



# SHAPING THE FUTURE OF RESEARCH AND DEVELOPMENT IN THE UK

How Government, academia and  
industry can become 'match fit'

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## EXECUTIVE SUMMARY

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There are untapped opportunities for the UK to make the most of our world-leading research base and capitalise on the record increase in public investment in UK research and development (R&D).

The Government has announced an increase in R&D spending from £10 billion per annum today to £22 billion by 2024/25. The UK's [R&D Roadmap](#), published in July 2020, laid out an ambitious and far-sighted vision stating: *“We have a once-in-a-generation opportunity to strengthen our global position in research, unleash a new wave of innovation, enhance our national security and revitalise our international ties.”*

In a post-Brexit world, the UK should be a global science superpower. We asked whether the UK is ‘match fit’ to make the most of these opportunities for UK economic prosperity.

At PA, we believe the UK can do even better. We know the UK has fantastic researchers, scientists, academics and universities, and a well-established funding structure. The creation of UK Research and Innovation (UKRI) to bring together the Research Councils and direct funding streams, through the Industrial Strategy, was right. But there are still too many structural, cultural, and practical barriers to commercialising research, such as access to funding at the right times, skills gaps, and not wanting to take risks with public money. We need to find better ways to spot new opportunities, rapidly develop them and bring them to market.

We have identified five key areas of focus:

1. **User needs should shape R&D priorities**, so R&D focuses more on solving real-world opportunities.
2. **Skills and capabilities gaps need to be closed** so that Government, industry and academia work better together.
3. **People must be empowered to take risks** so that Government can take a more end-to-end view of the R&D lifecycle, and industry is able to co-invest at earlier stages.
4. **There needs to be more provision of public funding for scale-ups** to help move the best ideas across the ‘Valley of Death’.
5. **All stakeholders need to know what success looks like** and develop metrics and incentives to drive improvements, underpinned by shared values.

For each area of focus, we have identified what we think needs to be done and who should do it. Our section on solutions ([page 18](#)) sets out where we think there are opportunities to do things differently, to increase research agility/efficiency, unblock the R&D system, and help scale-up companies to grow rapidly – considering all the elements they will need to succeed.

In terms of next steps there are important implications for three key stakeholder groups:

- Government policymakers
- funding bodies (public and private sector)
- the R&D start-up/scale-up community, including universities’ technology transfer offices and the wider innovation ecosystem

Each of these groups will have different needs and perspectives, which we outline on page 29. These are intended to open a discussion to engage with key stakeholders on how, by working together, we can make a real difference for the UK.

# 1

## OUR APPROACH

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**We carried out a rapid review of the current state of R&D in the UK.**

UK R&D is a broad landscape and the subject of many research papers and reviews, including the [Dowling Review of Business-University Research Collaborations](#), which attempted to map UK R&D's complex landscape:



The Dowling Review concluded that “the UK is not reaping the full potential provided by the opportunity to connect innovative businesses — from the UK and overseas — with the excellence in the UK’s academic research base”. It added that effective brokerage is crucial, particularly for SMEs, along with ‘pump-prime’ funding to stimulate the development of high quality research collaborations with critical mass and sustainability.

Dowling called for “a new public and private co-funded scheme that would provide pump-priming funds on a competitive basis to enable strong relationships between individuals in industry and academia to transition into group collaborations with critical mass, substantial industry funding and a long-term horizon”. Since then, the UK voted to leave the EU, UKRI was created, and COVID-19 has changed the way we think about translating R&D into real-world benefits at pace.

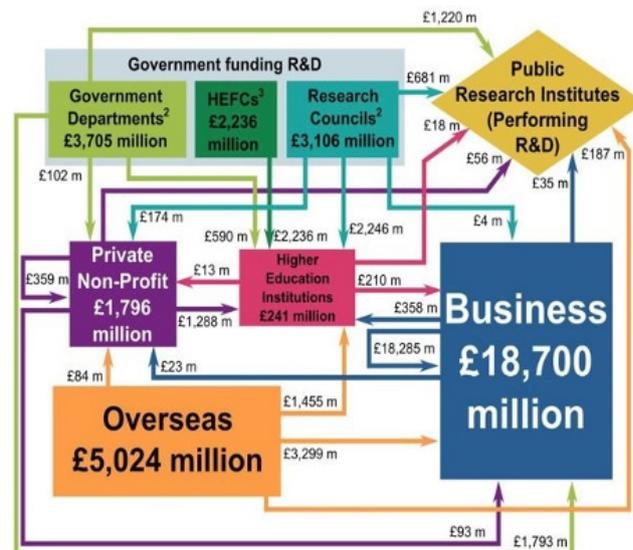
[Given the Government’s announcement of £15 billion investment in UK R&D in 2021](#) to “cement the UK’s future as a scientific superpower and drive economic growth”, with plans to more than double the current total to £22 billion p.a. by 2024/25, and the potential impact of Brexit on international research collaborations, we wanted to explore:

- what works well in the R&D ecosystem?
- what works less well, and why?
- what can the UK do to be match fit for the future, especially making the most of this extra investment?

