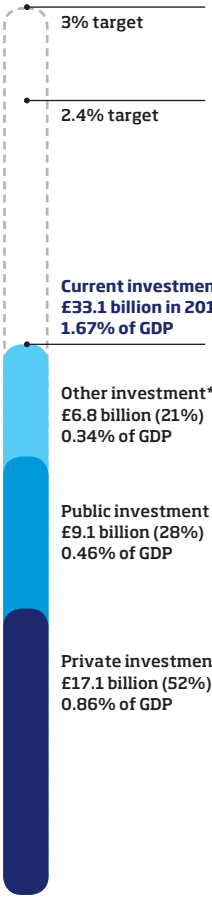
ROYAL ACADEMY OF ENGINEERING

Increasing R&D investment: business perspectives

Introduction

Where are we now? Total investment in UK R&D as a percentage of GDP in 2016[1]



*Other investment refers to funding from private non-profits from overseas, including from non-UK business and EU funding programmes.

The UK government has committed to increasing investment in R&D in the UK from the current 1.7% of GDP to 2.4% by 2027, with a longer-term goal of 3%.

This is an ambitious target that will require further public investment. But it will also need businesses to do more: that they invest in more R&D, conduct more R&D, and do more with that R&D.

The people at the centre of businesses' decisions around R&D are chief technology officers, chief engineers, and in some businesses, chief executives. They are the ones that make the case for R&D within the business and direct it, including where it is done and how it is used to drive business success.

The decisions they make are complex and sensitive to the individual nature of the company. They are also affected by a diverse set of factors in the business environment both in the UK and abroad.

Understanding how they make those decisions, and which aspects of the current UK environment encourage or discourage further R&D and innovation, is crucial not only to hitting the target, but to realising the potential benefits of doing so in terms of better jobs and better outcomes for people in the UK.

Businesses in sectors that are tightly linked to engineering are responsible for a significant amount of R&D expenditure in the UK, delivering innovation across a vast range of industries, from technology and construction to aerospace and energy.

The Royal Academy of Engineering has spoken to the people responsible for business decisions about R&D at engineering companies across a range of sectors, sizes and locations. This report presents the findings of these interviews.

Interviews revealed numerous factors that influence their decisions on R&D investment. Many of these are complex topics, involving numerous stakeholders, with conflicting drivers and barriers. However, they broadly divide into two groups:

- **Building on strengths** – Areas where the UK is strong, such as R&D or innovation support mechanisms often focused on early-stage R&D. These are the factors that drive companies to make R&D and innovation investments in the UK.
- **Action needed** – Areas where the UK performs poorly relative to competitor countries. In general, these areas fall outside traditional R&D or innovation policy support mechanisms and relate to the broader policy and business environment, and the pull through of new technologies to market. Action here has the potential to transform how businesses invest in R&D.

Building on strengths	Action needed
Engineering workforce	Late-stage development and demonstrators
Innovation funding	Public procurement
Non-financial innovation support	Joined-up government approach
Collaboration with universities	Ownership and financial structures
Collaboration between businesses	Innovation in engineering services
Tax incentives	Innovation across sectors

Engineering R&D and innovation in context

"Now is the right time to ask ourselves some big questions when it comes to our public R&D investment. How can we do more to ensure our investment crowds in private money?"

Sam Gyimah MP, Minister of State for Universities, Science, Research and Innovation, 6 July 2018

Many of the themes identified here have also been highlighted in the Industrial Strategy, which was welcomed by the engineering community, together with the 2.4% target. It is now time to act and ensure that they deliver the social and economic benefits of innovation to the whole of the UK.

R&D and innovation are at the heart of the engineering companies interviewed, and these companies are the lifeblood of R&D in the UK, spanning sectors from artificial intelligence (AI) to construction. R&D and innovation allow companies to stay ahead of market competition.

Decisions to invest in R&D and innovation are not made in isolation and take place in different ways across companies and wider contexts, depending on how R&D fits into each company's business strategy. Understanding this context is critical to identifying how the 2.4% target can be achieved.

Engineering R&D and innovation looks different across companies

The following factors are all influential:

- Whether it offers services or products.
- The industrial sector it operates in.
- Company size.
- Stage of product or service development.
- Ownership, including nature of investors.
- Whether R&D is conducted internally, in collaboration or contracted.
- Heritage of the company.
- Stage of company growth.

This diversity means that no two companies make decisions about R&D investment in exactly the same way. The package of factors that are important to one company may differ from the next.

Therefore, **there is no one-size-fits-all solution** to encourage engineering businesses to invest more in R&D and innovation in the UK. Instead, a range of measures are required to attract and support future investment across the business environment.

