 44% decline in the number of patients recruited to industry trials (2017/18-21/22) on the NIHR Clinical Research Network. The UK has a huge opportunity to build on its scientific strength and data infrastructure to continue to lead here, but without urgent action to address the increases in study setup times and other factors driving these declines, the benefits to UK patients, the NHS, and economy from clinical research in the UK will be limited.

The UK life sciences ecosystem has demonstrated that it can lead the world through COVID-19, but these successes were only possible due to decades of previous investment and collaboration across industry, academia, governments, and others. To unlock the full potential of its internationally renowned science base, the UK needs to fully implement the aims of its Life Sciences Vision, from continued support for early research, through to internationally competitive investment incentives, and realise the goal of the NHS as a true ‘innovation partner’.

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28 Abpi. (2022). Life sciences superpower, growing the leading global hub in the UK.
29 Abpi. Rescuing patient access to industry clinical trials in the UK.
Before joining the National Institute for Health Research (NIHR) as Programme Director, I chaired multiple government grant panels from life sciences to 5G and from robotics to drones, and was always frustrated by two things: Firstly, we never had enough money to fund all the innovative and worthy concepts coming from across academia in the UK; secondly, that our processes slowed down innovation by being bureaucratic and unwieldy, and we were part of the problem rather than being a solution.

From my time in industry, working with digital health, device and biotech startups, innovation often hit what I termed the inflexion-block. This is the time when answering a single question could either make or break a project and then allow it to accelerate and raise funds. Questions such as - will I be able to make this small enough? Will the market pay the price I need? Or what is the route to regulatory acceptance?

We designed FAST grants (Funding At the Speed of Translation) to become an enabler to accessing funds to answer these singular questions. It wasn’t about funding a post-doc but more about delivering a yes or no, a go or no-go. The programme was designed so applicants would answer three questions and get a response back within six to eight weeks rather than the traditional six to twelve months of classic grant funding. FAST was also aimed to be a vehicle that younger researchers or innovators could access themselves even with little experience of grant application writing.

We ran a pilot to evaluate the process itself and to look at whether it would impact other streams across the NIHR programme, to see if we were additive to or cannibalising from alternative funding. I also wanted to look at whether applicants started an application and whether that turned into a full submission. In other words, did they finish and submit their application.

We took the same philosophy on failing fast with FAST itself as we do with the programme applications themselves.
We designed FAST grants (Funding At the Speed of Translation) to become an enabler to accessing funds to answer these singular questions.

We needed to see if it worked or not, and we needed to be able to show the funders at the Department of Health (now Department of Health and Social Care) that there was a need, a demand and a mechanism that worked for FAST, which is why we ran the pilot.

In terms of impact, attendance at webinars where we explained FAST were among some of the largest yet seen at NIHR, but the test was whether this flowed into full applications. The initial data is being analysed but the volume of applications was slow initially and at the end of the pilot we were over-run with applications. Word spread quickly of the ease of application, simple approach, rapid decision making and openness of the process.

On the assumption that FAST is a success, I would certainly advise existing funders like Gates, Templeton, Rockefeller and other charities to add FAST to their offering, and the NIHR would be happy to help and share as we can all benefit from collaboration. But FAST-like programmes could also be a vehicle for our wealthy, benevolent and social-minded citizens without their own foundation setup to help accelerate innovation in life sciences. If they wanted to provide small contributions in the $1 million to $10 million range and let NIH or NIHR run the administration and paperwork we can find and fund more innovations. The positive contributions from money plus expertise would be highly synergistic - and probably tax deductible. FAST could be a method for the non-science funders to become science funders.

So many scientific breakthroughs have been accidental like microwaves, plastic, penicillin and even Viagra. The more we can fund, with the greater spread, the higher our chances are of finding new innovation, and funding more projects to commercialisation.

Introduction to case studies

Realising new, cutting-edge ideas is not a straightforward business. It often needs different actors to come together, each bringing different and complementary capabilities. This typically includes universities and academic research teams, innovative businesses – large and small, alongside public sector organisations and research and innovation funders.

The last few years have seen tremendous innovation in how these collaborations can be best formed and managed – helping to build the right strategic partnerships that will drive fast, impactful outcomes. The following case studies provide excellent examples of how sustained and purposeful collaborations between universities and businesses can accelerate the translation and commercialisation of research, which in turn drives transformative societal and economic impacts.
The climate and environmental crises necessitate rapid societal transformation to reach net zero and nature recovery goals. Innovation across the whole economy is required to develop and commercialise the goods and services needed for a net zero, sustainable world.

Clean Growth UK (CGUK)\textsuperscript{30} was launched in 2019 to unite businesses and universities to collaborate and accelerate green R&D. The network has grown to 2,300+ members including SMEs, social enterprises, large companies, and public sector bodies. Our three hubs, at the Universities of Brighton (lead hub), Portsmouth and Liverpool John Moores, deliver innovation, commercialisation and funding services to companies developing clean-green products/services/processes and sustainable/circular business models. CGUK is delivered by knowledge exchange (KE) teams who bring academic expertise/facilities to bear to help companies create climate solutions and grow the green economy.

In response to growing demand from SMEs following COP26 and following market research we have launched Net Zero 360 a new service to help SMEs quantify their carbon footprint and develop net-zero plans. We believe this is the UK’s first service that takes SMEs through to innovating green R&D. The network has grown to 2,300+ members including SMEs, social enterprises, large companies, and public sector bodies. Our three hubs, at the Universities of Brighton (lead hub), Portsmouth and Liverpool John Moores, deliver innovation, commercialisation and funding services to companies developing clean-green products/services/processes and sustainable/circular business models. CGUK is delivered by knowledge exchange (KE) teams who bring academic expertise/facilities to bear to help companies create climate solutions and grow the green economy.

CGUK was funded by Research England’s Connecting Capability Fund and is a national evolution of the University of Brighton’s regional network, the Green Growth Platform, launched in 2014 funded by HEFCE Catalyst Fund. It was designed as a KE engagement method encompassing novel features:

- Membership creates enduring trust-based relationships between companies and universities leading to repeated engagements
- Clear brand, service offer and business-focused marketing clarify and de-mystify university offers to business
- Peer to peer collaborations between members adds to the innovation pool
- Triple helix regional boards bring HEIs, private and public sector together to tackle climate crisis
- Virtual rather than physical innovation centres allow for interactions with large numbers of companies
- A financially sustainable model with a business plan integrating grant, commercial and HEI income.

CGUK has successfully delivered its vision: creating a thriving national clean growth business-innovation network, which adds significant value to member businesses, organisations and universities, supporting their aims to create and mainstream the products, services and business models required for rapid transition to a net-zero, sustainable economy. We have delivered significant impact having met or exceeded funder KPIs:

- 2,300+ members
- 400+ innovation/KE projects
- £25million+ value of innovation/KE projects
- 260+ products and services
- 720+ jobs

The KE facilitated by CGUK has ranged from two-way projects such as KTPs and multi-partner projects bringing together universities with companies and public sector bodies to address environmental challenges and create commercial solutions. The approach is characterised by “market pull” rather than “research push” and given that challenges and market opportunities are identified by members active in the market this provides a rapid route to impact. The Universities are contributing financially to continue CGUK post RE funding given the demonstrated impact. Examples of the transformative KE projects and market impacts can be found on the web.\textsuperscript{31}

\begin{itemize}
\item As we transition to net-zero, every aspect of the economy - from products to supply chains - needs to transform. Clean Growth UK was launched in 2019 to help drive that transformation.
\item Our three hubs at the Universities of Brighton (lead), Portsmouth and Liverpool John Moores, deliver innovation, commercialisation, net-zero planning and funding services to companies developing clean-green products/services/processes and sustainable/circular business models.
\item By brokering innovation collaborations with the universities, we support businesses to undertake the innovation needed to decarbonise their operations and their products and services. Businesses get access to academic expertise, university facilities and equipment, and R&D funding.
\item Our work is focused on creating impact. We have:
  \begin{itemize}
  \item 2,300+ members from both the private and public sector
  \item Developed 400+ innovation/KE projects
  \item Raised 25million+ value of innovation/KE projects
  \item Contributed to the development of 260+ products and services
  \item Helped create 720+ jobs
  \end{itemize}
\end{itemize}
Over the past decade, numerous governments, universities, businesses and other bodies have voiced their intention to innovate more quickly and effectively. Their ambition is the right one, but many have struggled to deliver in practice. Technological innovation is difficult, and doing it at pace is even harder.

As the UK seeks to become a higher-growth economy, it’s more important than ever that we accelerate the way we develop and scale innovative technology solutions. Businesses, universities and the public sector must learn from bodies that are already succeeding in this, and one place to turn their gaze lies north of the border.

CENSIS is a not-for-profit Innovation Centre (IC) established by the Scottish Funding Council and Scotland’s enterprise agencies to support businesses, universities, and public-sector organisations to accelerate the pace of innovation by exploiting sensing, imaging and Internet of Things (IoT) technologies. In less than a decade since its launch, this small, Glasgow-headquartered IC has put itself at the heart of Scotland’s digital transformation, supporting 300-plus innovation projects spanning market sectors from housing to health and agriculture to aerospace. The benefits are environmental and societal as well as economic.

So, how has this been achieved and what can others learn from it?

**An evolving but steady focus**

Since its launch in 2013, CENSIS has retained a core focus: the application of key enabling and emerging IoT and connected technologies. In practice, this has meant an evolution of activity:

Phase 1 was to create the ecosystem, through multi-faceted activity from supporting IoT, imaging and sensing network infrastructure to community-building to skills development to provision of hardware facilities for researchers and businesses.

Phase 2 was to grow the ecosystem, extending its reach and proactively forming and leading large-scale collaborative R&D projects, bringing external funding into the ecosystem in Scotland.

Phase 3 is to scale the ecosystem, promoting the growth and roll-out of enabling technologies, and seeking to support green recovery and a just transition to net zero.

The acceleration of innovation at each stage is built on the groundwork done in the previous stages. With connections made, communities of interest nurtured, and skills and infrastructure in place, innovation and commercialisation can mushroom.

**Clarity about value and benefits**

Another lesson from CENSIS, success over its first decade has been its focus on bringing people to the table, offering them a clear value proposition. Organisations working with CENSIS can expect business-driven, technology-agnostic support at multiple touchpoints, bridging the gaps between academic capabilities, commercial activities and public-sector priorities. Importantly, the experience and expertise across the CENSIS in-house team allows it to get inside the heads of partners, understanding what support will genuinely accelerate successful innovation. This can be seen in two diverse examples, both rooted in an understanding of different partners’ challenges and opportunities and the need to capture both big picture and small details.

**Hands-on assistance for spinouts, start-ups and SMEs:** An industry-experienced in-house engineering team can support on proof of concept, prototypes or minimum viable products, putting in place a plan to build, test and implement a solution, whether it is sourced from academia, off the shelf commercially, or a combination of these. Professional project managers ensure projects can be delivered on time, on spec and on budget.

Creation of new digital markets: CENSIS works with potential end-users in the public sector in Scotland to increase digital uptake and ‘circular innovation’. Having helped them explore needs and opportunities for new products and services, it then supports them with connections to solution providers. To scale up this activity, CENSIS partnered with the Digital Office for Scottish Local Government on a smart infrastructure programme that has led numerous councils to plan large-scale rollouts, in turn creating opportunities for Scottish SMEs.

**What next?**

As CENSIS plans for its second decade, its delivery approach will continue to be based around innovation support, and community and skills-building, always looking to build reach and scale without losing definition and always learning lessons from what has worked well. It’s a model well worth further exploration.

[www.censis.org.uk](http://www.censis.org.uk)
[https://www.linkedin.com/company/censis-innovation-centre](https://www.linkedin.com/company/censis-innovation-centre)
[https://twitter.com/CENSIS121](https://twitter.com/CENSIS121)
In 2020, the UK Government set an ambitious target to achieve net-zero carbon emissions by 2050 and create up to 250,000 green jobs in the process. However, there is an innovation gap that needs to be filled for these green goals to be met.

In April 2021 the Centre for Applied Sustainable Technologies (iCAST) was launched as an R&D and collaboration hub for companies working on clean growth technologies and offering a new approach to accelerating the translation of research. It focuses on translating sustainable chemical technology research into commercial products to tackle the global challenges of climate emergency, sustainable development and plastic pollution.

The £17 million facility with a hub in Swindon is backed by the Research England Development Fund, an initiative from UKRI that drives innovation in research and knowledge exchange in higher education.

iCAST brings together industry with expertise at the Universities of Bath and Oxford, the High Value Manufacturing Catapult’s Sustainability Partnership (National Composites Centre and Centre for Process Innovation), innovation experts at SETsquared, Local Enterprise Partnerships and investors.

Its core job is to provide agile and flexible support for businesses to scale up new sustainable technologies and bring them to market. Critically, it delivers proof-of-principle, scale-up and feasibility studies to accelerate how soon cutting-edge sustainable concepts will mature so that focus can be placed on those with the largest potential impacts.

**Bridging the innovation gap**

To meet the sustainability challenges set by Government, industry and society more generally, there needs to be a step-change in our strategy for translating sustainable chemical technologies into clean growth.