Our review comprised desk-based review of UK R&D and SWOT analysis; the development of our R&D Lifecycle framework; interviews with senior stakeholders; a roundtable event with external stakeholders; and a final internal review.

Over six weeks, we interviewed more than 30 senior-level stakeholders across the R&D sector, including Government policymakers and scientists, industry leads and academia.

## Flows of research and development funding



Credit: [Office for National Statistics \(2019\)](#)

## KEY FACTS ABOUT UK R&D

While actual R&D investment has risen steadily over the past few decades, from £18.5 billion in 1981 to £37.1 billion in 2019 (a real terms increase of 101 per cent), as a proportion of UK GDP R&D expenditure has fallen over this period. With the new funding announcement, it is set to rise to record levels of 2.4 per cent of GDP by 2027.

The Government has been a key supporter of the UK's world-leading research base: however, the business sector is the largest funder of R&D performed in the UK. [In 2018, industry funded £20.3 billion \(55 per cent\) of R&D](#) – mainly in the pharmaceutical industry (£4.5 billion) and the automotive manufacturing industry (£3.8 billion). In the UK in 2018, total (Government and industry) expenditure on R&D was £37.1 billion. To reach the overall goal of 2.4 per cent GDP by 2027, the private sector will need to increase its R&D spending to £44 billion.

As well as business funding for R&D, overseas funding has also been significant. The impact of Brexit on UK R&D remains uncertain, although the recent Brexit deal announced that the UK would join the forthcoming Horizon Europe research programme, which will spend €85 billion over the next seven years. Historically the UK has benefited overall from this grant. [In 2014/15 UK universities attracted over £836 million in research grants and contracts from the EU](#), 14.2 per cent of all income from research grants and contracts in that year.

Another area of uncertainty is the wider economic impact of the COVID-19 pandemic, which could impact on the Government's future spending on R&D.

With this background in mind, we undertook a SWOT analysis to understand the strengths, weaknesses, opportunities and threats facing the UK R&D landscape.

### Gross expenditure of research and development



Source: ONS, Series GLBH, and Commons Library calculations



## UK R&D SWOT ANALYSIS

The UK has many strengths to build on. The UK is ranked second in the world for science and research, with [54 per cent of our output considered world-leading – more than the US, Canada, Germany, Japan or Brazil](#). Despite some good examples of success, such as UK-based AI business DeepMind and Improbable, and cybersecurity company Darktrace, [there remains a perception that the UK is less good than some other countries at commercialising the outputs of research for economic benefit](#). (The evidence for this is somewhat mixed, [with some pointing to the UK's recent track record in forming spinout companies and number of patents held](#)). While it is easy to start a company in the UK, with 2020 recording the highest percentage growth of new companies since 2011, it seems much harder to [scale up rapidly](#). Diversity is also an issue in the UK and globally, with [most Venture Capital \(VC\) funding going to white men](#) and [there is more to be done to increase diversity in STEM R&D too, to access the best talent and ensure fairness](#).

There are opportunities however, including the potential in a post-Brexit environment to 'pick winners' and redirect investment into growing UK companies (especially in the regions) in a way in which the Government has traditionally been reluctant.

### Strengths

- World-class research capability (13.7 per cent of top research) with breadth and depth of capability;
- Some good example of success from c.400 accelerators and the Cambridge phenomenon;
- Well-regarded regulatory and legal system;
- London as a financial centre;
- Relatively easy to start a new business with multiple offers of support and funding.

### Weaknesses

- Historically relatively low levels of success in commercialising ideas in the UK, outpaced by China and the US;
- Government procurement can be slow and favour incumbents;
- No common approach to measuring end to end impact;
- Despite initiatives such as the British Business Bank there is a perceived lack of funding at scale-up stage;
- Diversity is an issue: 98% of VC funding goes to men, and black entrepreneurs receive <1% venture capital.

