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SYNOPSIS

Singapore's National Quantum Strategy turned one in May 2025. While there has been progress across the strategy's four strategic thrusts, challenges remain in areas such as the availability of talent. There are also opportunities ahead, particularly in supporting the region to develop its quantum ecosystem. Nevertheless, it may still be some years before NQS 2.0 is launched, although the upcoming Research, Innovation and Enterprise plan covering 2026 to 2030 may signal adjustments to Singapore's quantum strategy through changes in funding priorities.

COMMENTARY

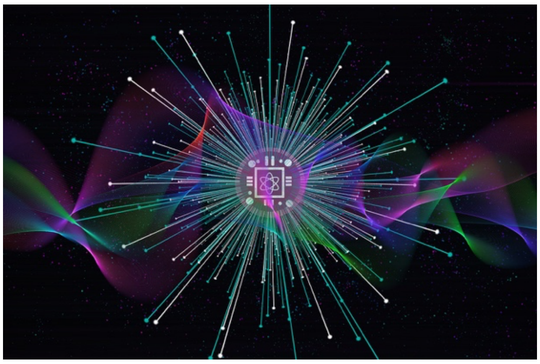
In May 2024, Singapore launched its National Quantum Strategy (NQS), backed by S$300 million under the Research, Innovation and Enterprise 2025 plan that guides public sector R&D investment. One year on, how has the NQS fared, and what are the challenges and opportunities that lie ahead?

The Strategic Importance of Quantum Technologies

Quantum technologies harness the principles of quantum mechanics – the physics of sub-atomic particles – in the form of novel devices and systems across three main application areas: computing, communication, and sensing.

Quantum mechanics is not a new field of study, having emerged in the early 20th century. Initial advancements led to the development of critical technologies such as the transistor and laser, which computers and fibre-optic communication rely on.

We are now in the midst of a "second quantum revolution", where the technologies being developed aim to leverage advancements in controlling individual quantum particles. This is expected to deliver new applications with significant economic and security implications.



The world, including Singapore, is witnessing a "second quantum revolution", with breakthroughs in technology being developed to control individual quantum particles.
Image by Gerd Altmann from Pixabay.

For example, quantum computing involves developing devices that can perform calculations that are beyond the capabilities of current "classical" computers. Quantum communication is expected to provide theoretically unbreakable exchange of information, while quantum sensing offers the possibility of measurement with greater sensitivity and precision.

Even though quantum technologies are at an early stage of development – with sensing and communication applications being more advanced than those in computing – they have garnered attention in recent years because of their significant potential.

Although we can already see quantum technologies being entangled in the rivalry that characterises the current global order, this is not necessarily a repeat of what is happening with AI and semiconductor chips. Supply chains for quantum technologies are still evolving, and the application of quantum technologies in the military domain remains nascent.

Singapore's Quantum Journey

Singapore's journey with quantum technologies began in the early 2000s, with a focus on quantum information science (QIS), which is the study of how information can be stored, transmitted and processed using the principles of quantum mechanics. QIS underpins the second quantum revolution's development of applications in computing, communication and sensing.

In 2007, Singapore set up its first research centre of excellence – the Centre for Quantum Technologies (CQT) – which received S$158 million to fund its first 10 years of operation. This bet has paid off handsomely, with the CQT driving Singapore's reputation as a global leader in quantum technologies research.

With the creation of a National Quantum Office (NQO) in 2022, Singapore signalled the strategic importance of having dedicated bureaucratic capacity to coordinate national quantum technology R&D and ecosystem-building efforts.

The NQO is responsible for implementing the NQS and reports to a National Quantum Steering Committee that brings together stakeholders from the research ecosystem and public sector.

In addition to overseeing the CQT, the NQO also has oversight of the Quantum Engineering Programme (QEP), which aims to translate research into scalable and commercially viable applications and solutions. The programme was set up in 2018 with an initial five-year investment of S$25 million, which was supplemented in 2020 with an additional S$96.6 million up to 2025.

Through the QEP, the NQO also supports various national programmes that were launched in 2022 – the National Quantum-Safe Network (NQSN), National Quantum Computing Hub (NQCH), and National Quantum Federated Foundry (NQFF). The NQSN supports trials of quantum-safe communication technologies, while the NQCH and NQFF aim to build domestic quantum computing capacity and design and fabrication capacity for quantum devices respectively.

Unpacking the National Quantum Strategy

The vision outlined in the NQS is straightforward – strengthen Singapore's position as a leading hub for the development and deployment of quantum technologies. This echoes a desired outcome that has remained constant across Singapore's science and technology policies over many decades.

