ATI response to UK R&D Roadmap

About the ATI

1. The ATI was created in 2013 by the UK government and commercial aerospace sector with both sides committing £150m each per year to fund aerospace research and development. The ATI sets the UK's aerospace technology strategy and we fund a wide variety of projects aimed at realising that strategy. The projects that we fund – advancing the development of new aircraft that are more efficient, quieter, and better for the environment – will help secure the UK's global leadership in aerospace technology.

2. R&D is essential for aerospace. Transitioning to net zero aircraft by 2050, re-building from the Covid-19 crisis, and competing against global competition will require the UK to be at the forefront of technological innovation. By investing heavily in R&D and keeping the UK competitive, the ATI programme supports key government objectives including increasing productivity, levelling up regional economies, reaching net zero carbon by 2050, and driving up skills through apprenticeships. In addition, ATI analysis has shown that the aerospace sector crowds in around £12 of private investment for every £1 of public investment and creates significant technology spillovers in other sectors worth four to five times more than the benefits accruing to aerospace.[1]

How can we best increase knowledge and understanding through research, including by achieving bigger breakthroughs?

3. Technological breakthroughs are underpinned by a strong connection between research and market, stimulating ingenuity and risk taking, leading to successful commercial outcomes. Whilst much innovation begins in universities, equally a significant proportion starts life in businesses themselves. The government should encourage more innovation to start and succeed in both places, as well as encouraging more linkages between the two. The potential of our universities must be better leveraged by industry, whilst more university research must focus on solving industrial and market problems, enabling UK leadership in technology and design. Research for research's sake will not increase productivity or competitive advantage or provide the impact the government is seeking.

4. The aerospace sector has a successful track record in this area. The University Technology Centres (UTCs) pioneered over the past 20 years have created a model that marries the research objectives of universities with industrial imperatives on a large scale, resulting in clear commercial benefits for both universities and company. The growth of the catapult centre network is another positive trend, linking centres of excellence in research-intensive universities and industrial innovation networks and helping companies to commercialise new technology-based products and services.

5. As well as enhancing the likelihood of commercialisation, the mix of company, university and catapult also increases the chances of that commercialisation taking place in the UK, as opposed to overseas. Developing technology in the UK in conjunction with manufacturing processes and

[1] For further information, see the ATI's Insight papers on spillovers and industrial strategy: ATI INSIGHT 13, Spillovers, revealing the broader economic benefits of aerospace R&D, 2019 (https://www.ati.org.uk/media/ufvdpces/ati-insight_13-spillovers.pdf) and ATI INSIGHT 03, The economic impact of UK aerospace industrial strategy, 2017 (https://www.ati.org.uk/media/szgojd4w/insight04-the-economics-of-aerospace_the-economic-impact-of-uk-aerospace-industrial-strategy.pdf)

associated skills creates an integrated capability that is hard to unpick and thereby a more compelling case to locate manufacture here. The engagement of universities and catapults also allows knowledge and insight from R&D projects to be deployed in other firms and sectors, increasing spill over benefits.

6. Accelerating innovation depends on a range of interventions, including developing cross-cutting and sector specific technologies and capabilities. Various key capabilities and technologies have underpinned much of the UK's past industrial success and will be central to its future. The government has been active in identifying these cross-cutting technologies and capabilities through the industrial strategy. However, such technologies need to be taken up by sectors and applied to specific markets for value to be unlocked and economic wealth created. Propelling new technologies forward in this way also creates momentum for further innovation and new industries.

How can we maximise the economic, environmental and societal impact of research through effective application of new knowledge?

7. The significant uplift in public investment in R&D funding provides an opportunity to experiment with a mix of different funding approaches and institutions to help realise the 2.4% target. The government's intention to establish 'moonshots' and a new agency focussed on high-risk, high-reward research projects are two ideas that could have transformative impacts.

8. Ambitious programmes targeted at solving major societal issues could instil a sense of urgency, direction and ambition to research efforts as well as showcasing the UK as a global leader in science and technology. A clear example of a moonshot would be the realisation of the Prime Minister's recently stated 'Jet Zero' aim to demonstrate flight across the Atlantic, without harming the environment. Formalising this ambition into a moonshot and providing the required funding could significantly bolster the development of a future zero-carbon emission commercial aircraft and the progress toward sustainable aviation.

