National Centre
for Universities and Business

RESEARCH TO RECOVERY

R&D TASKFORCE 2020

The National Centre for Universities and Business is the collective voice of the UK's universities and leading businesses, promoting and shaping their collaboration through research, digital insight and advocacy to secure the UK's prosperity.

HELPING THE UK PROSPER, BY WORKING FOR THE UK TOGETHER

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FOREWORD

Priorities, synergies, enablers.

2020 will be a year not easily forgotten. A pandemic that has affected every corner of the globe. This is also a year that brought the importance of collaboration between academia and industry into the public consciousness. Partnerships between universities and businesses have driven an unprecedented pace of progress in the development of a vaccine for Covid-19. Such a vaccine is only possible because of a translation of knowledge and cutting-edge ideas into products and solutions to real world challenges.

For many businesses in the UK, harnessing the power of research and innovation is critical to their future success. Some recognise this and invest year-on-year in research, however the vast majority of businesses in the UK do not invest in research and development (R&D) at all.

The R&D Roadmap, published by the Government in July 2020, set out an important and ambitious vision for a more research intensive, innovation-led economy. The R&D Roadmap is a critical intervention, which provides a positive and timely response to the distinct but cumulative changes driven by Covid-19, the UK's withdrawal from the EU and our bold commitment to carbon neutrality.

Success will require change and collective action from the Government, universities, businesses and other central actors in our research and innovation system. To achieve the vision set out in the Roadmap, more businesses will have to invest more financial and human resources in R&D across the UK. How to achieve this is the fundamental question that lies at the heart of this report.

I am indebted to colleagues across industry and academia that have supported the work of the Taskforce and provided firsthand insights into the drivers, motivations and barriers to R&D investment in the UK.

As this report sets out, the opportunities from R&D are significant and if achieved could have a transformational effect on the UK economy. To deliver the ambitious R&D aspirations set out by the Government, all participants in the system need to collaborate. This report argues fundamentally that to succeed there is a need to prioritise efforts to seize strategic commercial opportunities, create synergies in the system, strengthen the enablers of the research and innovation system, and attract global investment.

I would like to express my gratitude to members of the Taskforce and Advisory Groups for their time, insights and contribution to this report. While there may have been differences of emphasis among Taskforce members, all have endorsed the content of this report and we hope it provides bold and ambitious recommendations for UK Research and Innovation (UKRI) to consider in partnership with universities, business and the Government.

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OVERVIEW

The global economy is changing

Advances in how science, technology and innovations are harnessed, applied and fused together will define the future in the Fourth Industrial Revolution[1].

For many businesses in many sectors of the economy, investing in research and development (R&D) will be a necessity to remain competitive and build back better in a fast-changing world. The Government's commitment to increase R&D investment to 2.4% of GDP by 2027 and 3% in the longer-term was a clear statement of intent that this should become common place – a new normal – for many businesses in the future[2].

> For the UK – now is the time for bold decision making to shape a resilient, world-leading economy.

The world faces broader environmental and societal changes that present both challenges and commercial opportunity. From tackling climate change to supporting an ageing society to confronting Covid-19, there is an opportunity to harness the power of new ideas, new approaches and new products and services. Increasingly, innovations will be delivered through interdisciplinary approaches that require collaboration across industries and expertise from the arts and social sciences through to science and engineering.

Covid-19 is only likely to accelerate the transformation of economies, affecting almost every aspect of global industry and disrupting activity in several sectors of particular importance to the UK's global competitiveness. Economists warn that this disruption will exacerbate the UK's weak productivity and investment growth seen in recent years[3]. Changing this trajectory, and driving recovery from Covid-19, will require bold investment in innovation and adaptation to an increasingly technology and data driven world[4]. Research, development and innovation will play a fundamental role in powering and shaping the businesses and sectors of tomorrow.

Collective response

In July 2020, the Government launched a consultation on the future of R&D in the UK through the publication of the R&D Roadmap. The Roadmap sets out an ambitious framework to reach the 2.4% target, which will require a step up in investment from both the public and private sector of some £28 billion a year by 2027.

Delivering the Roadmap's vision will require a collective response from universities and businesses as critical drivers of research and innovation. A research-intensive, innovation-led economy will be characterised by flows of ideas and collaboration between industry and academia.

1 Department for Business, Energy & Industrial Strategy. (2019). *Regulation for the Fourth Industrial Revolution* [White Paper]. Retrieved from www.gov.uk/government/publications/regulation-for-the-fourth-industrial-revolution/regulation-for-the-fourth-industrial-revolution

2 Department for Business, Energy & Industrial Strategy. (2020). *UK Research and Development Roadmap* [Policy Paper]. Retrieved from www.gov.uk/government/publications/uk-research-and-development-roadmap

3 OECD. (2020). *OECD Economic Surveys United Kingdom 2020* [Survey]. OECD. Retrieved from www.oecd.org/economy/surveys/United-Kingdom-2020-OECD-economic-survey-overview.pdf

4 McKinsey & Company. (2020). *Innovation in a crisis: Why it is more critical than ever.* Retrieved from www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/innovation-in-a-crisis-why-it-is-more-critical-than-ever

The National Centre for Universities and Business (NCUB) is the collective voice of the UK's universities and leading businesses. To bring together universities and businesses to consider the opportunities and challenges set out in the R&D Roadmap, NCUB, at the request of UK Research and Innovation (UKRI), formed a Taskforce of senior leaders from both industry and academia. The purpose of the Taskforce was to provide UKRI with advice on how the Government's ambitions for R&D could be met through greater partnerships and collaborations.

A succession of reviews have considered and helped shape the R&D system that we have today[5]. The challenge therefore is not to understand what initiatives are needed, but rather how the existing framework can be made to work better together to achieve the required scale and be more responsive to economic and societal changes.

The work of the Taskforce purposely captured the breadth of the R&D Roadmap and areas of university-business collaboration. Specific areas considered were:

- **Successes and learning from the Covid-19 crisis: particularly how to continue the openness, connectivity and pace of collaboration from the crisis;**
- **How value can be captured from the significant increases in discovery research proposed, including the implications of 'moonshots';**
- **Increasing diversity, particularly in research and innovation leadership;**
- **Supporting the whole innovation system, particularly to attract greater private investment – where are the gaps, opportunities and priorities that could be enabled by better university-business working;**
- **How to identify and strengthen the most important international partnerships;**
- **Ensuring the UK is renowned as a place for innovators and entrepreneurs; and communicating the excitement behind the vision;**
- **Maintaining and further advancing the UK's high level talent capabilities and capacity needed to drive a research and innovation powered economy.**

This report sets out recommendations based on the Taskforce's discussions, building on advice received from four Advisory Groups and NCUB's Leadership Council. The findings and recommendations presented in this report are underpinned by evidence from analysis, interviews and surveys on the impact of Covid-19 on innovation in universities and businesses respectively.

The recommendations in this report are focused on a UK-wide agenda and will have implications for devolved governments and funding bodies too. The Taskforce has sought to engage stakeholders across all parts of the R&D and innovation system and many parts of the UK.

Whilst this report is not directly focussed on the levelling up agenda, the Taskforce strongly emphasised the importance of developing recommendations that help to unlock growth and societal benefits across all of the UK. Universities and businesses working together have an important role to play and some of the recommendations in this report , notably recommendation 3, should be considered as part of the expected UK R&D Place Strategy.

The central purpose of this report is to bring together key actors in the UK's R&D system to contribute to a collective response to a changing economy.

5 See, for example;
Lambert, R. (2003). *Lambert Review of Business-University Collaboration*. Retrieved from www.ncub.co.uk/reports/lambert-review.html
Wilson, T. (2012). *A Review of Business–University Collaboration*. Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/32383/12-610-wilson-review-business-university-collaboration.pdf
Witty, A. (2013). *Encouraging a British Invention Revolution: Sir Andrew Witty's Review of Universities and Growth*. Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/249720/bis-13-1241-encouraging-a-british-invention-revolution-andrew-witty-review-R1.pdf
Dowling, A. (2015). *The Dowling Review of Business-University Research Collaborations*. Retrieved from www.raeng.org.uk/publications/reports/the-dowling-review-of-business-university-research

SUMMARY OF RECOMMENDATIONS

PRIORITIES

The UK needs a bold economic plan with research and innovation as its engine. The Taskforce recommends that the Government delivers this through commercial missions – specific areas where the UK will seek to achieve a dominant global market position.

The UK needs a bold economic plan to drive recovery from the Covid-19 pandemic but also seize the opportunities of the fourth industrial revolution. Developing and implementing this plan will require more holistic, systemic policy making that coordinates the decisions that need to be taken across different levels of government and parts of the UK, as well as across the remits of departments and budgets.

01 RECOMMENDATION

The Government should unite its twin aims of developing a more productive, resilient economy with its aspirations to grow research intensity and innovation, by refreshing the Industrial Strategy.

The UK has changed significantly since the Industrial Strategy was developed in 2017, with the impact of Covid-19, the UK's withdrawal from the European Union and a renewed emphasis on carbon neutrality affecting policy priorities. In response, the UK needs national coordination rather than individual interventions. The 2017 Industrial Strategy should be refreshed to define business R&D and innovation as a critical driver of competitiveness. This should be followed by a cross-cutting R&D and innovation plan to create the right conditions to encourage greater business investment in research, development and innovation.

02 RECOMMENDATION

The Industrial Strategy should establish a framework to define priorities for the research and innovation agenda through commercial missions.

The UK needs to identify specific commercial opportunities that it can focus support and resource around to encourage research translation and become world leading in targeted domains. The UK and many other countries have adopted mission-orientated approaches to focus resource on tackling Global Challenges. This report recommends the development of "commercial missions", which are carefully chosen, specific commercial opportunities of broad societal benefit that the UK is focussing on to achieve a dominant market position and where more public support is targeted. These areas must be able to bridge from cutting edge research through to commercially viable products and services with both local and international market potential.

SYNERGIES

The UK needs a business focused offer. The Taskforce recommends achieving this by creating synergies between components of the research and innovation system.

Successful innovation requires agile, responsive, risk-driven approaches with a clear focus on a purpose defined by demand led signals and user needs. UKRI, in partnership with devolved funding bodies, should review the foundational components of their research and innovation funding systems and actively identify where a more joined up approach can be developed. The Government also has a critical role to play in joining up wider fiscal and regulatory initiatives to business designed to encourage research and innovation.

03 RECOMMENDATION

The Government, with UKRI, should establish a network of Innovation Collaboration Zones across the UK aligned to commercial missions.

To level up across the UK, create simpler mechanisms to help businesses innovate, and galvanise industry and academia around specific, defined commercial challenges, the Government should establish Innovation Collaboration Zones. The purpose of the Innovation Collaboration Zones would be to leverage all R&D and innovation drivers, from tax incentives and deregulation of land use, through to co-location of expertise and research facilities, to deliver the commercial missions from research through to development and innovation.

04 RECOMMENDATION

UKRI should review how existing funding schemes may be more overtly joined up to deliver Commercial Missions.

To deliver commercial missions, UKRI, in partnership with devolved funding bodies, should consider ways to more overtly join existing funds up to create a more streamlined experience for the businesses and universities accessing them. There is also a need for more funding for higher risk breakthrough research. The proposed UK ARPA should play a complementary and coordinated role in attracting public and private sector investment to supporting such breakthrough research.

ENABLERS

An innovation-led economy requires strong foundations. The Taskforce recommends that the Government, with UKRI, should scale up the enablers of the research and innovation system.

As the UK scales up its research, development and innovation activities, the Government and devolved governments must also strengthen their foundations through investment in strategic enablers of the system. UK R&D is not only set to expand but will also transform. In response the UK must develop a larger, more adaptable and more diverse R&D workforce and be prepared to invest in emerging technologies and infrastructure.

