Airbus welcomes the opportunity to respond to the National Assembly of Wales Economy, Infrastructure and Skills Committee consultation on research and innovation in Wales.

About Airbus

Airbus is a global leader in aerospace, defence, space and related services. This includes a 14,000-strong UK workforce spread over more than 25 UK sites, generating annual revenues close to £6bn, making Airbus the second largest aerospace and defence employer in the UK and a major contributor to the UK economy.

Building on a proud 100-year British industrial heritage, Airbus is the largest UK commercial aerospace company and biggest civil aerospace exporter. Wings for all models of Airbus commercial aircraft are manufactured in Broughton, North Wales which employs over 6,000 people.

Airbus' defence and space activities across the UK make it a world-leader in cyber security and the world's leading commercial provider of military satellite communications. At the Newport site in South Wales, Airbus specialises in secure information services, cyber solutions and the security of critical infrastructure in the UK, serving as key partners in government and NATO-led information infrastructure programmes.

As Britain's civil helicopter hub, Airbus provides 50% of the UK's helicopter market and is a key supplier of military helicopters to the Ministry of Defence. Because of this, every UK military pilot is trained on an Airbus Helicopter. Airbus also supplies Air Ambulance helicopters across the whole of the UK.

Introduction

Airbus is one of the UK's biggest inward investors in research and development (R&D), investing approximately £400 million annually. Investing in world leading science and research allows Airbus to grow our business footprint, deliver new products to our customers which ultimately sustains high value jobs and secures the future for Airbus in the UK.

The Airbus General Market Forecast identifies a requirement for over 37,000 new aircraft over the next 20 years with customers demanding more competitive, cost effective, environmentally friendly, and technically advanced aircraft. Therefore, Airbus has invested heavily into advanced research facilities, highly skilled R&D teams and long-term funding lines which deliver critical technical innovations that help the Group to remain at the top of an extremely competitive world market. For example, Airbus in the UK is leading research into application of composites in novel structural architectures which will deliver significant cost advantages to our Wing of Tomorrow programme portfolio, hence Airbus plays a vital role in increasing productivity and delivering growth in the aerospace sector.

Research delivered by Airbus in the UK is strategic, long-term and supported by a mix of EU research initiatives such as Horizon 2020, Welsh Government Research such as Airbus Endeavr Wales and UK Government programmes led through Innovate UK and the Aerospace Technology Institute (ATI). The support received by EU, Welsh and UK Government research programmes is a critical factor in the decision making process of locating new research programmes in the UK and helps to secure future product lines and technical capabilities at the company's UK sites which ultimately secures high value UK jobs.

Welsh Government says that there needs to be a "major increase" in research intended to help solve specific challenges facing Wales (challenge-led research). It also says this type of research needs to be balanced with the more traditional type of long-term research undertaken by universities which pushes the boundaries of knowledge. To what extent do you agree with this view?

Airbus works in a highly competitive, intellectual property (IP) rich, R&D intensive sector and understands the importance of traditional and challenge-led research. Delivering vital technological innovations that help us as a business remain profitable and effective amongst close competitors is of paramount importance to us, hence why Airbus relies on long-term research for new innovations from UK academia to support long-term growth. Academic collaboration is therefore an essential component to Airbus' R&D lifecycle which is the reason why Airbus has partnerships with over 20 universities in the UK and works closely with the majority of universities in Wales through Airbus Endeavr Wales. It is for this reason that the benefits of leading long-term academic research centres is closely considered when selecting locations for research and innovation.

Often academia has the skills which complement the engineering community within Airbus. For instance, the Advanced Composite Training and Development Centre located in Broughton, North Wales is the result of a ground-breaking partnership between Glyndŵr University, Airbus, Coleg Cambria and the Welsh Government which helps thousands of Airbus employees and apprentices to develop their composite manufacturing skills. Through combining challenge-led and long-term research, led by Glyndŵr University, the centre is focused on developing faster manufacturing and processing techniques for composite materials which will help to meet future demand for aircraft and composites in general.

Fundamental long-term research, led by academia, is also crucial to discovering innovations that are rarely considered by industry. Academic research centres have the ability to investigate and study in areas where businesses do not have the capacity or scope to carry out such in-depth research. An example of this is the University of Manchester's vital contribution to the discovery of Graphene. This was a revolutionary finding as the properties of graphene have the potential to aid in the aeronautic industry drive to produce safer, cheaper and quieter aircraft. For this reason, Airbus has launched a project into Graphene Oxide Filter which aims to produce an automatic self-regulating fuel tank water drain system. This project will build upon other investments, through work with world-leading academic partners, to address key questions about practical graphene performance; it will accelerate the commercial application of emerging graphene and related 2D atomic materials nano-technologies.

