IN PERSPECTIVE

A quantum leap in tech research

The National Quantum Mission must build translational capabilities

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Recently, India's National Quantum Mission received Cabinet approval for about Rs 6,000 crore spread over eight years to scale up scientific and industrial R&D in quantum technologies and their applications. This is a welcome announcement since it signals that our policymakers are willing to invest not only in building world-class capabilities in strategic emerging technologies but also translating them into applications.

To put this investment in perspective, the USA spent about $710 million per year in 2021 on quantum technologies while China conservatively spent about $84 million per year. These numbers are likely to grow in the coming years. The proposed Indian investment is about $91 million per year. While the scientific workforce costs are likely to be lower in India, we may have to import hardware components at least for now. India can also optimise costs by collaborating with friendly countries.

The National Quantum Mission proposes to focus on four main domains — quantum computing, quantum communication, quantum sensing and metrology, and quantum materials and devices. Our choice of domains appears balanced, and it is likely that the intensity of focus on each of them may get fine-tuned as we move forward.

Historically, India was more successful in vertically integrated mission mode technology projects compared to developing a horizontal capability in technologies. Vertically integrated projects were run as a national priority, top-down from the highest levels in the government with committed and generous funding. Usually, one dominant government technology organisation was responsible for the end-to-end delivery of vertically integrated programs. Most often, the technology developed in these programs were not for mass production. Some examples of vertically integrated projects include satellites for remote sensing and communications, nuclear energy, missile technology, etc.

On the other hand, developing a capability in a horizontal family of related technologies and applications often spread across different organisations and translating these capabilities to industry and startups has been a challenge. The National Quantum Mission must overcome this. How can this be done? We need to evolve agile organisational structures and processes that are conducive to frictionless research collaboration, managing the ups and downs in capability development and research projects, and translating applications to industry and startups.

We need to build a strong capability in 'Pasteur's quadrant' which is application-inspired basic research. The National Quantum Mission's focus on applications provides an opportunity to build a national-scale translation capability. It is imperative that the Indian industry, including startups, participates and contributes to the mission's projects from inception. One model to encourage translation of quantum technologies is to explore coupling them to a few national priority use cases.

The value of all types of digital transactions in banking has increased from about Rs 2,000 lakh crores in 2017-18 to about Rs 3,000 lakh crores in 2021-22. The increasing value of digital transactions also increases the threat of cybercrime. While current encryption with classical computers is vulnerable, with the advent of quantum computers, quantum encryption is expected to be strong enough to prevent break-ins by classical or quantum computers. This use case provides a prospect for firms in the Indian banking and IT industries to participate in the mission.

It is also important that we are self-sufficient in inventing medicines that cater to our current and emerging healthcare needs. Inventing new molecules that become effective medicines is increasingly becoming computing-intensive. One of the applications for our quantum computers can be new drug discovery.

Another possible use case is using quantum sensing to develop inertial sensors that can help provide accurate global navigation capabilities for our defence forces. Quantum sensors can provide in-situ, real-time calibration, and thereby reduce the reliance on transmitting and receiving signals from global navigation satellite systems that may not have the required coverage. This provides an opportunity for both our public and private sector firms that supply advanced systems to our defence forces to join the mission.

We should also focus on spin-off startups from our quantum technology labs. Our incubators and venture capital must be incentivised to support translational startups in quantum technologies.

Lastly, quantum applications make it interesting for the National Quantum Mission to communicate their contribution to Indian citizens. This helps capture the imagination of millions of young Indians just like how the Mangalyaan mission did in the past decade. This will motivate some of our bright young minds to seriously consider STEM careers in India.

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