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Telangana Quantum Strategy for Research, Skilling, Innovation, and Economic Growth

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Abstract

It is possible that quantum technologies will reshape global industry, governance, and science. These technologies constitute a once-in-a-generation technology frontier. Through the implementation of the Telangana Quantum Strategy, which was initiated by the Government of Telangana, the state is positioned to become a national and global leader in the utilization of potentially revolutionary talents. This strategy presents a forward-looking, multi-pillar strategy to transfer quantum science into real-world effect. It does so by using Telangana's powerful information technology (IT) environment, outstanding academic institutions, and thriving start-up culture. The objective is to develop complementary and modular capabilities in the areas of computing, communication, and cryptography. This endeavour is in line with India's National Quantum Mission (NQM), which was announced in 2023. As a result of its robust technology environment, prestigious academic institutions, and thriving start-up culture, Telangana is in a position that is particularly advantageous for leading this drive. This Strategy delineates an ambitious vision: to establish Telangana as a globally acknowledged centre for quantum innovation by cultivating a robust ecosystem that converts scientific advancements into practical applications, enhances the start-up landscape, and generates societal benefits. This will be executed through deliberate interventions across six fundamental pillars are Research, Innovation and Commercialization, Skilling and Workforce Development, Start-up Ecosystem Enablement, Sectorial Adoption, Cybersecurity and Resilience and Global Positioning and Ecosystem Partnerships.

1. Introduction

There is a rapid emergence of quantum technologies as the defining frontier of the 21st century, which will shape the future of computing, communication, sensing, and materials research. Countries all around the world are making significant investments, with over $55 billion1 (the worldwide market for QT is expected to reach $106 billion by 2040) dedicated to accelerating discoveries. In addition to being a scientific competition, this race is also a competition for economic resiliency, security, and strategic advantage. For India, the National Quantum Mission (NQM, 2023; ₹6,003 crore) serves as the national framework that facilitates the advancement of quantum capabilities in a wide range of subject areas. It is a manifestation of the awareness that quantum is not just a scientific opportunity but also a strategic need for the purpose of ensuring national security and maintaining global competitiveness. The state of Telangana is in the process of becoming a co-creator of a quantum architecture that is distributed and has regional roots. It is a state that is uniquely positioned to act as a force multiplier, advancing sovereign capacity and delivering impact in the areas of banking and financial services, defence, life sciences, cybersecurity, and citizen services. This is because the state has established strengths in emerging technologies, academic clusters, industry, and start-ups. A forward-looking roadmap will be designed by the Government of Telangana in order to speed up this trip. Utilizing national and regional knowledge, fostering state-specific use cases, and bringing together academia, start-ups, business, and government to prototype reference applications, reinforce cybersecurity and logistics, and create policy

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and regulatory foundations for scalable deployment are all things that will be accomplished through the implementation of this roadmap.

2. The Difficulty of Quantum Progress

In spite of the considerable momentum that quantum technologies are experiencing, the ecosystem continues to be hampered by a variety of structural constraints that need for coordinated intervention. The global and domestic education systems have not yet produced talent at the scale and cross-disciplinary breadth that quantum research and applications require. This scarcity of skilled quantum professionals is a fundamental problem that needs to be addressed. A skills bottleneck has been developed as a result of this, which restricts both the level of scientific investigation and the rate at which commercial readiness may be achieved. Due to the fact that quantum technologies, whether in computing or communication, are largely still in the proof-of-concept or prototype stage, industrial implementation is similarly limited. Enterprises frequently lack the confidence to integrate quantum systems without clear evidence of performance reliability, cost-effectiveness, and interoperability with existing infrastructure. This is because quantum systems are complicated and difficult to implement. The lack of sandbox environments or viable go-to-market channels that can bridge the gap between lab-stage innovation and real-world deployment is another factor that contributes to the diminished effectiveness of the commercialization pipeline.

The ecosystem's fragmentation makes these issues much more difficult to overcome. There is a gap between the priorities of public investment, the needs of the private sector, and the research conducted in academic institutions, which leads to misaligned goals and missing chances for translational impact. This is made worse by the limited venture capital investment that is targeted to quantum timelines, which frequently surpass that of conventional deep technology sectors due to the longer development cycles and infrastructure dependencies that are associated with quantum technology. There are substantial barriers to entry for quantum research centres due to the infrastructure intensity of these centres, which requires advanced facilities such as cryogenic labs, photonics fabrication centres, and quantum test beds. This is especially true for start-ups and Tier II/III academic institutions. Without infrastructure that allow for shared use and frameworks that facilitate access, participation in ecosystems will continue to be concentrated and uneven. Due to the fact that quantum advancements have the potential to reveal flaws in existing encryption systems, it is essential to conduct proactive cryptographic intelligence assessments in order to identify and deal with any dangers. Addressing these vulnerabilities is an essential component of any complete plan pertaining to quantum computing. Regulatory ambiguity may represent a threat to the system. Developers, investors, and consumers are all subject to an increased level of uncertainty as a result of the lack of standardized worldwide and national standards for quantum protocols, encryption regulations, ethical precautions, and export controls. The ecosystem's ability to transition from experimentation to scaled adoption is hindered as a result of these constraints, which highlights the urgent need for policy frameworks that are anticipatory, integrated, and are friendly to innovation.