The UK is one of the world’s top producers of chemicals and pharmaceuticals, which contribute £17.8 billion in gross value added (GVA) to the economy each year. The sector also directly employs more than 140,000 highly skilled people and supports the jobs of around 500,000 more, as well as investing in world-class research in the sector. However, until now, industry and research have been disconnected.

**Delivering on net-zero.**

iCAST has been established as a ‘one-stop shop’ for delivering net-zero carbon emissions with the resources, facilities and know-how to accelerate the UK’s transition to a more sustainable and circular economic model.

It is delivering this in a three-step process to accelerate innovation from proof of principle towards market readiness. First, it leverages existing public investment in research through the unique partnership of Bath, Oxford and the High Value Manufacturing Catapult. Researchers and businesses are then assisted in discovering and prioritising the highest value innovations. And finally, iCAST resources are deployed in joint industry projects to develop and accelerate the best new commercial products, services and processes. Access to investment and business expertise via SETsquared further enhances commercial readiness levels.

**A strategic location**

While the research home of iCAST is at the universities of Bath and Oxford, its innovation space is located in Swindon’s iconic Carriage Works, through its collaboration with Swindon Borough Council and Swindon and Wiltshire Local Enterprise Partnership. This off-campus location provides a dedicated place where iCAST’s partners can work together on the Centre’s mission. Swindon itself provides national and international connectivity for iCAST businesses in the heart of the region’s Western Gateway Powerhouse innovation system, as well as close proximity to the lab facilities in Bath and Oxford.

**A flying start**

The partnership is already off to a flying start: barriers to collaboration between the four very different research partners have been minimised from the start; and in its first year of operation iCAST has attracted over 65 member companies ranging from spinouts, high growth SMEs and multinational corporates. With a pool of specialist expertise and equipment now in place at Bath and Oxford, 13 exciting joint industry projects are currently underway or completed. As iCAST’s new innovation space in the Carriage Works comes on line in early 2023, the team looks forward to delivering further on the goal of providing a bridge over the innovation gap in sustainable and green technologies.

Wiltshire Local Enterprise Partnership.

32 | www.csct.ac.uk/icast
The Accelerate programme, established in 2018, is co-funded by the European Regional Development Fund, the Welsh European Funding Office, Welsh Government’s Health and Social Services group, Welsh universities; Cardiff University, Swansea University, University of Wales Trinity Saint David, Life Sciences Hub Wales and Welsh health boards. The aim was to spearhead the development of collaborative innovation between industry, academia and health thus helping drive the development and adoption of Welsh healthcare innovations that will benefit patients, improve health and social care in Wales, and boost the Welsh economy.

Small and medium-sized life science businesses face a challenging innovation journey with effective collaboration and access to the right expertise often the difference between success and failure. Recognising this, the programme was developed to be flexible, with applications accepted from academics, industry partners, or clinicians, and tailored support focussed on:

- **Identifying** research and development collaboration opportunities between industry, academia, and health.
- **Connecting** innovators to appropriate experts in health technology, user experience and clinical engagement.
- **Helping** innovators navigate the life sciences ecosystem.

During its first four years of operation, the programme supported over 100 business-academic health collaborations, which in turn led to more than 100 new products/services being brought to the market, the creation of 144 jobs and 11 new businesses, and over £3m of private investment into the sector.

The strength of the programme has been the complimentary skills and expertise of the partners that together enable us to support a broad range of innovations. Working closely with health boards across the country ensures we support the development of technologies with real potential for health and social care impact. It also ensures that innovators gain access to clinical input at an early stage so that technologies can be shaped to address real needs.

Our successes show that the relationships developed are helping to accelerate health and social care solutions, bringing innovations closer to patients, and boosting the health and economy of the nation. Our impact comes from working together. Harnessing Welsh skills and knowledge to support economic growth and prosperity and improve the nation’s well-being. What is clear, however, is that demand far outstrips our current capacity to support. To continue growing innovation in line with our ambition, in addition to financial support we need to invest in the time and space to innovate.

As we move towards the next phase of the programme, our aim is to embed this approach to innovation across Wales. To do this we need to grow, working more closely with complimentary innovation programmes, adding new partners to the programme, and reaching beyond Wales to bring the best health innovations to the people of Wales and help take Welsh innovations to the world.

We will continue to foster the relationships we have developed, and build new relationships aimed at enhancing collaborative innovation in Wales. With a focus on improving health, we will support the solutions that are needed and ensure they are available to all.

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Case study: The Wales Health Technology Accelerator

The programme supported over 100 business-academic health collaborations, which in turn led to more than 100 new products/services being brought to the market, the creation of 144 jobs and 11 new businesses, and over £3m of private investment into the sector.
3.2 Drivers of change within the R&D workforce

Understanding the impact of labour market shortages on R&D

Since the publication of the 2021 People and Culture Strategy, efforts have been made across the innovation ecosystem to improve workplace and research cultures, for the benefit of the R&D workforce. Training, recruiting and retaining a highly skilled, adaptive and diverse R&D workforce is essential to delivering the economic and innovative ambitions of the nation, and requires a welcoming culture which facilitates collaboration and mobility between academia and industry.

From prioritising diversity within the R&D workforce to interventions to broaden post-PhD career pathways, the recent shift in working patterns and opportunities has been a catalyst of much change within the R&D workforce. However, against the backdrop of unprecedented job vacancies, and a growing demand for new and evolving skills not yet met by supply, the challenge is great.

Considering reduced international mobility post Brexit and COVID-19, inflationary pressures and the challenges to living standards, this section presents a holistic review of the drivers of change for the R&D workforce, and ways in which universities and businesses are working together to evolve and adapt.

Charlie Ball from Jisc comments on the impact that labour shortages are having, specifically on R&D. Dr Kostas Kollydas, Professor Anne Green and Professor Simon Collinson at City-REDI/WMREDI, University of Birmingham go on to comment how R&D labour shortages across the UK are infringing economic growth and Kate Murray from King’s College London explores how her institution is building and nurturing a highly skilled and adaptive R&D workforce.

33 ONS. (2022). UK Labour Market: October 2022. ONS.
34 ONS. (2022). Economic activity and social change in the UK, real-time indicators: 13 October 2022. ONS.
How has this come about? COVID-19 is one key factor. At the outset of the pandemic, employers planned for the worst case scenario and cut hiring to the bone. During the summer of 2020 it started to become clear that remote working was a good deal more effective than many had expected and many businesses – especially those with professional staff and good tech - were able to carry on with only mild disruption. At the same time the Government’s furlough scheme preserved jobs at many businesses unable to make use of hybrid working. By autumn 2020, it was starting to look as if the worst case scenarios for employment across the economy had been avoided and that the effectiveness of remote working meant that recruitment for 2021 might be much closer to normal. By spring 2021 businesses were starting to (quietly) report labour shortages, and then in May 2021, most remaining restrictions were lifted and recruitment took off. At this point widespread labour shortages across multiple sectors were reported. Other factors exacerbated labour issues. Many older workers left the workforce during COVID-19 and sectors – such as R&D and engineering – with a significant proportion of older employees - found that talent and experience difficult to replace.

Wage inflation, and the erosion of some of the competitive advantages sometimes enjoyed by universities and public bodies in the way of terms and conditions and, especially, pensions, has also meant that these organisations are now sometimes seen by the private sector as relatively easy sources of scarce talent – the HE sector has had issues retaining skilled technical workers, project managers and similar in-demand professionals for some time now.

Restrictions on overseas hiring as a consequence of Brexit also made it more difficult for R&D employers to tap into the global workforce; while at the same time, the UK is no longer part of trans-national research collaborations such as Horizon, placing other strains on the R&D workforce.

Long-standing issues with career structures in academia remain stubbornly unresolved, adding further pressure on retention in HE and making it ever more imperative that the options available to our highly-skilled R&D workforce are clearly spelled out.

With the UK looking at difficult economic times ahead, it is important to stress that the labour market, particularly for skilled workers, is not showing the same kinds of strains as much of the rest of the economy. Put simply, we are entering a downturn with a labour shortage, and nobody quite knows how that will play out.
One analysis predicts "a potential shortfall in England of 2.5 million highly skilled people in 2030 and surpluses of 3.1 million people both for intermediate skills and low skills. This puts at risk economic output of around £120 billion". 31

Digital skills are an important case in point. A McKinsey study presented stark figures to the UK government in 2019, estimating that over 21 million people had a 'basic digital skills deficit' and over five million could be acutely under-skilled in digital by 2030. 36 A more recent report suggests that 61% of UK business growth depends on 'digital outcomes' and that £50 billion per year is at risk to the UK economy (more than £240bn between now and 2026) if we fail to bridge the supply-demand digital skills gap. 37 This should be seen as a £50 billion per year opportunity.

We chose to focus on the "R&D Workforce and Skills" in a joint project with BEIS, because it is clear that economic growth in 'knowledge economies' is increasingly dependent on these. 38

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R&D skills underpin the innovation capabilities of firms, regions and national economies. Innovation in turn is the driver of long-run economic growth. Appropriately, the UK Government’s stated policy is to expand and strengthen the R&D workforce, aiming to level up UK regions and improve the country’s global competitiveness. But this will take time and the resulting demand-supply gap will be costly.

Analysts in the past tended to assume that if firms increased their demand for particular kinds of skills, then these would be (or soon become) available. The real world is very different. Mismatches between skills demand and supply and the long timescales needed to build up new skills affect the pace at which firms can transition into new emergent industries and the economy overall can grow. Estimates vary, but one analysis predicts "a potential shortfall in England of 2.5 million highly skilled people in 2030 and surpluses of 3.1 million people both for intermediate skills and low skills. This puts at risk economic output of around £120 billion". 35

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37 AndDigital. (2022), The nature of the UK’s digital skills gap.
38 The West Midlands Regional Economic Development Institute (WMREDI) is collaborating with the Department for Business, Energy and Industrial Strategy (BEIS) on the “R&D Workforce and Skills” project. This project quantitatively explores regional and temporal trends in workers’ probability of being employed in R&D-related occupations and examines the demand for R&D skills across sectors. It identifies challenges that businesses face in attracting and retaining people with R&D skills through interviews with employers and representatives from organisations interested in R&D skills development.
Eurostat data shows that the proportion of R&D personnel in the total labour force in the UK (in FTEs) is 1.49% which is higher than the EU-27 average but below that of competitor countries, such as Germany (1.78%) and France (1.61%) (Denmark and Finland are over 2%).

Using a wider definition to capture more innovation-related activities, we find a mixed picture in the UK.

On the positive side there has been a marked growth in the proportion of R&D workers in the total UK labour force using this definition, from 5.4% in 2012 to 7.9% in the first half of 2021. The growth in participation rates was more pronounced in 2020 and 2021, mainly reflecting changes in the demand for specific skills due to the COVID-19 pandemic. But there are marked regional differences and very pronounced gender and ethnicity-related differences across these occupations.

As Figure 9 illustrates, the South East and London have the highest shares of R&D professionals in the total labour force (7.6% and 6.8%, respectively). In contrast, the lowest proportions are observed in Wales (5.0%), Yorkshire & the Humber (5.1%), and the North East (5.4%). This picture likely mirrors regional imbalances in the distribution of R&D investments and disparities in the industry structure and specialisation across regions, thus influencing the demand for R&D skills.

There is solid evidence that the R&D workforce is less diverse than the broader labour force. Specifically, men are three times more likely than women (8.8% versus 3.1%) to be employed in R&D-pertinent occupations, and the gender gap has not decreased over time (see Figure 9). Intriguingly, the West Midlands sees the lowest percentage of women in the R&D workforce in the country (2.5%). Chinese (15.0%) and Indian (12.2%) workers are more likely to be engaged in R&D than other ethnic groups, whereas people from Black, Pakistani, and Bangladeshi ethnic backgrounds are under-represented in the R&D labour force. Similarly, the probability of conducting R&D activities is significantly lower for people with learning difficulties (2.8% versus 6.0% in the wider workforce).

In depth interviews with employers and stakeholders reveal that specific skills in high demand in R&D-related industries include technical skills (such as digital and programming), problem-solving, management and leadership skills, and interdisciplinary skills to support the commercialisation of graduate ideas. The variety of skills required in the R&D workforce demonstrates that innovation is much more than developing new products or services. Collaborations between universities and industry are cited as important for facilitating knowledge transfer and consequently addressing R&D skills shortages. Such shortages appear to have been exacerbated by the pandemic, in part due to changes in workers’ attitudes and behaviours (including early retirements and a desire for reduced and flexible work hours).

The immigration system also poses challenges that affect the attraction of international talent and access to R&D employees in Europe. Given that a diversified workforce is positively correlated with productivity, economic growth and innovative performance, these challenges emphasise the importance of nurturing equality, diversity and inclusion in the R&D workforce. The limited visibility and recognition of specific R&D professionals (engineers and technicians, for instance), partly reflected in their lower remuneration also acts to limit attraction and retention of STEM graduates.

