

CII Quantum Technology Conclave

Quantum to Impact: From research to real-world adoption



Quantum technology is rapidly advancing from theoretical research to early real-world applications in computing, communication, sensing, and security. While global investments and research momentum are accelerating, significant challenges remain in scaling, commercialisation, infrastructure and talent availability. The theme "Quantum to Impact: From Research to Real-World Adoption" underscores the urgent need to bridge this gap — aligning research with industry needs and fostering deep collaboration across government, academia, startups and enterprise to unlock tangible economic and societal benefits.

Against this backdrop, CII organised the Quantum Technology Conclave on March 16, 2026 at Le Meridien, New Delhi. Bringing together policymakers, scientists, industry leaders and innovators. The conclave served as a vital platform to assess India's quantum readiness, chart a roadmap for adoption and ensure that the country's growing quantum capabilities

translate into strategic and commercial advantage. The deliberations spanned the full spectrum — from the science of qubits and quantum cryptography to indigenous hardware development, sovereign security infrastructure and India's place in the global quantum race. TelecomLive brings you the key deliberations from the event.

Quantum Technologies are knocking at our door — We can be complacent only at our own risk

Prof. Ajay Kumar Sood, Govt of India

The effort started a few years back when, in the Prime Minister's Science Technology Innovation Advisory Council, it was discussed that India should launch sustained and serious efforts in promoting quantum technologies. That was pre-COVID — I was a member of PM-STIAC at that time and made a presentation to the Prime Minister in 2019. Then, when it was about to be started, COVID took over and we lost almost two years.

It was very clear to us that we needed a concerted effort in this

direction — including academia, startups and industry, all the players. We needed a policy framework and resources. This effort is now resulting in appreciable outcomes, and I hope that in the coming years it will become even better.

Quantum mechanics is not new — it describes the behaviour of particles and matter at atomic or subatomic scales. Unlike gravity, you don't feel quantum effects in daily life. But in the scientific fields, it has enabled an enormous number of breakthroughs whose results we see every day. Semiconductors and lasers could not have been possible without an understanding of quantum mechanics. Quantum technology is the engineering exploitation of quantum mechanics — this is what we are talking about in the second quantum revolution. It exploits three fundamental principles: superposition, entanglement and measurement. This is what gives us enormous compute power, extremely secure communication systems and very sensitive sensors and detectors — all reflected in the Quantum Mission,

where four hubs have been established across the four key areas. This is also a technology that will have strong synergy with AI, machine learning and HPC.

India has committed about Rs 6,500 crores over the coming years. The driving urgency is encryption. Whatever we are relying on today in terms of encryption is going to be proven unsafe. A 128-bit AES would take a traditional supercomputer about 100 trillion years to break. But even a 2048-bit RSA-based cryptosystem can be broken with a quantum computer of 4,000 qubits and 100 million gates (possibly by 2030) in just 10 seconds. This is what is driving every country to urgently double down on quantum technology efforts, so that strategic autonomy is not compromised.

Efforts are already underway to develop quantum-safe encryption and that is the whole area of post-quantum cryptography, using HPCs rather than quantum computers. India has put in significant effort here. Recently, we released a policy framework on what is needed for PQC to be implemented across all sectors within a reasonable timeframe of three to four years.

Is quantum technology too far away to worry about? Definitely not. There are already products — some at the R&D level and some at a commercial level. Quantum computing needs qubits, and these qubits are very fragile because they lose coherence. There is no single winner right now. Various types of qubits are being worked upon — superconducting qubits are at the most mature stage, while photonic, spin, trapped ion, and topological qubits are all being actively explored. The biggest issue remains error correction, since these operations are probabilistic rather than deterministic, and the error rate needs to be significantly improved.

AI became a household word only when ChatGPT arrived in 2022. AI is not new, it started in the 1950s, but the common person was

not excited about it until that moment. I think there will be a "quantum day" too — when quantum computers begin breaking classical encryption almost on a daily basis. That is when all of the public, all governments, and all industries will wake up. But we must be aware: efforts cannot be postponed. It cannot happen overnight. Both post-quantum cryptography and quantum key distribution will be critical parallel strategies going forward. The market is growing as we speak and this is a race none of us can afford to lose.

Quantum sensing is one area that can make a huge economic impact — in navigation, defence and national security, scientific instrumentation, biological imaging, energy, and mineral prospecting. Quantum gravimeters, for example, can sense very small changes in gravitational attraction, and quantum magnetometers can make extremely precise measurements of magnetic fields, with enormous strategic and commercial applications.

