EXECUTIVE SUMMARY

Quantum technologies are rapidly advancing from scientific propositions to commercial realities. The UK National Quantum Technologies Programme (NQTP) has successfully advanced quantum science and technology to a point of maturity where commercialisation and business model design are increasingly becoming a major topic among policymakers and managers in industry (EY, 2022). Quantum technology (QT) offers potential new applications in computing and simulation, communications, sensing, imaging and timing. However, the route to commercialising QT is still highly uncertain and risky, which presents challenges for firms adopting the technology, innovating their business model and delivering the potential benefits to consumers and society.

The aim with this White Paper is to explore the enablers and barriers to the adoption and commercialisation of QT in the UK. To this end, we conducted 61 interviews with various stakeholders in the UK quantum landscape, such as senior managers of large and established firms, CEOs and founders of start-ups, investors, government representatives, consultants and academics. In addition, we held three roundtable discussions in Cambridge, Oxford and London to better understand the adoption and commercialisation challenges of QT.

The insights from the interviews, roundtable discussions and continuous dialogue with the relevant stakeholders enabled us to identify the key strengths of the UK QT landscape and the challenges around the adoption and commercialisation of quantum computers. Based on the findings from the study, we propose several recommendations to strengthen UK QT adoption and commercialisation efforts.

Key Strengths of the UK QT Landscape

The UK is among the first nations to invest in quantum technology through a national quantum programme, which gives it a first-mover advantage in QT development. We identified several key strengths of the UK QT landscape. First, the UK is considered to be the leader in quantum science and engineering. Second, it has effective funding programmes (e.g. Innovate UK) to support the development of QT. Third, the UK has a high-quality talent pool in quantum science and engineering and a knowledgeable workforce with a more general background in maths, physics and computer science that can be reskilled to be quantum-ready. Fourth, the UK has a considerable venture capital (VC) and business angel community to fund quantum start-ups in early-stage funding. Lastly, the UK has a vibrant start-up community with over forty start-ups spun out directly or indirectly through the UK NQTP.

Adoption and Commercialisation Challenges

Despite the key strengths, we identified several challenges that could hinder the adoption and commercialisation of quantum technology in the UK. Those challenges revolve around market demand and adoption, supply and ecosystem, regulation and policy, funding and skills, as follows:

1. An inability to build a credible business case and uncertain demand because of changing policies and the lack of government role as a buyer.
2. Inadequate incentives for enabling technology providers (e.g. photonic firms) to get more involved in quantum technologies, an absence of technological standards and a lack of systems integrators affecting the supply-side ecosystem development.
3. Uncertainty around the longevity of government support for NQTP, the perceived lack of clarity around the role of NQCC, emerging geopolitical issues and the protection of intellectual property (IP).
4. Insufficient funding schemes to support commercialisation and manufacturing capabilities and a lack of private-sector funding to help scale up homegrown start-ups.
5. Shortages of available quantum-related talent and skills and domain experts with an understanding of QT.

Recommendations for the Way Forward

Based on the findings on the strengths and challenges for quantum technology development in the UK, we propose six recommendations to strengthen QT adoption and commercialisation efforts, in order to benefit society and deliver economic growth:

1. Initiating *mission-driven* funding calls as an addition to the UK NQTP, involving a combination of key stakeholders across the end-to-end of the value chain, with a focus on using QT to solve industry-wide and/or societal challenges for the public benefit.
2. Forming a forum of systems integrators in the UK.
3. Introducing a strategic initiative that brings together quantum computing and quantum communications (network) for better synergy.
4. Developing IP policies to maintain broader accessibility, while allowing for commercialisation.
5. Preparing scale-up capabilities in both technology and manufacturing.
6. Creating training programmes with shorter timescales that increase quantum literacy and skills.

Overall, the UK is in a strong position to translate its advances in quantum science and engineering into increased productivity and economic growth. In doing so, the nation needs to strengthen its efforts to address the adoption and commercialisation challenges of QT.