Note: The error bars in Figure A represent the 95% confidence intervals of the proportions. The analysis uses restricted-access pooled data from the Annual Population Survey (July 2012–June 2021) to describe the structure and characteristics of the R&D workforce. The R&D workforce is defined based on 28 four-digit codes of the Standard Occupational Classification.
Preparing research students and staff for their future work

KATE MURRAY
Senior Careers Consultant and Careers Consultant for Researchers, at King’s College London

University careers services have been quietly preparing researchers for the world of work – whether inside or beyond academia – for years. The type and depth of that support has depended on services’ funding priorities. As research student outcomes do not feature in league tables, often specialist careers consultants posts are funded through Doctoral Colleges or similar departments rather than from central student services budgets. In institutions where this funding is not possible, working with researchers becomes a small part of a generalist’s post. Additionally, in rare cases, there are specialist employer engagement officers, doing the much-needed work of advocating for researchers with employers, finding those niche roles where research experience is valued.

How do university careers services fit in the university-industry ecosystem?

Universities are complex places and there is an incredible range of employer connectivity with researchers, from spin-outs, clinical academic training pathways, to industrial collaborations and PhD programme sponsorships or placements.

Careers service activities offer a different way for researchers to engage with employers. At King’s College London, we run hundreds of employer-led events, ranging from 30 different Discover Careers In panels; events for different demographics across race, gender and disability; and in-depth Fireside chats with CEOs.

Quote from Tom Sharpe, a 3rd year Maths PhD, about attending an Oct 2022 Discover Careers In... panel:

‘As a final year mathematics PhD student looking to transition out of academia, I found the Discover Careers In...AI, Data Science, and Machine Learning panel very interesting and equipping. It was useful to get an inside perspective on what working in and entering the industry is like, especially from some fairly recent graduates whose experience was fresh in their minds. Things I personally found it helpful to learn about were the value of ‘closing doors’ when considering internships and early career opportunities, the preference of doing mini projects over online courses when learning software skills, and the existence of jobs that pay you to train. I’m very grateful to King’s Careers & Employability for this valuable event!’

Our virtual and in-person Careers Fairs include a collaboration with Imperial and UCL on a Life and Health Sciences event, attracting 40 science employers.

Employer engagement colleagues establish which events are most appealing for researchers and try to ensure the attendance of doctorate-holding employers to talk through their career journeys. Briefing notes for employers remind them that research students and staff, who could count as ‘experienced hires’, may be attending events, so that researchers feel welcomed when they approach employers.
Communicating the value of these central events to researchers is important: careers consultants work to build up the brand of them through regular communication with Faculty contacts. We use all possible channels to remind researchers that there are employers attending, with similar backgrounds to them, that can act as inspiration and information in making career moves. [See Chart below for figures on attendances at researcher-specific and centrally-run events.]

**How do we train researchers to understand what they have to offer?**

A key factor in enabling any career move is the ability to be able to translate existing experience into the language and requirements of the future employer.

At King's, we use a model called KASE: Knowledge, Attributes, Skills and Experience, to help all our clients, including researchers, to be able to understand their existing value. This is particularly important for researchers who tend to assume that their next role will be found solely in the niche area of research they are creating.

KASE complements Vitae's Researcher Development Framework often used in researcher development, by being a holistic view of the whole researcher.

Alumni in our Career Tracks case studies, enhanced this year using research culture project funding, and researchers on our podcast Careers In Your Ears, often touch on the importance of understanding the breadth of an individual's value to look beyond research knowledge in the search for career direction.

**How do we train researchers to understand their labour market?**

Once we’ve helped researchers understand what they have to offer through workshops and one:one guidance appointments – we then seek to support them to understand what their next steps might be. We use a cycle of Discover, Focus, and Action, recognising that all career research is a continuous learning process. This cycle informs the type of delivery we do, which can be targeted to specific groups in need of particular information on their career stage. We harness our clients’ research abilities and give them confidence to attend events to learn more, seek information interviews with contacts, and be curious about the academic world in which they work, to understand career progression.

**Future vision**

The researcher careers offer at King’s has been immensely strengthened through close partnership working with colleagues in Research Talent, and the new Research Culture initiatives. Streaming communications by working through colleagues and researcher groups, and valuing and promoting complementary work across the institution, serves to support researchers through the bewildering array of opportunities.

In the future, accessing longer-term funding to create well-managed work opportunities, for both PGRs and research staff, would allow for those transformative opportunities of insight into different work environments.

Finally, further work with employers to enable them to recognise the incredible value of our researchers, whether at a national or individual institution level, would help reduce barriers to a flexible workforce.

**Case studies**

The UK is home to a wide variety of university- and business-led collaborative initiatives that work to build a highly-skilled and diverse R&D workforce. Collaborating to nurture talent within all areas of R&D, universities and businesses provides training, funding and upskilling to match workforce skills with the evolving demands of employers.

Employer-led and university delivered training provides the high-level capabilities and skills needed to meet the UK’s national challenges. Universities are working collaboratively to drive genuine and effective change for researchers to enhance the attractiveness of researcher careers.

The following section includes three such initiatives led by universities in the UK that are aimed at transforming research career opportunities. Looking to the future, as technologies and sectors are evolving at pace, it is now more important than ever for universities and businesses to share their experiences and collectively share learning to reduce risk and expand opportunity.

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**Figure 10: Attendances at researcher-specific and centrally-run events**

Chart to show 2021-22 numbers, illustrating the numbers of researchers accessing central Careers delivery as well as research-specific careers management workshops.
TALENT is a transformative programme which is advancing status and opportunities for technical skills, roles and careers within higher education and research.

Since launching in 2020 the national initiative, led by Midlands Innovation with support from industry partners, has generated new strategic insights on the UK’s technical workforce and piloted several successful professional development initiatives.

The Role of Technicians In Knowledge Exchange report\(^{41}\) explored the role of technicians in KE and found many examples of technicians supporting business engagement and delivering services for industry, but these technical contributions were rarely recognised. The report demonstrates the influence technicians’ expertise, knowledge and capability has on KE and recommends how organisations can better recognise technical expertise and support professional development opportunities.

To enact positive change, all Midlands Innovation partners have pledged to implement the recommendations for employers outlined in the TALENT Commission. The eight universities have committed to addressing existing EDI challenges, costing technicians on grants and proposals consistently, broadening technical career pathways and expanding technician job roles, making it easier to attract the best talent and create a diverse technical workforce.

Alongside these institutional changes, TALENT is helping empower the technical community through tailor-made professional development programmes including mentoring, leadership programmes and technician-led workshops.

The Herschel Programme for Women in Technical Leadership was a successful six-month pilot which aims to address the leadership gap in technical roles and teaches new skills for current and aspiring technical leaders who identify as women. More than 170 technicians took part in the 2022 programme from 53 institutions nationwide. It was described as ‘life-changing’ and ‘immensely rewarding’ and returns for its second cohort in 2023.

Other development opportunities for technicians offered through TALENT include a partnership with the global YES Programme which develops entrepreneurial skills and commercial awareness. The team competition encourages greater collaboration with PhDs and postdocs, further increasing the visibility and value of technicians in the research ecosystem.

To help plug the future skills gap and increase the visibility of technical roles, TALENT is helping to deliver TechXFest, a new technical careers event to inspire the next generation of technical professionals in the UK. The Midlands-based expo will take place in March 2023 where industry partners from across the UK will exhibit prospects and career opportunities within industry technical roles. Thanks to new insights and data, strategic partnerships with the Technician Commitment, Midlands Innovation partners and with support from the TALENT Advisory Board, the programme will continue to share best practice and engage with organisations to influence positive change. Find out more about TALENT at [www.mitalent.ac.uk](http://www.mitalent.ac.uk).

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Challenges exist around postdoctoral researchers accessing development opportunities, including insufficient time for engagement, precarious contracts and being a relatively inaccessible community in university structures. C-DICE is working with partners such as the Research England-funded ‘Prosper’ programme and research funders to share practice and build an evidence base for addressing the structural difficulties in ensuring postdoctoral development is given a greater priority in the research ecosystem, aligned with the Researcher Concordat.

The Centre for Postdoctoral Development in Infrastructure, Cities and Energy (C-DICE) is a Research England-funded programme, established in 2021 that is delivering a wide range of bespoke development opportunities for postdoctoral researchers to provide the high-level capabilities and skills needed to meet the decarbonisation challenge. The key objectives of the programme include providing tailored opportunities for postdoctoral development against a backdrop of the structural challenges faced by postdoctoral researcher careers, and accelerating research and innovation towards net zero through interdisciplinary opportunities that up-skill and network postdoctoral and early career researchers. The programme is also capitalising on investments in research infrastructure by UKRI through the UKCRI43 and ERA44 collaborations, and is providing an evidence-base including case studies on the impact of substantial, expert, postdoctoral researcher development on research and innovation, the postdoctoral researcher community as a whole, and individuals.

Innovations within C-DICE include opportunities to access training, funding, new networks and to develop collaborations, including with industry. One example is the C-DICE developmental sandpits, which can be conducted in collaboration with industry. The sandpits have been designed to provide the capability necessary to undertake interdisciplinary research, to innovate and form new interdisciplinary teams, to craft a funding proposal, to act as principal investigator on a funded projects and to gain experience of peer review; opportunities that are not commonly available to postdoctoral researchers. Groups of up to 25 researchers participate in each sandpit, with teams of around 5 researchers taking forward funded ‘pathway’ projects of up to £30k, intended to lead to new collaborations and funding proposals.

C-DICE also offers a limited number of fully-funded Fellowships (offered flexibly), creating a cohort of C-DICE Fellows, funded secondments with industry and partner universities, and a range of flexibly offered training pathways covering both technical expertise and knowledge, peer-to-peer training through ‘expert-led’ sessions and drawing on capabilities at our partner universities. C-DICE now also offers a range of ‘micro-credentials’, endorsed by our advisory board, to enable researchers to evidence the skills and experience they have developed through engaging with different elements of the programme.

Since its inception in 2021, C-DICE has had well over 500 attendances at our courses, training and events, 20 universities have participated in the programme and we have engaged with over 30 companies. Four sandpits have taken place, which have included industry participation in co-creation, peer review, and two Fellowships have been awarded. In total £375,000 has been awarded to support postdoctoral researcher development since 2021.

C-DICE is led by Loughborough University, Cranfield University and the University of Birmingham whilst the full partnership covers over 18 HEIs and institutions plus around 30 industry and other partners. Further information, including more detail on the programme and impacts can be found at https://www.cdice.ac.uk/programme/case-studies/.

43 https://www.ukcric.com/
44 https://www.era.ac.uk/
In October 2020 the South East Physics Network (SEPnet) launched the SME-DTN collaborative PhD studentship scheme with funding from the Research England Development Fund and partner universities. This scheme is distinct from UKRI-supported centres for doctoral training (CDTs) as it requires strong engagement with regional SMEs in collaborative research from the outset.

Industry-focused PhD studentships are an excellent opportunity to develop graduates with the skills and knowledge needed to support business and research. SMEs are key employers in the UK and engines for growth but often lack the ability to invest in risky yet vital R&D, particularly at the earlier technology readiness levels where university physics departments excel.

SEPnet has drawn on established links with SMEs in condensed matter, numerical modelling, simulation and gaming, data science, photonic materials and sensors through their existing employer engagement activities to develop the network. They have successfully initiated five PhD projects this year with a further three or four in the pipeline.

A large part of their success has been the knowledge they gained from running an earlier proof of concept PhD consortium (RADnet). This focussed on the radiation detection sector and involved three university partners with co-funding from SMEs and one large employer (National Physical Laboratory). The SMEs involved proved they were prepared to collaborate and share in pre-competitive research with a view to reducing risk and expanding opportunity in an affordable manner, to create new business opportunities and to network with, and influence the training of, potential future recruits.

Launching the SME-DTN during a pandemic proved to be challenging: networking and workshop opportunities for companies and academics, as well as PhD recruitment events were impacted; promotion of the scheme and buy-in from academics and business partners were hampered; and some SMEs became more cautious about taking on new partnership projects. The initial intention of involving two or more companies in each project also proved challenging due to IP barriers and the need to develop potentially complex supply chains.

SEPnet has had to be agile to overcome these challenges. In particular, they have opened the scheme to larger companies as well as other disciplines, such as sports science and chemical process engineering. One particular success is offering an EngD route to a mature student: “My research is aligned with the technical direction my company wishes to take so my research benefits the company whilst also giving me a new challenge and route for professional development. The support from SEPnet has been invaluable to help me navigate my way back into the world of academia. The access to training through SEPnet and my EngD course are helping to refine my technical and professional skills.”

For the future, SEPnet plans to make use of the valuable experience gained through the SME-DTN and to use their contacts, resources and training programmes in supporting CDT bids. These will help them fulfil one of their key goals of equipping students with the skills needed to thrive in rewarding STEM-based careers. More information can be found at: [www.sepnet.ac.uk/sme-dtn/](http://www.sepnet.ac.uk/sme-dtn/)
3.3 Innovation-led local growth – zones, clusters and institutions

At the last UK General Election in 2019, the Conservative Party’s grip on power was tightened thanks in large part to its electoral success in the traditional Labour Heartlands in the North of England and the Midlands. Their manifesto promised to Level Up the UK, by unlocking the vast potential that exists across the whole country, noting that the economic divide between the greater South East and the rest of the UK has widened over decades.