The National Quantum Mission is implemented by the Department of Science and Technology, with a Mission Governing Board chaired by Ajay Chaudhary and an Executive Council chaired by me. We have already funded four hubs: Quantum Computing at IISc with CDAC playing a role; Quantum Communication with CDoT at IIT Madras; Quantum Sensing and Metrology at IIT Bombay; and Quantum Materials and Devices at IIT Delhi. These hubs bring together 152 researchers from 43 institutes across 17 states and two union territories. Thirteen projects on quantum algorithms have been funded, cutting across medical imaging, climate change, and more — with another 13 projects involving around 25 academic institutes, national labs, and startups. Two fabrication facilities for quantum devices and chips have been sanctioned and will be commissioned very soon.

On hardware, a 6-qubit quantum computer — entirely indigen-

ously built, pre-dating the Mission through prior DST funding — is now being scaled up to higher qubit counts. IISc demonstrated a 6-qubit photonic GHZ state using gate operations — the first step towards room-temperature quantum computing using photonic rather than superconducting qubits. QpiAI has built a 25-qubit system in Bangalore. On quantum communication, projects connecting Delhi to Bangalore (2,000 km) and Chennai to Bangalore (350 km) are underway using secure nodes, with quantum repeater projects already funded. At IIT Bombay, the quantum sensing hub using NV centres in diamond has already produced one or two products last year.

India is contemporary with the world in quantum technologies — unlike in semiconductors, where we are still catching up. We missed many revolutions. We do not want to be in that position with quantum. This is a technology where India can genuinely take the lead — not just in R&D, but in the diffusion of that R&D into products that make a real difference to all our lives. Quantum technologies are knocking at our door, and we can be complacent only at our own risk.

India must ensure Quantum moves from laboratories to industry

Vinod Sood, *Hughes Systique*

Ancient Indian philosophy — particularly the Vaisheshika school founded by Rishi Kanada — described the universe as composed of tiny, indivisible particles called *Parmanu*. Texts like the Upanishads also explored ideas of universal interconnectedness through the concept of *Brahman* — formless, infinite, and present everywhere — representing the ultimate truth behind the entire universe. India's modern contribution to quantum science came through Satyendranath Bose, whose work with Albert Einstein on Bose-Einstein statistics led to the discovery of the Bose-Einstein condensate. Today, India is



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advancing quantum technologies through the National Quantum Mission, focusing on computing, communication, sensing, and cryptography.

Over the decades, the world has witnessed several technological revolutions — from computing and the Internet to mobile connectivity, cloud computing, and now artificial intelligence. Quantum technology represents the next frontier, with the potential to redefine computing, communication, sensing, and security. However, while the promise is enormous, the journey from research laboratories to real-world deployment requires coordinated efforts across government, industry, academia, and startups. This is precisely the purpose of platforms like this conclave.

India has recognised the strategic importance of quantum technologies and has taken decisive steps to position itself as a global leader. But India must ensure that quantum technologies do not remain confined to laboratories — they must begin addressing real enterprise and industrial challenges. This is where industry bodies like CII have a vital role: creating a sustained dialogue between technology innovators and industry users.

The convergence of quantum computing, artificial intelligence, and high-performance computing is emerging as the next intelligent stack. While each technology is transformative individually, their integration will unlock exponentially greater impact. With India's

strong capabilities in AI and software, and its rapidly expanding HPC infrastructure, integrating quantum technologies will create significant opportunities for innovation and economic growth. For India's ambition to become a global manufacturing hub, quantum capabilities complement Industry 4.0 technologies — AI, robotics, IoT, and digital twins and will be absolutely essential going forward. While governments support research and policy, industry participation is crucial to translating innovation into real impact. Companies must start building quantum readiness now — by understanding its potential and preparing for future adoption.

On recent developments: the National Quantum Mission is doing a phenomenal job. India's first 25-qubit quantum computer was developed by QpiAI in 2025. The creation of the Amaravati Quantum Valley as a major innovation hub also deserves applause. I would like to congratulate Sunil Gupta, Founder and CEO of QNu Labs, who has built the world's first hybrid quantum security platform and the world's first satellite-based quantum security solution. Startups like QNu Labs will play a very critical role in accelerating innovation in this space.

We are seeing a growing number of quantum startups developing software platforms, hardware technologies, and applications across the world. India must continue encouraging entrepreneurship by creating an enabling ecosystem

with access to funding, infrastructure, and mentorship. The global quantum computing market is projected to reach around \$20 billion by 2030. The world is entering a global quantum race — with the United States, China, the European Union, Canada, and Japan all investing heavily. India must move with speed and strategic clarity, focusing not only on adopting quantum technologies but on developing indigenous capabilities and contributing to the global quantum ecosystem. Let us work together to ensure that quantum technologies move from laboratories to industry, from research to real-world impact, and from potential to prosperity — for India and for the world.