05 RECOMMENDATION

UKRI must invest sustainably in fundamental research.

UKRI must invest more in discovery-led science across the Research Councils and, in particular, increase Quality Related research funding. This is the cornerstone of the research base and underpins business R&D and innovation. Simultaneously there is a need to invest in the UK's R&D capital and digital infrastructure to remain at the forefront of emerging capabilities.

06 RECOMMENDATION

To mitigate the impacts of Covid-19 and stimulate R&D investment, the Government should increase business-focused R&D incentives.

There is an opportunity for government to accelerate changes already in train to modernise the UK's R&D tax credit system to include data costs and capital expenditure and also to make it easier for SMEs to access the credit system. The Government should also explore offering equivalent incentives to encourage greater corporate venturing activity.

07 RECOMMENDATION

The Government should widen the remit of the Office for Talent to help grow and deliver domestic talent, alongside attracting global talent.

A coordinated, cross-cutting approach needs to be taken to develop, upskill, retain and retrain domestic talent. The remit of the Office for Talent should be expanded to include domestic talent to create a more strategic and evidence based approach to understanding current and future skills needs. The Office for Talent would recommend policy solutions to the Government across education, training, research, immigration and diversity and inclusion policy.

08 RECOMMENDATION

UKRI should support universities to develop a strong and diverse pipeline of R&D and innovation talent for the future that flows in and between academia and industry.

The UK does not just need more people with the right skills, but also a culture of collaboration and mobility between academia and industry. Driving forward the skills and talent needs that are a prerequisite of a R&D intensive economy is only possible if the UK fundamentally rethinks research careers. Remaining with the current system will mean that R&D will remain too siloed, homogenous, unrewarding and potentially unattractive. For the R&D Roadmap goals to be achieved, R&D careers must move to a position where they attract people of all backgrounds and experience. Developing diverse teams and thinking, through interdisciplinary work and collaboration, and attracting those from all backgrounds into research careers is central to this.

ATTRACTIVENESS

The UK needs to act as a competitor in a global R&D and innovation market. The Taskforce recommends that the Government develops and delivers a comprehensive foreign direct investment strategy for R&D.

To attract global R&D investment, the UK not only needs attractive framework conditions but also needs to promote and constantly evaluate the attractiveness of its offer. The UK must start behaving as a competitor in the global market for R&D investment to retain existing business investment and attract higher levels of globally mobile business research.

09 RECOMMENDATION

The Government should develop a foreign direct investment in R&D strategy to retain and attract a higher level of globally mobile business investment to R&D in the UK.

The Government, through UKRI, the Department of Business, Energy and Industrial Strategy (BEIS), Home Office, Treasury and the Department for International Trade (DIT), should develop a foreign direct investment in R&D strategy to retain and attract a higher level of globally mobile business investment in R&D to the UK.

10 RECOMMENDATION

UKRI should create a Global Collaboration Fund to encourage universities and businesses to pool their strengths to attract inward investment.

Building on the concept of the Connecting Capability Fund, UKRI should develop a Global Collaboration Fund that encourages universities to collaborate and pool their strengths to attract investment from businesses in the UK and overseas. Aligned to the foreign direct investment in R&D strategy, the Global Collaboration Fund would be a focused mechanism to encourage groups of universities to form consortia and create a joined-up, cohesive offer that would be attractive to mobile international R&D funding.

SECTION

01

if (conn == NULL)
{
fprintf(stderr, "Failed to create CURL connection\n");
exit(EXIT_FAILURE);
}
code = curl_easy_setopt(conn, CURLOPT_ERRORBUFFER,
errorBuffer);
if (COMPARE((char *)name, "TITLE"))
{
context->title = "";
context->addTitle = true;
}
(void) attributes;
//
// libxml end element callback function

CONTEXT

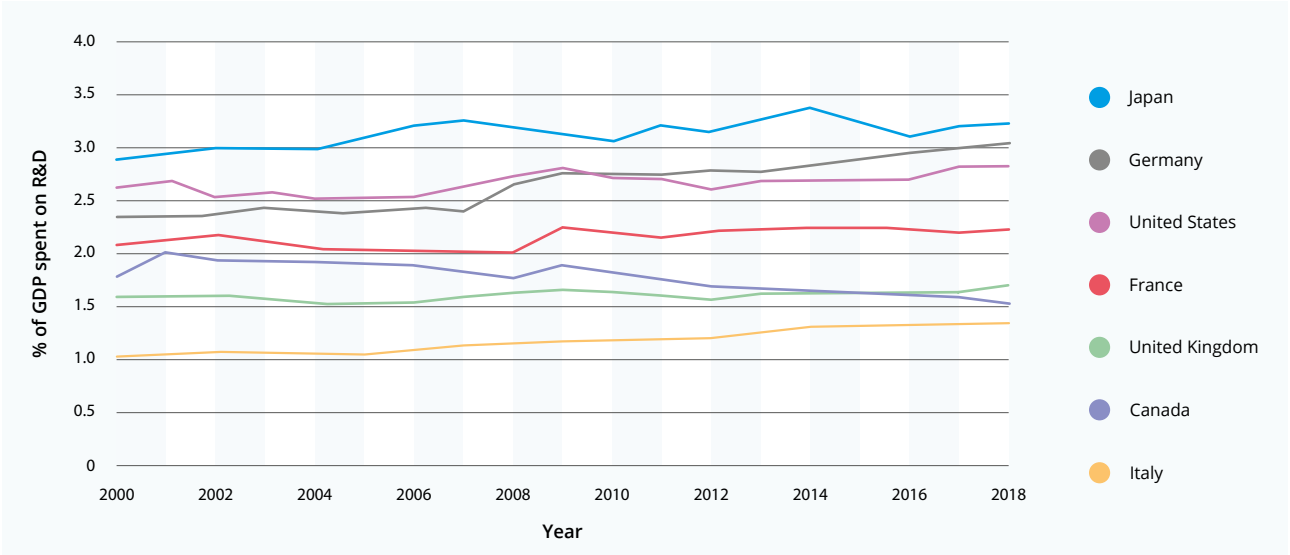
An ambitious vision for UK research and innovation.

The Covid-19 pandemic has demonstrated how important research and innovation is to our society, our health and our economy. In the midst of the pandemic, the UK Government published an R&D Roadmap[6] that affirmed the scale of its R&D ambitions - pledging to transform the UK into the very best place in the world to be a researcher, inventor and innovator.

To seize this opportunity, the UK has set a target to raise UK spend on R&D to 2.4% by 2027 and 3% in the longer term[7]. This does not simply represent a tweak in R&D spending, but rather resets the baseline of spending and refocuses the UK's economy towards research intensive activities. The Government has made an important commitment to spend £22 billion on R&D in 2024/25. This commitment is critical to realising the ambitions of the R&D Roadmap as for many years UK R&D spending has lagged behind key competitors.

UK public funding in R&D is currently around 0.5% of GDP, which is much lower than the levels of 0.7%-0.8% invested by the US, Germany and France. The ratio of public and private spending on R&D in the UK is above OECD average, but the UK's total R&D spending is lower because both public and private sectors invest proportionately less. Cumulatively, the UK has spent £44 billion less on R&D in the last ten years than it would have if it had invested at the OECD average[8]. This means that the UK starts from a lower baseline than competitors.

Figure 1: GERD as a % of GDP, selected countries, 2000-18



Source: OECD

6 Department for Business, Energy & Industrial Strategy. (2020). *UK Research and Development Roadmap* [Policy Paper]. Retrieved from www.gov.uk/government/publications/uk-research-and-development-roadmap

7 This target was first set in the 2017 Industrial Strategy and was restated in the R&D roadmap. Department for Business, Energy & Industrial Strategy. (2017). *Industrial Strategy: building a Britain fit for the future* [White Paper]. Retrieved from www.gov.uk/government/publications/industrial-strategy-building-a-britain-fit-for-the-future

8 NCUB analysis comparing UK R&D spend to average OECD R&D spend between 2008 and 2018.

Reframing the opportunity

The R&D Roadmap is a rallying cry to the drivers of the R&D system and all actors who are, or should be, invested in the importance of R&D. For government, for businesses and for universities, it raises the expectations as to the scale of ambitions for R&D in the UK. The private sector invests around £25 billion per annum in R&D. Achieving the 2.4% target, will require businesses to spend an estimated £17.5 billion more on R&D in 2027 than they did in 2017[9].

The forthcoming R&D plan must recognise that:

01

Setting out a new vision for R&D in the UK requires a **commitment from business as much as it does from universities and government**. This stems from viewing businesses as fundamental partners in the R&D ecosystem, rather than just beneficiaries.

02

The Government's target to **double R&D investment** will not be achieved through greater investment by existing R&D investors in UK research alone. The UK will also need to capture a greater share of the global R&D market and attract R&D investment from UK businesses that do not traditionally engage in R&D.

03

The UK is world-leading at research, but the greatest challenge and opportunity of the R&D plan is translating this success in basic research into greater business driven research, development and, innovation.

04

UK universities, which are dispersed across all parts of the UK, **have a fundamental role to play**, individually and with their partners, in levelling up the UK through research and education.

To realise the aspirations of the R&D Roadmap, there is a need to develop an exciting and compelling case for UK PLC across all parts of the UK. The R&D Plan should speak more directly to businesses by articulating the market opportunities that greater R&D and innovation can present to those in R&D intensive and less R&D intensive industries and focusing on establishing the enabling infrastructures that encourage business investment. Developing an exciting case will require a better understanding of the drivers that shape the decision making for those that approve investment decisions in businesses. Reaching beyond the converted requires an understanding of the factors that influence their thinking and priorities. The case needs to be framed in ways that demonstrate and deliver value, benefit and return comparable to other competing investment priorities.

To illustrate the scale of the ambition to increase R&D spending articulated in the R&D Roadmap, the average increase in privately funded R&D expenditure per year from 2007-2018 was £0.9 billion. The average increase required to meet the Government's target between 2019 and 2030 is more than double, £1.95 billion, and necessitates significant percentage increases year-on-year over the next seven years.

9 Oxford Economics. (2020). *Modelling the impact of public R&D spending plans*. Oxford Economics. Retrieved from www.ncub.co.uk/reports/modelling-the-impact-of-public-r-d-spending-plans

Figure 2: Private R&D expenditure, actual and forecasted, 2006-07 to 2027-28

Year	Total private expenditure	Year-on-year increase	Year-on-year % change
	£ billion	£ billion	%
2006-07	17.1		
2007-08	17.3	0.3	1.7%
2008-09	17.1	-0.3	-1.6%
2009-10	17.6	0.5	2.8%
2010-11	18.9	1.3	7.6%
2011-12	19.1	0.3	1.3%
2012-13	19.9	0.8	4.0%
2013-14	21.3	1.4	7.2%
2014-15	22.6	1.3	5.9%
2015-16	24.4	1.8	7.9%
2016-17	25.5	1.2	4.83%

Year	Total private expenditure	Year-on-year increase	Year-on-year % change
	£ billion	£ billion	%
2017-18	27.2	1.7	6.7%
2018-19	28.2	0.9	3.3%
2019-20	29.8	1.6	5.7%
2020-21	30.9	1.1	3.7%
2021-22	32.7	1.8	5.8%
2022-23	34.8	2.1	6.4%
2023-24	37.2	2.4	6.9%
2024-25	39.9	2.7	7.3%
2025-26	42.3	2.4	6.0%
2026-27	44.7	2.4	5.7%
2027-28	46.8	2.1	4.7%

Source: ONS, Oxford Economics, NCUB analysis

Increasing public spend on R&D has historically encouraged private spending. Multiplier effects that 'crowd in' private investment have both short-term effects (within the same year) and long run impacts. Public R&D spending continues to influence levels of private investment in subsequent years.