Any modern knowledge economy is powered by dynamic businesses that benefit from a thriving research and innovation ecosystem – through the skilled people it develops, the transformative technologies it creates and diffuses, and the valuable networks and infrastructure it provides. As government plans for Levelling Up developed over the last few years, it became clear that research and innovation would be important to the success of the new local growth policy landscape.

We have seen proposals from government for new spatial policies: Freeports were proposed and then established under Boris Johnson’s premiership – an early priority for then Chancellor, now Prime Minister, Rishi Sunak. These continue to develop. Liz Truss’ government explored the introduction of Investment Zones – and Jeremy Hunt recently announced these he would be changing the approach to investment zones, which would now focus on leveraging research strengths by being centred on universities in left-behind areas. All these policies aim to support increases in economic activity in particular places through deregulation, co-location and investment incentives. However, given the importance of universities to national and local economic growth, it has not always been entirely clear how what role they will play in these new initiatives.

For this section, we have invited Professor David Bailey from the University of Birmingham and Dr Ivan Rajic from Anglia Ruskin University and Steve Beel, CEO of Freeport East, to comment on the role that economic zoning can play in supporting research and innovation-led local growth. We have also asked Dr Eoin O’Sullivan from the University of Cambridge and Professor Richard Jones from the University of Manchester to offer an alternative local innovation model with purposeful new institutions at its heart.

As government plans for Levelling Up developed over the last few years, it became clear that research and innovation would be important to the success of the new local growth policy landscape.
Freeports aren’t a silver bullet. Economic development in the UK needs a broader take on industrial and regional policy

PROFESSOR DAVID BAILEY
Birmingham Business School and The UK in a Changing Europe programme

DR IVAN RAJIC
Anglia Ruskin University

The UK government is setting up freeports to act as “innovative hubs, boost global trade, attract inward investment and increase productivity” while also generating employment opportunities in deprived communities. That’s a lot to ask for from one policy tool.

Freeports aren’t actually new; the UK had a version of them prior to 2012, but the Government is now arguing that they can function better now that the UK is no longer bound by EU State Aid rules. The problem is that there is little evidence to back up such claims.

Freeports are designated areas meant to offer advantages to businesses located there, especially with regard to tariffs. Normally, when a company imports goods to a country, it pays tariffs when the goods cross the border. In a freeport, however, this works somewhat differently. In the UK’s model, companies will be able to benefit from things like duty suspension, duty inversion, duty exemption for re-exports, and simplified customs procedures.

Other supports could comprise things like tax breaks for firms in freeports, guaranteed infrastructure investment, easier planning permissions for freeport operators, potentially testing out new customs and administrative technologies, and so on.

Overall, the Government hopes that freeports can become hubs of economic activity, employment, and innovation, particularly in the UK’s poorer regions. But can freeports actually deliver this? Research by the UK Trade Policy Observatory has shown that the benefits of duty inversion are likely to be negligible, because there are very few cases where tariffs on components are substantially higher than the tariffs on the final goods made with them.

And there are important issues around firms’ business models and supply chain strategies that complicate the picture on freeports as an economic development tool.

46 HMT. (2022) Freeports Consultation. Boosting Trade, Jobs and Investment Across the UK.
For example, if firms are already producing in the UK, for sale on the domestic UK market, and using imported components, it is possible that some of them may decide to move their production to a freeport, in order to take advantage of duty suspension. But this doesn’t mean more economic growth; no additional economic activity is being created; rather there is a geographical relocation of existing activity. This is termed a displacement effect, raising issues such as ‘enterprise zones’.48

But the fundamental thing behind such zones is that they are normally an economic policy tool that is used by poorer countries that do not have much else to offer, so they opt for supplying low cost labour, relaxing regulations (such as cutting worker rights, reducing environmental standards), and offering tax cuts, subsidies and the like. And even then, many such zones have failed to attract substantial investment and remain underutilized.49

There are examples (such as in China) where such zones have been used successfully to provide jobs and stepping stones to development (which could also involve linking up production in freeports to domestic supply chains). But, in these cases, special economic zones were just one part of much broader industrial policies.

In cases where special economic zones have been used in richer countries to attract investment and jobs to poorer areas, they have been moderately successful, but this generally involved business activity relocating from other parts of the same country and not net job creation.

Overall, perhaps freeports in the UK could be a part of a broader industrial policy, for example if used to solve a specific problem such as helping some lagging regions, but as a general policy tool, we don’t feel that they can lead to the sort of transformation that the Government seems to be hoping for. So when looking at the potential role for freeports let’s not get too carried away.

The role of Freeport East in driving local innovation

STEVE BEEL
CEO, Freeport East

One of the overriding policy objectives for the Government’s freeports policy is that freeports should act as hubs of innovation. That is certainly something Freeport East takes very seriously, both as a responsibility and opportunity, and we continue to explore how best we can make this a reality. The relationship between universities and businesses will be a central part of that.

Although it is still very early days, we feel Freeport East, together with other partners in the region, can play a key role in enhancing and developing many of the innovation components that already make the east of England one of the most dynamic and diversified economies in the UK, and we are ambitious in wanting to maximise how we play that role. More than anything else, we are open to all and any kinds of partnerships and collaborations that can contribute to this goal.

While focused on the ports of the Haven Gateway, predominantly Felixstowe and Harwich, but also Ipswich, the full Freeport East area extends 45km inland and includes several urban centres, the Universities of Essex and Suffolk, several colleges of higher education and a range of other specialist skills, research and innovation institutes. It therefore has the potential to draw together many facets of existing innovation networks as well as create new opportunities across the sub-region.

In addition, the heart of Freeport East is no more than 90 minutes from the City of London, Cambridge and a number of excellent research facilities near Norwich – enabling it to be a centre of innovation in its own right, but also connect seamlessly into those other globally-recognised centres. This makes for an extremely strong offer for international businesses looking to locate to the UK and also provides some incredible opportunities for local companies, universities and others to contribute to a step change in productivity in the region.

One of our primary objectives is to help strengthen the interactions between businesses and the surrounding innovation ecosystem that can help identify, develop and apply the types of innovation that will support those businesses and sectors to be more effective. In some cases this will be through creating hubs for those new connections ourselves, such as through the proposed innovation centre at Gateway 14 in Stowmarket. However, it will also be about building on what is already working well. New Anglia Local Economic Partnership (NALEP) for example, already do a great amount of work on connecting the users and developers of innovation and supporting a network of innovation hubs across the region. Their experience in green energy sectors means that our ambitions for Felixstowe and Harwich to become centres of green energy innovation of the future are able to draw upon sound foundations.

Initially, it makes sense to focus on those sectors with strong business communities already present within the Freeport East area.
We would expect these to include trade and logistics, with Felixstowe already being the country's busiest container port and Harwich being a key route into Europe. Felixstowe has already been trialling the use of 5G technology for example to see how it can support port operations and there are many opportunities to explore innovations to make trade more efficient, including with parts of the world, such as the Commonwealth, where trade volumes have significant scope to grow. Likewise, the green energy sector within the Freeport region has a number of exciting areas of development. The volume of energy industry activity in the region, including offshore wind, nuclear power, oil & gas decommissioning and green hydrogen production offer the prospect of valuable cross-sectoral applications in areas such as data analytics, robotics, artificial intelligence and remote sensing.

Other sectors of interest will range from agricultural technology to modern methods of construction as well as specific areas of local academic strength such as data science. The University of Essex, where data science is such a strength, is already one of the leading Universities in the UK for building Knowledge Transfer Partnerships between the university and business. One of the KTPs shortlisted by Innovate UK's KTP Awards in 2022, involved a partnership with the Mediterranean Shipping Company (MSC), a significant player in the global logistics industry. These types of existing activity provide a great platform and we want to see Freeport East contributing to future KTPs and ensuring the university retains its leadership role in this space.

Elsewhere, Adastral Park is one the UK’s leading centre of technological innovation and similarly provides a building-block that the Freeport initiative is looking forward to working closely with.

Overall, as we seek to build Freeport East into a genuine innovation hub that supports our ambitions on levelling up and productivity, we are looking forward confidently, based on the tools and mechanisms we have available and the partnerships we will be able to build in the coming months and years.

"The University of Essex, where data science is such a strength, is already one of the leading Universities in the UK for building Knowledge Transfer Partnerships between the University and business."
Developing regional and sectoral innovation capabilities: the role of intermediate research, development & innovation institutes

In our view, the missing elements in the UK landscape of RD&I institutions are regional institutes with a specific mandate to enhance and fill gaps in regional innovation capabilities.

In other countries the missions of intermediate R&I institutes are often framed more broadly in terms of developing national or regional capabilities. There is an understanding

National innovation systems are a complex landscape of different types of research institutes with different missions and goals. These include both research universities and institutes devoted to fundamental science, and public sector research establishments (PSREs) which support government strategic goals. A majority of research, development and innovation takes place in the private sector, in firms’ own laboratories, and in for-profit contract research organisations. It is this private sector innovation that most directly drives productivity growth. Public and private sector R&D can be connected in intermediate RD&I institutes, which carry out more applied research, often as public/private partnerships, as well as taking a wider role in building regional and sectoral private sector capability, through the promotion of innovation diffusion and skills development.

In the UK, basic research is carried out in a strong university base, supplemented by some standalone institutes, such as the Laboratory of Molecular Biology at Cambridge and the Crick Institute in London. The PSRE sector has diminished in size over the past few decades, because of privatisations and absorption of some institutes into universities, but it retains some strong institutions such as the National Physical Laboratory and the Meteorological Office.

The activities of intermediate institutes in the UK are largely focused on the generation of applied research knowledge (mid-technology readiness levels, TRLs) generally in collaboration with industry partners or other stakeholders. Their missions are typically defined in terms of particular scientific fields (e.g. molecular biology), technology domains (e.g. compound semiconductors), industrial sectors (e.g. aerospace), or societal challenges (e.g. ‘connected places’). The criteria by which these mission topics were selected for Catapult Centres - large potential global market, UK global lead in research capability, and the necessary absorptive capacity for commercial exploitation in the UK - presuppose existing capability. Taken literally, these criteria suggest that Catapults should not have a role addressing challenges of slow innovation diffusion or creating new innovation capabilities in economically-lagging regions (where firms don’t always have the absorptive capacity to benefit fully from new tech). While, in practice, some do undertake wider capability development activities, there remains a need for intermediate institutes that perform this role.

In other countries the missions of intermediate R&I institutes are often framed more broadly in terms of developing national or regional capabilities. There is an understanding
that new technological knowledge is not sufficient for industrial competitiveness and economic value capture. New technologies need to have a workforce that can develop them into applications and deploy them in real industrial contexts. Furthermore, regional competitiveness will require supply chains with the required engineering competences, facilities and resources.

Intermediate research institutes will only be able to make a significant impact on regional economic growth if they embrace a wider range of activities than applied research. Locally created R&D-based value can only lead to local industrial economic value capture if technical knowledge resources are translated into industrial capabilities that are competitive with other national and international clusters pursuing the same opportunities.

A more complete categorisation of the different combinations of innovation activities and functions would include the following:

- **Knowledge development:** basic science, applied science, technology development, technology demonstration, application demonstration and product/solution scale-up;

- **Knowledge deployment/capability development:** Skills & education (graduate students, vocational training, management programmes...); access to facilities & experts (testbeds, contract manufacturing...); manufacturing advisory & incubation services; and

- **Knowledge diffusion:** Network building (community seminars, consortium development...); system intelligence (e.g. roadmapping, benchmarking...); standards & regulations (working groups, certification...).

In our view, the missing elements in the UK landscape of RD&I institutions are regional institutes with a specific mandate to enhance and fill gaps in regional innovation capabilities. Addressing this gap would support high value industry clusters across the country that are crucial for productivity growth and reducing regional inequality. For the UK, it could be that institutions that are part of, or allied to, the Catapult Network can fill this role (although this would need some explicit modifications of their mission and the criteria for creating new ones).

Such regional institutes would support existing and developing clusters by targeting those innovation bottlenecks that prevent firms from taking advantage of existing and new technologies to capture high-value opportunities. These institutes need to be configured to respond to the existing business base, aligning distinctive local R&D strengths with distinctive industrial value capture opportunities. They must work with the grain of existing regional economies, avoiding the tendency, seen too frequently in the past, to establish generic R&D institutes in fashionable areas such as nanotech, biotech and ICT, which fail to take root locally. The missions of these institutes need to be defined more broadly than simply in terms of applied research at mid-TRLs. An explicit regional mission should be supplemented with programmes for workforce development and innovation diffusion to ensure they can connect into and drive the development of their regional economies and attract investment from outside.
Freeports: Opportunities and benefits

Proposed and confirmed sites for freeports can be found across the UK, providing a range of opportunities for collaboration for the surrounding universities.1]

“In Teesside the freeport has been aligned with the region’s ambitions around Net Zero and this offers significant potential. Teesside University has growing expertise in hydrogen, net zero and the green economy and our close proximity to the freeport area is presenting us with significant opportunities – for example our £13.1 million Net Zero Industry Innovation Centre will open next year and we are developing several collaborative partnerships with industry in this sector. We are hopeful that synergies between the freeport and the University will enable us to grow our expertise and ultimately become global leaders in net-zero innovation, driving growth and galvanising the economy through our research, knowledge exchange and skills activity.”