9. It would fulfil the seven key principles for guiding the creation of moonshots and in doing so, several scientific, engineering, and technological breakthroughs would be delivered to enable a transition from fossil fuel kerosene to zero-carbon alternatives. Producing a zero-carbon airliner would be a multi-disciplinary and multi-stakeholder enterprise, bringing together a range of partners from academia and industry to work towards the overall, single goal of zero-emission flight. The ATI has already begun work on its FlyZero programme (supporting the vision of the government's newly formed Jet Zero council) to investigate the technical and commercial feasibility of different aircraft concepts and their associated sources of power. Following its feasibility phase (year 1), it is our view that the conclusions of FlyZero will provide the Jet Zero Council with a tangible follow-on phase moonshot which will drive UK innovation and economic activity.

10. The creation of a new funding agency that takes inspiration from the US Defense Advanced Research Projects Agency (DARPA) could also be of significant value to the UK's innovation system. When setting out further details, consideration should be given to the objectives and mission of UK ARPA and how they relate to UK national policy priorities. Stated government priorities such as bringing all greenhouse gas emissions to net zero by 2050 for example, could act as a focus area for research. How research goals are determined and the extent to which they should prioritise and complement UK policy are important issues that need to be considered.

11. Consideration will also need to be given to how the new funding agency will interact with other UK funding bodies. As well as having a strong relationship with Innovate UK and the Research

Councils, UK ARPA should have a close working relationship with organisations like the UK's wide network of Catapult Centres, Advanced Propulsion Centre, Defence and Security Accelerator, and ATI, all of whom are uniquely placed to identify areas of research suitable for ARPA funding.

12. For it to be truly effective, it is important that it is given a large degree of independence and is given genuine autonomy to identify and commission early stage high potential research projects. Programme managers – highly capable individuals with strong networks in industry and academia - should play a central role in identifying research areas. They will need to be given considerable freedom to fund, plan and deliver their projects, often bypassing the UK's current practice of funding innovation, which is focussed on models that provide a decision-making framework that help to define an evaluation criteria and verify the feasibility of a new research idea. Ultimately, a new high-risk, high-reward funding agency will need to be able to spend public money and fail – if everything it supports succeeds the government will not have created something that adds to the landscape we already have.

How can we encourage innovation and ensure it is used to greatest effect, not just in our cutting-edge industries, but right across the economy and throughout our public services?

13. Innovation can be incentivised in many ways through both supply and demand sides of the economy and government is critical to both. On the supply side, measures include incentives for companies to drive research and development – both cross-cutting and sector-specific, mechanisms to facilitate R&D and exploitation, and enabling academic researchers to commercialise discoveries. As the previous section makes clear, bringing industry and academia together can be very powerful, as is deploying mechanisms such as the Catapults to maximise technology spillovers. Competition policy can promote innovation as well, although this is often not its primary objective. Whilst much innovation can be market driven, government can set ambitious goals beyond the reach of individual companies or institutions and use its convening power to bring about innovation at scale through collaboration.

14. On the demand side, innovation can be driven by public procurement (eg. defence, health, infrastructure) or regulation (eg. environmental or product standards). Central government, local authorities and companies can create innovative ways of working with the population at large or their supply chains by driving digital interactions.

How can we attract, retain and develop talented and diverse people to R&D roles? How can we make R&D for everyone?

15. Having a greater number of researchers and workers will be crucial in realising the government's aim of raising research intensity to 2.4%. An immigration system that is flexible is essential and it will be important that new immigration arrangements introduced when the UK leaves the EU help attract research leaders to the UK.

16. From an industrial point of view, most companies involved in aerospace research are either overseas owned or have major overseas functions which are also engaged in the R&D operations carried out in the UK. Free movement should apply to researchers, technicians and business support staff in both industry and academia, encompassing all levels and career stages, from early stage researchers to business leaders. It must allow for short term visits between collaborators, secondments and placements, and long-term or permanent relocation. Whilst productive collaborations do not necessarily require long-term residency, a permissive immigration system must form part of a concerted approach to ensure that the UK remains, and is seen to remain, open to researchers from both within and outside the EU.

17. While the passage of the new Immigration Bill is important and paves the way for a new, more flexible immigration system, the government should also look at UK visa costs and their expected impact on the recruitment of international research and innovation staff. We welcome the

creation of an Office for Talent and being based in Number 10, Centrally located, it should be well placed to address any issues or incompatibilities between the positions of different departments with regard to immigration policy.

How should we ensure that R&D plays its fullest role in levelling up all over the UK?

18. Improving regional growth can be achieved by the clustering of research, talent and industry. Regional clusters attract skills, improving the supply of talent, and encourage business to locate and invest to tap into the ecosystem. Spillovers are likely to be greater where clusters exist, resulting from workers moving between firms, organisations interacting with one another, and attracting researchers. This accelerates learning and innovation, leading to increased output and productivity.