R&D and innovation are global activities

- Nearly all companies interviewed are developing products and services for a global market. This means that they conduct R&D in close collaboration with customers around the world.
- There is significant international competition to attract business R&D investment. Several of the UK companies interviewed said that they had been approached by foreign governments offering attractive incentives to locate R&D activities in their countries.
- Many companies look for the best innovation partners, regardless of where they are in the world. This means that companies collaborate on R&D with universities, other companies and suppliers across the globe.
- Many companies strongly value international diversity in their R&D teams. This provides cultural understanding, language skills, and a diverse source of ideas, facilitating the development of goods and services for a global market.
- Most multinational companies have R&D sites around the world and small companies interviewed either have or are considering opening R&D sites outside the UK in the coming years. Having sites in multiple countries supports access to local customers, a broader knowledge base and a greater range of expertise.
- Not all R&D can be conducted in the UK. In industries such as mining or oil and gas, some of the work needs to be conducted near relevant natural resources. However, the design, commissioning and management of the R&D for this work is internationally mobile and could be placed in the UK, bringing in high-value jobs.

R&D and Innovation

R&D is defined as creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society and the use of this stock of knowledge to devise new applications and includes basic research, applied research and experimental development.

Frascati manual[2]

R&D has an internationally agreed definition and is used for national accounting, which is why it is the focus of the UK government's target.

However, elements of late-stage development and demonstration are excluded from the definition of R&D.

Innovation is the process by which ideas are converted into value, in the form of new and improved products, services and approaches. Innovation activity amounts to more than is captured in the definition of R&D and while innovation often draws on R&D, with technology a common source of innovation, it can also derive from developments in design, business modes and mechanisms of service delivery.

While this project is set in the context of the government's R&D investment target, the discussions in the interviews went beyond the definition of R&D and even innovation, capturing **what really matters to businesses in creating value from investments in R&D and innovation**.

An overly narrow focus on the Frascati definition of R&D risks failing to realise the full societal and economic benefits from R&D and innovation.

How are decisions on R&D made in a company?

Deciding on how much, where and what R&D to do is a complex process, informed by top-down business strategy and bottom-up technology opportunities.

R&D investment depends on a broad range of internal and external factors. The factors outlined in the explainers that follow are some of the elements that shape investment decisions and are embedded into companies' broader decision-making processes.

R&D investment decisions are not made independently of the rest of the company: they are integrated with and flow from the broader business strategy. The areas where the UK performs poorly do not relate specifically to the R&D ecosystem in the UK, but refer to the broader environment that supports companies to pull innovations through from idea to market in the UK.

- The budget for R&D investment is often set by the board and senior management team.
- If companies are incentivised to do more R&D, or the value of R&D to their company increases, they will do more.
- Companies need to balance R&D investment against spend in areas such as production and marketing as they are vital for company revenue and growth. Many of these other areas are intertwined with R&D. For example, customer engagement and marketing informs product development.
- Spend in different areas varies depending on the stage of company and product or service development. For example, a new startup where products have not yet reached market will spend proportionally more on R&D than an established company.
- Understanding of future market trends and needs is an important determinant of R&D direction and strategy for all engineering companies. Feedback from close collaboration with customers also helps to inform technology strategy.
- Feedback from technology groups on emerging technological opportunities and threats can inform R&D direction and spend.

Advisory Group

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Companies interviewed

Interviews were conducted with chief technology officers, chief engineers, heads of R&D or, in some cases, chief executives from 31 companies, including:

- Anglo American plc
- Babcock International
- BAE Systems plc
- Blatchford Group
- BOXARR Ltd
- BP plc
- CCm Technologies Ltd
- Electricity North West Ltd
- GreenSpur Renewables Ltd
- Intelligent Ultrasound Ltd
- ITM Power plc
- JCB Ltd
- KENOTEQ Ltd
- Kier Group plc
- Laing O'Rourke plc
- M Squared Lasers Ltd
- McLaren Applied Technologies Ltd
- Mercedes AMG High Performance Powertrains Ltd
- Mondelez International
- Process Systems Enterprise Ltd
- Quanta Dialysis Technologies Ltd
- Radio Design Ltd
- Ricardo plc
- Rolls-Royce plc
- Siemens UK plc
- Surrey Satellite Technology Ltd
- Vivacity Labs Ltd
- Vodafone Group plc
- WSP Global plc

1 *Gross domestic expenditure on research and development, UK*: 2016, Office for National Statistics, 2018. Note: figures are rounded.

2 *Frascati Manual 2015, Guidelines for Collecting and Reporting Data on Research and Experimental Development, The Measurement of Scientific, Technological and Innovation Activities*. OECD, 2015. OECD Publishing, Paris.