Professor Stephen Cummings, Pro Vice-Chancellor (Research and Innovation), Teesside University
Introduction

As the UK and the world begin to emerge from the COVID-19 pandemic, we face a series of new threats and challenges. Nations around the world are designing and beginning to deliver ambitious new strategies to help meet the world’s carbon reduction targets, while tensioning these against immediate energy security threats and competing short term investment priorities. Governments are also exploring how to protect their citizens and economies against future health threats, having learnt the hard lesson of the importance of preparedness from COVID-19.

The UK government is fighting to achieve short term political, economic and fiscal stability. These imperatives are driving difficult decisions around tax and spending and, in turn, between support for overburdened public services and long-term investment in skills, infrastructure and research.

This section of the report explores the full range of future challenges and opportunities facing universities and businesses and invites expert commentators to offer their insights.

The common theme across these contributions is the importance that networks, information sharing and partnerships between government, universities and businesses will play in taking on these challenges and realising the value from the opportunities.

The UK has a solid policy background to build on: a future-focused innovation strategy, an R&D people and culture strategy that recognises the importance of careers that span academia and industry and a historic rise in public sector R&D funding commitments. We also have a world leading policy on research assessment and exciting plans to develop this through the Future Research Assessment Programme.

But the international context is constantly evolving, and the UK policy framework will have to evolve with it to ensure our industrial and academic communities continue to play a major role in the global ideas and innovation marketplace. This section offers a series of thoughtful predictions, lessons and warnings for policymakers, businesses and universities alike.
4.1 Opportunities, challenges and the road ahead

There are a raft of challenges facing the current UK government: the war in Ukraine continues to add to disruption in global supply chains, impacting prices and trading relationships; inflation is increasing the cost of doing business at a time when economic disruption is biting, recession is looming and public services are straining under the weight of unprecedented demand and tightening budgets.

In this chapter, David Prosser, a freelance journalist and regular contributor for The Times and Forbes Magazine, offers a scene-setting piece, highlighting the issues facing R&D-active UK businesses. Lord David Willetts, Chair of the Resolution Foundation and former Universities Minister, continues this section with his personal reflections on what the evidence and insights from this report might mean for university-business collaborations. He explores IP income, amongst a raft of indicators of where university-business collaborations are increasing. It was in this context that the Universities Commercialisation and Innovation Policy Evidence Unit published their report, Busting myths and moving forward: the reality of UK university approaches to taking equity in spinouts. One of their main findings showed that contrary to popular perceptions, the level of founding equity typically taken by universities is much less than often claimed.

Finally, we conclude this section with former Research England Executive Chair, David Sweeney, offering a history lesson on the UK policy landscape for research and impact assessment – highlighting important lessons for the future.

The Road ahead for R&D intensive British businesses

DAVID PROSSER
Freelance Economics and Business Journalist

The UK may finally be emerging from the Covid-19 pandemic, but this is not a return to business as usual. The worst of the disruption from the COVID-19 crisis, including the lockdowns that paralysed the economy, now appear to be over. But businesses face an unprecedented raft of new challenges including the threat of a potentially enduring recession.

Headwinds all around
The list of problems is a long one.

The war in Ukraine, combined with lingering COVID-19 impacts on global supply chains, has driven up food and energy prices. That pushed inflation to 40-year highs in the summer and Autumn of 2022 and inflation is expected to remain elevated in 2023. Globally, geopolitical tension and the travails of economies such as China threaten to depress the international economy by acting as a brake on trade. Closer to home, disruption from Brexit continues to worry many businesses, with sentiment research suggesting the problems have actually escalated in recent months rather than easing. Domestic political upheaval, moreover, has added to the UK’s economic problems. Meanwhile, the threats and imperatives of climate change loom ever larger.

Against this backdrop, the outlook for the UK economy has deteriorated significantly in recent months. Forecasters are revising their predictions for growth downwards in both 2022 and 2023. The OECD, for example, now expects the UK economy to stagnate over the next year. The Office for Budgetary Responsibility predicts that a recession that began in the third quarter of 2022 will last well into 2023. The Bank of England is even more pessimistic, forecasting no recovery until 2024.

November’s Autumn Statement from Jeremy Hunt saw the Government attempt to steady the ship following the disastrous reaction of financial markets to the mini-budget announced in September by the new Chancellor of the Exchequer’s ill-fated predecessor Kwasi Kwarteng.
The UK’s borrowing does appear to have stabilised under the new administration. But Hunt’s tax increases and public spending cuts—deemed crucial for the UK’s credibility—will be a further drag on growth.

Winners and losers

Inevitably, some sectors of the economy will fare better than others. Consumer-facing industries exposed to the impacts of the cost-of-living crisis look particularly vulnerable. Energy-intensive businesses such as manufacturers are already facing severe difficulties, research from Make UK warns. Smaller businesses with no international sales to provide diversification may find the going particularly tough. Innovative start-up and scale-up businesses looking for capital may find international investors less keen on the UK; there is already some evidence that these investors are growing more nervous.

The energy sector, by contrast, looks more resilient. Traditional energy businesses have enjoyed huge windfalls from recent price spikes; those working on the transition to greener energy have been boosted as the economic case for decarbonisation has added to the environmental imperative. Similarly, exporters may benefit from continued weakness in the pound, which boosts their competitiveness.

It should also be pointed out that September’s much criticised mini-budget did include a raft of new incentives to encourage business investment. Measures such as setting the annual investment allowance permanently at £1 million and the extension of venture capital trusts that invest in small firms were confirmed in the Autumn Statement. And while plans for investment zones were dropped, the new Chancellor did offer more support for research and development and innovation, and the introduction of investment zones all have the potential to boost businesses in sectors where investment can drive accelerated growth. Technology and life sciences are two obvious examples of sectors where this could prove to be a real positive if R&D flourishes.

Indeed, both industries already have a strong story to tell, providing some light amid the gloom. During the first half of 2022, UK-based technology companies raised record sums, picking up $11.3 billion of new investment—more than both China and India, and second only to the US. In the life sciences sector, UK biotechs saw investment increase by 60% last year.

Structural challenges

Overall, however, it is difficult to escape the unease. Even in these bright spots of the economy, the UK faces difficult structural challenges that threaten to hold back innovation and growth.

Skills shortages, in particular, are beginning to bite. Across the whole economy, industries of all types are facing labour market problems, with unemployment and vacancy rates now close to all-time highs. However, in industries that are especially dependent on human capital, the skills gap is becoming a chasm. In pharmaceuticals, for example, rising vacancies now threaten the UK’s global leadership role. These problems can have dangerous knock-on effects: the Government’s own research suggests almost 700,000 businesses lack staff with cyber security expertise.

Investing for a brighter tomorrow

Such problems highlight where the priorities for businesses and policymakers should now lie. PricewaterhouseCooper (PwC) calculates, for example, that policy interventions promoting upskilling and training could drive GDP growth through digital transformation by as much as £63 billion a year. Targeted support for particular sections of the labour market—more and better-quality apprenticeships for younger workers, for example, and help for economically inactive people—will also be important.

54 Make UK. (2022). Out of control energy bills are now business threatening for 60% of manufacturers.
Elsewhere, leaving aside the politics of the levelling-up agenda, closing the UK’s regional income imbalances can be a major driver of growth; London’s output is 2.5 times that of the North East of England, studies show. Looking outwards, further progress on trade agreements and liberalisation – including resolving outstanding Brexit issues – represents a huge opportunity.

In this difficult environment, moreover, resilience is a key word. If the “new normal” is increased volatility and uncertainty, businesses and industries will need strategies to navigate accordingly. One example is the growing determination of many businesses to reshore their supply chains, which will reduce their exposure to international disruptions. Investment in sustainability – improving energy efficiency, focusing on self-sufficiency, and mitigating climate change risk – will also drive resilience and potentially unlock new value.

None of which is to suggest that pursuing such priorities will be easy. While there are some upside factors that favour the UK – including resilient household spending to date, modest growth in business investment, and the existence of support with rising energy costs – the downside risk remains significant. At home, high inflation and increased mortgage costs are a real and present danger; globally, the slowing international economy and worsening political tension loom large.

Nevertheless, British businesses must now begin to plot a path through these difficulties, with the support of policymakers and stakeholders across the broader economic and investment ecosystem. It would be easy to panic in the headlights, but doing nothing is not an option.

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If the “new normal” is increased volatility and uncertainty, businesses and industries will need strategies to navigate accordingly.

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If economic growth is to be the overwhelming priority for Government policy then an increase in the quantity and quality of R&D spend is crucial. A target has already been set to increase this to 2.4% of GDP, the OECD average when the target was set. The Office for National Statistics (ONS) has now re-assessed its data for R&D and concluded that actually our R&D spend may already be at the target rather than bumping along towards the bottom of the OECD league table at about 1.7% of GDP, which is where we all believed it to be. This is an exceptionally large revision to data. The ONS suggests that the survey on which its old figures rested did not give sufficient weight to R&D activity amongst smaller companies. The new estimate also reflects evidence from the increasing take up of R&D tax credits. There is still a lot to be done to understand what is going on here.

The target for R&D spend is for a combination of public and private spend. The aim is for public spending to leverage as much private spend as possible. More interactions between businesses and universities are a key way to achieve this mix. That makes the work done by the NCUB and the data it collects particularly relevant and significant. It is a reliable time series of great interest.

The latest data in this report shows some strong and welcome trends but also some challenges. First, the good news. There is very encouraging evidence of universities focussing more on employability. Universities are providing more courses with a sandwich year, particularly in industry disciplines. This may be a response to the increasing emphasis on technical education and pressure from students themselves for university courses which make them work-ready. There are more higher level apprenticeships and more internships too. All this is a particularly striking achievement as this survey covers graduates who studied and graduated during the COVID-19 pandemic.

There is also a continuing increase in university commercialisation activities such as spin-offs and start-ups. It is good news that patent and IP activity in universities is going up. Intellectual Property (IP)-related income, however, declined from £313 million in 2019-20 to £284m in 2020-21, though this is quite a volatile indicator and may not necessarily be part of a wider trend. Universities may however be pressing for too large a stake in spin-offs deterring some investors.

There was a welcome increase in the value of university/ SME inter-actions. However there is a modest decline in the total number of university interactions with business and SMEs which is worrying. Perhaps COVID-19 has disrupted behaviour. There are other possible explanations. The decline may be a result of the withdrawal of ERDF funding (European Regional Development Funds) which was aimed to stimulate university partnerships with SMEs.

There was also a decline in Innovate UK academic grants in 2020/21. This may be the result of Innovate UK funding being rather uncertain and short term until a funding settlement for 2021 and then the full Spending Review.

The data shows the wide range of ways in which universities interact with business. It looks as if forms of engagement directly involving students – what one might regard in a broad sense as teaching inter-actions – are growing. However, the picture is not so good when it comes to R&D based inter-actions with business. Perhaps students are expecting close engagement with business whereas researchers are finding it harder. This opens up issues such as the case for full economic costs for research grants. Moreover it is important to have long-term steady and recognised sources of applied research grants – such as SMART awards – which may work better than funding calls for very specific once-off challenges which can be harder for business to spot and to respond to in the time available.

Overall my own experience, confirmed by this report, is that there is broad and healthy engagement between universities and business. The NCUB itself makes an important contribution to this. There is important evidence here for policy makers universities and business leaders to reflect and learn from to strengthen these interactions even further.
Introduction

In 2022, the results from the most recent iteration of the Research Excellence Framework (REF) exercise were published. They showed strong research performance in universities across diverse disciplines and geographies, while also highlighting the important impacts that universities’ research capabilities are helping to drive, in collaboration with external partners, including businesses.

Following the conclusion of the last exercise, the UK Government and Devolved Administrations asked the four UK Higher Education Funding Bodies to initiate the Future Research Assessment Programme (FRAP). This is exploring possible approaches to assessing UK research performance in the future, working closely with the sector to build a picture of a healthy thriving research system and to determine what the best research assessment model would be to support it.

As the UK embarks on the next stage of its research assessment policy, this provides an opportunity to reflect on decades of initiatives and policies to deliver excellent research, accelerate impact and support effective collaborations.

In this chapter, former Executive Chair of Research England, David Sweeney, explores how business-university collaboration has changed since the first formal UK research assessment exercise in 1986; and considers its evolution in line with policy changes over the years.

Research Assessment and University-Business Engagement

DAVID SWEENEY
Former Executive Chair of Research England

Stepping down inevitably leads to retrospectives and NCUB have indulged me by asking about the evolution of business-university collaboration since the first version of the research assessment exercise in 1986. I started work in 1976, working in a sector-oriented horticulture research institute, which carried out a balance of underpinning and applied research. My job as a statistician was to design and analyse experimental trials which were often carried out on commercial growers’ sites. In itself that is a strong reminder that governments of various shades have seen research and universities as a key economic driver for a long time. That has been a consistent strategic approach, not seen in many aspects of government policy. Despite frequent comments about ‘step-change’ and ‘new strategy’ most of the developments over the last 50 years have been about refining implementation plans including the adoption of new funding, assessment and engagement initiatives.