19. These clusters develop brands of their own and increasingly UK regions are becoming known for their key strengths, e.g; South Wales for its semiconductor cluster supporting innovative SMEs, the University of Sheffield's Advanced Manufacturing Research Centre, now a global centre for innovation in manufacturing; and the wider Midlands area, well known for its strengths in aerospace and automotive. As concentrations of related activities grow, more firms use similar goods and services, increasing the size and security of broader markets and enabling a wider range of inputs to be produced at lower costs. The UK aerospace sector bears this out well with over 80% of UK aerospace sector activity located away from London and the South East, with strong aerospace clusters located in the Midlands, South West, North West, Scotland, Wales and Northern Ireland. The ATI programme has actively sought to award grant funding for research and technology project to companies based in these clusters, as well as to the research institutes such as High Value Manufacturing Catapult Centres located nearby.

20. The recent 'Power of Place' report by the Campaign for Science and Engineering (CaSE) contains some important recommendations. On regional branding, the report recommends that investment should be focussed on R&D excellence that already exists as it is likely to give a greater return when it builds on existing excellence. Regions should clarify their distinctive strengths and sectors in order to present a pitch for national and overseas investment and this should be coupled with greater local and national championing to attract UK and global investment. The report also recommends that central and local government should work together to improve national coordination between local and national R&D priorities. This will help maintain the breadth of the UK research base by ensuring that regions do not all focus on the same areas or disciplines.

21. Consideration should also be given to the loss of funding from EU Structural Funds. A significant proportion of these funds have historically been allocated for research and innovation, helping to support a wide array of projects building research capacity across the UK. Some regions are more reliant than others on this type of funding and as such it will be important for continued funding to be considered in any domestic replacements for structural funds, including the Shared Prosperity Fund.

How should we strengthen our research infrastructure and institutions in support of our vision?

22. For the aerospace sector, UK technology infrastructure plays a key strategic role in anchoring aerospace research and development activities, capabilities and skills in the UK. Technology infrastructure provides data for the validation and verification of the performance of aerospace systems, components, manufacturing processes and materials up to and including whole aircraft.

23. The challenge is for technology infrastructure to provide more accurate data earlier in the product lifecycle at lower cost. As the overall cost rises markedly through the product lifecycle, there is an overall cost advantage in making the right decisions at earlier points in the product

lifecycle, as the later adverse behaviours are discovered, the more expensive it is to correct them. Making the right decisions, earlier in the lifecycle, is driven by the capabilities of the infrastructure to provide the right data and the availability of more sophisticated modelling and simulation techniques.

24. Aerospace infrastructure needs are similar to other sectors and so in addition to maintaining investment in aerospace specific infrastructure such as wind tunnels, multi-sectoral approaches can also be considered to maximise economic benefits. This includes continued investment within digital to increase applications in advanced robotics and automation, digital design tools, data analytics; advanced manufacturing to validate novel manufacturing processes and applications, such as additive layer manufacturing, and; factories of the future to demonstrate future integrated flexible manufacturing facilities.

25. In addition to large scale physical research facilities and digital infrastructure, the UK benefits from its wide network of Catapult centres. We welcome the roadmap's intention to review and build on the Catapult network's performance and where a Catapult has been particularly successful, consideration should be given to expanding its facilities and capabilities.

26. The High Value Manufacturing Centre (HVMC) is an example of a Catapult that has consistently driven innovation in additive manufacturing, composites manufacturing, automated assembly and accelerating the incorporation of digital technologies into manufacturing. The unique capability of the HVMC was seen recently in its ability to organise the delivery of ventilators and PPE to the NHS - a programme of national scale delivered in a very short timeframe. Continued investment is critical as future success will depend on high-value manufacturing technologies that differentiate the UK on capability as opposed to labour cost. The HVMC serves as a good example for the adaptability of Catapults and demonstrates that they can respond to new challenges and are well positioned to exploit new opportunities.

27. At a more fundamental level, developing advanced technology lies at the heart of long-term competitiveness and economic growth and the ability to translate advanced engineering from concept to market is key. This capability, known as High Value Design (HVD) is the combination of skills and capabilities required to define and integrate complex technologies into viable products.

28. However, at present there is no co-ordinated UK programme of engineering capability development. Set against the emergence of developing countries like India and China and other low cost manufacturing bases into the realm of advanced engineering, UK leadership in advanced engineering is by no means guaranteed. The government should accelerate its progress to create an ambitious High Value Design programme that will challenge traditional practices and co-ordinate stakeholders to undertake bold design challenges.