The train has already left the station — Quantum Security is a present requirement, not a future one

Sunil Gupta, QNu Labs

There is a great technology transition happening — one where we are moving from scientific theory to products and to building meaningful solutions. And that technology is quantum. For decades, quantum science has been largely in the realm of R&D. But we know that because of the advent of quantum computers — probably within the next two to three years — scalable quantum computers will be available, threatening the world's encryption. All critical communication, critical infrastructure, and data security will be at risk. Quantum chip modules are already conquering space. Ultra-secure satel-

lite-to-ground communication networks are something global space agencies are desperately trying to replicate.

The important question — not just for India but for the entire world — is: how do we move this technology rapidly from prototype to real-life deployment? The theme "Quantum to Impact" reflects precisely this transformation. NIST has now defined the standards for quantum security, and timelines have been drawn. That becomes very important for India — how do we achieve this transition within the given timeframe?

I would like to speak on three points, drawn from experience at QNu Labs.

First, quantum security is not a future concept — it is a present requirement. For a long time, people have been saying quantum computers will come perhaps a decade later, and the world can wait. When we speak to customers — other than defence, which operates with a zero-tolerance policy — most enterprises believe this is a problem of the future. That is exactly where our worry lies, because they will be wrong. Experts say the winners who successfully transition to a quantum-safe situation will not be those who throw millions of dollars at the problem later. The winners will be those who start early. One thing is very clear: the full transition to a quantum-safe posture takes three to five years. If quantum computers are going to arrive in the next three to five years, the train has already left the station.

Today, when we speak to clients, two problems consistently emerge. One is that they do not know which are the right partners to help them achieve the transition. The second is that they are not fully clear about what encryption they already have — we call it cryptographic dark matter — hidden from and unknown to the very people who own it. There is therefore a requirement for innovators and product companies to develop platforms that help clients through discovery,

and help them move from debate to a clear, unambiguous roadmap.

Second, this cannot be done alone — you need an ecosystem. Scientists and academics generate breakthrough ideas. Engineers convert those ideas into meaningful products. Industry partners integrate those solutions into existing networks. And government builds the policy framework to support and accelerate adoption. The National Quantum Mission and the broader government effort are bringing all four players together. The draft policy has been released recently, and the full policy is about to be launched. India is in a very good position.

Third — and most important for India's future — sovereignty. Fifty years ago, countries needed nuclear codes. Today, in the cyber world, you need to own your encryption keys — generated, distributed, and stored on sovereign platforms. That is why we need to build this technology ourselves, and ensure that our enterprises, defence, and government institutions adopt Indian technology. If we achieve that, we can imagine a future where we control our satellites, our drones, and our terrestrial networks. This is also a historic window of opportunity — perhaps in the last 30 to 40 years, we never had one like it, and in the next 20 to 30 years, it may not come again. A chance for India to transition from foreign-made encryption products to home-grown sovereign solutions.

India is already leading globally in the quantum communication space. With these three pieces in place — present urgency, ecosystem building, and sovereignty — I am very confident that India will be among the top few countries in the world to turn this quantum vision into a real and lasting reality.

Quantum is no longer a lab experiment — It is a business reality

Vijay Sethi, BQP

Over the last 30 to 35 years in technology, I have seen certain technologies that have fundamen-

tally changed the way the world works — starting with the Internet, then mobile, then cloud computing, and now AI and Generative AI. As I see it, quantum computing falls squarely into that category. To me, it is the fifth great inflection point — and it has already started making its impact felt.

While we speak about quantum going from research to the real world, the reality is we are already beginning that real-world journey today. The ideas were forming in the 1980s and long before that, but the last 10 to 15 years saw research labs making significant hardware progress and developing algorithms. I believe 2025 and 2026 mark the years when real-world applications have truly begun. I see the next decade as the decade of quantum execution.

Having had significant experience in the automotive and manufacturing industries, one of the key things I have seen is a massive focus on rapid product development. The real bottleneck is often not manpower but simulation capability — structural analysis, fluid dynamics, and modelling. That, from an industry perspective, is what quantum computing is directly impacting. Even in experiments and projects at BQP, using quantum-inspired optimisation, we have seen 10 to 100 times performance improvements — even where the work is not yet running on quantum hardware. As we move forward, product life cycles could be significantly shortened. This is a genuine game-changer for manufacturing and industry.