Government support for the agenda increased after polytechnics became universities in 1992, a constraint
Government support for the agenda increased after polytechnics became universities in 1992, a constraint on student numbers was relaxed in 1993 (albeit not fully-funded) and new universities were established in places where higher education had little presence.
Perhaps it was an advantage that the public debate on assessing impact lasted for two years with TV and radio exposure in addition to much written discussion in the so-called ‘opinion-forming media’. Although some felt strongly that the core purposes of research were being unduly driven by external views, that debate allowed a much broader understanding of what was entailed, and in itself was part of significant engagement between universities and their external partners. In Australia a similar exercise was abandoned and the public debate on the role of universities continues to this day, adversely affecting relations between government and academics. In the UK, universities became part of the way forward, most recently in response to the pandemic and in the challenging discussions about ‘place’ and providing better opportunities for citizens in all parts of the country. Despite doom-laden prophecies about the consequences for underpinning research it remains the case that the UK performs very strongly indeed in taking forward global research directions.

The willingness of universities to support this agenda led to further funding opportunities through the UK Research Partnership Investment Fund, the Industrial Strategy Challenge Fund and the Strength in Places Fund, none of which would have proved so fruitful without the positive culture and increased reputation provided by research assessment including consideration of impact. That societal engagement lies at the heart of the research role on net-zero, artificial intelligence, quantum and pandemic research and even a cursory glance at various forms of Industrial and Innovation strategy demonstrates the synergies that can be drawn with the rise of certain industries and the supply of personnel and expertise being provided by universities to fuel their growth. The creation and development of the National Centre for Universities and Business has had a considerable catalytic effect and also allowed much of the substantial discussions about optimal ways to proceed to be carried out collaboratively between industry and academia without over-bearing government involvement.

“A consistent government strategy and willing actors from both industry and universities has significantly impacted economic outcomes but there is still much further to go in understanding our economy to best deliver growth.”

More practically and quantitatively the number of and income from university-business interactions has steadily increased since 2009. The portfolio has varied over time, recognising business need and different incentives, but consultancy services have become more important whereas facilities and equipment has diminished proportionately, demonstrating that active engagement continues to increase compared with passive provision of services. A consistent government strategy and willing actors from both industry and universities has significantly impacted economic outcomes but there is still much further to go in understanding our economy to best deliver growth in GDP and better opportunities across the whole of the country.
4.2 Integrating the lessons of the pandemic into a more dynamic research and innovation system

The COVID-19 pandemic presented unprecedented challenges. The rapid proliferation of a previously unknown virus required policymakers, businesses and universities to work together to develop critical solutions at breakneck speed. This process has identified a series of important lessons around how to make collaborations work smoothly and deliver solutions quickly.

In this chapter, we invite Tomas Coates Ulrichsen and Dr Leonard Kelleher from the University of Cambridge to offer their reflections on this. They identify a series of insights, in particular the essential roles that networks and partnerships between universities, research and technology organisations, businesses, investors and public sector bodies must play in responding to other urgent and emerging crises facing the UK and the world.

The chapter also includes insights from Professor Muthu De Silva, Dr Caroline Paunov and Nikolas Schmidt, who explore how international co-created initiatives – between industry and researchers – were able to address the socio-economic costs imposed by COVID-19. These initiatives were mobilised at speed, drawing on existing collaborative relationships and building on them to connect new partners beyond the ‘traditional’ innovators.

Going for growth: the importance of a ‘both/and’ mindset for investing in the commercialisation of research

Tackling the current set of urgent crises buffeting the UK – from the climate crisis to unsustainable increases in the cost-of-living to stagnant productivity growth – will require a significant step-change in our nation’s innovation effort. It will require investments to drive not just breakthrough technologies to seed new industries and markets, but also to deliver and diffuse innovations that improve productivity, develop new and sustainable production methods, and create new business models to create new sources of value and capture more of the value here in the UK.

Delivering this will require focused investment not just in research, but also in the partnerships that form between universities, research and technology organisations, private enterprise and investors, and the public sector. All of these are crucial to accelerating the commercialisation of research and its deployment at scale.

The response to the pandemic demonstrated what is possible when these types of organisations come together to work closely to find solutions to very specific health and socio-economic challenges. Examples abound in areas of vaccine and therapeutics development, diagnostics, and hospital resilience. Through their combined efforts they managed to develop workable innovations at significant pace and deployed them rapidly in the real world at scale.

TOMAS COATES ULRICHSEN
DR LEONARD KELLEHER
Policy Evidence Unit for Universities Commercialisation and Innovation, University of Cambridge
Our recent research on the effects of the COVID-19 pandemic on universities and their ability to contribute to innovation demonstrated the many and varied activities university leadership were prioritising to enable and support innovation in their partners (in industry, the public sector, charities etc.). As we move through the crisis, greater emphasis was being placed on:

- Challenge-led programmes that integrate research with its translation and commercialisation as well as use-inspired basic research and applied research
- Delivering services to partners to support their own R&D and innovation activities, including taking new technologies and ideas to market, adopting new technologies to improve productivity, and helping them to solve specific technical challenges
- Building networks to better connect innovators to facilitate innovation
- A wide range of activities aimed at strengthening the conditions that underpin the innovation system’s ability to develop, diffuse and deploy innovations. This includes providing intelligence and insight to inform the strategic development of the place, sector or technology system, developing workforce skills, working with local partners to attract inward investment, investing in the infrastructure within the local area to drive innovation and entrepreneurship, and efforts to improve the local quality of life and innovation culture

We also showed that the ability of universities to make significant contributions to the pandemic response depended heavily not just on the research and knowledge available within their institutions, but crucially on their ability to work with companies, investors, hospitals, regulators etc. to rapidly translate it into practical solutions that were deployable at scale. Their network of relationships, and the professional support for knowledge exchange and research commercialisation, built up over many years and enabled by dedicated public investment from funds like the Higher Education Innovation Funding (HEIF) were seen as critically important enablers. In a separate report, we highlight how the urgency of the pandemic creating strongly aligned motivations to rapidly find solutions, meant that universities, companies and governments alike became more flexible and less bureaucratic in how they approached partnering and the terms upon which they would engage.

In looking to the future, our research explored whether universities saw strategic and viable opportunities for their institutions in contributing to an innovation-led economic recovery in areas aligned with key government priorities. We also asked them to identify whether they have sufficient resources (financial or other) to pursue the opportunity.

The results are shown in Figure 11. It shows that many universities saw significant strategic and viable opportunities around supporting their local economy and the needs of SMEs. A large majority of research-intensive universities also identified the commercialisation of emerging technologies and contributing to specific societal missions and innovation challenges as key priorities moving forward. By contrast, less research-intensive universities were more likely to identify strategic opportunities around skills needs and (to a lesser extent) working to raise the productivity of companies.

![Figure 11. Percent of universities identifying area as a strategic and viable opportunity for contributing to an innovation-led economic recovery](image)

Source: Author’s analysis of UCL/NCUB 2022 survey of universities on the effects of the pandemic on the ability of universities to contribute to innovation through the crisis.

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The results also show that many universities identified moderate or significant gaps between the level of resource (financial or other) available and what was needed to pursue the opportunity.

The results also show that few universities – research-intensive or otherwise – saw strategic and viable opportunities in building international collaborations to drive innovation. This is incredibly concerning given the historically global outlook of universities and the importance of global collaborations for national success post-Brexit. We must urgently understand the barriers (non-financial and financial) and disincentives that are making it difficult for universities to pursue such collaborations.

Drawing on their experiences from the pandemic, our research also highlighted areas where the government could do more to further enable universities to play an active and strategic role in driving an innovation-led recovery. These are captured in Box 1.

At the policy level, we need to move beyond the dualisms – basic and applied research, public and private R&D, short-term and long-term focus – that dominated the post-war linear innovation policy approach and the either/or mindset approach to decision-making. Rather, modern technology and innovation policies, such as the recently passed US Chips and Science Act that focuses primarily on driving national competitiveness, focus on investing in both basic and applied research around strategic technology areas, and in the translation, demonstration, and commercialisation of the research to unlock economic opportunities. And in driving the research-to-innovation journey, they recognise a need to create significant funding structures and policies that act to directly incentivise and reinforce the bringing together of universities, research and technology organisations, private enterprise and investors, and the public sector to work in partnership to unlock and advance innovation opportunities for long-term, sustainable and equitable growth.

To ‘go for growth’ in the UK, we must adopt a similar systems-thinking approach and both/and mindset to ensure we target our efforts to the portfolios of activities and partnerships, and the enabling and supporting infrastructure, that are required to accelerate the successful translation and commercialisation of university-based knowledge and research into new opportunities for economic wealth.

Box 1. University calls for actions government should take to strengthen their ability to help drive an innovation-led recovery

- Greater flexible funding for research, translation, and knowledge exchange to enable greater responsiveness to long-term opportunities. Additional funding to tackle major societal problems, translate and develop research into innovative applications, and contribute to local and regional development.
- Improved coordination and coherence of funding across the technology development and innovation lifecycle; levels and areas of policy; and between policy intent and implementation.
- Greater involvement of a range of actors in the self-governance of innovation systems, and strategic intelligence to aid decision-making.
- Greater support to build collaboration and innovation capacities within the innovation system, both within universities, and in the economy (in particular in SMEs and in regions of low innovation maturity).
- Support to build and strengthen innovation networks and platforms to drive collaborations, including pre-competitive R&D consortia, regional technology clusters, and international research and innovation platforms.

The results also show that few universities – research-intensive or otherwise – saw strategic and viable opportunities in building international collaborations to drive innovation.

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Co-creation during the pandemic: Lessons for the future

Co-creation – the joint production of innovation between combinations of industry, research, government and civil society – was widely used to respond to COVID-19 challenges. This article summarises key insights from two recently-released OECD Science, Technology and Industry Policy Papers analysing and documenting the experiences of 30 COVID-19 co-creation initiatives from 21 countries and three transnational initiatives.

What are key features of international co-creation initiatives during COVID-19?

Overall, existing co-creation networks enabled the rapid emergence of new initiatives to address urgent needs, while digital technologies enabled establishing new – and, where necessary, socially distanced – collaborations. Governments engaged actively in co-creation by advising on initiative goals and fostering especially linkages between industry and the research community, in order to collaborate on COVID-19 research-driven projects or speed up the manufacturing of products necessary to combat the pandemic. The role of civil society was important as well, and the socially impactful nature of research and innovation was a motivating factor for engagement. Harnessing a similarly strong motivation is an important driver of effective future co-creation endeavours also to address the challenges of the green transition.

What role did co-creation of industry and research play to address the COVID-19 crisis?

The socio-economic costs imposed by COVID-19 would have been much larger in the absence of many co-creation initiatives that produced solutions to COVID-19 challenges. Co-creation led to the development of vaccines, quickly produced ventilators for COVID-19 patient treatment and data platforms that supported research, innovation and policy in dealing with the pandemic. Co-creating in the COVID-19 context required adjustments to established collaboration practices. Consequently, the COVID-19 crisis offered a testbed for new practices, technologies, operational models and partnership structures. Such practices will be essential going forward to address complex socio-economic challenges.

What was special about co-creation during the COVID-19 pandemic?

Co-creation partners mobilised at speed, driven by their motivation to make a meaningful contribution to society. This motivation engaged also stand-alone entrepreneurs and civil society to collaborate with the science community and governments.

Existing networks, technologies, infrastructure, and policy programmes were leveraged to quickly respond to the COVID-19 emergency. Using the existing bases of collaboration...
proving a useful step to quickly advance on collaboration plans, such as Innovation Clusters in Canada, an initiative that brought together private companies of all sizes, academic institutions, government and not-for-profit organisations.

At the same time, open calls for solutions that leveraged digital tools and social media engaged more diverse actors in co-creation, connecting actors from industry and science with new partners beyond the "traditional" innovators. Prominent examples are hackathons, which are events involving possibly large numbers of participants in generating ideas and solutions primarily through technology and innovation.

**How did co-creation initiatives operate in the context of crisis?**

Co-creation practices adapted to the context of crisis in order to speed up solutions. Next to adopting agile management practices, streamlining processes and leveraging digital tools, setting up multidisciplinary teams and combining a diverse range of expertise, technologies, and infrastructure from industry and science, was key to generate solutions.

Given the complexity and nature of the pandemic, solutions depended on combining expertise or pooling technologies from different industries and scientific disciplines, and often involved collaboration between medical sciences and diverse other fields. Using the private sector’s production/manufacturing, logistics and design facilities, the initiatives focussing on manufacturing end products built connections between those with the conceptual idea (often research/science) and the material and component suppliers from different sectors (industry).

**What were the key outcomes of the COVID-19 initiatives for the future?**

Transferable skills and know-how for future innovation were developed. These include skills acquired by domain experts – researchers as well as industry professionals – in medical sciences and data scientists from applying machine learning techniques and supercomputing capacities to COVID-19 medical challenges. Other relevant skills for future innovations were gained by the researchers, entrepreneurs and manufacturers from working together on manufacturing products (e.g. ventilators, medical masks).

New networks and connections were formed that are valuable for innovation going forward. Connections between industry and public researchers, or between data scientists and government institutions, may lead to new ways of thinking about joint collaborations and lead to the creation of new initiatives.

