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Gujarat Quantum Mission Models Understanding Guide

A plain language guide to the technology, mission, state, funding and delivery models used in the strategy

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Purpose of this guide

This guide explains what each model in the Gujarat quantum strategy means, how the models differ, what evidence exists in India, and what Gujarat should decide before it commits public funds. It is written for board members, government officers, institutional leaders and industry participants who do not work in quantum technology every day.

The central conclusion is that Gujarat should combine national facility access, owner-backed applications, talent development and selective infrastructure. India does not yet provide evidence of a fully mature state quantum mission that Gujarat can copy without adaptation.

How to read the strategy

The strategy uses the word model in four different ways. Keeping these meanings separate prevents confusion.

Model type	What it describes	Question it answers
Technology model	The part of quantum technology being developed or used	What technical capability are we discussing
Mission model	How government organises authority, funding and accountability	Who decides and who delivers
Ecosystem model	How universities, startups, industry and facilities work together	How capability reaches users
Investment model	How pilots, access and infrastructure receive funds	What should be funded and at what stage

The evidence rule

A public announcement shows intent. A policy establishes direction. A sanction authorises spending. A tender requests bids. An award selects a supplier. Installation creates an asset. Acceptance testing shows that the asset meets its specification. Independent validation tests whether it produces a useful result. These stages must not be treated as equivalent.

Status	What it proves	What it does not prove
Announced	A public intention exists	Funding, procurement or delivery
Approved or sanctioned	An authority has permitted the programme or expenditure	Money released or work completed
Tendered	Government has sought a supplier	Award, installation or acceptance
Awarded	A supplier or grantee has been selected	Working capability
Installed	Equipment or software exists at a site	Reliable use or user value
Operational	Named users can access the capability under defined conditions	Independent performance or scale
Validated	Testing supports a stated performance claim	Broad deployment
Scaled	The capability serves repeated users or sites with sustained funding	That every use case is valuable

Quantum technology models

Quantum technology is not one product. The National Quantum Mission divides the field into four technical verticals. The Gujarat strategy adds post-quantum security and hybrid quantum and classical computing because they can create near-term work before large quantum computers become broadly useful.

Technology	Plain meaning	Typical Gujarat question	Planning position
Quantum computing	Computers that use quantum states for selected classes of problems	Can a defined optimisation or simulation problem beat a strong classical method	Use national or cloud access first
Hybrid quantum and classical	A workflow in which ordinary computers and quantum processors handle different parts	Does the hybrid workflow improve time, quality or cost	Benchmark against leading classical solvers
Post quantum cryptography	Classical cryptography designed to resist future quantum attacks	Which systems and long-lived data require migration	Start inventories and controlled migration now
Quantum communication	Quantum methods for distributing or detecting changes to security keys	How will QKD, PQC, key management and networks work together	Test architecture and interoperability before buying equipment
Quantum sensing and metrology	Quantum effects used for precise measurement	Does a sensor outperform a calibrated classical instrument in the field	Require blinded and repeatable tests
Quantum materials and devices	Materials, photonics and components used to build quantum systems	Where can Gujarat supply a qualified component or process	Use national fabrication and test routes before duplicating them

What a useful quantum application claim requires

- A named user who owns the operational problem
- A measurable baseline using the best available classical method
- A defined dataset, test environment and security decision
- An acceptance threshold and a stop condition agreed before testing
- A record of cost, repeatability and operational constraints

India national mission model

The National Quantum Mission is the main public framework for quantum research and technology development in India. The Union Cabinet approved an outlay of ₹6,003.65 crore for 2023–24 to 2030–31. Four thematic hubs coordinate the principal technical verticals.

