Publication: Open Gov Asia Online
Date: 10 January 2020
Headline: Could Quantum Computing accelerate governments' journey to achieve smart nation goals?

Could Quantum Computing accelerate governments' journey to achieve smart nation goals?

It is hard to imagine daily life without our 'smart' devices even though they were only introduced to us just over a decade ago, and although the prospect of Quantum Computing seems futuristic and complex, it is possible that in less than a decade from now we may not remember life without Quantum Computing. Quantum Computing is set to be the 'fifth generation' of computers.

Computers of today rely on bits that can only take the value of 0 or 1, quantum computers would function on quantum bits, or qubits, that can be both 0 and 1 simultaneously — a superposition that allows for incredibly fast computing. It is this very property of the quantum computing that technologists are hoping to leverage to build the next generation of computers.

Even at this early stage of research and development, Governments, large tech companies and global industry firms are investing heavily into what they believe is the next generation of disruption.

Governments around the world investing in quantum computing initiatives

Governments are committing a serious level of investment in quantum computing, this is due to the significant implications it could have on national security and economic competitiveness. Already governments in the US, EU, China, Australia, Canada, and others have announced research programmes and significant funding. However, funding levels vary significantly among countries with China leading the way.

The Chinese government has made quantum a strategic focus and has set its sights on major breakthroughs in quantum communications and quantum computing. It is reportedly investing $10bn in building the National Laboratory for Quantum Information Sciences in Hefei.

The Australian government has invested in the long-term development of quantum computing. 2016 saw a boost in investment to the tune of $70 million AUD over five years from business, academia and the government has helped solidify Australia's position as a real competitor in what has been dubbed the "quantum race", relying heavily on support from the private sector and research from NSW knowledge institutions like the University of Sydney's Nano Institute and UNSW's Centre for Computation and Communication Technology (CQC2T).

In September 2018, the House of Representatives in the United States passed its version of the National Quantum Initiative Act. The purpose of the Act is to "ensure the continued leadership of the United States in quantum information science (QIS) and its technology

applications". The Act proposes to do so through four key strategies, starting with additional support for the research, development and application of QIS technologies.
The US certainly seems to be taking quantum technologies seriously as the Act proposes $1.2billion of investment over the next ten years. The Act also proposes greater interagency planning and coordination of research into QIS; improved collaboration between government, industry and academia; and the development of standards for QIS technology and security.

The European Commission launched a $1.13 billion project in 2018 to support a range of quantum technologies.
The Quantum Technologies Flagship is a large-scale, long-term research initiative that brings together research institutions, industry and public funders, consolidating and expanding European scientific leadership and excellence in this field. It will foster the development of a competitive quantum industry in Europe, making the results of quantum research available as commercial applications and disruptive technologies.

The Flagship will run for ten years, with an expected budget of EUR 1 billion. In its ramp-up phase (October 2018-September 2021), it will provide EUR 132 million of funding for 20 projects in four application areas: quantum communication, quantum simulation, quantum computing, quantum metrology and sensing.

Innovation and Partnerships crucial for Quantum Computing Success

Research partnerships between large companies and top universities are forming, most notably Google and the University of California-Santa Barbara; Lockheed Martin and the University of Maryland; and Intel and Delft University of Technology.

Other partnerships in Singapore include industry, university and government bodies such as: Fujitsu & A*Star and Singapore Management University, SingTel & National University of Singapore and 1Qbit & Accenture & BioGen. And these are just very few of the thousands of new relationships that are evolving in the Quantum Computing Ecosystem.

As quantum computing evolves it will create opportunities for companies in every industry. Leaders need to begin thinking now about integrating quantum computing into their long-term strategic plans, building on knowledge for the future and addressing the challenges that this next generation of computing will present.

For the Singapore Government and in line with their Smart Nation goals some of the opportunities that Quantum Computing will enhance are:

Smart Cities: transport and city planning

The transportation sector is looking at quantum computing to make traffic management and public transport systems more efficient. For example automotive firm, Volkswagen have developed a quantum algorithm to predict urban traffic volume, allowing public transportation organizations and taxi companies to optimally deploy their fleets to meet demand. With autonomous vehicles, ships, drones and even delivery robots set to invade roads, pavements, waterways and airways around the world, quantum computing could play a critical role in optimizing routes to ease congestion and improve efficiency.

Another near-term application is the development of quantum sensors. Quantum gravity sensors would allow surveyors to map underground structures before embarking on large construction projects. Quantum sensors could also be used in applications to monitor volcanoes, forecast weather conditions more effectively or predict climate change effects.

Publication: Open Gov Asia Online
Date: 10 January 2020
Headline: Could Quantum Computing accelerate governments' journey to achieve smart nation goals?

Financial services – A true match for Quantum Computing capabilities

Quantum computing could solve complex optimisation problems that require processing a vast number of potential solutions extremely quickly. The financial services industry is already using quantum computing to explore risk optimisation across large financial portfolios. Quantum computing is considered a true match for the finance industry especially when it comes to calculating probability and risk through analysing huge volumes of data.

National Security: Balancing Opportunity and Threat

In the field of information and communication security, quantum has proven to be able of breaking encryption protocols. Although this could be cause for alarm from a government perspective, it also provides opportunities for government to develop new methods for future quantum-resilient encryption and secure communications.

The pharma, life sciences and chemicals opportunity

Pharmaceutical companies are already exploring quantum computing's ability to build more precise models of complex molecules and effectively simulate their interactions. Quantum computing could eventually accelerate drug development and even lead to the discovery of better drugs to treat previously incurable diseases.

Companies in materials and chemicals manufacturing, automotive and aerospace sectors are experimenting with quantum simulation to discover better compounds for more efficient batteries to power electric vehicles, fuel efficient aircraft materials, better solar panels, as well as new chemical catalysts for fertilizers that would reduce carbon emissions and improve crop yields.

The quantum revolution is coming.

These are just a few of the hundred of real industry applications Quantum Computing could be used for. Government and business leaders must ensure their organizations are ready now. What remains to be seen is how Research Institutes commercialise their findings? How governments bridge the gap in knowledge for its citizens? How different industries will use Quantum Computing differently? How to balance the opportunities and threats that it will present? And how much of an impact will Quantum Computing have on our daily lives and in what space of time?