Analysis by Oxford Economics[10] demonstrated that the long-run impact of public R&D on private R&D was more than three times the short-run impacts. The long-run leverage rate was estimated to be between 1.01% and 1.32%, suggesting that each £1 of public R&D eventually stimulates between £1.96 and £2.34 of private R&D. The impact is most substantial in the first year and fades over time. Almost all of the effects materialise within around 15 years, and the majority of private investment is crowded in by the fifth year.

Understanding the leverage rate[11] is important as it is not a static multiplier. Government investment has an important catalytic effect especially in the short run to attract greater private investment. But as the impact wanes with time it will be critical for the Government to take action to keep the leveraging rate from falling in future years.

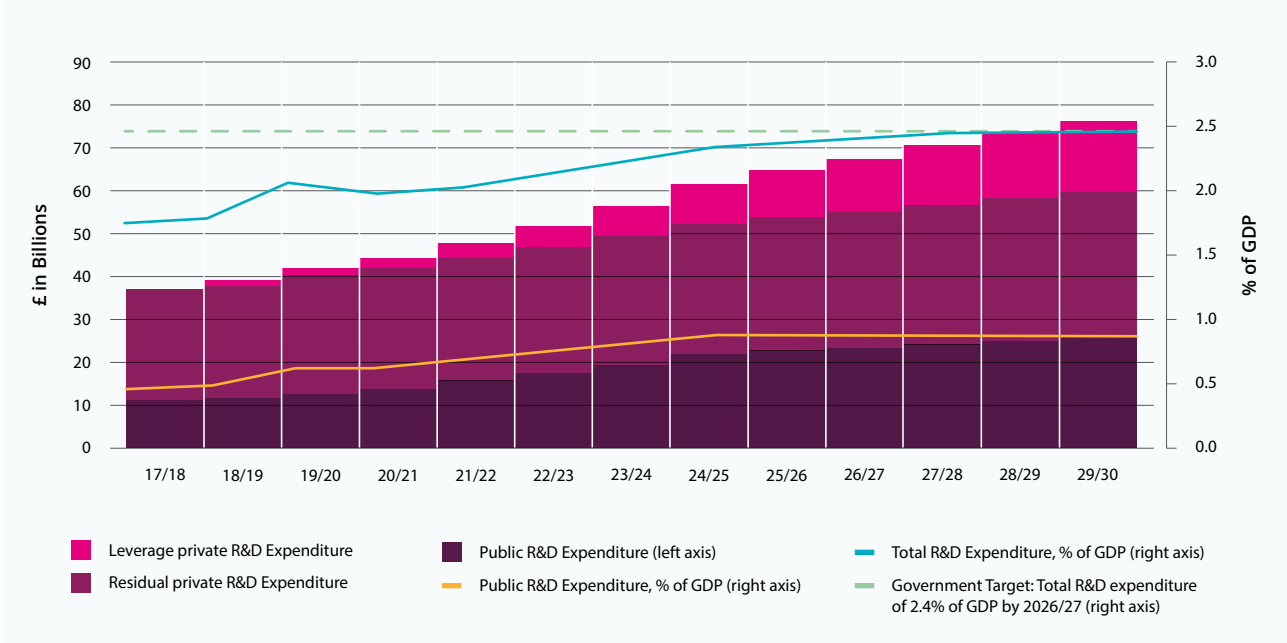
If the UK maintains its historic leverage rate, analysis for NCUB by Oxford Economics[12] suggests that increasing public R&D spending and leveraging greater private investment, combined with the residual private R&D spending that might be expected to occur independently of government spending, should bring the UK up to 2.4% of GDP spend on R&D by 2026-27 as targeted (figure 3).

10 Department for Business, Energy & Industrial Strategy, Oxford Economics. (2020). *The relationship between public and private R&D funding*. Retrieved from www.gov.uk/government/publications/research-and-development-relationship-between-public-and-private-funding

11 The increase in private R&D investment which results from each additional unit of public R&D investment is known as the "leverage rate" and is a key measure used by policy makers to understand the ripple effects of public investment.

12 Oxford Economics. (2020). *Modelling the impact of public R&D spending plans*. Retrieved from www.ncub.co.uk/reports/modelling-the-impact-of-public-r-d-spending-plans

Figure 3: Public and private R&D spending projections



Source: Oxford Economics

There are, however, a range of variables that could impact the private sector's ability to spend on R&D, not least the uncertainty of their current operating environment. The R&D Plan must therefore be focused on improving the environment that encourages private investment so the historic leverage rate is maintained.

From research to development to innovation

The 2.4% target is important in so far as it articulates the scale of the ambition and recognises years of significant underinvestment in R&D. However, to achieve the greater vision of a more research-driven, innovative economy, greater spending on R&D cannot be the only objective. The UK must also become more adept at developing and adopting innovations.

For a business, R&D is just one part of the innovation process. To see a return on investment from exploratory R&D, businesses also have to invest in developing business applications, design, revenue models and markets for new products and services. These are activities that generally require more time and resources, than inventions themselves. For a business, innovation is not just about R&D spending, but about building robust innovation capacity.

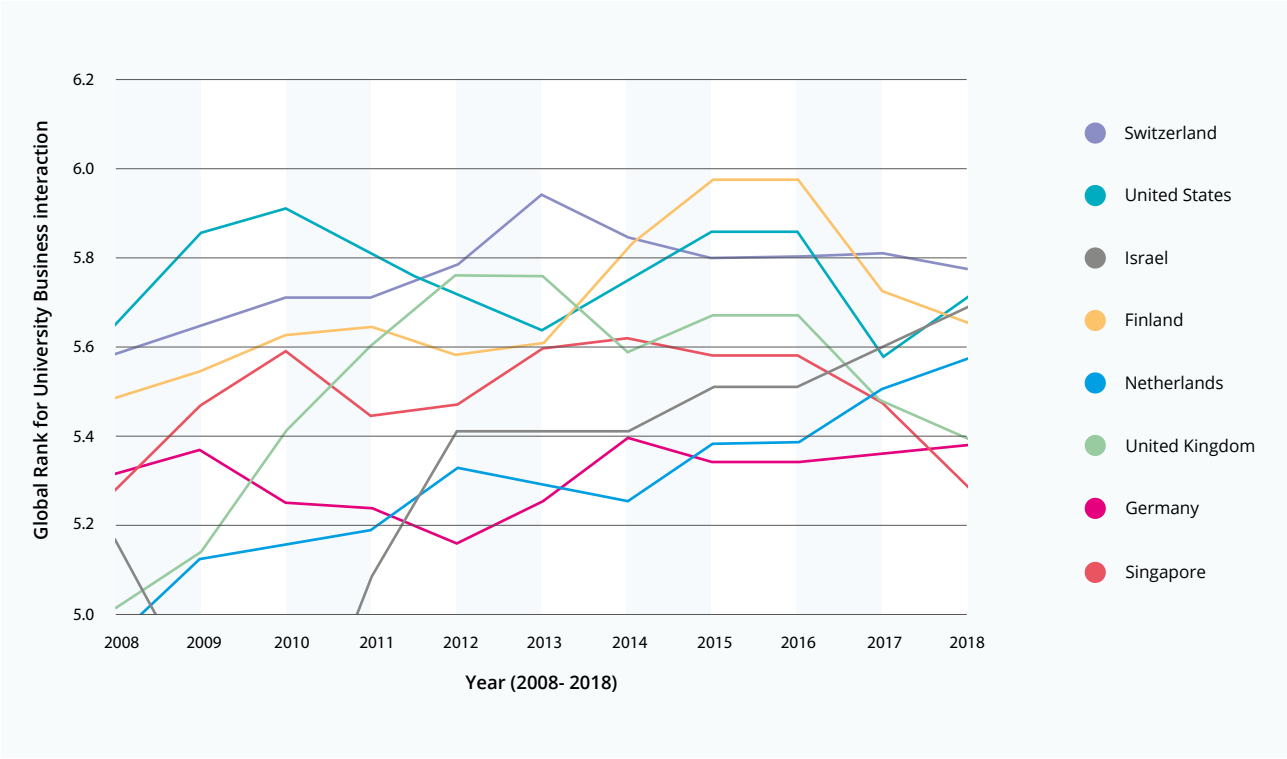
By a range of measures, the UK performs exceptionally well in research. The UK has ranked first on field weighted citation impact[13] since 2007, produces 7% of the world's academic publications and 14% of the world's most highly-cited academic publications. The UK's research base is also exceptionally collaborative[14]. 55% of the UK's academic publications were the result of international collaboration, making the UK the second most internationally collaborative country in the G7. The UK ranks sixth on a global measure developed by the World Economic Forum[15] that measures university and business interaction, behind Switzerland, the US, Israel, Finland, and the Netherlands. This is not celebrated often, but is an important factor in the UK's research strength.

13 The field-weighted citation impact is the total citations actually received by a publication, divided by the total citations that would be expected based on the average of the subject field the publication falls into.

14 Elsevier, Scopus

15 World Economic Forum. (2020). *Executive Opinion Survey - University-industry collaboration in R&D*. Retrieved from http://reports.weforum.org/pdf/gci-2017-2018-scorecard/WEF_GCI_2017_2018_Scorecard_EOSQ072.pdf

Figure 4: Global rank for University-Business interaction, 2008-2018



Source: World Economic Forum/ Worldbank

All of these strengths are important but not sufficient to becoming world leading in research translation. Countries around the world are grappling with the difficult question of how to move from research, through to development and innovation. The UK is no exception.

The Government has an important role to play in an effective innovative economy[16]. First, governments affect how markets operate and can either encourage or stifle innovation through regulation. Second, governments are important investors in innovation. Many economists argue that innovation investments tend to have large spillovers, meaning that the benefits of innovation investment are not solely felt by the company investing. Moreover, realising the financial benefits of innovation investments often takes time, typically reflecting the prohibitive cost and risk associated with proof-of-concept research. The Government plays a fundamental part in finding ways to help business overcome the so-called "Valley of Death".

There is greater urgency than ever for the UK Government to effectively support research translation and innovation. The Fourth Industrial Revolution, the Covid-19 pandemic, energy transition and rapidly transforming global markets are likely to have a long-term impact on the needs of society and customer demand. The UK must position itself to capitalise on the opportunities that this generates, as well as encourage its businesses to innovate to remain competitive in a transformed global market. Research from the McKinsey Institute[17] suggests that companies that innovate are more resilient in a crisis, more likely to expand into new markets during disruptions and more likely to be able to hold on to staff and grow in difficult trading conditions.

A key function of this report is to consider measures that the Government, industry and universities can take to support the journey from research through to development and innovation.