Quantum computing also has a great deal to offer from a cybersecurity perspective. While the world accelerates on AI and other technologies, threats are escalating equally. Post-quantum cryptography and quantum-safe security will be essential tools in that fight, and there are organisations doing extraordinary work in this space.

As I see it today, the science is proven. We are no longer debating whether quantum will work — the

results are there. Hardware and software work is advancing rapidly. But this is the moment when, as a country and as a world, we really need to scale up and take off. It is no longer a lab experiment. It is a business reality.

For any technology to reach mass adoption, two things must happen. There is the technology-first approach — enormous development on hardware and software. But as we saw clearly in the case of AI, technology truly takes off only when it starts solving real business problems. It has to work backwards from the business problem as much as it works forward from technology development. When these two things meet — and I see both happening simultaneously today, with more than enough real business problems in cybersecurity, optimisation, research, and manufacturing being addressed by quantum algorithms and hardware — things will accelerate very quickly.

The last point: if this has to happen and it is not if, it will surely happen — industry, academia and policymakers all have to work together. With all three present in this room today, I am pretty confident we are at a stage where quantum will make a real and lasting impact on this world.

Quantum Computers will let us speak to nature efficiently — For the first time in human history

Dr Nagendra Nagaraja

QpiAI

The era is changing. We are seeing things happen every day in the lab and with our customers and those breakthroughs will reach you as and when they achieve mass adoption or wider recognition. Many breakthroughs are already happening.

The role of technology in the 21st century can be understood through one simple analogy: there is only one godfather, and it is called data. For AI, the enabling technology was the GPU and compute. But data is what drives everything — the nature of data shapes the tools

we build. AI data, based on images, videos, high-dimensional data, and language, could not be processed by CPUs, so the world moved to GPUs. We entered the era of AI, which is massive and has disrupted entire industries. Traditional IT companies are having to fundamentally change their business models. This paradigm shift became visible when one company — NVIDIA, my former company — reached a \$5 trillion market capitalisation, bigger than many national economies.

But what comes after this is orders of magnitude — millions or billions of times — larger. Because the next godfather is data not created by humans. It is the data of the natural universe. It is quantum. When that data awakens, I think we will see ourselves as super-beings in our capabilities. That is where we are headed.

We cannot access quantum data with current computing. Quantum data exists in nature, abundantly. The language data we have is miniscule by comparison. We are still struggling to achieve true reasoning in AI models, and those models are hitting saturation. Open AI is reportedly planning to spend trillions of dollars to improve models that require nuclear-reactor-scale energy to power. That is not efficiency or sustainability — it also signals that we may be pursuing something that is fundamentally not the right path.

Moving to quantum data changes everything. There is a chemical reaction that occurs when plants absorb fertiliser. Even if we put all the supercomputers in the world together, we cannot replicate that reaction. Photosynthesis contains hidden science we simply do not understand yet. To access the intelligence embedded in nature and in the universe, you need to access quantum data and that is almost impossible with current computing. It cannot be done with GPUs, CPUs or any classical hardware. It can only be done through quantum computers. That is fundamentally important to understand.

As a company, QpiAI has completed its 25-qubit machine, and the 64-qubit system is currently being fabricated. We have established India's first quantum foundry in Bangalore with an investment of around \$30 million. We are also developing a Quantum Supremacy Centre on the Electronics City campus in Bangalore, where we have invested around Rs 1,000 crores to enable a massive array of quantum computing systems. Our goal is to build a facility of 100,000-qubit machines in Bangalore — designed to be the most powerful quantum data centre in the world. The work has already started and should be operational within a couple of years.

The real potential of quantum computing is not to make LLMs better. The real potential is this: for the first time in human history, we will be speaking to nature efficiently. It took around 5,000 years of human civilisation to discover approximately 10 to the power of 10 molecules. But for precision medicine, precision materials, advanced manufacturing, and to ensure we do not cause catastrophic damage to planet Earth, we need to understand around 10 to the power of 50 molecules. We do not have 25,000 years to get there. And that knowledge cannot be unlocked by putting \$500 billion worth of GPUs in a data centre next to a nuclear reactor — causing even more damage to the planet. That path is not viable.

Just as high-dimensional data enabled the AI era, quantum data will enable the next great era and for that, quantum compute is the only answer. India should be very proud of the government's steps, including the formation of the National Quantum Mission. It is in mission mode, which is exactly right. Opportunity multiplies with size, and this is the biggest size we have ever seen. For the first time, we will be able to say that we are doing things efficiently, sustainably, and magically. And that is the true importance of quantum computers, quantum computing, and quantum technologies.