The NQS comprises four strategic thrusts – scientific excellence, engineering capabilities, innovation and enterprise partnerships, and talent.

Under scientific excellence, a key outcome is the elevation of the CQT to a flagship national research centre to improve coordination of capabilities across research institutions and support the development of new talent. This was realised in January 2025, and the CQT now manages research nodes based in Singapore's lead public sector R&D agency, the Agency for Science, Technology and Research, and three universities – the National University of Singapore, Nanyang Technological University, and Singapore University of Technology and Design.

The engineering capabilities strategic thrust focuses on enhancing the existing QEP with two new programmes – the National Quantum Sensor Programme (NQSP) and National Quantum Processor Initiative (NQPI). The NQSP was launched in August 2024 and focuses on position, navigation, timing, biomedical sensing and imaging, and remote sensing. The NQPI, also launched in 2024, aims to strengthen Singapore's capabilities in designing and manufacturing processors for quantum computers, which will support domestic quantum computing capacity.

The strategic thrust on innovation and enterprise partnerships aims to leverage the various national programmes to promote collaboration with industry and support the overall development of Singapore's quantum ecosystem through spin-offs and startups. For example, the NQCH is partnering industry and end-users to develop use cases in finance, drug discovery and development, and logistics, which are key sectors in Singapore's economy.

For the talent strategic thrust, a key initiative is the launch of a national scholarship scheme for quantum to develop a pipeline of up to 100 PhD- and 100 master-level graduates over five years to meet the growing needs of industry and research institutions. Thus far, 14 PhD students from five countries have joined the CQT since May 2025 under this scheme. The first cohort of sponsored master's students are expected to begin their courses later in 2025.

Challenges and Opportunities Ahead

A key element missing in the NQS is a concrete translation of its vision into milestones that allow Singapore's progress to be assessed. What does a "leading hub" look like in practical terms, and how will the returns on the S$300 million backing the NQS be assessed? No measurable targets are available, such as those in the United Kingdom's National Quantum Strategy.

However, a counterargument for defining success in terms of milestones is that it may result in tunnel vision and limit the flexibility needed to adapt to shifting circumstances. Milestones framed in superficial terms using a numerical target may not necessarily signify actual progress or advancement of the quantum ecosystem. Japan has managed this challenge by studying ongoing trends and implementing course corrections while maintaining continuity of the overall strategy.

Nevertheless, transparency regarding the choice of metrics matters as these drive the behaviours of those responsible for implementing the NQS and managing the various national programmes. Australia's approach avoids specifically defined targets but unpacks what will be measured as indicators of success, and also links each indicator to the various action points outlined in the national strategy.

A further challenge for the NQS is that its current approach to attract talent is entirely dependent on a scholarship scheme for PhD and master's students only. Given the shortage of global talent, more attention may be needed on creating alternative pathways to enter the quantum industry. For instance, the United States' quantum workforce development plan outlines specific initiatives to broaden access, and a key American industry association – the Quantum Economic Development Consortium – has explored how experiential learning can strengthen the quantum talent pipeline beyond those with specialised training in physics.

In addition, the NQS has yet to pay attention to the social and ethical implications of quantum technologies. These will become increasingly important as quantum technology applications mature. In the Netherlands, the Centre for Quantum and Society conducts research into ethics and legal frameworks in support of "quantum for good".

Turning to opportunities, the NQS can look beyond Singapore's shores. Within Southeast Asia, Singapore is in a position to lead the development of regional standards and governance frameworks. This could be through the ASEAN Consultative Committee for Standards and Quality, or could involve regional translation of standards being developed jointly by the International Organization for Standardization and International Electrotechnical Commission.

There may also be a sizeable regional market in the long term for quantum-computing-as-a-service and quantum-safe communication solutions. This is because it is likely that not every Southeast Asian country has the capacity to develop a quantum computer domestically. Furthermore, with established cloud computing service providers such as Amazon Web Services already providing quantum computing offerings, Singapore may benefit as it is an established regional hub for cloud computing services.

Looking ahead, with the next edition of the Research, Innovation and Enterprise plan covering 2026 to 2030 due this year, there could be potential adjustments to Singapore's quantum strategy signalled through changes in funding priorities, even if the NQS document itself does not undergo a refresh.

A refresh to update the NQS is likely to be a few years away. In the meantime, we can expect continued advances in quantum technologies along with developments in the approaches of other countries, which the NQO would need to track with CQT's help to inform a strategy refresh. There may also be many more quantum startups than the current handful, necessitating consideration of how to consolidate and develop the industry ecosystem and associated value and supply chains.

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