16 Bowman, S., & Westlake, S. (2020). *Reviving Economic Thinking on the Right: A short plan for the UK.* Retrieved from https://revivingeconomicthinking.com/technology-and-innovation

17 McKinsey. (2020). "Innovation in a crisis: why is is more critical than ever".
Available online at: www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/innovation-in-a-crisis-why-it-is-more-critical-than-ever

The challenges and opportunities of Covid-19

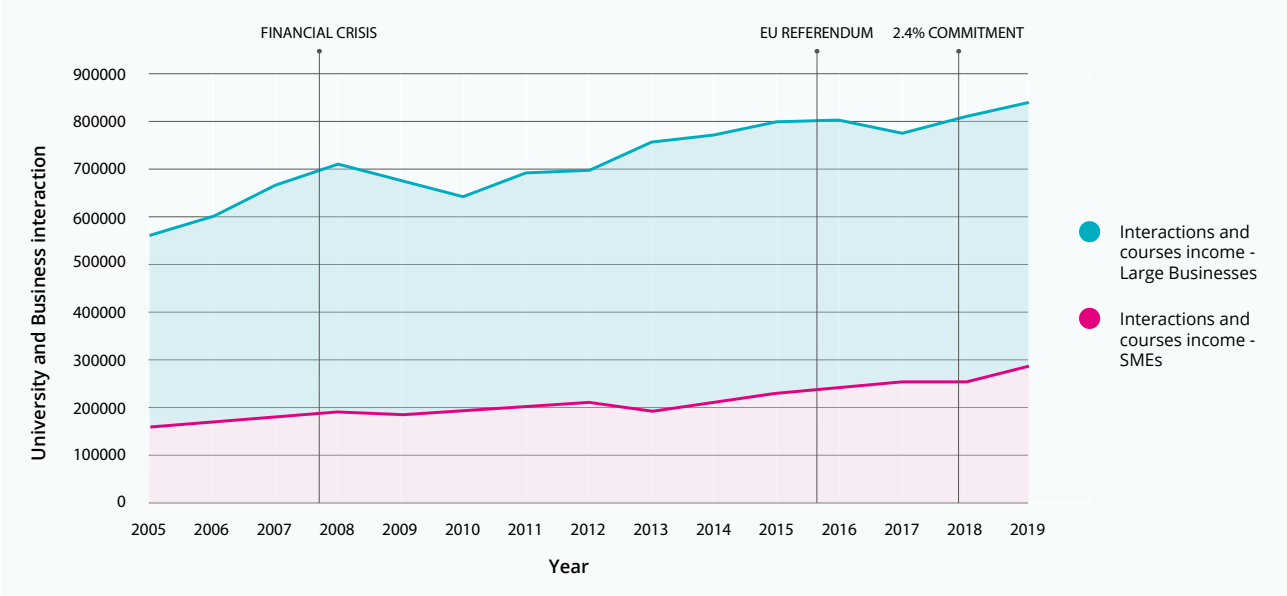
The R&D Roadmap, and work of the NCUB R&D Taskforce, was delivered in the midst of the Covid-19 pandemic. This report in part responds to the crisis and its implications for research, development and innovation. However, it is equally important to recognise that Covid-19 has greatly disrupted the operational environmental for universities and businesses.

The businesses and universities engaged in this work consistently reported that:

- **The Covid-19 crisis has demonstrated how much can be achieved when government, universities and businesses are galvanised into action with a clear, shared purpose.**
- **However, the current pace of development cannot be maintained indefinitely. The response to the Covid-19 pandemic was driven by the urgency of an immediate crisis and was only possible due to ruthless prioritisation and extraordinary dedication of people. The UK R&D system cannot sustain a crisis-mode operation forever.**
- **Maintaining the successes and pace of R&D will require a sustainable scale up of the system, including infrastructure, processes and incentives.**
- **Delivering an R&D plan, and driving greater collaboration between industry and academia, requires strong partners. Government support has a fundamentally important role to play in helping universities and businesses recover so that they are able to drive a research-led, innovative economy.**

The UK is encouraging businesses and universities to focus on more research, development and innovation at a time when some may be forced to scale back their activities due to the uncertainty of the current operating environment. Evidence from the last recession suggests that UK businesses invested less in R&D and partnerships. The number of interactions between universities and businesses following the 2007 recession and the EU referendum declined (figure 5).

Figure 5: University interactions with large businesses and SMEs, 2005-2019



Source: Policy Evidence Unit for University Commercialisation and Innovation

To understand where universities and business are on their journey to recovery, UKRI requested information on how the Covid-19 pandemic is affecting university and business research, development and innovation. In response, NCUB held a series of interviews and two surveys led by Policy Evidence Unit for University Commercialisation and Innovation (UCI) at the University of Cambridge in summer 2020. The findings of these surveys will shortly be published to provide UKRI and the Government with more detailed information on how the crisis has impacted innovation activities.

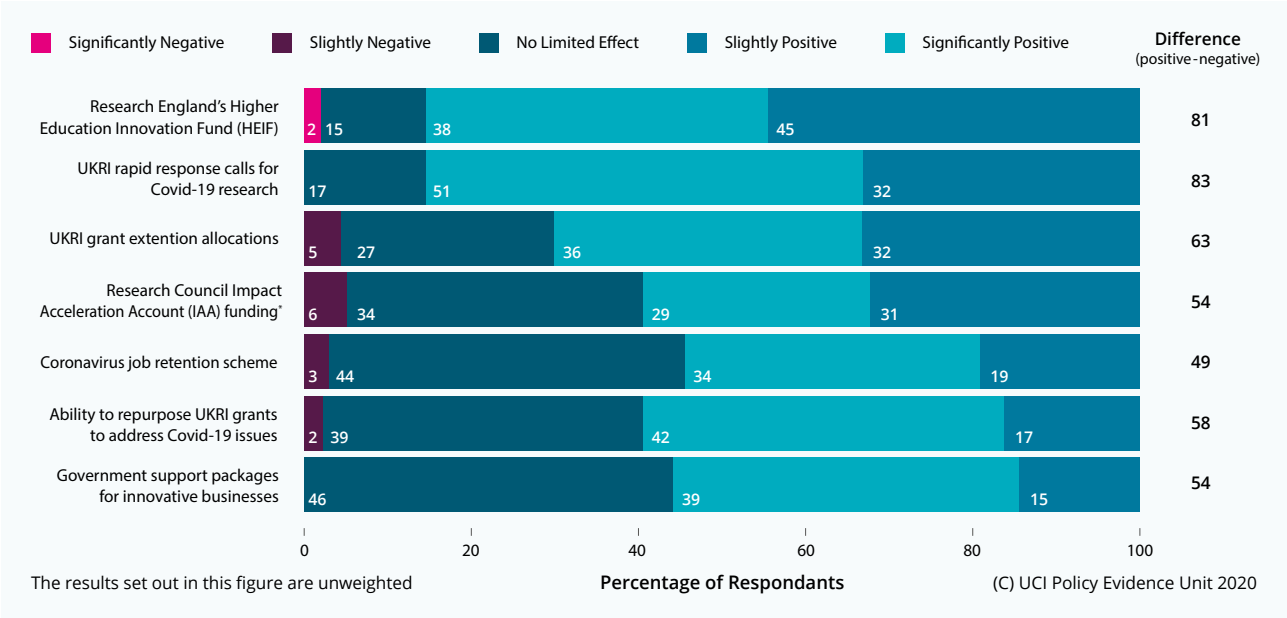
The surveys and interviews show that the crisis has had an immediate impact on university and business collaborations. In the survey of universities, almost half of university respondents reported a decrease in the level of innovation-focused activities and projects across all of their partnerships and engagements with external partners during lockdown compared with the situation pre-Covid. Just over a fifth reported an increase. Experiences appear to be affected by the types of sectors universities engage with, with activities with aerospace particularly badly affected, while those in healthcare and the life sciences stayed about the same or increased. Levels of innovation-focused activities between universities and SMEs have been particularly badly affected, with almost 60% of universities identifying a decrease.

Many businesses are concentrating on working with universities with whom they have worked before, and with whom their partnerships are strategic and 'easy'. Some businesses are reviewing their approach to engaging with universities, preferring large strategic partnerships to more responsive, ad-hoc interaction. This may lead some businesses to fundamentally change how they interact with universities in the longer term.

For most businesses, R&D is still seen as a discretionary spend funded by profits. As Covid-19 continues to impact the financial performance of businesses in many sectors, their desire and ability to invest in R&D is expected to decline. Universities that had seen a decline in innovation-focused activities and projects with external partners largely attributed the decline to financial resources within the partner no longer being available or resources being insufficient to fund collaborations/projects with the university. Almost half of university respondents reported a decrease in industry or charitable funding for non-Covid-19 related projects or activities. This may have delayed valuable advances in areas not related to the Covid-19 response.

Support measures by the Government to date have had a positive impact (figure 6), demonstrating the critical role played by the Government in sustaining innovation in this crisis.

Figure 6: Universities' perceptions of Covid-19 support measures



Source: Policy Evidence Unit for University Commercialisation and Innovation

SECTION

02

if (conn == NULL)
{
fprintf(stderr, "Failed to create CURL connection\n");
exit(EXIT_FAILURE);
}
code = curl_easy_setopt(conn, CURLOPT_ERRORBUFFER,
errorBuffer);
if (COMPARE((char *)name, "TITLE"))
{
context->title = "";
context->addTitle = true;
}
(void) attributes;
//
// libxml end element callback function

PRIORITIES

The UK needs a bold economic plan with research and innovation as its engine. The Taskforce recommends that the Government delivers this through commercial missions – specific areas where the UK will seek to achieve a dominant global market position.

A bold economic plan with research and innovation as its engine.

As the UK begins to move from recovery to rejuvenation, it needs a bold economic plan to seize the opportunities of the Fourth Industrial Revolution. Research and innovation should not be seen as one of a series of important cogs in the system, but as the critical engine that will power a bold economic plan.

Harnessing research and innovation will require prioritisation. Innovation cycles are being broken into finer stages across complex global value chains and data, knowledge and application is being generated at ever greater speeds. To convert research into innovation and into wider opportunities for the economy, the UK needs to take a targeted approach to avoid spreading itself too thinly and losing out to competitors.

The Government has an important role to play in creating a framework for prioritisation, as well as communicating and supporting priority areas for academia and industry.There was strong agreement amongst those businesses engaged through the Taskforce that to encourage more business research, development and innovation, the UK needs to focus its efforts on attracting and incentivising investment in specific areas of commercial opportunity where the UK has potential to become world leading.

01

RECOMMENDATION

The Government should unite its twin aims of developing a more productive, resilient economy with its aspirations to grow research intensity and innovation, by refreshing the Industrial Strategy.

The UK has changed significantly since the Industrial Strategy was developed in 2017, with the impact of Covid-19, the UK's new relationship with the European Union and a renewed emphasis on carbon neutrality affecting policy priorities. To reflect these changes, the Taskforce recommends refreshing the Industrial Strategy.

R&D should be at the heart of a refreshed Industrial Strategy. In the Fourth Industrial Revolution, R&D, innovation and technology are not just elements of the global economy, but rather they are the fundamental driver. An updated Industrial Strategy must therefore position R&D and innovation as an engine of a greener, more sustainable and resilient economy. R&D must be treated as a critical enabler, rather than just as an end in itself.

Establishing R&D as a driver of the economy will allow the UK to respond to the Fourth Industrial Revolution, to raise the UK's competitiveness, create jobs and enhance livelihoods and opportunities. Fundamental changes to

the balance of the UK economy will also require change. To support research translation and raise R&D spending to 2.4%, the use of public funding, fiscal and regulatory measures, and policy to encourage businesses to invest resources into research, development and innovation must be optimised. The changes required will reach beyond the authority of UKRI and any individual government department, spanning all the major facets of fiscal, trade, education and regulatory policy.

The UK needs national coordination rather than individual interventions. A refreshed Industrial Strategy should define business R&D and innovation as the driver of global competitiveness. The Industrial Strategy should set priorities for the national economy and, by extension, the R&D agenda. This should be followed by a cross-cutting R&D and innovation plan to create the right framework conditions to encourage greater business investment in R&D and innovation, and innovation adoption.