3. Telangana Quantum Strategy

The state government of Telangana is going to put into action a Quantum Strategy that is future-oriented and will concentrate on bringing quantum research from the laboratory to the business world. This purpose will be accomplished through the establishment of strategic institutional collaborations, the development of a robust research and innovation infrastructure, the facilitation of regulatory compliance, and the implementation of dynamic skilling initiatives. In accordance with the goals of India's National Quantum Mission, the plan would hasten the establishment of research centres, the deployment of commercial technologies, and the creation of workforces in priority industries like as cybersecurity, healthcare, and finance. As a result of this action, Telangana will set directions for cryptography rules and implement a risk prioritization–based transition and roadmap. This will ensure that the quantum ecosystem is impact-driven, security-resilient, and globally competitive.

- **Research, Innovation & Commercialization**

The upstream enablers for Telangana's quantum objectives include research and innovation. These enablers create the foundation upon which the downstream industry's readiness, talent, and adoption are dependent. The strategy of the state places an emphasis on the development of a research ecosystem that is globally benchmarked and regionally distributed, and that contributes to the advancement of basic science, translational routes, and commercial scale-up.

- **Skilling Workforce Development**

According to Telangana's Quantum strategy, a robust talent pipeline is absolutely necessary. Skilling encompasses schooling as well as advanced global fellowships, thereby constructing workforce capacity that is driven by demand. These efforts intend to facilitate the creation of jobs that are in line with the impact areas that have been identified as part of the National Quantum Mission. This will ensure that there is a consistent supply of competent individuals for up-and-coming quantum industries.

- **Start-up Ecosystem Enablement**

Through capabilities mapping, bilateral technological collaborations, and targeted start-up support, Telangana will contribute to the expansion of the quantum start-up ecosystem. This support will include shared research and development facilities, seed money, and organized mentorship. For the purpose of bolstering the quantum start-up ecosystem, the state will build a Quantum Readiness Index as well as strategic global collaborations. These will serve to direct investments and the development of technologies in collaboration with other entities.

- **Sectorial Adoption**

A demonstration of the usefulness of quantum technology must be achieved through its implementation in priority verticals. The state of Telangana will serve as a tested for pilot proof-of-concept (Poc) and scaled adoption across priority industries. It is focussing mainly in the following sectors like Banking, Financial Services and Insurance, Defence and Strategic Technologies, Life Sciences and Drug Discovery, Citizen Services and Public Infrastructure and finally Cybersecurity and secure Communications.

- **Cybersecurity and Resilience**

Quantum advancements pose a threat to the cryptography and digital infrastructure that is now in use. Telangana will take the initiative to set standards and implement quantum-resilient measures in order to future-proof data, promote trust in digital infrastructure, and shape a strategic advantage for the state. To safeguard national security and prepare

for quantum threats, Telangana will set cryptography standards, conduct crypto graphical intelligence evaluations, prioritize risks, and keep early warning systems operational. To maintain an innovation pipeline that meets national and international standards, Telangana will also focus on developing and deploying quantum materials and devices throughout the Hub-Spoke-Spike paradigm.

- **Global Pestering and Ecosystem Partnerships**

Quantum mechanics places a premium on early placement. Telangana will make use of its research and ecology in order to make worldwide collaborations and secure international mind-sets. In order to become a world-class hub for quantum innovation, Telangana will use bilateral partnerships to boost its global competitiveness and establish strategic alliances.