Today at Airbus, we are using challenge-led research to grow our business footprint and deliver new products to our customers which, ultimately, sustains high value jobs and secures the future for Airbus in the UK. UK aerospace currently has a need to design the next generation aircraft; this will involve ambitious structures, complex architectures and greater levels of integration within the aircraft. As a nation, we currently have a capability gap in High Value Engineering Design Integration capabilities. Through challenge-led research, we propose to plug the capability gap by establishing a High Value Design Organisation focused on enabling advanced engineering businesses like Airbus to develop increasingly complex products quicker and at lower cost – this is the UK's ability to design next generation of aircraft configurations.

Challenge-led research, alongside existing fundamental long-term research, is fully encouraged to solve specific challenges and issues facing Wales. A strong R&D ecosystem acts as a source of economic growth; numerous studies from OECD, Russell Group and Research Councils all illustrate the high returns on investment derived from technology. Welsh Government investment has the potential to move beyond R&D and progress towards funding the innovation required to transition leading research and technologies into new opportunities, such as start-ups, spin-outs, business investments and future offerings. These types of research programmes help organisations, like Airbus, secure additional inward investment, enabling greater productivity to really champion the ecosystem of innovation in the region.

How can Welsh Government ensure that an increase in one type of research activity doesn't mean the other type loses out?

There are different avenues of research activity which Airbus is involved in. This approach to research supports knowledge and skills transfer and has enabled technologies to emerge cross sector; stimulating economic growth across Wales. Our investment into sectors such as Cyber Security, Automation, Artificial Intelligence and Communications (e.g. 5G) has brought about benefits to healthcare, transport and citizens, alongside innovative advancements in manufacturing. For example, our digital living platform has enabled data to be provided on CO2 emissions detected across cities and our developments in 3D printing has been applicable to wider sectors, such as healthcare. Welsh Government can safeguard certain types of research activity by funding programmes that support a range of sectors. It is important to note that only a small amount of Welsh research is funded by the UK funding bodies, Research and Innovation (UKRI) and Innovate UK. Therefore, to ensure that Wales doesn't lose out on funding for research, Professor Graeme Reid's recommendation to align closer and work better with UK Government to plug the gap should be considered because the growing budget in UKRI and Innovate UK now presents major opportunities for businesses and universities in Wales to win sizeable amounts of additional research and innovation funding. There is no limit to the proportion of funding that can be won in these 'competitions', and the benefits to Wales would be significant[1].

Airbus recognise key areas in technology innovation and UK strategy to which Wales has an opportunity to become a leading region in these areas. For this reason, Airbus welcomes the opportunity to fund early stage R&D projects that have the potential to solve business, industrial and technological challenges. An example of this is the Welsh Government funded Advanced Manufacturing Research Institute (AMRI) being built in Broughton, North Wales. The AMRI is open access to all advanced manufacturing sectors which helps facilitate strong linkage and participation between the other industrial initiatives across the UK and the North Wales Region, including the High Value Manufacturing Catapult network, the Northern Powerhouse, Aerospace Technology Institute, Automotive Propulsion Council and the Welsh Government Economic Renewal programme. The AMRI will be a research facility operated in a collaborative partnership between industry and academia, providing support and training to the nations' industry and educational establishments for manufacturing technology ensuring that research carried out by one organisation doesn't lead to another organisation or research type losing out. The AMRI investment by Welsh Government is a major contribution to the ecosystem supporting the Wing of Tomorrow programme. The programme is a major technology investment that will explore the best materials, manufacturing and assembly techniques to assemble wings faster and cheaper, as well as establishing new technologies in aerodynamics and wing architecture.

Welsh Government has said it wants to bring all research funding together and that this funding should then be available to small and medium-sized enterprises (SMEs), large private businesses, and other organisations as well as universities and colleges:

Research funding should continue to have a clear focus and act as a lever to achieve directed outcomes. Many Airbus research programmes are carried out in collaboration with SME's, academia or other industry partners as it allows us to pull together talent and knowledge from different backgrounds to ensure the company's research is maximised. Collaboration in innovation is a great thing because it brings people together around a shared vision where diverse skills, knowledge and experiences add significant value.

Airbus recognises the importance of collaboration to create growth in the economy and deliver results. Airbus Endeavr Wales, the joint initiative between the Welsh Government and Airbus, is an example of how encouraging organisations to play to their individual strengths supports innovation in Wales.

[1] Reid, G. (2018). Review of Government Funded Research and Innovation in Wales. *Llwodraeth Cymru Welsh Government*, 92. Retrieved from https://gov.wales/docs/det/publications/reid-review-en.pdf

Since 2007, Endeavr has commissioned almost 40 projects, with each project being led by a business, academic or industry partner. The majority of these R&T projects have been undertaken by Airbus in collaboration with a research-intensive university. While, over the last 3 years, one in four of the collaborative projects have been led by a SME business; helping to forge strong working relationships between business, industry and academia while cultivating long lasting links between potential collaborators. SME's can be more agile compared with large companies, so collaboration brings about broad benefits to industry. An example of this is Gofore; an SME headquartered in Finland with offices in Swansea and throughout Europe. Gofore has successfully completed Endeavr research projects, with clear focus and directed outcomes, in collaboration with Welsh academia. As a result, Airbus has contracted with Gofore on a transnational scale to exploit the research commercially within our business.

