How we can harness the potential of Quantum technologies in the UK

techUK is the trade association for the technology sector in the UK. Our over-1000 members, the majority of which are UK-based SMEs, are based around the United Kingdom. Our members employ 1.1 million people across the UK, with a turnover of £329bn in 2023 and an estimated annual growth rate of 10%.

We have prepared this briefing to help Prospective Parliamentary Candidates understand key issues for the UK technology sector, what can be done to tackle these issues and the benefits of doing so.

This briefing draws upon:

- Our UK Tech Plan: How the next Government can use technology to build a better Britain
- The *Seven Tech Priorities for the next Government and polling of 250 tech industry leaders in February 2023*.
- techUK report: Quantum commercialisation: Positioning the UK for success

More briefings, both from ourselves and techUK's members, can be found on our online briefing hub.

techUK has the largest quantum industry group through our Quantum Working Group. With this group. we push forward the UK's emerging quantum market whilst addressing key challenges hindering commercialisation. This includes areas such as funding, skills, procurement and trade.

A new government will arrive at a crucial time in the development of quantum technologies. It is critical to keep pace across all quantum technologies, from sensing, communications, security and computing, to secure the UK as a world leader in quantum commercialisation.

With this in mind, we have set out the benefits of quantum technologies for the UK's economy and public sector, and the challenges that we still need to overcome in the UK to realise their full potential. It is important to note that quantum technologies are incredibly varied, with technologies and use cases maturing at different rates.

How is the UK benefiting from quantum technologies and what are the opportunities for the future?

The UK is a world leader in quantum technologies. **The UK has more quantum start-ups than anywhere in Europe, while also ranking second for commercialising quantum businesses worldwide**. This quantum ecosystem is already viewed favourably outside of the UK, and we are starting to see international quantum companies interested in the UK market. This means that the UK is developing a wealth of expertise, businesses, and opportunities in quantum. End users who are able to use these strong foundations will have first mover advantage for revolutionary use cases across logistics and optimisation, pharmaceutical and drug development, and national security.

The UK's quantum economy has a strong presence in the nations and regions, with regional centres of excellence in quantum exist across the country. As the National Quantum Strategy highlights, this is building on the success of the National Quantum Technologies Programme from 2014. These include the National Quantum Computing

Centre (NQCC) in Harwell, Oxfordshire, the National Physical Laboratory (NPL) in Teddington, the Fraunhofer Centre for Applied Photonics in Glasgow, and the four research hubs led by the Universities of York, Birmingham, Glasgow, and Oxford. These centres and their communities have built wide-ranging networks and is widely admired and emulated by other countries, as it has built a vibrant collaborative environment.

Furthermore, the quantum sector can provide high-paid, high-quality work to employees. According to The Data City, the quantum sector supports 20,000 full-time equivalent jobs, while Research by Quantum Futures shows that salaries in quantum are starting at £50,000, increasing to over £90,000 in five years. However, for positions in the United States salaries are reaching $250,000 (£192,000) within five years of experience in the industry, creating talent problems for firms.

To realise the benefits of a commercially driven quantum economy the below activities will be critical:

1. **Remain committed to the National Quantum Strategy and funding its associated missions to ensure the commercialisation of all quantum technologies**

The UK is in a strong position on Quantum. However, as other leading nations publish their forward-thinking national strategies, we must not become complacent. The *National Quantum Strategy* sets out a commitment to deliver an ambitious quantum programme, backed by 2.5 billion of funding. techUK recently welcomed the announcement of the *five quantum missions* that seek to find applications across a plurality of quantum technologies. This approach is internationally pioneering, and it is integral for commercialisation.

2. **Support quantum businesses to scale in the UK**

As start-ups grow, the UK's business environment can create barriers to growth including skills shortages, under-investment in the tech sector from UK financial institutions, uneven spin-out conditions, high lab and site costs and regulatory barriers.