To set priorities and drive business investment to seize specific commercial opportunities will require systematic and strategic policy development, as well as coordinated decision making across different levels of government and parts of the UK, as well as across the remits of Departments and budgets. This report therefore endorses the CBI's call for a National Commission for Economic Recovery to set clear targets and a bold remit to create new approaches for a fair and sustainable revival of the UK economy over the next 12 months. To succeed, it is critical that the Commission defines research and innovation as central drivers of economic recovery.

02

RECOMMENDATION

The Industrial Strategy should establish a framework to define priorities for the research and innovation agenda through commercial missions.

An important function of the Industrial Strategy should be to create a framework to focus the UK's economy and define priorities for the research and innovation agenda so it can deliver greater opportunities, not just for UK research, but also for UK manufacturing, design and for sectors that have traditionally engaged less in R&D and innovation. If the UK spreads itself too thinly across a range of areas with innovation potential based on its existing breadth of research strengths alone, it risks developing ideas but not converting them into something of commercial and societal value to the UK[18].

In a competitive and changing global market, the UK needs to identify unique areas of opportunity that it can focus support and resource around to become world-leading. These areas must be able to bridge cutting edge research through to commercially viable products and services, and could play to the strengths of particular parts of the UK.

The 2017 Industrial Strategy set the first steps towards defining missions for the UK to concentrate on. Four Grand Challenges were identified including: AI and data; ageing society; clean growth; and future mobility, as well as eight sectors to develop sector-specific deals for. However, an evaluation by the Industrial Strategy Council[19] concluded that "only modest progress has been made in turning these challenges into policy proposals, much less in implementing these proposals" and that "it would be useful to assess how best to use this funding to "crowd-in" private sector R&D. It is clear that more work needs to be done to move beyond the what and towards the how.

For many universities and businesses the most important consideration is how prioritisation occurs and is followed through. Competitive advantages will not remain forever. The UK must identify opportunities of comparative advantage and move quickly to exploit them.

18 As set out in the Government's R&D Roadmap. Department for Business, Energy & Industrial Strategy. (2020). *UK Research and Development Roadmap* [Policy Paper]. Retrieved from www.gov.uk/government/publications/uk-research-and-development-roadmap

19 Industrial Strategy Council. (2020). *Annual Report*. Retrieved from https://industrialstrategycouncil.org/sites/default/files/attachments/ISC%20Annual%20Report%202020.pdf

The Taskforce therefore recommends that the mission-led, grand challenge approach is maintained in a refreshed Industrial Strategy, but that its execution is reviewed. Above all, there is a need for far greater specificity in the missions identified to send clear signals to industry and academia as to what the priorities are. This could include grand challenges such as achieving net zero carbon emissions; and supporting healthy ageing. But it should also include specific, commercially-focused opportunities (or "commercial missions) that build on existing UK strengths such as clinical research, biotechnology or functional genomics and aspects of Artificial Intelligence, Quantum Technologies and Robotics. The commercial missions could set the focus for the recently announced Office for Investment.

To excite businesses and crowd-in investment, a mission-orientated approach must be focussed on the ultimate goal of large-scale take up of the innovations in the real world. Delivering innovations that will be taken up should be the starting point of the innovation approach, not the end point. To encourage innovation adoption, successful commercial missions must be defined through the needs of end-users.

There are two important drivers of innovations that are adopted in the real world and these must be considered when determining and supporting commercial missions. First, the Government itself has a fundamental role to play as a first customer of innovations through large-scale government procurement to generate usable, practical and commercialisable innovations. The US Defense Advanced Research Projects Agency (DARPA), for example, has a budget of approximately $3 billion to invest in 250 R&D programs around six breakthrough technologies, and is complemented by a US military procurement budget of approximately $126 billion[20].

There is a need for far greater specificity in the missions identified to send clear signals to industry and academia.

Second, businesses providing goods and services to consumers must have razor-sharp focus on end-users and delivering holistic solutions to their actual problems. They need to take the lead in solving customers' problems and reaching "back" into the R&D value chain to make use of the latest research and technology available. Doing this effectively typically requires companies themselves to have both good marketing functions (that understand customers' needs) and, joined up to this, excellent technological knowhow (e.g., in their R&D departments, or absorptive capacity to know where to look for and how to apply the latest science). To businesses, research is a means to an end, rather than an end in itself.

To define, support and deliver commercial missions, not only now but also in the future, it must be recognised that innovations are built from ideas and it is challenging to predict where the big opportunities in the future will appear. The UK must therefore maintain investment in world-leading research across a broad range of disciplines so that the UK is well positioned to generate domain expertise, insight and knowledge across domains. Fundamental research is of critical importance to the innovation system and would underpin a system of priortisation through commercial missions.

In the 2020 Budget, the UK Government announced an investment of at least £800 million to fund a new "blue skies" research agency modelled on the Advanced Research Projects Agency (ARPA) in the US. This agency will play an important part in supporting high-risk, high-return projects and innovative breakthroughs[21].

The UK ARPA will need to strike an important balance between introducing a new agency with a strong risk appetite to tackle big ambitious challenges and not undermining baseline funding for research and innovation. The Taskforce welcomes the planned introduction of ARPA as an opportunity to take a much longer-term focus on strategic opportunities and priorities for the UK. ARPA could easily be seen as the mechanism of long-term ideation that develops a pipeline of areas that over time reach a stage of sufficient maturation that they become future commercial missions.

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20 Office of the Under Secretary of Defense (Comptroller). (2017). *National Defense Budget Estimates for FY 2018*. Retrieved from https://comptroller.defense.gov/Portals/45/Documents/defbudget/fy2018/FY18_Green_Book.pdf

21 For NCUB's response to ARPA see: National Centre for Universities and Business. (2020). *NCUB Response to ARPA July 2020*. Retrieved from www.ncub.co.uk/reports/uk-parliament-science-and-technology-committee-call-for-evidence-for-a-new-uk-research-funding-agency

SYNERGIES

The UK needs a business focused offer. The Taskforce recommends achieving this by creating synergies between components of the research and innovation system.

A business focused offer to drive innovation.

Successful innovation requires agile, responsive, risk-driven approaches with a clear focus on a purpose defined by demand led signals and user needs. Over decades, the UK has developed a world-leading research base, supported by a system comprised of quality related funding, research councils and cross-cutting funds. This system has supported and delivered world-class research and should be maintained. However, an exceptionally strong research base does not necessarily translate into innovation strength and the UK needs to adopt deliberate initiatives and policies to encourage research translation and innovation.

The Dowling Review, published in 2015, called for a reduction in the complexity of the UK's innovation system[22], suggesting a need to "hide the wiring" to achieve simplification. Five years on, many businesses engaged in the work for the NCUB Taskforce maintain that the system remains too complex, challenging to navigate and a barrier to collaboration.

For large businesses where R&D is a well-established and an embedded activity, resource is available to help find the latest research and technologies (wherever that is in the world), to navigate different funding streams from different funders, and maximise incentives such as tax relief. However, for businesses (large or small) where R&D is not the norm this can be complex to navigate.

Simplification is part of the solution to the complexities but there is also a need for the system to be much more overtly joined up. This is not just about hiding the wiring but making the system work together by creating synergies and avoiding operating in silos.

Supporting both research and innovation across a range of sectors and industries will necessarily require a web of policies (fiscal and regulatory), funding streams and organisations. Considered changes to simplify the system without removing some of its strengths will therefore not occur overnight. There are, however, more immediate interventions that could be made to identify and drive synergies between the existing components of the research and innovation system.

This report recommends that the R&D Plan articulates a clear aim that all the publicly funded components of the innovation system are all designed to work towards. This joint and clearly articulated aim should be to help businesses meet user-led demands to succeed in a changing global market. There should also be a very deliberate focus in the R&D Plan to prioritise efforts across actors in the research and innovation system to create the required synergies that would make it easier and more conducive for new to R&D businesses to engage. UKRI, in partnership with devolved funding bodies, should review the foundational components of research and innovation funding systems and actively identify where a more joined up approach can be developed.

22 Dowling, A. (2015). *The Dowling Review of Business-University Research Collaborations*. Retrieved from www.raeng.org.uk/publications/reports/the-dowling-review-of-business-university-research

The review should serve to:

Identify synergies and thereby deliver greater collaboration between the components in the system

Improve communication of the system and enhance support functions and the customer journey for businesses

Start the process of identifying areas where simplification is possible

03

RECOMMENDATION

The Government, with UKRI, should establish a network of Innovation Collaboration Zones across the UK aligned to commercial missions.

There are an array of factors that influence and shape the decision making of businesses when it comes to making an investment in R&D. The businesses engaged in the work of the Taskforce emphasised the need for a critical mass of talent, ideas, like minded businesses and competitors, as well as favourable framework conditions to encourage business investment in R&D.

A mission-led approach to R&D, and realising the ambitions of the R&D Roadmap, will require enhanced and scaled up collaboration between and within industry and academia across disciplines and sectors[23]. Initiatives like the UK's Catapult Network and University Enterprise Zones have played an important part in building critical mass by creating and attracting businesses and encouraging collaboration with academic partners.

The UK has an opportunity to go further.

To level up across the UK, create simpler mechanisms to support businesses to innovate, and to galvanise industry and academia around specific, defined commercial challenges, this report recommends the establishment of Innovation Collaboration Zones.

Influenced by the Research Campuses in Germany and Silicon Valley in the US as well as harnessing the opportunities with the advent of Freeports in the UK, Innovation Collaboration Zones would seek to create critical mass across research, development and innovation across the UK. Each zone would be built around the specific commercial missions established in the R&D-driven Industrial Strategy and would join up existing initiatives such as Catapults and large-scale collaborative activities such as the Royce Institute and sites such as the Babraham Research Campus[24].

The purpose of the Innovation Collaboration Zones would be to join up possible levers to maximise R&D investment amongst start-ups and SMEs as well as large multi-national companies, and to make it simple and effective for a business to invest in R&D and to capitalise on the different opportunities available. Importantly, the levers deployed could be tailored to the specific focus of the Zone.

23 OECD. (2018). *OECD Science, Technology and Innovation Outlook 2018 - Adapting to Technological and Societal Disruption*. OECD. Retrieved from www.oecd-ilibrary.org/sites/sti_in_outlook-2018-6-en/index.html?itemId=/content/component/sti_in_outlook-2018-6-en

24 Babraham Research Campus. (2020). Retrieved from www.babraham.com

Particular enablers that could be strategically deployed in Innovation Collaboration Zones are:

R&D Enablers

- **Strategic funding from the UK Government or UKRI to ensure the long-term sustainability of the Zone which will give businesses confidence to commit as well.**
- **Investment in full end-to-end research, testing, development, demonstration and deployment facilities and infrastructure including incubator, accelerator and grow-on spaces.**
- **Creation of a series of co-location and co-creation spaces to facilitate interactions between different actors operating in the Zone.**

Fiscal Enablers

- **Increased R&D tax credits from 13% to 25% for businesses undertaking R&D inside the Zone.**
- **Enhanced Patent Box allowance (20% reduction to corporation tax on profits relating to patented income) for companies licensing IP inside the Zone.**
- **Unlimited Annual Investment Allowance inside the Zone to incentivise R&D investment by companies.**

Regulatory Enablers

- **Simplified local planning processes by giving accountability to a designated Board inside the Zone mandated to make decisions on proposals aligned with strategic priorities.**
- **Regulatory sandboxes to support the development and testing of new innovative technologies in a controlled environment.**
- **Allowing existing university infrastructure (such as high-speed broadband and other facilities) to be made available to drive activity inside the Zone.**

People Enablers

- **Creation of a joined-up skills offer to meet the needs of current and future businesses located inside the Zone (including significant investment in retraining and reskilling).**
- **Enabling joint-appointments that work for both the university and businesses inside the Zone.**

If the UK introduces Freeports there may be an opportunity to build some of the Innovation Collaboration Zones within, or in proximity of, a Freeport. A recent consultation on Freeports talked extensively about their potential role in the R&D and innovation system, but no mention of Freeports was made the in the R&D Roadmap despite the significant opportunities they could represent. A Freeport would allow for both tax incentives and streamlined regulation on the domestic side, as well as import duty waving on the international side. This could help to attract multinational companies to the Zones.