To what extent should businesses and other organisations be able to receive Government research funding that might have otherwise gone to universities and colleges? How could this be done without under-funding some organisations – might there be unintended consequences?

Airbus collaborates with a number of universities across the UK and such interactions are essential to maintaining technological leadership and the flow of skilled graduates. The funding landscape has changed significantly in the last few years and we are seeing universities increasingly keen to collaborate with industry partners.

The UK government recently created a single research funding body called UK Research and Innovation (UKRI) in order to bring together the seven Research Councils, Innovate UK and the Higher Education Funding Council for England. UKRI has an annual budget of £6 billion and aims to coordinate the activities of the various research funders and promote increased collaboration, particularly between universities and the business sector. We hope that this will lead to further opportunities for collaboration, whilst maintaining the research excellence of UK universities. The Welsh Government also provides funding to both industry and academia through a range of schemes. Many of these schemes, such as the SMART Expertise program, already require significant industry contribution and this can be problematic for many companies, especially SME's. Airbus has also benefited from direct investments in Welsh universities such as the Ser Cymru programme that has built new capacity in key technologies, such as compound semiconductors.

Continued investment in the university sector is essential to ensure that UK universities are able to undertake world-leading, cutting edge research. Reducing investment in university research risks undermining the next generation of technologies, and risks damaging Wales' medium term research capability. University research provides ideas and technologies that drive innovation and the industries of the future. A reduction in investment would also affect the flow of graduates and post-graduates that have the necessary skills and expertise that enable our business to grow.

It is important that the balance of funding between universities and business is maintained so not to undermine our prosperity in the long-term. Airbus is already involved in a number of Research Council initiatives, such as Centre for Doctoral Training, CASE Awards and Prosperity Partnership. These provide examples of good practice of how university funding is having a direct benefit to our company.

What needs to be done to ensure businesses and their interests are not over-shadowed by universities when it comes to research and innovation funding and activity?

Collaboration is key to successful research and innovation activity. All parties involved benefit and no one is overshadowed if mechanisms are established for academia, SME's and business to work together. One such mechanism that has proven to be a success is the Airbus Endeavr Wales initiative that encourages cooperation and partnership between organisations to boost innovation across Wales. Endeavr has brought together business, academia and industry to bridge the gap from early stage research to proof-of-concept, which is the point where commercial value can be realised.

This approach has led to significant benefits, including the creation of the new Airbus Centre of Excellence (CoE) in Cyber Security Analytics based at Cardiff University's School of Computer Science and Information. The centre, which launched in October 2017, builds on the success of an Endeavr funded project with additional funding sourced from UK research councils, industry and government. It is a leading UK academic research unit for cyber security analytics, focused on the interpretation and effective communication of applied data science and artificial intelligence methods through interdisciplinary insights into cyber risk, threat intelligence, attack detection and situational awareness. The Centre has been named as an Academic Centre of Excellence in Cyber Security Research by the UK's National Cyber Security Centre (NCSC), becoming the first institution in Wales to be given this status. The technologies, tools and IP developed are commercialised and used by industry to detect and counter the threat of a cyber-attack.

Similarly, Airbus has established a Quantum Technology Application Centre based at its facility in Newport, South Wales. The Centre is supporting academic institutions to explore future aerospace and defence applications for quantum computers, sensors, and communications and clock devices.

What are businesses and universities able to offer each other when they work in collaboration on research and innovation projects?

Businesses can offer universities funding, technology exploitation pathways, knowledge in how research will be applied in the real world and gravitas in working with a multinational which helps them to attract greater external funding for their research. Also, businesses offer letters of support that help universities secure significant research funding as working in consortia with businesses and academia improves the chances of the academic research projects getting funded.

Equally, universities can offer business the agility and ability to explore broader research themes that would not normally be possible within industry. Businesses and universities working in collaboration makes the Technology Readiness Level (TRL) cycle more efficient as businesses tend to focus on stages 3 to 9 whilst academia cover 1 to 6, focusing heavily on the conceptual phase and blue sky thinking that can garner innovations to be pushed through.

Academia often has specialist equipment and capabilities that can advance research at a greater pace whilst also offering a different perspective. Airbus and other high technology companies rely on new innovations from UK academia to support long-term growth. Academic collaboration is therefore an essential component to Airbus' R&D lifecycle and the UK's reputation for world class research which makes our nation a more attractive place to locate and invest in innovative research programmes.