National hub	Lead institution	Technical focus	What Gujarat should seek
Foundation for QC Innovation	Indian Institute of Science Bengaluru	Quantum computing	Access routes, algorithm programmes, startup support and expert review
IITM C-DOT Samgnya Technologies Foundation	IIT Madras and C-DOT	Quantum communication	Network architecture, testbeds, standards and component pathways
Qmet Tech Foundation	IIT Bombay	Quantum sensing and metrology	Calibration, field validation and IIT Gandhinagar work packages
QMD Foundation	IIT Delhi	Quantum materials and devices	Fabrication, testing, qualification, tariffs and intellectual property terms

Hub spoke and spike model

The hub coordinates a technology area. Spoke institutions undertake coordinated projects. Individual research groups may participate as spikes. This distributed model allows institutions across India to share programmes and facilities instead of every state recreating a complete national laboratory system.

What national alignment does not mean

- It does not guarantee that Gujarat receives facility time or funding
- It does not remove the need for written access, cost, security and intellectual property terms
- Participation by one Gujarat institution does not establish statewide capability

Department of Science and Technology National Quantum Mission https://dst.gov.in/national-quantum-mission-nqm

Department of Science and Technology thematic hubs https://dst.gov.in/node/7834

Indian state implementation models

Indian states are using different approaches. These are implementation benchmarks rather than completed success stories.

State model	How it works	Observed example	Lesson for Gujarat
Capital led	Government anchors the programme with a named facility and procurement	Andhra Pradesh and the Amaravati Quantum Computation Centre process	Use its authority and procurement discipline, but require utilisation and operating evidence
Translation network	A state innovation organisation links national hubs, researchers and startups	Tamil Nadu through iTNT, its deep-tech policy and Samgnya-linked challenges	Strong model for challenge calls, testbed access and venture translation
Institution led cluster	Existing research institutions form the core and attract national programmes	Karnataka through IISc, RRI, JNCASR, C-DAC and the NQM computing hub	Build around real institutional depth rather than branding alone
Research and infrastructure	Major institutions combine with emerging state and industry infrastructure proposals	Maharashtra	Verify the status of each facility and partnership before comparison
Ecosystem ambition	The state positions quantum within a wider technology, photonics or innovation agenda	Telangana and several enabling-policy states	Convert ambition into authority, budget, work packages and acceptance evidence

Why the states cannot yet be ranked as final winners

The public record is uneven. Some states show policy commitments, some show tenders or partnerships, and some benefit from long-established national institutions. Comparable public data on expenditure, operating access, facility utilisation, independently validated results and recurring industry use remain limited.

Andhra Pradesh AQCC procurement approval
https://crda.ap.gov.in/APCRDADOCS/GOSACTSRULES/Capital%20City/01~16 132 025MAUD_RT1233_E.pdf

Tamil Nadu Deep Tech Startup Policy https://itnthub.tn.gov.in/assets/deep-tech-policy-book.pdf

Tamil Nadu Samgnya innovation challenge https://itnthub.tn.gov.in/samgnya-innovation-challenge.html

Mission delivery models

Delivery model	Strength	Main risk	When it fits
Infrastructure first	Creates a visible asset and may attract researchers	Low use, rapid obsolescence and unfunded operations	Only after repeated demand and access constraints are documented
Research grant	Supports scientific depth and long-term capability	Weak connection to users or adoption	For defined research milestones and peer review
Challenge programme	Starts from a user problem and compares solutions	Poorly framed problems produce demonstrations without decisions	For logistics, sensing, security and industrial applications
National facility access	Uses specialist capability without duplicating capital	Queues, security, cost or intellectual property terms may block use	The default starting point for Gujarat
Talent network	Expands faculty and student capability across institutions	Participation counts can replace competence measures	When tied to completed experiments and hub work
Startup support	Moves technology toward products and customers	Funding may precede validation or create conflicts	Use milestone payments and independent tests
Mission portfolio	Combines research, access, pilots, talent and selective assets	Requires strong programme management and evidence discipline	Recommended overall model for Gujarat

Recommended Gujarat model

Gujarat should use a mission portfolio model. The mission office would manage national hub access, user-led pilots, talent programmes, startup pathways and a small number of justified facilities. Capital investment would follow evidence of recurring demand, limited external access, qualified operators and sustainable operating costs.