## SWOT

### Opportunities

- Government investment in R&D to grow to £22bn p.a.;
- Brexit could reduce State Aid constraints;
- New leadership at UKRI and Innovate UK looking to join up, streamline and simplify R&D ecosystem;
- Recognition that research metrics (Research Excellence Framework) needs to be even more impact-based;
- Industrial Strategy provides a future focus: Clean Growth; AI/data; Mobility; Ageing Society;
- 'Levelling up' agenda and regional investment;
- Technical skills development within academia, industry and government.

### Threats

- US, China investment in R&D is larger and growing, with higher proportion focused on late stage rather than seed funding;
- Covid-19 reduced investment and focus;
- UK policy can prevent top academics coming to the UK, which inhibits international R&D collaborations;
- 'Brain-drain' effect of top academics/business leaving the UK;
- Overseas investment in UK innovation can lead to innovations benefiting other countries - start-ups may choose to grow their businesses elsewhere.

## OUR R&D LIFECYCLE

To understand the UK R&D lifecycle from early stage research through to market, and in the absence of an existing model, we created our own framework.

We mapped four main stages of maturity broadly corresponding to technology readiness levels (TRL). To delve deeper into how the system is operating, we split this out by key stakeholder groups: customers (those who use and get value from R&D), providers, funders, and enablers. We also mapped out the relevant metrics used across the system.

We found there are many different stakeholders playing different roles at different stages:

- there is a broad shift from public sector participants at the lower end of TRLs, towards private sector involvement in later-stage TRLs and reaching market: the lack of handover between these is often referred to as the 'Valley of Death' and is where the main gap in scale-up funding lies
- while Government appears in many places in the lifecycle, as a customer of research and as a key source of funding, this is often in reality different parts of Government playing different roles without necessarily working to a coherent overarching objective
- participants at different stages have different aims and purposes; many academics, for example, would contend that the overall purpose of research is not to create new market products, but to understand more about the world around us
- similarly, metrics and incentives drive very different cultures and behaviours at different stages.

	Research Discovery Applied	Development	Deployment	Expansion
<b>TRL Level</b>	<b>1-4</b>	<b>5-8</b>	<b>9</b>	
<b>Customers/users</b> Get value from and normally pays for the service/product	<ul style="list-style-type: none"> <li>Government</li> <li>Large organisation</li> <li>Other researches, via publications</li> </ul>	<ul style="list-style-type: none"> <li>Government</li> <li>Large organisation</li> <li>Early adopters</li> </ul>	<ul style="list-style-type: none"> <li>Government</li> <li>Large organisation</li> <li>Early adopters</li> </ul>	<ul style="list-style-type: none"> <li>Government</li> <li>Large organisation</li> <li>General public</li> </ul>
<b>Providers</b> Provide the service/product	<ul style="list-style-type: none"> <li>Universities</li> <li>Research centres</li> <li>Think tanks</li> <li>Large organisations</li> <li>Third sector</li> </ul>	<ul style="list-style-type: none"> <li>Universities</li> <li>Research centres</li> <li>Large organisations</li> <li>Technology transfer offices</li> <li>Start-ups</li> <li>Technology centres</li> </ul>	<ul style="list-style-type: none"> <li>Large organisations</li> <li>Start-ups/SME's</li> </ul>	<ul style="list-style-type: none"> <li>Large organisations</li> <li>SME's</li> </ul>
<b>Funders/investors</b> Invest in the organisation (typically via an equity stake or loan) to make a financial return	<ul style="list-style-type: none"> <li>UKRI</li> <li>Large organisations</li> <li>EU grants</li> </ul>	<ul style="list-style-type: none"> <li>UKRI</li> <li>Large organisations</li> <li>Co-founders</li> <li>Angel investors</li> <li>Accelerators</li> </ul>	<ul style="list-style-type: none"> <li>Large organisations</li> <li>Venture capitalist</li> <li>Banks</li> <li>Self-funded by company</li> </ul>	<ul style="list-style-type: none"> <li>Large organisations</li> <li>Venture capitalist</li> <li>Banks</li> <li>Self-funded by company</li> <li>Private equity</li> </ul>
<b>Enablers</b> Support and enable the R&D process	<ul style="list-style-type: none"> <li>Government</li> <li>UKRI</li> <li>Accelerators</li> <li>Catapults</li> <li>Networking forums</li> <li>Professional advisors</li> </ul>	<ul style="list-style-type: none"> <li>Government</li> <li>UKRI</li> <li>Accelerators</li> <li>Catapults</li> <li>Networking forums</li> <li>Professional advisors</li> <li>Innovation consultants</li> </ul>	<ul style="list-style-type: none"> <li>Government</li> <li>Accelerators</li> <li>Catapults</li> <li>Professional advisors</li> <li>Innovation consultants</li> </ul>	<ul style="list-style-type: none"> <li>Government</li> <li>Professional advisors</li> </ul>
<b>Metrics</b>	<ul style="list-style-type: none"> <li>Parents/novelty</li> <li>Research impact (via REF)</li> <li>Publications/citations</li> </ul>	<ul style="list-style-type: none"> <li>Patients/novelty</li> <li>Number of start-ups</li> <li>New product ideas/pro-types</li> <li>Quality/quantity of ideas</li> </ul>	<ul style="list-style-type: none"> <li>Number of start-ups</li> <li>Value of start-ups</li> <li>Investment levels</li> </ul>	<ul style="list-style-type: none"> <li>Number of start-ups/SMEs</li> <li>Value of start-ups/scale ups</li> <li>Investment levels</li> <li>New jobs created</li> </ul>