04

RECOMMENDATION

UKRI should review how existing funding schemes may be more overtly joined up to deliver commercial missions.

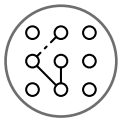
To support an R&D driven Industrial Strategy, drive recovery from Covid-19 and to help build world-leading capabilities, the UK and its businesses need to be able to join up the gap between research and innovation activity and funding. The Government should invest more in higher risk-based commercial-mission focused grants and government procurement. There is also an opportunity to consider the scales, processes and synergies of existing UKRI funding schemes that support research translation.

The proposed approach of commercial missions would allow the UK to specifically target funding for higher risk research and innovation towards those areas where it is seeking to become world-leading, maximising spillover and value to the UK.

UKRI has a number of cross-cutting funds, including the Industrial Strategy Challenge Fund (ISCF) and Strategic Priorities Fund (SPF), as well as Research Council and Innovate UK funding streams, that could help businesses, with universities, deliver against commercial missions. This report therefore does not recommend developing a new fund to deliver commercial missions, but it does call for a unification of funding to create a more streamlined experience for the businesses and universities accessing them.

In particular, it is recommended that UKRI:

+ **Reviews how ISCF, SPF and other relevant funds and schemes, map against agreed commercial missions (identified in a refreshed Industrial Strategy) and how these funds may be unified to deliver against a commercial mission.**
+ **Considers how funding in support of commercial missions can be delivered in a way that matches the pace of innovation cycles, and the rapid, user led process of a business seeking global competitiveness.**
+ **Reviews the total quantum of funding dedicated to delivering commercial missions.**



ENABLERS

An innovation-led economy requires strong foundations. The Taskforce recommends that the Government with UKRI should scale up the enablers of the research and innovation system.

Scale up the foundations of the research and innovation system.

As the UK scales up its research, development and innovation activities, the Government and devolved governments must also strengthen their foundations through investment in strategic enablers of the system. UK R&D is not only set to expand but will also transform. In response the UK must develop a larger, more adaptable and more diverse R&D workforce and be prepared to invest in emerging technologies and infrastructure. It is therefore essential that the Government and devolved governments, with UKRI and devolved funding bodies, work to scale up the foundations of the research and innovation system.

05 RECOMMENDATION

UKRI must invest sustainably in fundamental research.

The businesses engaged in the Taskforce all emphasised that fundamental research performed in universities and research labs underpins the R&D and innovation system. To provide a sustainable foundation to a more research-intensive, innovative economy, the UK Government should invest more in discovery-led research across the Research Councils and, in particular, increase Quality Related research funding. The UK should also invest in the UK's R&D capital and digital infrastructure to remain at the forefront of emerging capabilities.

The principles of the UK's highly efficient Dual Support System for funding should be maintained, but the balance needs to be amended. The growth in Quality Related funding, and devolved equivalents, has not kept pace with growth in grant funding from all sources (that includes government grants, but also investment in university research by charities and business). There is a need to increase Quality Related funding to help universities build and maintain capacity, and take on more research grants without making a financial loss.

Universities have delivered on generating the efficiencies that the practice of funding research far below cost aimed to incentivise. However, this has led to a reliance on other sources of income to support research activity. The consequences of this dependence has threatened the research base during the Covid crisis at a time when research is most needed. Building a system that allows more institutions to engage in R&I activity increases opportunities for growth, which can generate high returns for the UK and local areas. The current system of funding research below cost also limits the opportunities for institutions to engage in commercialisation and other knowledge exchange activities that do not generate returns to the institution[25].

25 www.universitiesuk.com. Universities UK R&D Roadmap response. Published July 2020.

A "Ministerial University Research and Knowledge Exchange Sustainability Taskforce" has been formed to review this. The Sustainability Taskforce must progress its work rapidly and in full consultation with all universities and non-university research and technology organisations that perform research to create a more sustainable system that captures the momentum built up during the pandemic and encourages (rather than dissuades) research performers to take grants from businesses and other sources for R&D.

06

RECOMMENDATION

To mitigate the impacts of Covid-19 and stimulate R&D investment, the Government should increase business-focused R&D incentives.

The ways and means by which businesses invest in R&D is changing. From an activity completed and funded exclusively from inside the organisation, increasingly businesses invest in R&D through different channels outside the organisation. This is more than the adoption of open innovation models but represents a more fundamental shift in how R&D is financed.

The R&D Roadmap makes important reference to improvements that should be made in access to finance. Increasing and improving access to risk capital is a critical element of a vibrant research and innovation ecosystem. The Rees Review published in 2019 made important recommendations as to how support investor relations with university spin-outs could be further enhanced[26].

For many corporates – investing in start-ups and spin-outs is an important vehicle to access new ideas and innovations. Through Corporate Venturing arms, businesses are able to make targeted investments in R&D by investing in research-intensive businesses to aid proof of concept work and identify first to market opportunities. It is also often very beneficial to small companies to be working with major corporates as they provide a more guaranteed first customer as well as access to know-how and expertise not commonly available to small companies. This activity is growing and a number of corporates are investing more funds into this activity. But to scale this up, the Government could consider equivalent incentives to R&D tax credits to encourage greater corporate venturing activity. The opportunity presents a win-win, enabling large corporates to invest in translational capability in the UK to increase jobs and growth for start-ups and the economy more generally.

Understanding the drivers for R&D investments needs to also recognise the importance of fiscal incentives and especially one of the key drivers – R&D tax credits. The Government has sent important signals to business with both an increase to R&D tax credits from 12 to 13% (announced at the Budget in March 2020) as well as an open consultation of the qualifying scope of the credit system. A critical outcome from this consultation is ensuring the tax credit system continues to modernise and keeps pace with advances in research and development approaches including data costs and capital expenditure.

Improving incentives is important, but it is equally important to make it as easy as possible for the benefits to be accessed. The replacement of the large company scheme in 2013 with the Research and Development Expenditure (RDEC) has been welcomed by businesses eligible to access the scheme. For large companies, RDEC is a payable tax credit equivalent to 13% of qualifying R&D costs claimed and provides an above-the-line contribution back to the company. In contrast, for Small and Medium-sized enterprises (SMEs), there is a tax relief scheme which, though more generous (up to 25% for profit making companies and up to 33% for non-profit companies), is much more complicated to apply for. At a time the UK is looking to support and nurture the next generation of companies, Treasury could consider an RDEC-type scheme for SMEs (especially for R&D-driven start-ups), which would both reduce the bureaucracy that SMEs face and encourage more research and innovation.

26 Rees, Mike. (2019) "Independent advice on university-investor links". Available online at: https://re.ukri.org/sector-guidance/publications/independent-advice-on-university-investor-links-mike-rees-report

07

RECOMMENDATION

The Government should widen the remit of the Office for Talent to help grow and deliver domestic talent, alongside attracting global talent.

R&D will be delivered by people with the knowledge, capabilities and ambition to lead research and innovation activities in both academia and industry. The Government's aspiration to refocus the UK's economy on more R&D intensive activity will only be achieved if universities and business can develop, attract and retain the talent and skills needed to drive it.

New technologies have led to significant skills shifts since at least the Industrial Revolution, and it is likely that the adoption of automation and artificial intelligence, coupled with the impact of Covid-19 on operations, is only going to accelerate the pace of shifts. As the UK prepares to refocus the economy towards more R&D intensive activity, skills and talent demand are likely to change even further and even faster.

> The Office for Talent, announced in the R&D Roadmap, is a welcome step towards attracting and retaining the most promising global science, research and innovation talent to the UK.

The Roadmap correctly identifies many problems with the current career culture within research. This includes: the need to attract more people into research within and beyond academia; improving equality, diversity and inclusion; low salaries; difficulties of moving between academia and other career paths; and the need for more commercial and entrepreneurial skills. These are long-standing problems, which ultimately will only be solved through a holistic, long term strategy.

The Office for Talent, announced in the R&D Roadmap, is a welcome step towards attracting and retaining the most promising global science, research and innovation talent to the UK. This recognises the importance of a cross-cutting approach, that works across the remits of UKRI, government departments and regional bodies, to attract global talent. However, a similar cross-cutting approach needs to be taken to develop, upskill, retain and retrain domestic talent, otherwise the benefits of the UK's R&D Plan may be limited to a highly qualified minority.

The Taskforce therefore recommends that the remit of the Office for Talent is expanded to include domestic talent to create a more strategic and evidence based approach to understanding current and future skills needs, recommending policy solutions to Government across education, training, research, immigration and diversity and inclusion policy.

Since the closure of the UK Commission for Employment and Skills (UKCES) in 2017, the UK has lacked a national body dedicated to gathering labour market intelligence to guide policy making. The Migration Advisory Committee (MAC), which advises the Government in immigration policy, has played an important role in determining the short term skills needs and shortages of the UK. However, it does not have a remit to forecast the longer-term skills needs of the economy and cannot make recommendations related to domestic training and education.

A new Office for Talent, with a wider remit to include domestic talent, should strategically assess current and future talent needs, recommending policy solutions to government across education, training, research, immigration as well as diversity and inclusion policy. The Office for Talent should:

+ **Be empowered to provide advice to all Whitehall departments, devolved government, regulators and funders, businesses, and education providers based on evidence and insight.**

- **Work closely with Skills Advisory Panels and local government to establish the skill needs of local areas and how central government can work with local government, local education providers and local business to make sure we have the workforce for a successful economy.**
- **Drive collaboration between government, universities and business in discussing the challenges of the current labour market.**
- **Work closely with the Migration Advisory Committee and the Department for Education's Skills and Productivity Board.**

The Office for Talent should evaluate the short, medium and long-term skills and competency needs of the UK, specifically, those required to deliver a more research intensive, innovative economy.

Without strong data collection, it will be near-impossible to assess and respond to changing talent demands. Understanding current talent capabilities is critical, building on the insights generated by the MAC to determine both the nature, scale and location of talent availability and gaps in the UK.

There is also a need to generate intelligence and insight from employers on education-leavers preparedness for work, so education-providers and policy makers have a stronger basis on which to assess not only hard skills demands, but also wider competencies.

08

RECOMMENDATION

UKRI should support universities to develop a strong and diverse pipeline of R&D and innovation talent for the future that flows in and between academia and industry.

Researchers and their capabilities are a fundamental asset of the national research and innovation system and underpin the aspirations of the Government's recent R&D Roadmap. The mobility of researchers between universities and business enables researchers to directly apply academic knowledge in non-academic roles and environments and vice versa.

An R&D driven economy will require a workforce capable and skilled to work seamlessly in both academia and industry. Tackling some of the biggest challenges will require new ways of thinking and new ways of working. As the Dowling Review highlighted, encouraging the mobility of researchers will enable them to become critical translators of the excellent knowledge created within the UK research base into economic growth and productivity[27].

Beyond this – the UK does not just need more people with the right skills, but also a culture of collaboration and mobility between academia and industry. Driving forward the skills and talent needs that are a prerequisite of an R&D intensive economy is only possible if the UK fundamentally rethinks research careers. Remaining with the current system will mean that R&D will remain too siloed, homogenous, unrewarding and potentially unnattractive. For the R&D Roadmap goals to be achieved, R&D careers must move to a position where they attract people of all backgrounds and experience. Developing diverse teams and thinking, through interdisciplinary work and collaboration, as well as attracting those from all backgrounds into research careers, is central to this.