Having worked closely with scale-up companies in our membership, we have identified that there is often a correlation in the issues faced by foreign firms seeking to invest in the UK FDI and supporting scale-up firms to grow. Initial areas of focus for aiding these firms should include:

- **The scale-up visa:** reviewing the effectiveness of the scale-up visa and UK visa system for scale-ups.
- **Planning and infrastructure:** analysing the availability of lab spaces and infrastructure for UK scale-ups and the impact of the planning system on business growth.
- **Access to talent:** see recommendation 9
- **Finance:** reviewing the progress of the Governments Mansion House and Edinburgh reforms, the culture of investment in the UK and the skill base of public investors, the British Business Bank and National Infrastructure Bank.
- **Nations and regions:** reviewing different scaler and start-up support initiatives across the UK's nations and regions and better facilitating joined up thinking and learning from best practice.

You can read more about supporting scale-ups in our scale up briefing.

3. Procure Quantum technologies to support the public sector

From transport, to energy, and chemical research, the recent £45 million in funding announcements from UKRI show how quantum can be used to address key challenges facing the UK. [1] This is an area where a future government could use procurement to support the UK's public sector through measures such as:

1. **Set ambitious plans for public procurement of quantum technologies** that will help find quantum-based solutions and drive forward commercialisation especially for SME's
2. **Use procurement to frame quantum as a part of a wider technology toolkit available in the UK.** Again, achieving Labour's five key missions will be crucial here
3. **Address the barriers limiting public sector adoption** of quantum such as skills and awareness, and accessibility for SMEs to the procurement process

4. Build a resilient quantum economy

UK Government can help the thriving quantum sector by building resilience. Resilience includes building international partnerships to secure international supply chains, as well as developing a strong domestic supply chain. and the quantum industry should work together and push forward engagement with the wider supply chain to ensure the UK does not lose its advantage as commercialisation scales. For example, the UK has a cryogenics market, but this industry needs to be incorporated into the quantum supply chain. This should certainly include engaging with the UK semiconductor chip supply chain who will play a leading role in scaling quantum.

Resilience also includes UK Government developing certainty through regulation, guidance, and standardisation, especially as it relates to quantum security. techUK members have expressed concern about the lack of guidance from UK Government on how to become cyber secure against the quantum threat. The next Government should update this work to include a focus on quantum-based secure communications that will leverage Post Quantum Cryptography (PQC) and Quantum Key Distribution (QKD), alongside classical symmetric encryption that is sustainable into the quantum era. These technologies will underpin the next generation of the cyber economy and it is critical that the UK is a leading player.

5. Tackle the growing quantum skills gap

As the quantum industry grows, we will need to increase pathways into a career within the quantum industry. If this is ignored, the UK risks losing momentum towards commercialisation. This also includes developing quantum readiness, where end users

[1] https://www.gov.uk/government/news/unlocking-the-potential-of-quantum-45-million-investment-to-drive-breakthroughs-in-brain-scanners-navigation-systems-and-quantum-computing

have the skills to understand and leverage the benefits of quantum technologies. techUK urges that the next Government enact the below:

1. **Develop a one-year quantum masters, similar to the AI masters course, to open quantum career pathways to engineers and STEM graduates.** Government and industry should work together to open access so that PhD's are not the only route into a career in quantum. For the crucial engineering and technician roles required for quantum development, a one-year masters course open access to a critical talent pool who have the technical capability but a limited understanding of quantum.
2. **Support upskilling for a quantum literate workforce.** This can be done through training opportunities and education programs that accelerate cross-disciplinary programs that bridge engineering, science, business, and social sciences to develop people with an understanding of the huge potential of quantum from a technological and business perspective.
3. **Ensure the UK has access and remains attractive to large international talent.** Enhancing visa flexibility for quantum talent, including short-term access for academic-industry placements and internships, will be crucial so that we hire the best and brightest to progress the UK's quantum journey.
4. **Drive wider business skills and socio-ethical skills.** To create a successful quantum ecosystem, key interventions in training should include business skills that needed for commercialisation.
5. **Increase STEM, especially physics, education within the school curriculum** to encourage the number of students taking this pathway within higher education.