**What are the key policy lessons to support co-creation?**

There is room for building new collaborations between researchers and producers to accelerate innovation - networks and infrastructures should be strengthened during "normal" times in order to prepare for crises. Particular focus should be placed on the creation and expansion of networks that go beyond disciplinary and sectoral boundaries and engage a wide variety of actors, as such networks are especially attractive and enriching for participants - one of the main incentives for co-creation identified in the COVID-19 case studies was the opportunity to work alongside leading experts in technology areas and research fields that were beyond one's core area of expertise.

Innovation policies aimed at creating new and strengthening existing partnerships between researchers and producers can enable more agile responses in the advent of a future crisis, and in turn help accelerate innovation today. Efforts at local and regional level to increase the visibility of the existing knowledge, technological and manufacturing capacities of universities, public research centres and industry, respectively, could facilitate the identification of potential collaboration partners, create new networks and reinforce existing ones. The densification of such collaboration networks would enhance systems' resilience to future shocks.
4.3 How universities and businesses can work together to define the big research questions of the next decade

The choices made by policymakers and other leaders over the coming decade will chart the course for humanity for the rest of the century. We face serious challenges: climate change and other human–caused environmental impacts threaten almost every aspect of global socioeconomic norms as well as the delicate balance in the natural world; the COVID-19 pandemic highlighted the fragility of societies in the face of new and rapidly emerging health threats; and geopolitical tensions alongside complex global demographic challenges pose threats to international stability and threaten unprecedented scales of human suffering.

Research and innovation; and science and technology – both how they are developed and how they are used – will play a critical role in creating the necessary solutions to the challenges facing humanity. Governments, universities and businesses each bring important knowledge, perspectives and capabilities – and only through meaningful collaboration can usable and effective solutions be delivered.

In this chapter, Kevin Forshaw from the University of Plymouth explores how the university has leveraged its own strengths and worked with businesses and other partners to help create a sustainable global ocean economy. Jack Snape, from the Government Office for Science, then offers insights into the approach that government is taking to work with universities and industry to understand how to use emerging technologies to develop new capabilities that can help to respond to significant public policy challenges.

Oceans of opportunity: driving sustainable growth of the global ocean economy

Universities are now far more than places of research and learning. The scale and breadth of expertise across the UK’s higher education sector knows few bounds. But applying that in tandem with businesses to address the UK’s grand challenges is increasingly achieving breakthroughs that change the course of society as a whole.

Our commitments in this vein are long-standing ones. For decades, we have engaged in knowledge exchange initiatives that have enabled companies in the South West and beyond to harness our academic input. Each year, that involves talking to over 3,500 businesses, and our activities are worth £433m to Plymouth in terms of output generated.

There is currently a global drive to understand and address the climate emergency, and particularly with regard to topics such as net-zero, energy independence, and digital security. As one of the world’s top five universities for marine research and teaching (according to the 2022 Times Higher Education Impact Rankings), we are increasingly focusing on these areas when it comes to business engagement.

The advances we have made in offshore renewable energy are just one example and would not have been possible if it wasn’t for universities, industry and government coming together. The upshot is we now realise the scale of the opportunity and the action needed to take advantage of it – and we are driving the innovation and engagement that will make those advances a reality.

In marine autonomy, we work with companies to optimise sensor
developments for the all-important data capture to monitor offshore operations. While in clean maritime, we have combined with local and global companies to launch the UK’s first electric passenger ferries and create the UK’s first network of shoreside charging facilities. We are also generating the data needed to assess how this benefits the environment, which will be crucial for this emerging sector to expand over the coming years.

Organisations such as the OECD have predicted a doubling in growth in the ocean economy by 2030. That means there is a massive opportunity here in the South West, a region that relies on – but also stands to benefit most economically from – the sector. The University has been instrumental in bringing together industry, research and local government to drive clustering initiatives to drive growth in marine technology. This provides societal application for our research to boost the UK’s drive for net zero, and dramatically reduce the nation’s collective environmental impact on land and at sea.

So how does this all come about? There are many ways in which we engage with businesses depending on urgency and the level of funding available. If there is an urgent need for commercial testing, we can usually accommodate this within our wide range of world-leading facilities. And these are constantly being updated as part of a capital investment programme that will generate 2,026 jobs in the city to address the UK’s grand challenges. Meanwhile if engagement could also enhance teaching, we could support via a student project at little or no cost.

Grant funding for industrially driven, collaborative research that a university can support was given a massive boost under the Industrial Strategy back in 2017. The Innovation Strategy in 2021 introduced even greater emphasis to unlock university resources to drive technological innovation.

This focus has enabled us to work directly with companies to test offshore renewable energy concepts, to explore how specially-designed blocks could protect our coastline and offshore energy infrastructure while also stimulating biodiversity, and to develop low-impact uncrewed vessel technology to capture coastal survey data.

The University has engaged in regional SME support programmes such as the Marine Business Technology Centre and Environmental and Big Data Impact Lab projects in Devon, and Marine-I in Cornwall. All of these draw in other regional partners and allow small companies to access the support and facilities they need to drive their new product development.

The benefits of this nature of engagement can go both ways, while also boosting the economy generally. Businesses get support to drive their innovation for new products or service development, while it enhances our students’ experience and helps inspire the next generation of innovators. It also provides a practical embodiment of our research-led thinking to positive social and economic benefit.
Drivers of Technology Needs - Bringing government, business and universities together to identify priority technologies

JACK SNAPE
Head of Foresight Projects, GO Science

The Government’s Integrated Review recognised that technological developments will be important to our future success as a nation. While developing and manufacturing any new technology could have benefits to the UK’s economy, what can often be forgotten is that technology is a means to an end, helping us to achieve things we want to achieve – like meeting net-zero or curing diseases.

It can give us either entirely new capabilities or provide transformative improvements to existing capabilities. Some technologies can help us to achieve more of our objectives than others, and there is an argument for using this information to prioritise which technologies we focus on.

At the Government Office for Science, we started a project earlier this year to help do just this, by assessing the importance of a long list of technologies to a set of government goals around health, national security, the environment and the economy. Ahead of publication of the final report on our approach we thought it would be helpful to share our process for running the project as it involved a significant amount of collaboration across sectors [the theme of this publication].

Directly mapping individual technologies to these ‘big picture’ goals would have been challenging. Instead, we have introduced an intermediate concept of ‘technical capabilities’ to make this easier and make the results more transparent. Technical capabilities are things that will be needed to support delivery of an overarching goal and are themselves underpinned by key technologies (alongside other enablers, such as skills and institutions). They should be technology-blind, where various (often competing) candidate technologies could support each capability. An example of a technical capability is long-term energy storage – this capability is important for our net-zero goal, and different technologies can contribute to it.
The image below shows how capabilities support goals, and how technologies support capabilities. Each link is scored in terms of its importance. In the image, thicker lines represent higher importance, so Technology 4 is most important for the goals because it has more, thicker lines connecting it to them.

The main activities within the project were to produce the lists of capabilities and technologies and assess their importance. This was a big task and was only possible because we were able to assemble a collaborative participant group made up of over 60 people from business, universities, government and other relevant sectors. By drawing on this wide range of expertise, the project has benefited from a diverse set of perspectives with understanding of the technical feasibility of potential future developments as well as wider enablers and barriers to achieving goals.

We designed a process where we collected both quantitative assessments of the importance of technologies and capabilities, but also qualitative rationale and context for these assessments. These insights are easily as useful as the scores themselves, and our expert group has been able to provide them in abundance.

We ran a series of virtual drop-in discussion sessions and workshops, which allowed the expert group to have some input into the design of the process, and to discuss and come to a consensus on their assessments. We used an iterative process to finalise the assessments, drawing on principles from the ‘Delphi’ method, which recognises the value of informed, expert judgements, but also that people can change their mind once they hear different perspectives on a complex issue. Using video-call based workshops allowed us to access experts from right across the UK and to set these up at short notice. This improved accessibility and agility for collaborative projects has been one of the unexpected benefits of the remote working boom following the COVID-19 pandemic.

One question most of our experts have had is – ‘how will the outputs of the project be used?’. The Innovation Strategy identified seven key technology families and said that the Office for Science and Technology Strategy (OSTS) would steer the process of prioritising technologies within those – this work is a contribution to that process. This project assesses the contribution of technologies to policy goals – an important consideration, but not the only one. This is being assessed alongside other factors to give a fuller picture of the UK’s strategic interest in a technology. It’s also important to say that this analytical approach does not ‘provide an answer’ and will be combined with a wider decision-making process that takes account of the qualitative context and other judgements. Insights from universities and businesses on this wider context has been invaluable.

An example of a technical capability is long-term energy storage – this capability is important for our net zero goal, and different technologies can contribute to it.
This report shows that there are two major challenges facing university-business collaboration in the UK. The first challenge will be in ensuring that these vital collaborations continue to thrive and develop despite the significant economic and political disruption that the world currently faces. It is all too easy, when faced with significant crises, for an organisation to retreat into where it feels safest. But the lessons from COVID-19 show us that networks and partnerships build resilience and bring benefits to all those involved. University-business collaborations, simply put, are an investment worth making whatever the climate.

The second, longer-term challenge will be in building even deeper, more purposeful, more strategic partnerships across universities, businesses, and public policy organisations to respond to the biggest challenges facing us all. Universities and businesses are the world’s intellectual immune system. They each bring different capabilities, expertise, knowledge and know-how – and solving the most difficult challenges and threats – and deriving the greatest benefits – will require all those capabilities to be aligned and united, supporting clear shared goals.
This year’s State of the Relationship report provides important insights into the key collaboration trends. Our Collaboration Progress Monitor shows continued improvement in university commercialisation, relative stability in the rate of collaboration between universities and SMEs compared to the previous year despite the challenges of the pandemic, and increases in degree apprenticeships and internships. It also highlights some more detailed observations. Despite the general fall in SME engagement, consultancy seems to have become a more important method of collaboration with universities over the course of the pandemic. Also, universities that have diverse, broad knowledge exchange strategies maintained greater resilience in business engagement compared to those with narrower approaches.

The CPM also highlights some interesting areas to watch for future years:

1. Whether we will see a significant bounce back in SME engagement as the data begins to reflect the full reopening of the UK economy
2. Whether we will continue to see an upward trend in research commercialisation indicators
3. Whether university-business collaboration on talent development is reflected in future apprenticeship and internship rates

Finally, we offered a series of experts’ reflections on the ways that emerging government spatial policies, including Freeports, are aiming to support place-based growth across the UK, while exploring the role that universities can play in making these a success.

The report concludes by attempting to predict the future context that universities and businesses will be navigating, drawing on a series of expert commentators gazing into the political, the economic, and the technological future.

What this report highlights most acutely is that the challenges we face – whether short term shocks or looming crises – will only be solved through collaboration. The UK research, innovation and skills system needs shared purpose, future-looking partnerships and supportive policy. Sustained public support for R&D, innovation and human capital – designed and delivered in partnership with the private sector and higher education sector – will be an essential enabler to our nation’s ability to grow and prosper throughout the 21st century.

NCUB is proud to play our role in that mission, by making the UK the lead destination for university-business collaboration.

“Sustained public support for R&D, innovation and human capital – designed and delivered in partnership with the private sector and higher education sector – will be an essential enabler to our nation’s ability to grow and prosper throughout the 21st century.”
Appendix A: Collaboration progress monitor data tables

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

<table>
<thead>
<tr>
<th>Indicator</th>
<th>2018/19</th>
<th>2019/20</th>
<th>2020/21</th>
<th>Relative difference from 2020 to 2021</th>
<th>Relative difference from 2019 to 2021</th>
<th>5-Year Average 2017-2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>HE income from business collaboration (excluding IP)</td>
<td>39.7%</td>
<td>37.6%</td>
<td>35.4%</td>
<td>-2.2%</td>
<td>-4.3%</td>
<td>37.6%</td>
</tr>
<tr>
<td>Business Funds in HE</td>
<td>4.45%</td>
<td>3.99%</td>
<td>8.8%†</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overseas Funds in HE</td>
<td>17.87%</td>
<td>16.23%</td>
<td>4.9%*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HEI interactions with SMEs*</td>
<td>62895</td>
<td>53390</td>
<td>52032</td>
<td>-2.5%</td>
<td>-17.3%</td>
<td>52032</td>
</tr>
<tr>
<td>Total income from interactions with SMEs (£000)†</td>
<td>£259,553</td>
<td>£231,657</td>
<td>£209,316</td>
<td>-9.6%</td>
<td>-19.4%</td>
<td>£233,527</td>
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<td>HEI interactions with large business</td>
<td>25610</td>
<td>25059</td>
<td>24920</td>
<td>-0.6%</td>
<td>-2.7%</td>
<td>25819</td>
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<tr>
<td>Total income from interactions with large businesses (£000)</td>
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<td>£738,264</td>
<td>£677,397</td>
<td>-8.2%</td>
<td>-11.6%</td>
<td>£725,322</td>
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<tr>
<td>Innovate UK academic grants</td>
<td>756</td>
<td>782</td>
<td>574</td>
<td>-26.6%</td>
<td>-24.1%</td>
<td>748</td>
</tr>
<tr>
<td>£ per Innovate UK academic grant</td>
<td>£281,765</td>
<td>£317,824</td>
<td>£195,023</td>
<td>-38.6%</td>
<td>-30.8%</td>
<td>£247,705</td>
</tr>
<tr>
<td>Licenses granted</td>
<td>12719</td>
<td>17580</td>
<td>18396</td>
<td>4.6%</td>
<td>44.6%</td>
<td>12858</td>
</tr>
<tr>
<td>Income from licensing (£000)</td>
<td>£200,540</td>
<td>£198,352</td>
<td>£172,229</td>
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<td>-14.1%</td>
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<td>Patents granted</td>
<td>1867</td>
<td>2027</td>
<td>2078</td>
<td>2.5%</td>
<td>11.3%</td>
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<tr>
<td>Academic spinouts</td>
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<td>1320</td>
<td>1379</td>
<td>4.5%</td>
<td>4.8%</td>
<td>1251.4</td>
</tr>
</tbody>
</table>

Source: NCUB based on ONS (2022), HESA (2022) and UKRI innovate UK grants (2022).