Gujarat opportunity model

Opportunity	Why Gujarat may have an advantage	First practical action	Evidence needed before scale
Quantum-safe finance	GIFT City provides a concentrated regulated financial environment	Run a voluntary cryptographic inventory and migration cohort	System owners, asset inventory, data-lifetime analysis and approved test scope
State crypto agility	Government operates systems with long-lived data and procurement cycles	Select systems for controlled discovery and migration planning	Department owner, security approval and dependency map
Space and communication	SAC and PRL create scientific and space-sector proximity	Define permissible joint problems and national-hub access	Written scope, security boundaries and test route
Sensing	IIT Gandhinagar participates in the national sensing network and Gujarat offers varied field environments	Run a calibrated field comparison	Reference instrument, blinded protocol and independent review
Logistics	GSV, ports and freight systems can provide real optimisation problems	Benchmark hybrid methods against strong classical solvers	Named user, data rights, baseline and decision threshold
Chemicals and pharma	The state has large industrial users with simulation and materials questions	Select one scientifically tractable question	Research partner, classical baseline, data and repeatability

Why post quantum security comes first

Post-quantum migration concerns existing information systems and long-lived data. Organisations can begin discovery, prioritisation and controlled testing without waiting for a fault-tolerant quantum computer. The work should follow applicable national and sectoral cybersecurity guidance and remain under the authority of each system owner.

Governance model

Body	Primary responsibility	What it should approve or produce
Mission governing board	Mandate, portfolio, budget and accountability	Annual priorities, funding envelope and major stage decisions
Mission office	Programme coordination, contracts, evidence and reporting	Work plans, calls, access agreements, portfolio dashboard and audit trail
Technical council	Scientific quality and technical claims	Methods, reviewers, validation requirements and claim language
User owners	Operational problem, data, test site and acceptance	Baseline, acceptance threshold, deployment decision and stop decision
National hub access team	Relationships with the four NQM hubs	Eligibility, facility time, cost, security, IP and first joint actions
Independent assurance	Security, standards, conflicts and evidence quality	Review findings and restrictions on unsupported claims

Decision rights

The technical council should judge scientific quality, while the user owner decides whether a result solves the operational problem. The mission office should not certify its own pilots. Large capital decisions should return to the governing board with demand, access, staffing and lifecycle-cost evidence.

Initial 90 day process

Period	Work	Required output
Days 0 to 30	Confirm mandate, sponsor, mission office and evidence room	Written authority, roles and evidence standard
Days 31 to 60	Inspect facilities, run user workshops and meet all four national hubs	Verified inventory, problem statements and written access positions
Days 61 to 90	Score pilots and obtain independent review	Costed first-year plan and three to five authorised pilots

Funding and procurement models

Instrument	Suitable use	Payment or approval gate
Planning and audit contract	Facility verification, demand discovery and access terms	Accepted evidence package
Challenge call	A user-defined problem open to competing approaches	Stage payments against test results
Hub access support	Facility time, specialist support and training	Written tariff, IP, security and deliverable terms
Research work package	A defined technical milestone led by a qualified institution	Peer review and reproducible milestone evidence
Talent consortium	Faculty development, courses, fellowships and laboratories	Completed experiments, competence and usage
Startup milestone funding	Prototype, validation and customer testing	Independent tests, customer evidence and conflict disclosure
Capital programme	Facilities that cannot be accessed adequately elsewhere	Utilisation case, operator, acceptance test and five-year budget

Infrastructure decision test

A proposed facility should pass all of the following tests before procurement.

Test	Required evidence
Scientific need	Defined experiments or services that existing access cannot provide
User demand	Named users, expected hours or sample volume, and budget owners
Access comparison	Written external access terms, queues, security conditions and full cost
Operations	Qualified operator, maintenance, calibration, safety and consumables
Procurement	Vendor-neutral specification and measurable acceptance tests
Lifecycle	Five-year operating budget, upgrade plan, utilisation review and asset disposition

Pilot and evaluation model

A pilot is a controlled decision exercise. It should establish whether a defined method produces enough value to justify continuation. A demonstration that merely runs is not sufficient.