Should Welsh Government and others be doing anything differently to bring smaller businesses together with universities to collaborate on research and innovation projects? What is working well and what isn't?

The new 'Prosperity for all' Economic Action Plan looks to align any Welsh Government investment with social economic development and set out a vision of inclusive growth, built on strong foundations, supercharged industries of the future and productive regions. This has been carried forward by the Industrial Strategy Challenge Fund (ISCF) which has successfully focused on bringing together the UK's world-leading research with business to meet the major industrial challenges of our time. Successful ISCF constructs like the FARADAY battery challenge, which is the government's programme to develop cost-effective, high-performance, durable, safe, low-weight and recyclable batteries has worked well to bring together expertise from universities and industry to support research, training, and analysis into electrochemical energy storage science and technology. Similar programmes can work well on a smaller scale in order to encourage collaborations on research and innovation projects between academia and SME's as far as 'group' level.

Similarly, the Endeavr Model established by Welsh Government alongside Airbus is a proven example of bringing together small businesses and universities in order to collaborate and pull

together knowledge, IP, skills and expertise to achieve results. Endeavr provides the guidance, resources, facilities and technology required to kick-start any innovation project proposed by any organisation, large or small, and helps the development of early stage research to the point where commercial value can be realised. An Endeavr success story is the SME 'Gofore' which has gained multinational success through successful completion of Endeavr research projects in collaboration with Welsh academia, such as Swansea University.

The role of Welsh Government funding following Brexit is significant as the UK is as one of the largest beneficiaries of EU Block Grant. The details of the Block Grant's replacement, known as the 'UK shared prosperity fund', is at an early stage of development and therefore, it is still unknown how much additional monies will be allocated by the UK, or what proportion of this sum will be allocated to Wales. This is particularly important as Wales, along with the rest of the UK, faces losing access to large scale EU funded programmes, such as Horizon 2020, after March 2019. The funding scheme is a huge advantage to businesses. The co-funded project by Welsh Government and the Aerospace Technology Institute (ATI) which, with the 'place agenda' and the focus on regionalisation, there is further scope to 'align' multiple funding sources across both administrations to bring greater benefit to industry. Because of this, it is important to establish how Welsh Government can work with UK Government on alignment of economic investments to better support industry.

What should Welsh Government and others be doing to help businesses use the knowledge gained from research activity and turn it into marketable products or improved services?

The knowledge gained from research projects carried out by businesses such as Airbus needs more demonstration capability to show how research can be applied in the real world. Our cyber lab project is one example of research being turned into a marketable product through the test bench facilities that have been established in Newport, which demonstrates to Airbus globally how cyber technologies developed in Wales can protect our factories of the future. As a direct result of this project, we have pilot projects running in our final assembly lines in Hamburg, Germany and Toulouse, France.

The research and innovation ecosystem in Wales is strong and includes strikingly successful examples of university-business collaboration and research impact. However, the research base does not have the scale needed to deliver its full potential to the people of Wales. It is important to improve the eco system for technology exploitation by providing regional technology parks and innovation-hubs that foster the start-up and innovation mentality. Assisting technology-oriented entrepreneurs in the start-up and early development stage of their firms through technology incubators, and helping companies to build out their business and avoid problems on the way through technological accelerators, is as critical as the fundamental R&T initiatives that exist; such as Horizon 2020, which is the European programme for research and development.

In addition, the ease of the mobility of people throughout Wales must continue to be at the forefront of the Welsh Government's decisions. Investing in critical infrastructure and ensuring there is sufficient infrastructure in place allows industry and academia to successfully conduct business throughout the entirety of Wales, allowing new knowledge and capabilities cross-borders through collaboration with the northern and GW4 regions. This brings inward investment opportunities on a global scale.

By expanding open networks and events for businesses to showcase innovation, it will also allow research activity to be effectively turned into improved services. A successful example of this being applied is the cyber ecosystems in place in Israel. This is based on the interaction between government, academia and industry which is considered crucial to developing research activity and turning it into improved services. A closer to home example is "Cyber Wales" which has recently been launched as a cross government, academia and industry initiative including prime businesses and SME's. The wide range of cyber security activity and depth of cyber expertise in Wales has contributed to the collaboration of the world's foremost cyber security communities to co-create and adopt world changing solutions to high impact cybersecurity challenges, both current and emergent highlighting the excellence in the region and catapulting further inward investment in the cyber regional ecosystem.

Conclusion

Funding for research and innovation in Wales is encouraged both for academia and industry because a strong research and technology ecosystem acts as the backbone to UK economic growth. Investing in first class R&D enables Airbus to be a step ahead in a highly competitive global market by delivering decisive and vital innovations allowing us to be more cost effective, environmentally and technically advanced.