How should we most effectively and safely collaborate with partners and networks around the globe?

29. The UK must collaborate globally if we are to remain at the forefront of cutting-edge research and innovation. International R&D collaboration creates opportunities that go above and beyond what can be achieved at national level, for example:

- Plugging capability gaps
- Improving the likelihood of business participation in global supply chains
- Providing access to infrastructure not in the UK
- De-risking early stage research
- Enabling projects that would be beyond the reach of an individual country
- Supporting the UK economy by bringing inward investment to the UK

30. This is particularly important for aerospace. The sector is inherently global - a handful of aerospace primes sell their products globally, but also purchase parts and services from the global supply chain. Primes and first tier suppliers have extended their presence around the world, investing in manufacturing and servicing operations in numerous countries. Financing for new products often comes from an array of countries and R&D is carried out at both national and international levels, often collaboratively between organisations. These attributes of the industry have major implications as exporting, attracting inward investment, financing aircraft projects, and conducting R&D are all interconnected.

31. We therefore welcome the stated intention to fully associate with the next European research and innovation programme, Horizon Europe. The EU's Framework Programmes are the most effective multilateral funding schemes in the world and are a practical and efficient way to support excellence in international collaboration. It is encouraging that both sides have committed to the principle of UK participation in their negotiating mandates, recognising that collaboration between the UK and the EU in the framework programmes strengthens our ability to tackle shared challenges, such as climate change.

32. It is vital that this commitment translates into an agreement on the terms of participation. Horizon Europe association should be a core part of the future relationship between the EU and the UK and a 'fair and balanced deal' should not only consider the financial benefits of collaboration but the myriad other benefits outlined above. In the event agreement cannot be reached, provision should be made in the Comprehensive Spending Review for funding to allow UK partners to participate in European schemes open to third countries.

33. In addition to pursuing collaboration with the EU, the government should expand its horizons by enhancing research collaborations with R&D intensive nations as well as building new partnerships with emerging knowledge economies. The offer of R&D funding could underpin future bilateral arrangements. Currently beyond Official Development Assistance (ODA) international research programmes, there is limited financial support to incentivise greater collaboration with other leading global research nations such as the USA, Canada and Singapore. As a result, those collaborations that do succeed are often very small in scale and tend to be the result of organic academic-to-academic relationships. The fund for international research collaboration established by UKRI in 2018 is welcome, but with a total budget of £110 million it is a relatively small part of the funding landscape. The roadmap is therefore right to consider a new funding offer for international collaboration to ensure the UK can further benefit from the opportunities of international partnerships.

How can we harness excitement about this vision, listen to a wider range of voices to ensure R&D is delivering for society, and inspire a whole new generation of scientists, researchers, technicians, engineers, and innovators?

34. To really excite scientists, researchers, innovators and entrepreneurs applying for funding, bureaucracy should be minimised. Financial support in the form of R&D grants are offered to enable riskier and faster R&D activity that private industry would not undertake alone due to not having the risk appetite do so. Yet the criteria and appetite for the risk within Government is sometimes less amenable than that of private industry, limiting the impact and purpose of the grant funding. For government funded R&D projects, a certain amount of due diligence is required to ensure projects are appropriate, strategic and beneficial to the UK economy. Whilst a degree of aversion to risk is expected and encouraged, it should not be so severe that it discourages innovation and organisations/individuals to apply for funding in the first place.

35. In addition, securing widespread support for the government's R&D vision requires the 'buy in' from a range of stakeholder groups and it is encouraging that the R&D roadmap recognises this. The public at large should be engaged to build popular support for research investment. The recent Public First report, commissioned by the Wellcome trust and CaSE, contains several recommendations that explore how advocacy will need to change between now and 2030 to sustain R&D as a political priority. Its fundamental message is that much more needs to be done to showcase the breadth of R&D activity and the outcomes of investment, as there remains a significant segment of the public who do not think investing in R&D should be a priority.

36. Finally, we are supportive of the government's plans to convene a series of Ministerial chaired meetings over the next two months to hear from a range of stakeholders from across the UK. We are also supportive of the planned Innovation Expert Group but would welcome further details on how research and business leaders could become involved. The same is true for the UK R&D Place Strategy, with the UK aerospace sector willing to provide input.

Contact details

For further details on the above, please contact:

Malcolm Scott
Corporate Development Officer
malcolm.scott.@ati.org.uk
07908556106

Scott Pendry
Head of International R&D and Policy Engagement
scott.pendry@ati.org.uk
07495 921560