Notes: † Data for 2020/21 includes an ONS revision to higher education R&D. As a new methodology was applied to this data and estimates are only available to 2020, year-to-year differences and the 5 year average were not estimated (i.e., data for metrics 2 and 3 from 2020/21 should not be compared to previous years). *Data on SME interactions and income from SME interactions for period covering 2016/17 to 2018/19 has been recalibrated to reflect a process review held by the University of Liverpool in 2020 to ensure their HE-BCI data is robust. For recalibration the regional GDP growth rates were used to backfill data on interactions between the University of Liverpool data and SMEs for the year16/17 to 2018/19. The information contained in the table is subject to change and does not commit NCUB.

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

<table>
<thead>
<tr>
<th>Indicator</th>
<th>ENGLAND</th>
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<tbody>
<tr>
<td>HE income from business collaboration (excluding IP)</td>
<td>39.2%</td>
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<tr>
<td>HEI interactions with SMEs</td>
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<tr>
<td>Total income from interactions with SMEs (£000)</td>
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<td>HEI interactions with large business</td>
<td>19657</td>
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<td>Total income from interactions with large businesses (£000)</td>
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</tr>
<tr>
<td>Innovate UK academic grants</td>
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<td>£ per Innovate UK academic grant</td>
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<tr>
<td>Licenses granted</td>
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<tr>
<td>Income from licensing (£000)</td>
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<td>Patents granted</td>
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</tr>
<tr>
<td>Academic spinouts</td>
<td>908</td>
</tr>
</tbody>
</table>

Source: NCUB based on ONS (2022), HESA (2022) and UKRI innovate UK grants (2022).
<table>
<thead>
<tr>
<th>Indicator</th>
<th>2018/19</th>
<th>2019/20</th>
<th>2020/21</th>
<th>Relative difference from 2020 to 2021</th>
<th>Relative difference from 2019 to 2021</th>
<th>5-Year Average 2017-2021</th>
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<tbody>
<tr>
<td><strong>SCOTLAND</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HE income from business collaboration (excluding IP)</td>
<td>46.0%</td>
<td>42.8%</td>
<td>37.1%</td>
<td>-5.7%</td>
<td>-8.9%</td>
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<tr>
<td>HEI interactions with SMEs</td>
<td>13381</td>
<td>13069</td>
<td>14054</td>
<td>7.5%</td>
<td>5.0%</td>
<td>15925</td>
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<td>Total income from interactions with SMEs (£000)</td>
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<td>£30,883</td>
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<td>HEI interactions with large business</td>
<td>4566</td>
<td>5738</td>
<td>6084</td>
<td>6.0%</td>
<td>33.2%</td>
<td>5167.6</td>
</tr>
<tr>
<td>Total income from interactions with large businesses (£000)</td>
<td>£97,448</td>
<td>£97,985</td>
<td>£100,872</td>
<td>2.9%</td>
<td>3.5%</td>
<td>£94,669</td>
</tr>
<tr>
<td>Innovate UK academic grants</td>
<td>78</td>
<td>90</td>
<td>81</td>
<td>-10.0%</td>
<td>3.8%</td>
<td>82.6</td>
</tr>
<tr>
<td>£ per Innovate UK academic grant (£000)</td>
<td>£235,003</td>
<td>£824,542</td>
<td>£166,782</td>
<td>-79.8%</td>
<td>-29.0%</td>
<td>£319,523</td>
</tr>
<tr>
<td>Licenses granted</td>
<td>516</td>
<td>461</td>
<td>483</td>
<td>4.8%</td>
<td>-6.4%</td>
<td>516</td>
</tr>
<tr>
<td>Income from licensing (£000)</td>
<td>£8,819</td>
<td>£6,912</td>
<td>£6,080</td>
<td>-12.0%</td>
<td>-31.1%</td>
<td>£7,993</td>
</tr>
<tr>
<td>Patents granted</td>
<td>256</td>
<td>209</td>
<td>193</td>
<td>-7.7%</td>
<td>-24.6%</td>
<td>247.4</td>
</tr>
<tr>
<td>Academic spinouts</td>
<td>244</td>
<td>237</td>
<td>195</td>
<td>-17.7%</td>
<td>-20.1%</td>
<td>221.6</td>
</tr>
<tr>
<td><strong>N. IRELAND</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HE income from business collaboration (excluding IP)</td>
<td>31.1%</td>
<td>28.2%</td>
<td>33.1%</td>
<td>4.9%</td>
<td>2.0%</td>
<td>28.1%</td>
</tr>
<tr>
<td>HEI interactions with SMEs</td>
<td>1072</td>
<td>1044</td>
<td>1122</td>
<td>7.5%</td>
<td>4.7%</td>
<td>1154.6</td>
</tr>
<tr>
<td>Total income from interactions with SMEs (£000)</td>
<td>£6,557</td>
<td>£6,016</td>
<td>£9,081</td>
<td>51.0%</td>
<td>38.5%</td>
<td>£6,371</td>
</tr>
<tr>
<td>HEI interactions with large business</td>
<td>416</td>
<td>355</td>
<td>405</td>
<td>14.1%</td>
<td>-2.6%</td>
<td>401.6</td>
</tr>
<tr>
<td>Total income from interactions with large businesses (£000)</td>
<td>£11,301</td>
<td>£9,315</td>
<td>£9,253</td>
<td>-0.7%</td>
<td>-18.1%</td>
<td>£9,127</td>
</tr>
<tr>
<td>Innovate UK academic grants</td>
<td>40</td>
<td>24</td>
<td>26</td>
<td>8.3%</td>
<td>-35.0%</td>
<td>27</td>
</tr>
<tr>
<td>£ per Innovate UK academic grant (£000)</td>
<td>£402,721</td>
<td>£407,280</td>
<td>£196,007</td>
<td>-51.9%</td>
<td>-51.3%</td>
<td>£259,101</td>
</tr>
<tr>
<td>Licenses granted</td>
<td>104</td>
<td>118</td>
<td>123</td>
<td>4.2%</td>
<td>18.3%</td>
<td>103.6</td>
</tr>
<tr>
<td>Income from licensing (£000)</td>
<td>£5,019</td>
<td>£440</td>
<td>£928</td>
<td>111.1%</td>
<td>-81.5%</td>
<td>£5,341</td>
</tr>
<tr>
<td>Patents granted</td>
<td>29</td>
<td>10</td>
<td>19</td>
<td>90.0%</td>
<td>-34.5%</td>
<td>27</td>
</tr>
<tr>
<td>Academic spinouts</td>
<td>63</td>
<td>77</td>
<td>64</td>
<td>-16.9%</td>
<td>1.6%</td>
<td>62.4</td>
</tr>
<tr>
<td><strong>WALES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HE income from business collaboration (excluding IP)</td>
<td>35.3%</td>
<td>35.7%</td>
<td>37.3%</td>
<td>1.6%</td>
<td>2.0%</td>
<td>32.3%</td>
</tr>
<tr>
<td>HEI interactions with SMEs</td>
<td>991</td>
<td>759</td>
<td>859</td>
<td>13.2%</td>
<td>-13.3%</td>
<td>969.8</td>
</tr>
<tr>
<td>Total income from interactions with SMEs (£000)</td>
<td>£6,167</td>
<td>£7,213</td>
<td>£6,751</td>
<td>-6.4%</td>
<td>9.5%</td>
<td>£6,458</td>
</tr>
<tr>
<td>HEI interactions with large business</td>
<td>971</td>
<td>768</td>
<td>943</td>
<td>22.8%</td>
<td>-2.9%</td>
<td>895.2</td>
</tr>
<tr>
<td>Total income from interactions with large businesses (£000)</td>
<td>£19,598</td>
<td>£18,225</td>
<td>£15,893</td>
<td>-12.8%</td>
<td>-18.9%</td>
<td>£15,671</td>
</tr>
<tr>
<td>Innovate UK academic grants</td>
<td>28</td>
<td>30</td>
<td>16</td>
<td>-46.7%</td>
<td>-42.9%</td>
<td>29.2</td>
</tr>
<tr>
<td>£ per Innovate UK academic grant (£000)</td>
<td>£132,957</td>
<td>£555,650</td>
<td>£124,627</td>
<td>-77.6%</td>
<td>-6.3%</td>
<td>£219,807</td>
</tr>
<tr>
<td>Licenses granted</td>
<td>630</td>
<td>701</td>
<td>820</td>
<td>17.0%</td>
<td>30.2%</td>
<td>606.6</td>
</tr>
<tr>
<td>Income from licensing (£000)</td>
<td>£2,969</td>
<td>£2,610</td>
<td>£2,973</td>
<td>13.9%</td>
<td>0.1%</td>
<td>£2,767</td>
</tr>
<tr>
<td>Patents granted</td>
<td>52</td>
<td>47</td>
<td>27</td>
<td>-40.0%</td>
<td>-48.1%</td>
<td>39.8</td>
</tr>
<tr>
<td>Academic spinouts</td>
<td>101</td>
<td>102</td>
<td>95</td>
<td>-6.9%</td>
<td>-5.9%</td>
<td>99.8</td>
</tr>
</tbody>
</table>

Source: NCUB based on ONS (2022), HESA (2022) and UKRI Innovate UK grants (2022).
Table 3: Collaboration Progress Monitor on Skills and 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>2020/21 (or 2019/20, marked*)</th>
<th>Change 21-20 (20-19, marked*)</th>
<th>5-Year Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degree apprenticeships starts</td>
<td>Number of degree apprenticeships starts (level 6 and 7) in England.</td>
<td>30460</td>
<td>39200</td>
<td>28.7%</td>
<td>20942</td>
</tr>
<tr>
<td>Higher apprenticeship participation</td>
<td>Number of Higher Apprenticeships provided by Universities in England, by apprenticeship participation.</td>
<td>26,221*</td>
<td>TBA</td>
<td>8085.4</td>
<td></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>3,999,377</td>
<td>4,136,090</td>
<td>3.4%</td>
<td>4,025,256</td>
</tr>
<tr>
<td>Source of salary of HE staff</td>
<td>HE provider</td>
<td>Industry (in %)</td>
<td>Percentage of all academic staff whose basic salary is: 'Wholly general financed by the HE provider' by 'UK industry, commerce and public corporations'.</td>
<td>77.96%</td>
<td>77.91%</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>67%*</td>
<td>1%*</td>
<td>NA</td>
</tr>
<tr>
<td>Postgraduate employment (in %)</td>
<td>as a share of all Postgraduate leavers in the UK.</td>
<td>78%*</td>
<td>77%*</td>
<td>-1%*</td>
<td>NA</td>
</tr>
<tr>
<td>PhDs in employment (in %)</td>
<td>Percentage of UK-domiciled PhD graduates entering employment: working in HE</td>
<td>42.1%*</td>
<td>40%*</td>
<td>-1%*</td>
<td>NA</td>
</tr>
<tr>
<td>PhDs in employment (in %)</td>
<td>not working in HE (industry and other)</td>
<td>57.9%*</td>
<td>60%*</td>
<td>1%*</td>
<td>NA</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>5720</td>
<td>-21.3%</td>
<td>6075</td>
</tr>
<tr>
<td>Source of salary of HE staff</td>
<td>HE provider</td>
<td>Industry (in %)</td>
<td>Percentage of all academic staff whose basic salary is: 'Wholly general financed by the HE provider' by 'UK industry, commerce and public corporations'.</td>
<td>77.96%</td>
<td>77.91%</td>
</tr>
<tr>
<td>HE leavers running own business</td>
<td>Number of UK-domiciled HE leavers that run their own business as an activity</td>
<td>5315*</td>
<td>5060*</td>
<td>2.1%</td>
<td>NA</td>
</tr>
<tr>
<td>HE leavers 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>69%*</td>
<td>1%*</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: Undergraduate</td>
<td>1050*</td>
<td>1255*</td>
<td>19.5%*</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 a share of all Undergraduate student enrolments.</td>
<td>25.7%</td>
<td>24.1%</td>
<td>-1.6%*</td>
<td>25.3%</td>
</tr>
</tbody>
</table>

Source: NCUB based on HESA (2022), Department for Education (2022)
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