# 2

## KEY FINDINGS

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Through our interviews with senior stakeholders, we wanted to explore several key questions:

- what works well in the R&D ecosystem?
- what works less well, and why?
- what can the UK do to be match-fit for the future, especially making the most of the extra investment?

**We have a once-in-a-generation opportunity to strengthen our global position in research, unleash a new wave of innovation, enhance our national security and revitalise our international ties.**

[Uk R&D Roadmap 2020](#)

## WHAT WORKS WELL?

The senior stakeholders we interviewed agreed that there has been a lot of good progress in the UK in recent years. [The Government has explored ways to invest more in innovation, such as creating the National Security Strategic Investment Fund \(NSSIF\)](#). The UK has around 400 accelerators, some are very good although some start-ups are ‘grant junkies’ going from one accelerator to another.

The UK’s many strengths include its well-regarded regulatory and legal system, strong financial centre, and world-leading research base with universities such as Cambridge and Oxford, each of which create a central focus for R&D and innovation. R&D currently has a high profile and is seen as the engine of future UK prosperity.

## WHAT WORKS LESS WELL?

The innovation ecosystem is very complex and can be hard for a small business to engage with effectively. There needs to be more effort to communicate requirements clearly and hunt out solutions. We should focus more on making start-ups into a viable business; it’s not just about the idea.

Sometimes venture capitalists are not adventurous enough, and skills gaps can be found at every stage. There is no clear pathway for a promising start-up to find the right level of investment at the right stage for growth. So much comes down to luck and timing, it’s better to have a broad portfolio. Metrics should focus on outcomes.

## WHAT CAN THE UK DO TO BE MATCH-FIT FOR THE FUTURE?

Some stakeholders felt that the current system will not cope well with increased funding and lacks the capacity to expand rapidly. The additional funding will need to be aligned to a clear sense of purpose and priority, more agile procurement routes, and more joining-up between Government, industry and academia.

There was a high level of agreement among stakeholders across several key themes:

- **customer needs should shape R&D priorities**, so R&D focuses more on solving real-world opportunities
- **skills and capabilities gaps need to be closed** so that Government, industry and academia work better together
- **people must be empowered to take risks** so that Government can take a more end-to-end view of the R&D lifecycle, and industry is able to co-invest at earlier stages
- **there needs to be more provision of public funding for scale-ups** to help move the best ideas across the Valley of Death
- **all stakeholders need to know what success looks like** and develop metrics and incentives to drive improvements, underpinned by our shared values.

While all these areas were felt to be important, the experts we spoke to prioritised skills and funding as the two areas with the most potential to improve, for greatest impact.

# 3 SOLUTIONS

**We identified key interventions which we think will make the difference.**

We considered a range of potential interventions which could be implemented across Government, industry and academia to make the most of the additional investment in UK R&D. These key opportunities are:

- **for academia to increase research agility**
- **for government to unblock UK R&D**
- **and for industry to bridge the Valley of Death.**

In 2020, scale-up leaders rated support for innovation, access to growth finance, and recruiting the right talent and skills as the top three barriers to growth.

[Scale-Up Institute Report 2020](#)

## ACADEMIA TO INCREASE RESEARCH AGILITY

The agile approach has been well-established in software development and the principles of the approach are being applied in other contexts. The approach is highly collaborative, focused on outcomes, and is able to flex. Increasing research agility means taking new adaptable approaches which promote cross-organisational working, at different paces and timescales.