Pilot element	Question that must be answered
Owner	Who has authority to provide the problem, data and final acceptance
Baseline	What is the best current classical or operational method
Hypothesis	What measurable improvement is being tested
Data and security	What data may be used, where it may run and who may access it
Method	Can another qualified team understand and reproduce the test
Acceptance	What result would cause the user to proceed
Stop condition	What result, cost or delay would end the pilot
Independent review	Who checks the method and claim without owning the result
Scale decision	What funding, procurement and operating changes follow a successful result

Useful measures

- Number of pilots with named users and approved baselines
- Percentage of pilots that reach an explicit proceed, revise or stop decision
- National facility access agreements completed and actually used
- Experiments completed by faculty and students, rather than registrations alone
- Startup milestones independently validated and connected to customer decisions
- Facility utilisation, uptime, qualified operators and full operating cost

What each presentation section means

Presentation section	What the reader should understand
Decision framework	Gujarat should use national capacity, prove local demand and build selectively
National architecture	The four NQM hubs are the first route for specialised capability and programmes
Technology choices	Different quantum fields have different timelines, risks and validation methods
Gujarat capability base	The state has credible institutions, but access, equipment and readiness require field verification
State benchmark	Other states provide useful mechanisms, not a proven template to copy wholesale
Lessons for Gujarat	Adopt translation and execution mechanisms, adapt them to Gujarat, and avoid premature capital
Opportunity portfolio	Begin with problems that have owners, data, baselines and decision thresholds
Hub strategy	Each hub discussion must produce written access conditions and a first joint action
Governance	Scientific review, programme coordination and user acceptance require separate roles
Capital discipline	Infrastructure follows demonstrated need and sustainable operations
Funding	Different activities need different instruments and payment gates
First 90 days	The immediate objective is a verified and costed first-year portfolio

Questions for leadership

- Which department will sponsor the mission and hold the budget
- Which three to five user problems merit formal discovery first
- Which institutions have facilities that can be inspected and accessed under written terms
- What may Gujarat access through the four national hubs before purchasing equipment
- Who will independently review technical claims and conflicts of interest
- What evidence will the governing board require before scaling a pilot or approving a facility

Boundaries and next verification

This guide explains the planning models supported by the current public evidence and the existing Gujarat research package. It does not establish that a facility is available, that a partnership has been approved, that a tender has been awarded, or that a programme has produced operational results unless the underlying evidence establishes that specific status.

Records still needed for final mission design

- State government order or Cabinet authority for the mission
- Annual budget, sanction, release and expenditure records
- Executed vendor and institutional agreements
- Equipment inventories, operator details, access rules and utilisation records
- National hub tariffs, queues, security conditions and intellectual property terms
- User-approved problem statements, datasets, baselines and acceptance criteria
- Acceptance tests and independent validation reports

Primary reference directory

National Quantum Mission https://dst.gov.in/national-quantum-mission-nqm

National Quantum Mission thematic hubs https://dst.gov.in/node/7834

National Quantum Mission startup call https://dst.gov.in/node/8226

Foundation for QC Innovation https://qcinnovation.co.in/

Samgnya quantum communication hub https://www.samgnya.in/

Qmet Tech Foundation https://qmettech.com/

QMD Foundation https://www.qmdhub.co.in/

Gujarat Science Technology and Innovation Policy https://dst.gujarat.gov.in/dst/Home/stip

International Financial Services Centres Authority https://ifsca.gov.in/

Gati Shakti Vishwavidyalaya https://gsv.ac.in/

Physical Research Laboratory https://www.prl.res.in/

Indian Institute of Technology Gandhinagar https://iitgn.ac.in/