There are no quick fixes to driving cultural change, but there are a number of measures that this report recommends are taken.

27 Dowling, A. (2015). *The Dowling Review of Business-University Research Collaborations*. Retrieved from www.raeng.org.uk/publications/reports/the-dowling-review-of-business-university-research

Provide greater career support, training and mentoring to PhD students and early career researchers.

Doctoral graduates are not just a pipeline for academic careers and it is important that they are prepared for broad careers that enable them to work in industry and academia.

Specific measures that should be taken are:

+ **Develop a world class mentoring programme to raise the perceived value and status of researchers and encourage further interaction between academia and business to increase the absorptive capacity of business for researchers and the value of movement between sectors.**
+ **Greater time allocation for, and value placed on, outreach and mentorship work should be incentivised (e.g. through the Research Excellence Framework or grant funding) both as development for researchers and to underpin attracting diverse talent into R&D careers.**
+ **Greater strategic investment in entrepreneurship/business development training and career development. The scaling up of UK R&D spending needs to be reciprocal on schemes that meet these goals. There are strong government-funded schemes in this space already, including UKRI sponsored Liverpool Prosper and the IPO's work with Vitae on intellectual property for research[28]. However, for these programmes to reach their full potential, funding for these schemes needs to be seen as a strategic priority.**

Revise the Researcher Development Framework to place greater value on innovation, collaborative culture and industry partnerships.

As UK R&D not only expands but also transforms, there is need to update the Researcher Development Framework to reflect its vision and ambition. Vitae is currently undertaking a Researcher Development Framework refresh, including validating with employers the future researcher skills, knowledge and behaviours needed and an audit of current institutional provision and practice[29].

The pace of this work should be accelerated through an increase in funding so that its impact is maximised as the Government increases public spend on R&D.

Collect and promote data and information on PhD Graduate Outcomes and researcher pathways.

The UK does not systematically gather information and longitudinal data on researcher career paths in academia and industry, which makes it more challenging to identify their progression. Governments across the world have had difficulties in collecting longitudinal data[30]. However, in the US there are several ongoing efforts to collect this data, including the National Science Foundation's Survey of Earned Doctorates, which was revised to collect longitudinal data from PhD holders. The UK could evaluate the progress US counterparts are making in this area before developing the country's own data collection.

NCUB is also piloting a new process of extracting ORCID data to allow for systematic data gathering on researcher pathways. A pilot of six universities will be published in early 2021.

28 Prosper - Researcher Hub - University of Liverpool. (2020). Retrieved from www.liverpool.ac.uk/researcher/prosper

29 Vitae. (2011). *Vitae Researcher Development Framework*. Retrieved from www.vitae.ac.uk/vitae-publications/rdf-related/researcher-development-framework-rdf-vitae.pdf/view

30 Topic 4: Global Labour Market developments (economic dimension). (2019). *In Forces and Forms of Doctoral Education 2019 Conference*. Retrieved from https://doctoral-education.info/dl/Workgroup-4_Global-Labour-Market-Developments.pdf

Develop a fund to promote entrepreneurship.

The German Government has run a very successful programme called EXIST for several years, part of which is the EXIST Business Start-up Grant[31]. The EXIST programme aims to remove the major barrier of financial risk for entrepreneurs wanting to start a company. These grants provide financial support to start-ups at the early stage to students, graduates and scientists from universities and other institutions of research. The grants last for one year and cover both subsistence and a level of material expenses. The institute has to provide a mentor and the infrastructure to help establish the start-up over the course of the year. To receive funding, applicants have to provide a business plan on how they would create a viable business.

The EXIST programme has been successful and created over 2,300 start-ups across sectors and universities[32]. To encourage more researchers to commercialise their research, the UK should consider replicating a similar scheme.

Collect data on equality and diversity to drive change.

While the R&D Roadmap correctly identifies the need to not wait on perfect data or conclusive evidence before taking action on EDI issues, the UK should in the longer-term improve its relevant data capture[33].

There should be consistent and regular reporting on:

- **The proportion of grant applications, successful grant applications and research funding provided to the nine protected characteristics.**
- **The proportion of university spin-outs created by people with different protected characteristics. A recent study identified a significant underrepresentation of female founders of UK university spin-outs[34].**
- **The percentages of early career researchers, other university staff and leadership identified under the nine protected characteristics. The Office for Students currently collects this data on undergraduate and postgraduate students[35].**

It is important to use this data to enable behaviour change. Horizon Europe requires bids to include Gender Equality Plans, UKRI could adopt a similar approach to its funding.

Evaluate and share institutional good practice.

The work of the Taskforce identified many examples of universities that have developed business start-up support schemes and permeability programmes, as well as programmes to improve PhD graduate outcomes, diversity and culture. The development of these schemes has mostly been through the initiative of individual universities and/or businesses rather than a strategy set by government.

It would be beneficial to evaluate under a single framework the merits and successes of current schemes designed to support porosity between academic and business careers, diversity in research and entrepreneurship. Sharing and promoting best practice as well as helping universities and/or businesses to further develop programmes that are working well through national funding should be a strategic priority.

31 EXIST Business Start-up Grant. (2020). Retrieved 10 November 2020, from www.exist.de/EN/Programme/EXIST-Business-Startup-Grant/content.html

32 Rao, M. (2020). How this government funding programme has launched over 2,300 startups. Retrieved 10 November 2020, from https://yourstory.com/2019/05/germany-funding-exist-startup-oliver-hunke

33 Department for Business, Energy & Industrial Strategy. (2020). *UK Research and Development Roadmap* [Policy Paper]. Retrieved from www.gov.uk/government/publications/uk-research-and-development-roadmap

34 Oxford Brookes University. (2020). *The Spinout Journey: Barriers and Enablers to Gender Inclusive Innovation*. Oxford Brookes University Centre for Diversity Policy Research and Practice. Retrieved from www.brookes.ac.uk/women-and-spinouts/gender-and-university-spinouts-in-the-uk

35 Experimental data - Office for Students. (2020). Retrieved 10 November 2020, from www.officeforstudents.org.uk/data-and-analysis/equality-and-diversity-student-data/experimental-data

ATTRACTIVENESS

The UK needs to act as a competitor in a global R&D and innovation market. The Taskforce recommends that the Government develops and delivers a comprehensive foreign direct investment strategy for R&D.

The UK must act as a competitor in a global R&D and innovation market.

As the UK establishes priorities, delivers synergies and scales up its R&D and innovation system, it will create new opportunities to compete in the global market. Importantly, it will also enhance some of the conditions and environment that encourage multinational firms to invest in R&D in the UK.

Simply having attractive framework conditions is not enough. To capitalise on them, the UK needs to promote and constantly evaluate the competitiveness of its offer. The UK must start behaving as a competitor in the global market for R&D investment to retain existing business investment and attract higher levels of globally mobile business research.

The global market opportunity is significant. Around the world, 1,000 multinationals spent $781.8 billion on R&D in 2017[36]. Just a 1 percentage point increase in the UK's share of the global R&D market would mean an extra £8 billion in foreign direct investment.

While multinational enterprises (MNEs) used to carry out most of their R&D activities in their home countries[37] R&D investments by MNEs abroad now account for an estimated 20% of all private R&D investments globally[38].One implication is that countries or regions have new opportunities to attract high value-added activities linked to global innovation value chains. The UK already attracts an exceptional share of research intensive FDI disproportionate to its size. In 2018, 53% of business-based R&D was funded and performed by foreign-owned businesses, a higher share than any country in the G7[39].

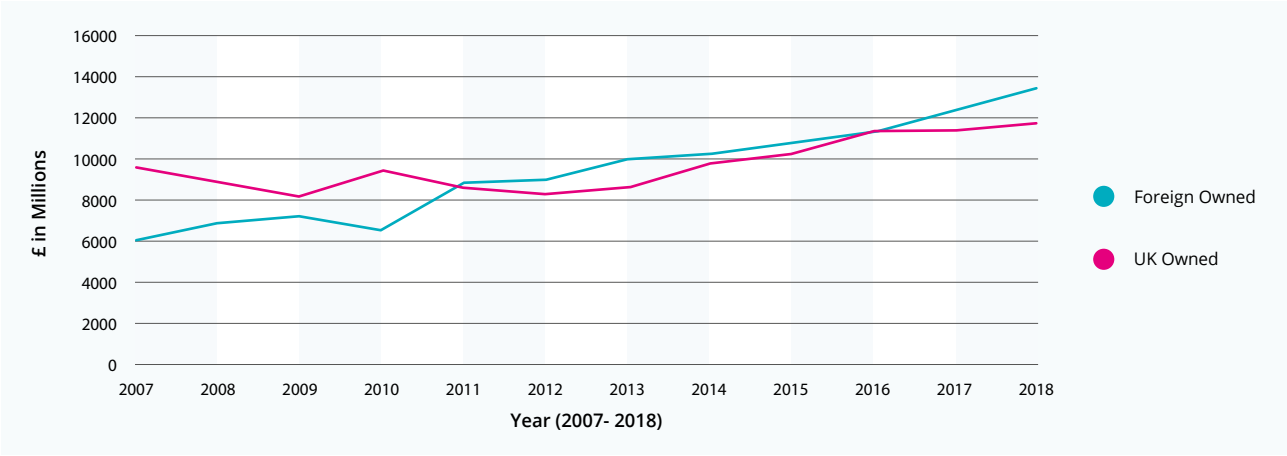
1. **With a high proportion of UK R&D financed by foreign-owned firms, realising the 2.4% target requires an even greater share of the global market to be captured by the UK.**

2. **Many governments now view foreign-owned multinational enterprises as central actors in their national innovation systems and competition among countries to attract FDI in R&D is rising[40] [41].**

3. **A trend in MNEs investing more in R&D abroad represents both an opportunity and a risk to the UK – UK businesses and current investors could move their R&D investments elsewhere if the UK is not competitive.**

36 PwC. (2019). The Global Innovation 1000 Study. Retrieved from www.strategyand.pwc.com/gx/en/insights/innovation1000.html
37 Iversen, E., Dachs, B., Poti, B., Patel, P., Cerulli, G., Spallone, R., Zahradnik, G., Knell, M., Scherngell, T., & Lang, F. (2017). *Internationalisation of business investments in R&D and analysis of their economic impact.*
38 Analysis by Dachs, Bernhard and Zahradnik, Georg based on OECD, Eurostat, national statistical offices data.
39 Analysis of data from the Office for National Statistics.
40 Guimón, J. (2008). *Government strategies to attract R&D-intensive FDI.* OECD. Retrieved from www.oecd.org/investment/globalforum/40310856.pdf
41 Iversen, E., Dachs, B., Poti, B., Patel, P., Cerulli, G., Spallone, R., Zahradnik, G., Knell, M., Scherngell, T., & Lang, F. (2017). *Internationalisation of business investments in R&D and analysis of their economic impact.*

Figure 7: R&D expenditure by domestic or foreign owned businesses, 2007-2018



Source: Office for National Statistics

09

RECOMMENDATION

The Government should develop a foreign direct investment in R&D strategy to retain and attract a higher level of globally mobile business investment to R&D in the UK.

The Government, through UKRI, BEIS, the Home Office, Treasury and the Department for International Trade, should develop a foreign direct investment (FDI) in R&D strategy to retain and attract a higher level of globally mobile business investment in R&D to the UK. Several organisations, including the Royal Society[42], have made similar proposals to help professionalise the UK's approach to attracting FDI in R&D, setting clear priorities, targets and ambitions. The FDI in R&D strategy would help set the priorities of the recently announced Office for Investment and could align its focus to determined commercial missions.