### Research portfolio management

Universities have an opportunity to explore ways to improve the efficiency of research, reduce bureaucracy and access different skillsets. They could, for example:

- draw on external programme managers to develop an enhanced portfolio management approach, making it easier to create and manage the contracts and administration of large, multi-disciplinary, international research programmes
- use a standardised benefit-tracking capability to ensure value for money
- invest in an independent assessment of key performance indicators to measure impact.

### **Adopting Agile methodologies**

Universities could adapt industry best practice of using Agile practices to improve the effectiveness and pace of research. Steps include:

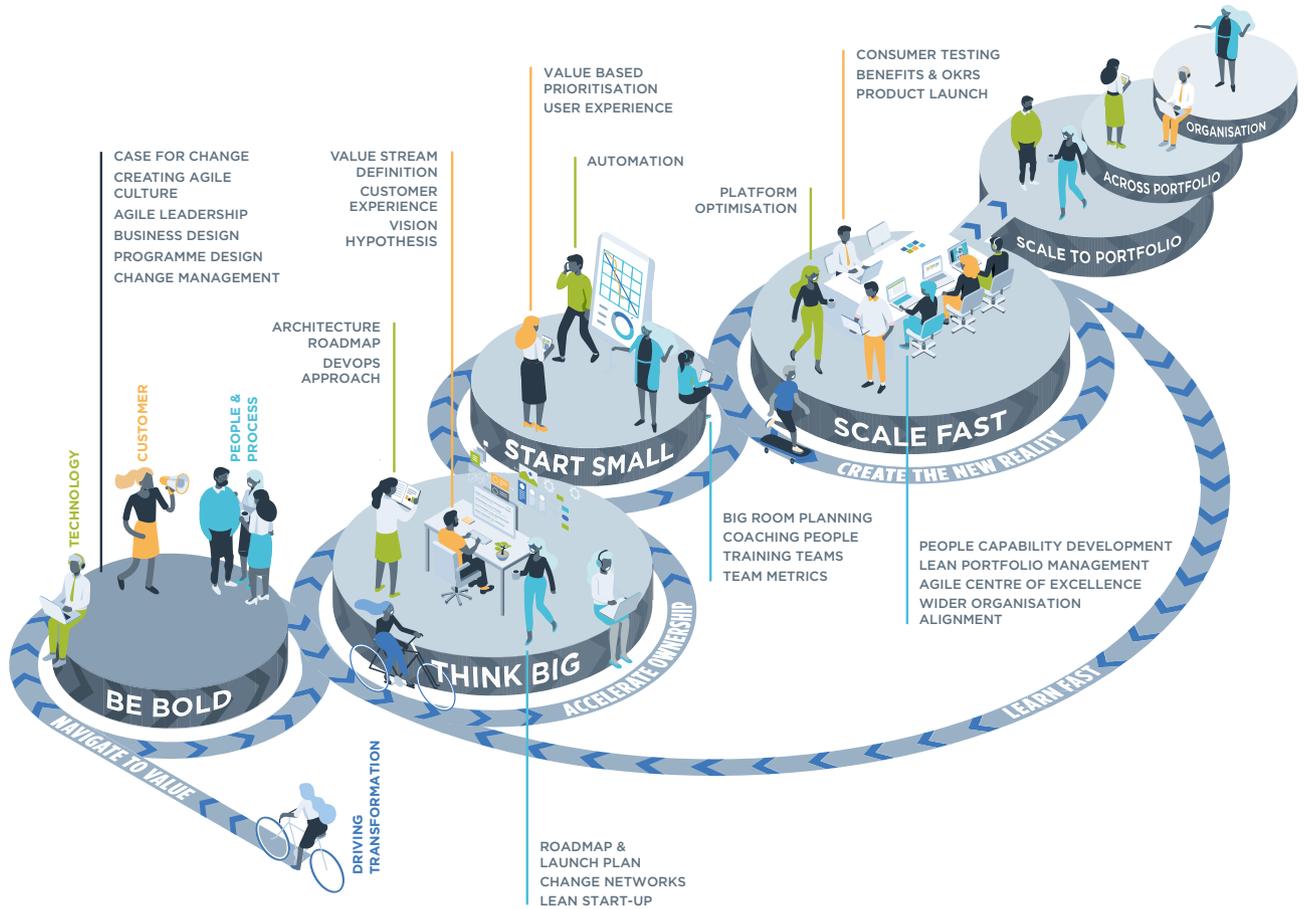
- increase organisational agility, including creating the right culture and behaviours, defining success/outcomes, creating more flexible funding structures which enable rapid changes as new priorities emerge, and having in mind a route to commercialisation from the outset
- streamline research approaches, including reviewing progress more frequently and inviting challenge outside of peer-review processes
- adopt a 'sprint'-based approach to research problems, quickly stopping what doesn't work to refocus resources and efforts.

