Airbus welcomes the opportunity to respond to the Science and Technology Committee consultation on the opportunities and challenges for Quantum Technologies.

About Airbus

Airbus is a global leader in aerospace, defence, space and related services. This includes a 15,000-strong UK workforce spread over more than 25 UK sites, generating annual revenues close to £6bn, making the 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 aircraft are designed in Filton, near Bristol and manufactured in Broughton, North Wales.

Airbus’s defence and space activities in Stevenage and Portsmouth make it the UK’s largest space company and the world’s leading commercial provider of military satellite communications. Airbus is the biggest supplier of large aircraft to the RAF and a world-leader in cyber security.

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 – indeed every UK military pilot is trained on an Airbus Helicopter. Airbus also supplies Air Ambulance helicopters across the whole of the UK.

Introduction

Success in aerospace is dependent on delivering greater performing, more efficient and environmentally friendly aircraft. These challenges are driving market demand and requires companies like Airbus to invest to help identify where these greater efficiencies can be achieved. Quantum technologies have a potential to support Airbus with this challenge. For example, Airbus sees a real opportunity to use quantum computing to digitally model and simulate airflow over existing and future wing structures. Using quantum technologies Airbus will be able to model every single atom of air flowing over a wing at all angles and speeds, from zero to hypersonic. This process normally takes seven years but through applying quantum techniques can be reduced to months. Quantum technologies therefore have the potential to help Airbus squeeze every last fraction of efficiency out of a wing design, potentially cutting fuel consumption, reducing drag, improve lift and enabling innovative, new product developments Other quantum technologies, such as communication and sensing/metrology, bear the promise to disruptively increase performances of our aircraft and payload, enabling us to design new products and new systems to meet the future needs of our customers. Furthermore, Airbus could envision using quantum technologies from cradle to grave in design and supply chain optimisation to create complex digital twin
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simulations or to enable step changes in Space service provision and mission planning of these platforms.

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

The current state of the UK quantum industry and its potential going forward, including particular strengths and challenges;

The establishment of the UK National Quantum Technology Programme (NQTP) has significantly enhanced the UKs quantum capability resulting in the UK's quantum ecosystem being recognised globally as world leading. This is a real asset for the UK with Quantum Hubs playing an important role in stimulating the ecosystem by bringing together the research, development and user community to deliver quantum technologies that have real world applications.

Formalising the links between fundamental research and its exploitation pathway through defining end user requirements and applications will further stimulate the growth of the quantum industry. Airbus recognises this and is collaborating with the University of Bristol who have just secured a £43 million investment to establish world’s first Quantum Technologies Innovation Centre focusing on taking quantum research from the lab and into the commercial world and positioning the UK as a global leader in the field. Together with other industry partners, Airbus will collaborate with the University of Bristol to shape ‘applications’ and feed in use case requirements for Quantum technologies in aerospace, space and defence. Initiatives like this are a real catalyst to growth and make a compelling case for inward investment into UK.

One area where the UK is behind international competition is related to the development of quantum computing technologies. US companies like IBM, Intel, Google, Microsoft are investing heavily and beginning to get ahead in developing this technology. Thanks to the investment already made, the UK has a clear time advantage over the US, so if as a nation we wish to develop a leadership role in quantum computing we must act quickly with financial support, investing in the appropriate infrastructure and defining the supportive programmes to compete at a global level.

What oversight or regulation is needed;

Adopting a standardisation process through the European Telecommunications Standards Institute (ETSI) (or similar organisation) is essential for the long term adoption of quantum technologies. Focusing on the standardisation of future applications, like Quantum Key Distribution, with NSC for example for critical national infrastructure, is necessary to provide the certainty needed to focus technology...
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application development and thus trigger investments for mass production. The National physics laboratory also has a role to play to support the establishment of verification and validation of such enabled technology especially for the safety mission critical based systems.

**Potential barriers for developing quantum technologies, and how these might be overcome;**

A lack of appropriately skilled engineers is a barrier to adoption of quantum technologies. The UK simply will not have enough engineers trained to meet the future demand for quantum based solutions. Critically, the skills needed are centered on probabilistic software programming as opposed to traditional computing. As these skills are scarce with a weak resource pool today, there is a requirement for a targeted skills programme to generate a future pipeline of engineers competitive to work in the field of Quantum technologies.

Airbus recommends establishing a challenge based programme designed to upskill engineers and train new engineers in the field of Quantum technologies. If Industry and academia jointly set grand challenges, the engineering community can collaborate to hone their skills learning about the key principles of quantum technologies whilst advancing key quantum technology roadmaps.

The speed at which quantum technology is developing is rapid. For the UK to maintain its leadership position, funding, facilities and supportive programmes need to be made available at the same pace as the development. Delays in support being made available due to complex governance and processes could risk the progress of research and impact the UK’s competitive advantage.

There is an additional risk of industry not adopting quantum technologies if research is delivered in isolation of industry requirements. Existing programmes like Bristol Universities Quantum Technologies Innovation Centre provide a strong foundation for this as they are proactively capturing use case requirements. However, existing funding initiatives are positively biased towards supporting SME’s and not larger industry who are more likely to be the early adopters and develop the market. An evaluation of the KPI’s for quantum grant awards would be useful. This could be overcome by ensuring there are sufficient test and verification facilities for quantum technologies to enable industry to assess and validate their viability before adoption.

**What research priorities there should be for quantum technologies and their possible uses, and who is best placed to undertake/fund that work;**

The two main research priorities for aerospace and defence sectors are quantum communications and quantum sensors.
1. Quantum communications will help industry to better manage software defined networks based on customer demand for greater or less bandwidth. In addition, quantum computers will allow the construction of even more accurate atomic clocks which can control the timing of data transmissions, allowing more information to be communicated. Overall, making networks more efficient by offering customers a better service and enabling providers to generate more revenue from available bandwidth. Many of these communications applications could be space based with industry demanding an increase in Space assets for mission planning, collision surveillance and avoidance and GPS less navigation. Future communications systems will also need to be secured by Quantum Key Distribution, protecting nationally sensitive communication channels from cyber-attacks.

2. Quantum sensors will deliver the ability to identify submarines on the sea bed from an aircraft without GPS. This will be an essential sovereign capability supporting the defence of UK.

The role of international collaboration in quantum technology research and development; and the risks and opportunities of Brexit in this area;

International collaboration is essential to support the development and adoption of quantum technologies. Sitting outside the EU could result in the UK’s loss of influence to shape key strategic frameworks such as the Horizon 2020 Future Emerging Technologies programme on quantum technologies which is working on setting out Europe’s vision on quantum. This would result in European industrial policy and research roadmaps being defined by other member states which could affect the UKs competitiveness and ability to shape major evolutions that will guide the future of quantum.

Initiatives like the Industrial Strategy Challenge Fund for quantum technologies is an important counter balance to the threat of Brexit. With the right investment in UK research programmes, test and verification facilities and skills development, the risk of Brexit can be mitigated.

Conclusion
The potential future applications for quantum technologies are significant and the UK is in a very strong position to take a global leadership role. Success will be dependent on the continued involvement of large industry in shaping future requirements combined with long term funding streams and world class research programmes.

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