To develop an effective FDI strategy, the UK must first understand the basis on which firms decide where to invest in R&D. This understanding can then inform and define the policies and regulations that should shape the strategy. This requires a data and evidence driven approach to understand firms' priorities, and design and implement effective measures in response. This information gathering should take place quickly: the UK must move faster than competitor nations. Success should be measured by how many more R&D intensive businesses decide to locate to the UK and conduct in-house research.

The factors behind investment decisions will vary between business sectors, the form of business ownership, and the type of R&D activity being offshored. The OECD and others have identified drivers for business R&D investment, including:

- **Skills and human capital**
- **Knowledge and R&D (including presence of R&D institutions and universities, research expertise in relevant sectors and effective cross-pollination of academic and commercial research)**
- **An innovative culture (including competition between firms, as well as the presence of start-ups, technology transfer organizations and other bodies as important signals of innovative thinking)**

42 The Royal Society. (2020). *Consultation response: Comprehensive Spending Review 2020 Representation*. Retrieved from https://royalsociety.org/topics-policy/publications/2020/consultation-response-comprehensive-spending-review-2020-representation/#:~:text=The%20Royal%20Society's%20representation%20to,against%20the%20government's%20stated%20priorities

- **Market and investment opportunities (including access and proximity to markets and access to funding solutions for different stages of corporate development)**
- **Sector drivers (including proximity to and opportunities in established value chains)**
- **Policy drivers (such as policy incentives to secure solutions to relevant problems and the support of national agencies)**
- **Enabling infrastructure (such as access to specialist machinery and equipment, transportation networks, and other critical infrastructure)**
- **National tax and regulation framework**
- **Familiarity (including softer factors, such as relationships, approachable partners, familiarity with a location or institution and language)**

Several global R&D investors engaged by the Taskforce suggested that their decision making was particularly influenced by the availability of world-class research infrastructure and talented researchers, the language in the UK and an environment that attracts higher level skills. The dynamism of the national innovation system, including the degree of interaction between firms and other R&D institutions was a further factor. The UK's competitiveness in this area should be improved by the recommendation to establish Innovation Collaboration Zones and specific commercial missions.

The FDI in R&D strategy should aim to make the UK an attractive destination for research intensive FDI, but must also set out how to retain foreign and domestic businesses that have already chosen to invest in the UK and have crossed key barriers to locate and grow their R&D investment within the UK. Importantly, it is also important to understand how firms acquire small UK technology companies and use their larger, scaled- up assets to grow smaller businesses.

To be successful the FDI in R&D strategy should seek to do the following:

Define and promote the UK's offer to R&D investors

National coordination is needed to promote R&D investment opportunities and the UK must move at speed to compete with the many offers that are being made to companies in the global R&D landscape. The UK must identify, communicate and promote the strengths of its offer to business R&D investors and recognise the distinctive strengths of different places in the UK within the UK's national offer.

+ **The articulation of the offer should be comprehensive, including fiscal incentives, location subsidies, education and immigration policy, planning regulations and research funding.**
+ **There could be value in developing an information hub that informs decisions to invest in R&D across the UK. This could build on lessons learnt from the National Innovation Audits and Smart Specialisation Hub, but must specifically be focused on providing information to businesses that helps them decide to invest in the UK. The konfer platform[43] could provide an effective tool for normalising, curating and visualising the data.**

Map the customer journey of R&D investors

DIT should consider the customer journey of businesses exploring R&D investment opportunities in the UK and elsewhere. This includes considering the quality and availability of information on the UK's offer, the effectiveness with which visits from large firms and investors are hosted in the UK, and the quality of guidance and advice on the UK environment given to prospective investors.

43 Unlock R&D with konfer. (2020). Retrieved from https://konfer.online

Establish business development teams to attract global investment in line with the UK's commercial missions

As the UK identifies commercial missions, it should seek investment from large MNEs in those areas through business development teams who are empowered to "bring the deals home". There would be benefits to housing the business development teams within UKRI to allow two-way intelligence sharing on MNE demands and the UK's research and innovation system.

Forecast future areas of strength, opportunity and challenge

There is a need to consider what opportunities changes in R&D practices present to the UK, and how it can best position itself to exploit them. Equally the UK needs to be poised to respond to opportunities identified through fundamental research. Now and in the future.

10 RECOMMENDATION

UKRI should create a Global Collaboration Fund to encourage universities and businesses to pool their strengths to attract inward investment.

Many of the businesses engaged in the work of the Taskforce suggested that competition between universities made it harder to benefit from their collective expertise. A joined-up offer that draws on the combined strengths of universities could enable the UK to compete more successfully on the global stage. Building on the concept of the Connecting Capability Fund, the UK should develop a Global Collaboration Fund that encourages universities to collaborate and pool their strengths to attract investment from businesses in the UK and overseas.

Aligned to the FDI in R&D strategy, the Global Collaboration Fund would be a focused mechanism to encourage groups of universities to form consortia and create a joined-up, cohesive offer that would be attractive to mobile international R&D funding.

The purpose, therefore, of the scheme is to boost the competitiveness of the UK offer by encouraging greater collaboration (rather than competition) between universities to present a joined-up offer that harnesses the collective strengths of a number universities. This is more likely to be attractive to Multinational Enterprises who will benefit from the combined strengths of multiple institutions and have a simpler way to access this (rather a series of individual relationships and partnerships).

Consortia would be self-forming and selecting, creating opportunities for universities with complementary strengths to provide a more compelling offer than a single institution on their own. Part of any GCF proposal would be a detailed understanding of the requirements of the business partner(s) such that any consortia could map their collective capabilities to their needs.

The fund would act to kickstart more activity in this space and encourage more collaboration between institutions. But if successful and greater R&D FDI was brought into the UK the scheme could be scaled up to include more funding to encourage more activity from existing consortia or encourage more consortia to form.

CONCLUSION

To every member of the Taskforce, the importance of R&D was unequivocal. The Government is right to make this a fundamental priority for the long-term growth and prosperity of the UK.

This report's calls to action are clear.

01	**The UK needs a bold economic plan with research and innovation as its engine, the Taskforce recommends that the Government delivers this through commercial missions – specific areas where the UK will seek to achieve a dominant global market position.**
02	**The UK needs a business focused offer, the Taskforce recommends achieving this by creating synergies and better joining up the components of the research and innovation system.**
03	**An innovation-led economy requires strong foundations, the Taskforce recommends that the Government, with UKRI, should scale up the enablers of the research and innovation system to attract both the capital and the talent required.**
04	**The UK needs to act as a competitor in a global R&D and innovation market, the Taskforce recommends that the Government develops and delivers a comprehensive foreign direct investment strategy for R&D.**

These calls to actions are supported by ten specific and targeted recommendations that require a collective and collaborative approach.

True before the pandemic but even more critical now, there is a need to support and nurture our businesses across the UK to see the value, benefit, and return from R&D. To help businesses adapt and build back better, **now is the time to invest in, not away from, research and innovation**. Investing in research and innovation allows new ideas, new processes and new practices to help transform a business to not just survive but thrive in a fast-changing operating environment and global market.

The opportunities from research and innovation are there for the UK to grasp. Seizing the opportunities will require bold and ambitious leadership, unwavering political will in concert with corporate and institutional drive. This is not a moment for minor interventions but for the adoption of collaborative leadership models that maximise the full levers of across the R&D system including government, industry and academia.

All participants have a vital role to play. Universities, research establishments, businesses large and small, private and charitable funders and government. The Government must not only set the ambition and commit public funding, but must also create the necessary enabling conditions that span the remits of multiple Departments. To achieve the step up in scale, the alignment with broader social and economic priorities and successful delivery will require more than just vision and collaboration. It will require leadership, ownership and accountability at senior levels of government.

To move from research to recovery requires bold and ambitious action. Working together, the Government, universities, businesses and others can deliver the research, development and innovation that will drive rejuvenation.

ACKNOWLEDGEMENTS

Over 150 people directly provided insights and ideas that contributed to this report and the work of the Taskforce. We are particularly grateful to the members of four Advisory Groups, which were formed to support the work of the Taskforce.

Successes and learning from the crisis	**Tom Kneen (co-chair)**, Head Of Academic, Research & Technology Partnerships	Cisco
	Phil Clare (co-chair), Deputy Director (Knowledge Exchange and Engagement)	University of Oxford
	Siobhan Jordan, Director	Interface
	Paul Gosling, Vice-President Engineering UK	Thales
	Gurmit Kler, Director of Business Engagement	University of Birmingham
	Tim Brundle, Director of Research and Impact	Ulster University
	Bryn Jones, Head of Knowledge Exchange	Bangor University
	Tomas Coates Ulrichsen, Director, Policy Evidence Unit for University Commercialisation and Innovation	University of Cambridge
	Bryony Butland, Programme Director UK Research and Innovation Infrastructure Roadmap	UKRI
	Helen Cross, Head of Strategy Coordination	UKRI
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	Mark Jefferies, Chief of University Research Liaison	Rolls-Royce
	Malcolm Skingle, Director Academic Liaison	GSK
	Chris McDonald, CEO	Materials Processing Institute (& Policy chair Innovation at FSB)
	Gillian Murray, Deputy Principal Enterprise and Business	Heriot Watt University
	Dame Jessica Corner, Pro-Vice-Chancellor, Research & Knowledge Exchange	University of Nottingham
	Liz Flint, Chief Business and Innovation Officer	Brunel University
	Freddie Jones, Senior Strategy Adviser, Commercialisation and Place	UKRI
	Alice Frost, Director of Knowledge Exchange	Research England
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	Carol Fletcher, Head of Academic and Research Partnerships	BT
	Iain Heath, Head of Emerging Talent	HSBC
	Kiran Trehan, Pro-Vice-Chancellor for Partnerships and Engagement, Director of the Centre for Women's Enterprise Leadership, Economy & Diversity	University of York
	Helen Higson, Provost and Deputy Vice Chancellor	Aston University
	Clare Viney, CEO	CRAC/Vitae
	Rory Duncan, Director for Talent and Skills	UKRI
	Dawn Bonfield MBE, Royal Academy of Engineering Visiting Professor of Inclusive Engineering	Aston University
Attracting business R&D investment to the UK	**Graeme Reid (chair)**, Professor of Science and Research Policy	University College London
	Michael Hill-King, Collaboration Director UK R&D Centre	Huawei
	Andy Wright, Director of Strategic Technologies	BAE Systems
	Nick Jenning, Vice-Provost for Research and Enterprise and Professor of Artificial Intelligence	Imperial College London
	Luke Georghiou, Deputy President and Deputy Vice-Chancellor	The University of Manchester
	Tony Raven, Chief Executive	Cambridge Enterprise
	Steven Hill, Director of Research	Research England
	Jonathan Legh-Smith, Head of Scientific Affairs Technology	BT

We are also grateful to: Professor Robert Allison (Vice Chancellor and President, Loughborough University), Professor Richard Parker CBE (Chairman, Singapore Aerospace Programme), Sir Peter Bonfield (Business Executive and former Senior Pro Chancellor at Loughborough University), Mr Peter Saraga CBE (former Director of Philips Research Laboratories UK), Paul Clarke (Chief Technology Officer, Ocado Group plc) and Dr Hayaatun Sillem CBE (CEO of the Royal Academy of Engineering), all participants in NCUB's two Leadership Council meetings and respondents to the UCI/NCUB surveys for providing their perspectives and insights. We also thank the Russell Group, University Alliance, MillionPlus, GuildHE and Yorkshire Universities for co-hosting events with NCUB, bringing together university leaders from across the sector and different parts of the UK.

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