### **Industry-academia partnerships**

Universities could do more together with industry partners to create multidisciplinary teams, bringing together the best of both worlds to ensure industry insights shape early stage R&D. This will deliver:

- technical expertise matched with industry and market insights
- a means to leverage funding from different sources and generate efficiencies
- the ability to create networks and commercial partnerships that can co-create solutions at pace.

# PA's approach to organisational agility



## GOVERNMENT TO UNBLOCK R&D

Government could explore new opportunities in three key areas: novel procurement mechanisms to ensure that funding is focused on pulling through ideas at pace to solve real-world problems; closing the skills and capabilities gaps; and acting as a broker to attract more overseas investment in UK R&D.

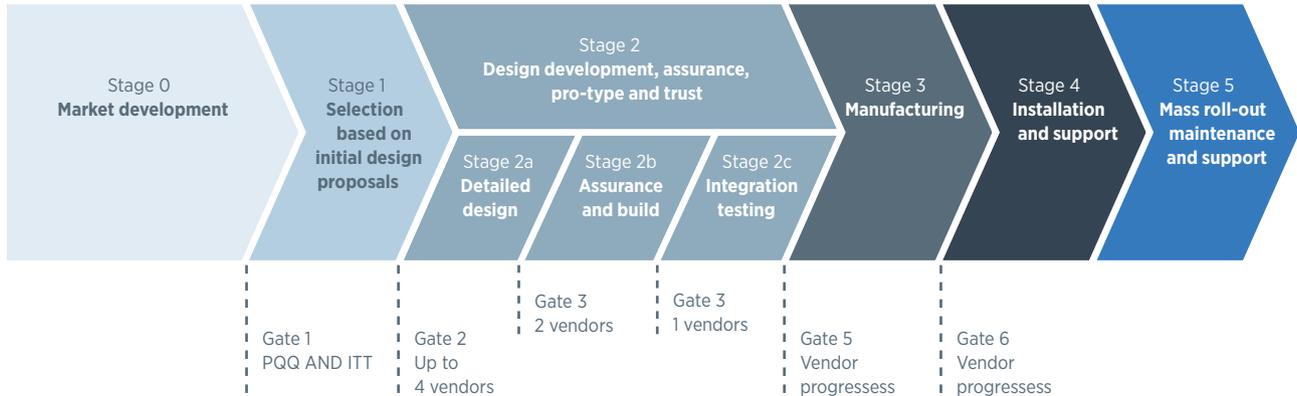
### **Novel procurements using Innovation Partnerships**

Public Sector Innovation Partnerships are a commercial model created under the Public Procurement Regulations 2015 to speed up innovation. The model allows Government to co-create solutions with industry and academia, removing some commercial barriers such as the need to re-compete later in the process.

To date, the mechanism has only been used a handful of times. A wider take-up of the model across Government could transform the way innovative R&D is created and exploited.

## Innovation Partnerships procurement

An illustrative time line for an Innovation Partnership procurement process



### Increasing certainty over time on:

- Maturity of and confidence in technology solutions
- Volumes of solutions required for specific use cases
- Clarity on the operational process for deployment

### **Skills development programmes**

Skills and capabilities gaps were identified at every stage of maturity from R&D to market. Government could create new skills programmes and facilitate career pathways which address these issues, such as:

- mentoring schemes between Government and industry at all career levels
- supporting secondments of civil servants out into industry and academia, and vice versa
- coaching and training programmes to help academics understand how to commercialise their research
- embedding entrepreneurs into universities and research institutes to actively search out ideas suitable for rapid commercialisation.

### **International matchmaking**

Government can build on the UK's global reputation for R&D by creating an organisation specifically focused on brokering opportunities for overseas industry to access and invest in UK R&D, through:

- identifying global technology trends and opportunities
- matchmaking between international industry and UK academics, connecting industry with academics directly
- curating problem-sets and commissioning work to co-design solutions.