In order to position the state of Telangana as a globally competitive hub at the junction of quantum and artificial intelligence, the Telangana Quantum Strategy marks the beginning of an adaptive and long-horizon journey. This is not a fixed policy; rather, it is a living approach that is always growing along with cutting-edge technological advancements, and it is founded on innovation, inclusivity, and resilience. Additionally, in order to put this vision into action, the government of Telangana will establish a Quantum Advisory Council, which would be responsible for providing strategic oversight and direction. The implementation anchors will be recognized as key institutional partners spanning academia, industry, and government. These anchors will be responsible for generating flagship projects in research, infrastructure, talent, and commercialization for the initiative. Quantum-enhanced machine learning, secure artificial intelligence systems, and computational acceleration frameworks are some of the areas that will be aggressively pursued by the state as part of its efforts to foster cross-domain innovation between quantum technology and artificial intelligence. The next phase of deep-tech leadership in Telangana will be underpinned by these growing synergies, which will serve as the foundation. It is planned to provide priority to strategic collaborations such as national and international partnerships in order to accelerate development, investment, and translational research. This will ensure that the project is aligned with global standards and the evolution of the market. In order to maintain a responsiveness to both the advancement of scientific knowledge and the requirements of society, the framework will undergo ongoing evolution through feedback loops, pilot learnings, and ecosystem consultations. The state of Telangana intends to take the lead in India's deep-tech revolution by utilizing this integrated approach, which strives to combine scientific excellence with flexible government and worldwide alliances. With the goal of becoming a paradigm for responsible quantum and artificial intelligence innovation, the state envisions itself as a place where talent, technology, and ideas that can revolutionize the world come together.

It is a multi-faceted strategy that focuses on attracting substantial global investments, fostering innovation through mega-projects such as the "Bharat Future City," and driving growth across key sectors such as information technology (IT), pharmaceuticals, life sciences, advanced manufacturing, green energy, and tourism. The blueprint for "Telangana Rising 2047" addresses all of these issues. One of the most important aspects of this concept is the 'Bharat Future metropolis,' which is a proposed net-zero Greenfield smart metropolis that spans 30,000 acres. It is intended to include specialized hubs such as an artificial intelligence city, a pharmaceutical city, a sports city, and a life sciences city, and it will serve as a magnet for global talent and investment. Especially from overseas engagements such as the World Economic Forum in Davos and visits to Japan and Singapore, significant investment promises have been revealed, with reports indicating that they exceed three lakh crore Indian rupees. The employment opportunities that they are expected to create are enormous. The government is also in the process of implementing new policies for the development of tourism (Telangana Tourism Policy 2025-2030), energy (Telangana Clean and Green Energy Policy, 2025), and general industrial and infrastructure development. In addition to these economic initiatives, there is a stated commitment to the development of human capital through the implementation of skill enhancement programs and the establishment of new specialized universities. Additionally, there is an emphasis on development that is inclusive through the implementation of substantial welfare programs and social justice measures. Nevertheless, this ambitious plan is constructed against the backdrop of a tough economic environment. Recent data indicates that both the Gross State Domestic Product (GSDP) and the Per Capita Income (PCI) growth for the fiscal year 2024-25 would slow down, despite the fact that Telangana has historically shown significant GSDP growth. The state is facing a hazardous fiscal position, which is marked by a rapid spike in public debt—over 824% between 2014-15 and 2023-24—and a high per capita debt burden. This is the most critical challenge that the state is currently facing. In stark contrast to the

bullish investment story, Chief Minister Reddy has admitted that the country is experiencing considerable financial trouble. This suffering includes a substantial monthly revenue-expenditure gap as well as challenges in getting further loans. As a result of Telangana's significant contingent liabilities, the National Institution for Transforming India (NITI) Aayog has also identified the state's debt trajectory as potentially unsustainable. The successful realization of the $3 trillion vision is contingent upon a number of essential factors, including the actual conversion of investment memorandums of understanding into tangible projects and revenue streams, the efficient and timely implementation of large-scale infrastructure and urban development projects such as "Bharat Future City," robust fiscal consolidation and prudent debt management, and the ongoing up skilling of the workforce to meet the demands of industries that are in the future. Furthermore, it will be of the utmost importance to make certain that this high-octane growth is simultaneously inclusive and environmentally sustainable.

4. Conclusion

The Quantum Strategy of Telangana comes to the conclusion that by investing in research, skilling, and infrastructure (such as a Centre of Excellence), the state intends to transform Hyderabad into a global "Quantum City." This will be accomplished by driving economic growth, national security, and leadership in deep technology. Additionally, it will align with India's National Quantum Mission, which aims to transition from being a tech consumer to an innovator and shape the future of transformative quantum technologies for the purpose of national prosperity. The plan that Telangana has devised is an all-encompassing strategy that aims to utilize quantum technology as a strategic driver. This will ensure that the state is at the forefront of India's quantum journey. This will be accomplished by developing deep capabilities, cultivating talent, and establishing robust industry-academic links. In other words, science will be translated into a significant economic and strategic advantage. The program known as "AI Powered Telangana" is an ambitious and forward-looking initiative that aims to establish the state as a leader in the artificial intelligence industry not only in India but also on a global scale. Through the establishment of an all-encompassing framework that has an effect on a variety of industries and stakeholders, the strategy creates the groundwork for Telangana to become a centre for the invention and development of artificial intelligence. This effort is not solely focused on technology; rather, it is cantered on the transformation of the state into a paradigm of how artificial intelligence can drive economic growth, improve public services, and increase the quality of life for all inhabitants.

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