What are the benefits?

Quantum technologies will have a formidable role to play in unlocking innovation in the UK and internationally. It will enable previously unattainable technological advancements across different industries from drug discovery, transport optimisation, carbon capture, battery research and more. Such advancements will have a profound and positive impact in the UK in boosting economy growth, supporting the NHS and progressing towards Net Zero. Below are some noted examples in several fields.

Transport

Embracing the quantum revolution is essential to develop the next generation of intelligent transportation. For example, Quantum-enhanced navigation systems could alleviate traffic delays and enhance precision, while quantum sensors and imaging technologies could ensure safer and more optimised travel. **The Port of Dover** has used quantum optimisation algorithms to investigate how to enhance operational efficiency and reduce congestion at the port. It manages huge amounts of passenger and cargo traffic within limited space and ensures that different vehicles are routed in an optimal way could help reduce queues and waiting times. This is a difficult optimisation problem that is well suited for a quantum processor. In the United States, techUK members D-Wave Systems worked with the Port of Los Angeles to use quantum applications to optimise a cargo pier to increase truck turnaround times by 12% and reduce crane movement, easing supply chain strain. The UK is recognising the importance of Quantum in transportation and this

year the **Quantum Catalyst Fund** announced funding Quantum optimised train schedules with **National Rail.**

Next-generation healthcare and treatment

Quantum provides great opportunities for diagnosing and treating a range of medical conditions. Wearable quantum-enabled brain scanners have been pioneered by engineers and physicists at the UK Quantum Technology Hub Sensors and Timing, who have spun out Cerca Magnetics, capitalising on this ground-breaking research which aims to bring to both a research and clinical commercial market. Since launching, Cerca successfully installed its OPM-MEG system at the Hospital for Sick Children (SickKids) in Toronto for ground-breaking research to revolutionise the diagnostic experience for children with Epilepsy.

On the treatment side the drug discovery programme QuPharma, **a consortium of quantum partners including techUK members is already developing high-value simulation tools to support photodynamic therapies for cancer treatment**. In the current market, **useful simulations of photosensitising drugs are not possible with classical compute alone**. This project will develop an application-specific quantum computer designed to simulate the most classically challenging tasks within this research, incorporating HPC and quantum computing together. Most recently, chemical giant BASF joined the consortium to leverage the value of this work.

Supporting AI

The relationship between quantum and AI will be significant, with one report by EY stating that the top-ranked quantum computing use case across sectors will be to enhance to AI and machine learning.[2] Kao Data, techUK members who specialise in data centres engineered for AI, is already showing the potential of quantum in this field, with their KLON-01 data centre in Harlow already hosting some of the UK's most advanced, AI computing infrastructure systems including NVIDIA's Cambridge-1 supercomputer.

Next steps

For further analysis on what is needed to build a quantum-enabled economy, including use cases from members, we recommend techUK's Quantum Commercialisation report.[3]

If you would like to know more about what can be done generally to support quantum and the tech sector, you can read our UK Tech Plan and our blog on how UK tech companies are playing their part to tackle the rise of online fraud

techUK can also arrange a call with yourself and our policy managers so we can brief you on this topic in more detail. If this would be of benefit to you, please contact archie.breare@techuk.org and alice.campbell@techuk.org.

techUK is also able to arrange a meeting between yourself and a member company of ours who has premises in your constituency if possible. This would provide you with a photo opportunity and

[2] ey.com/en_uk/emerging-technologies/ quantum-readiness-survey

[3] techUK's Quantum Commercialisation report can be viewed here: https://www.techuk.org/resource/techuk-report-quantum-commercialisation-positioning-the-uk-for-success.html.

allow you to discuss the importance of this issue further with a company operating in your constituency.