## INDUSTRY TO BRIDGE THE VALLEY OF DEATH

The research end of the lifecycle is relatively well-served and works well, with many new start-ups and spinout companies launched. We want the UK to focus efforts on ways to help start-ups scale, bridge the Valley of Death and emerge as fully-formed businesses contributing hugely to UK prosperity.

For a start-up to grow, it needs to successfully co-ordinate the development of three key capabilities:

- developing the product or service offer
- growing the business
- having the right enablers in place at the right stage/time.

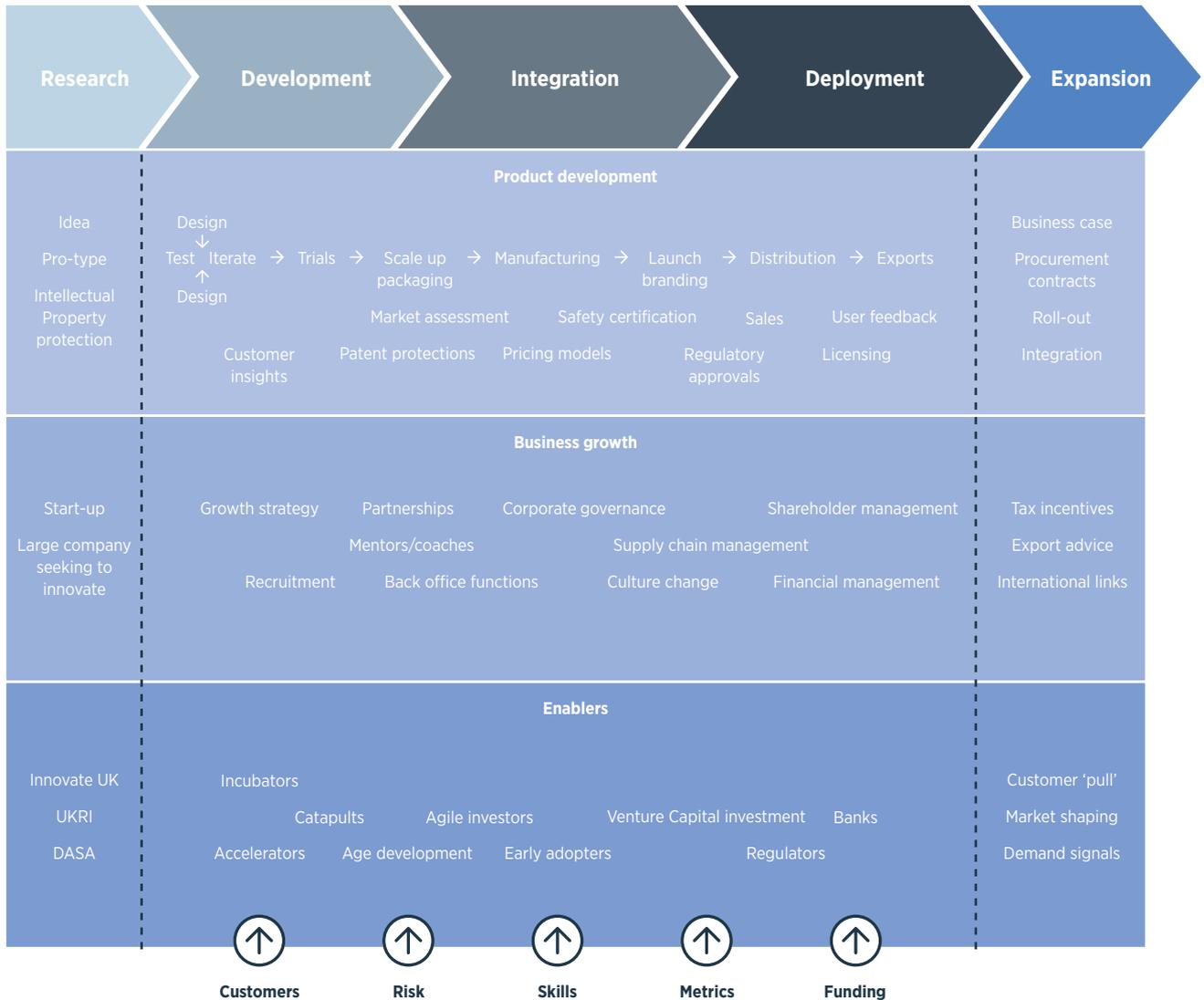
Each area involves a lot of different elements in order to be successful. Product development may need several cycles of user-centred design, testing and iteration before a product is ready for trials and (if needed) passing regulatory hurdles. Customers need a sustainable supply, at scale, with assured manufacturing processes. These all take time and money to put in place.

