Australia's National Science Agency

Growing Australia's Quantum Technology Industry

Positioning Australia for a four billion-dollar opportunity

May 2020

EXECUTIVE SUMMARY

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Why quantum?

Advanced quantum technologies can create an $86 billion global industry by 2040[1]

In recent years, scientists and engineers have developed unprecedented capabilities to isolate, control and sense individual quantum particles (such as electrons and photons) and their properties. This is underpinning the development of transformational technologies including precision sensors, secure communication networks, and quantum computers. The successful commercialisation of these technologies will create a new high growth industry with the potential to enable decades of economic growth and job creation, and support productivity growth and enhanced security across a range of industries.

Why Australia?

Australia has world class quantum technology research and development capabilities

Australia was a pioneer in quantum technology development and has established world-class quantum research capabilities and expertise through over two decades of sustained research investment. We are now witnessing a growing number of quantum technology related businesses pursuing research and commercialisation efforts in Australia. These includes early stage university spinouts, VC-funded start-ups, joint ventures, and multinationals.

Why now?

The global quantum industry is maturing rapidly as nations invest in technology advancement

Many countries have now recognised the value that will be generated by quantum technology and are investing to prepare their domestic quantum ecosystems for this opportunity. Global capital investment in quantum technology companies grew almost fourfold between 2012 and 2018[2] and the UK, US, EU, India, Germany and Russia have all established billion-dollar scale quantum technology initiatives or funding packages since 2018.[3]

If Australia is to secure its place in this emerging global industry it must act now

To secure its competitive advantages and enable the continued growth of its domestic quantum industry Australia will need to implement a focused and nationally coordinated approach to enhancing its capability, collaboration, and industry readiness. This report explores Australia's opportunity to develop a domestic quantum technology industry, including an assessment of the nation's strengths and challenges, and economic analysis of key opportunity areas for the year 2040. It then describes a series of recommendations that could be undertaken in the short-term to ensure the nation remains strongly positioned to pursue this global opportunity.

1 This figured was developed by CSIRO Futures and uses conservative assumptions. Further, commercial figures do not reflect the total value creation potential of quantum technologies. This would include broader benefits such as gains in productivity, improved national security and indirect industry growth and job creation. Further detail on the economic assessment methodology can be found in Appendix A.

2 Data from Gibney E (2019) Quantum gold rush: the private funding pouring into quantum start-ups. Nature. 574, 22-24. DOI: 10.1038/d41586-019-02935-4

3 See Appendix C for information sources.

A 2040 vision for Australia's quantum industry

VISION: Australia has maintained its globally competitive strengths in quantum technology R&D and developed a sustainable quantum technology industry; generating and owning IP that underpins commercialised applications.

In 2040, Australia's quantum technology industry could generate over **$4B revenue** and **16K new jobs**

Computing
$2.5B
10K jobs

Sensing and measurement
$0.9B
3K jobs

Communications
$0.8B
3K jobs

Quantum technology applications enhance productivity and enable new capabilities in a range of existing industries, including...

Healthcare and medicine

- Quantum sensors enable early disease detection and medical research.
- Quantum computers support accelerated drug development through quantum chemistry simulation.

Defence

- Ultrasensitive quantum sensors detect small signals of interest including magnetic anomalies and trace chemicals.
- Quantum positioning and timing devices enable accurate navigation in GPS-denied environments.

Natural resources

- Quantum sensors enable discovery of valuable ore deposits and efficient groundwater monitoring.
- Quantum computers enhance modelling of complex weather and climate systems.

Financial services

- Quantum computers model and optimise complex systems such as investment portfolios.
- Secure communications are underpinned by key generation and communication using quantum mechanical properties.

Enabling Australia's quantum technology industry

Realising the benefits associated with the 2040 vision will not occur without coordinated action to enable the growth of Australia's quantum technology industry. The following table provides a high-level overview of near-term actions designed to support the long-term success of Australia's quantum technology industry for consideration by stakeholders in Australia's quantum ecosystem. These activities could be commenced immediately, with follow up activities arising as the industry begins to scale. Section 4 of the Roadmap describes these recommendations in greater detail.

FOCUS

Focus and coordinate Australia's quantum industry development efforts.

CAPABILITY

Build Australia's quantum workforce and infrastructure capabilities.

KEY RECOMMENDATIONS FOR CONSIDERATION

Develop a national quantum technology strategy to implement this roadmap's enabling actions and set long-term strategic priorities, commitments and indicators of success for Australia's quantum industry.

Attract, train and retain the best quantum talent and assess the future quantum technology workforce's skill needs to inform strategic capability development and growth.

Explore efficient and effective funding mechanisms to support the demonstration and commercialisation of quantum technology applications and enable the growth of emerging quantum businesses.

Assess the industry capabilities and infrastructure facilities that will be critical to the success of a domestic quantum industry and develop business cases to address any gaps.

ADDITIONAL RECOMMENDATIONS

- Support entrepreneurship and accelerator programs that enhance the commercialisation skills of deep technology start-ups.
- Continue to support and leverage Australia's shared research infrastructure through the National Collaborative Research Infrastructure Strategy to promote open collaboration and cost-effective capital expenditure.
- Enhance research and training linkages between Australian Universities with complementary quantum strengths.
- Proactively explore and address any unknown ethical, social or environmental risks that may arise with the next generation of quantum technologies.

COLLABORATION

Support productive collaboration with local and international partners.

Establish multidisciplinary and multi-institution projects to demonstrate commercial applications of advanced quantum technologies; and develop software applications and control techniques for noisy intermediate-scale and large-scale quantum computers.

Promote Australia's domestic quantum technology capabilities and explore opportunities to undertake R&D projects with trusted partners.

READINESS

Enhance the readiness of governments, society and end-users for next generation quantum technologies.

Provide clarity on the implementation of defence trade control regulations to provide confidence to the industry and ensure that Australia's IP and national security are protected.

Encourage proactive local end-user and government engagement with Australia's quantum ecosystem.

- Undertake a thorough assessment of critical materials and components for quantum technologies.
- Develop strong guidance and standards for the development and deployment of quantum applications.
- Consider encouraging universities to ensure that their IP management practices encourage collaboration, entrepreneurship and commercialisation.
- Enhance domestic capabilities and engage with international efforts to develop post-quantum cryptographic methods.

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Full report is available at
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