

Science for Scale: Charting India's scientific and impact leadership in the next phase of the evolution of computing

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Computing in India has gone through transformative cycles of adoption and scale with the rise of the IT services industry, Digital India programs, and the technology start-up boom of recent years. The country is poised at an exciting juncture where we now have the opportunity to bring deep scientific innovation together with the technology scale that India is already capable of. This opportunity is especially timely given the rise of exponential technologies that will power the future of computing such as Quantum, AI, and 5G, and at the same time the challenges posed to our nation and the world in ensuring a sustainable future.

IBM Research has had the privilege to be a key contributor in the research and industry ecosystem in India over the last 25 years as a driver for advancements in the state of the art and as an engaged supporter of the research ecosystem in India. On this occasion of our 25th anniversary, we at IBM Research India (IRL) were privileged to facilitate an ecosystem dialogue on this opportunity, in the form of a Science for Scale summit on April 13, 2023.

The world of research and scientific pursuit is where the next breakthroughs can happen — we represent this with the term “Science”. The world of digital transformation and socio-economic impact is where nation-scale value is created — we represent this with the term “Scale”. In India, we can create a virtuous cycle between these two worlds, leveraging the formidable technology and intellectual capacity available in the country. One major enabler for closing this cycle will be Computing and the technology vectors shaping the future of Computing. Science for Scale brought leaders, experts, and imaginative thinkers together for a dialogue to explore the linkage between the world of research and the world of scale, through the lens of computing, and what is needed to realize this virtuous cycle alongside an evolving policy landscape.

Leaders from academia, industry, and government shared their vision of opportunities, priorities, and requirements along key technology vectors such as Artificial Intelligence, Quantum computing, 5G and Distributed cloud, Cybersecurity, and Sustainability. This vision is documented in the form of a [readout book](#) that covers the findings and recommendations from the plenary session and the five workshops. Here are the key takeaways from the discussions:



- **Preparing for the next Artificial Intelligence revolution:** AI applications such as generative AI are poised to have a great impact on a country like India, given its size and diversity, and enable better interaction/service delivery between the citizenry and government services. To benefit from this emerging AI landscape, India needs to invest in capacity building along multiple dimensions including skilling people, building robust infrastructure for collecting datasets and large-scale computing infrastructure at a national level, while leveraging its formidable technology stack.
- **Navigating forward in Quantum computing:** The Quantum industry in India is expected to grow to a \$310 B industry by

2030 with 100x or more growth in India's quantum skilled workforce over the next few decades. Achieving this growth requires a holistic policy intervention in terms of funding for mission-specific large-scale efforts. India also needs a vibrant quantum ecosystem that brings together government, academia, and industry to innovate in quantum applications in areas of national importance such as chemistry, materials, agriculture, logistics, healthcare and green energy.

- **Scaling 5G and Distributed cloud for impact** For a country like India where the majority of the population uses mobile phones as the sole technology touch point, 5G and Edge computing is predicted to have a great impact in terms of improved connectivity and enabling innovative applications across telehealth, agriculture, smart manufacturing etc. Realizing this promise requires innovation across the network, hardware and software stack with the industry, government, and academia to work in synergy to cultivate an ecosystem where innovation thrives.
- **Securing Digital India:** India's approach to developing a responsible and scalable Digital Public Infrastructure has played a significant role in improving the quality of life for its citizens. However, there is a need for India to adopt advanced cryptographic and security technologies to increase the security and privacy posture of this digital platform and of its physical infrastructure as we go into the Quantum computing era. The academia and industry need to work together to create a sustainable model for creating a sizeable and skilled workforce in areas like applied cryptography, security, and privacy. This will not only secure the future of Digital India but also help India's technology ecosystem to emerge as a global leader.
- **Path to achieving sustainability goals:** Scaling India's sustainability solutions is a key imperative considering our country is already facing and will continue to face, adverse effects from climate change in the coming decades. In this regard, science and computing are poised to play a key role in mitigation and adaptation solutions, enabling hyperlocal earth system models, helping enterprises and governments measure and ultimately reduce their carbon footprints, and supporting energy transitions.

We look forward to more conversations and actions in our technology and scientific ecosystem, catalyzed in part by the perspectives shared via this book, toward a soon-to-come future where India is a global leader in scientific pursuit that enables nation-scale impact.

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