At the same time, the start-up faces all the challenges of rapid growth: finding the right people, skills, corporate governance, back-office functions, and access to specialist knowledge needed to become an investable business. These are often different skills to that of an entrepreneur, or those of an academic, and may need to be brought in from outside to support the company through this stage of growth. Funding for this support is too often unavailable.

Government and industry could do more to redirect funding and resources to helping scale-up companies.

A small proportion of the increase in R&D budget could be transformational in supporting promising scale-ups to be successful, through:

- creating a truly end-to-end innovation service delivering the best possible experience for the start-up/ scale-up
- offering flexible funding to scale-ups with easy access, up to considerable amounts for the right company
- offering 'vouchers' or direct access to business support services which can be adapted to the specific needs of the scale-up (for example, additional technical support, market research, growth strategy development, and recruitment).



## 4 CONCLUSIONS AND NEXT STEPS

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**We want to take this thinking forward to make a difference.**

R&D is a strategic asset for the UK. There is a unique opportunity to do things better, to make the best use of the additional investment in R&D not only by the Government, but also by industry. We've highlighted some of the opportunities we feel would make a difference. And we want to help.

**The R&D market is the lifeblood of innovation. Getting this right is vital for the UK and central to PA's purpose.**

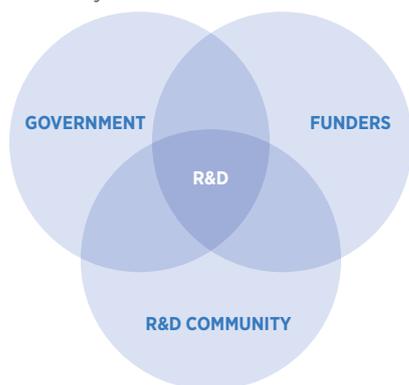
Conrad Thompson, PA Board Director  
and Global Consulting Lead

Our aim is to make the case for investing a proportion of R&D funding into promising scale-ups by providing an end-to-end innovation service which will fuel dramatic growth and contribute to UK prosperity. We believe there needs to be three key elements:

- **adopting a challenge-based approach**, which will enable better join-up between Government, industry and academia around a shared purpose
- **providing access to holistic support for start-ups**, not only funding in the right amounts at the right time, but also technical and business support services
- **repurposing some of the additional R&D investment** to ensure impact, by supporting commercialisation through a managed portfolio approach.

In terms of next steps there are important implications for three key stakeholder groups:

- Government policymakers
- funding bodies (public and private sector)
- the R&D start-up/scale-up community, including universities' technology transfer offices and the wider innovation ecosystem.



Each of these groups will have different needs and perspectives:

### 1. Government

Government policymakers will need rapid, insightful inputs into shaping the approach, identifying suitable challenges and priority areas, and designing a system that works. As an honest broker, PA can convene our broad networks across Government, industry, research and academia to provide these insights through workshops and (virtual) roundtable discussions.

### 2. Funding bodies (public and private sector)

UKRI and Innovate UK are key funding bodies: they should consider how to repurpose some of the additional R&D funding and set up easy-to-access funds for scale-up companies to access, which they can use to draw on wider support – or make this support available directly. Industry and private equity funding sources are important too. The UK needs to find new ways to enable co-investment and align Government and industry funding in R&D, so that the best of both worlds is brought together for the benefit of UK plc.

### 3. R&D start-up/scale-up community

The R&D community is very large and diverse. We believe there is a role for brokers who understand how to connect R&D with entrepreneurs, investors and industry to accelerate solutions into markets.

**We want to engage with each sector to explore how, by working together, we can make a real difference for the UK. We invite you to be part of it too.**



## About PA

We believe in the power of ingenuity to build a positive human future in a technology-driven world.

As strategies, technologies and innovation collide, we create opportunity from complexity.

Our diverse teams of experts combine innovative thinking and breakthrough use of technologies to progress further, faster. Our clients adapt and transform, and together we achieve enduring results.

An innovation and transformation consultancy, we are over 3,200 specialists in consumer, defence and security, energy and utilities, financial services, government, health and life sciences, manufacturing, and transport. Our people are strategists, innovators, designers, consultants, digital experts, scientists, engineers and technologists. We operate globally from offices across the UK, US, Europe, and the Nordics.

**PA. Bringing Ingenuity to Life.**

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