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India's Quantum Intelligence Strategy

A Quantitative Assessment of Strategic Alternatives

Phase III: India Quantum Capability and Economic Model

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Research Notice

This document is the Phase III instalment of the triNetra Quantum Intelligence Strategy research series. Phases I and II established the analytical framework (15-vertical research chain, 30 derived metrics), conducted a forensic audit, and produced a verified quantitative baseline. Phase III builds the quantitative economic model and strategy assessment. All three phases draw on cited primary and secondary sources. Where sources are unavailable or data are absent, evidence gaps are explicitly identified. This is a strategy research document, not an investment prospectus or government policy circular.

1 Executive Summary

This document tests the intelligence-led hybrid strategy for India's quantum technology development against three alternatives: hardware-first, application-first, and pure intelligence-first. The comparison uses a structured economic model across four workstreams: capability efficiency, capital requirements, talent economics, and commercial opportunity. The model is constructed from verified primary sources and explicitly labelled estimates. Strategic conclusions are drawn as inferences from the model, not as empirically established findings.

Central Findings

- [CALCULATION] Hardware-first is capital-infeasible at India's NQM funding level. The modelled low-case 10-year cost of Rs 8,000 crore exceeds India's entire NQM allocation of Rs 6,003.65 crore [1]. A base-case partially competitive programme at Rs 25,000 crore would require four times the NQM budget. India cannot compete with global hardware leaders at current investment levels.
- [INFERENCE] Application-first delivers near-term commercial returns but generates insufficient intellectual property to sustain an export thesis and leaves India dependent on both foreign hardware and foreign algorithms.
- [INFERENCE] Pure intelligence-first has the highest capital efficiency per unit of weighted capability in conservative and base scenarios, but its dependence on foreign quantum processing units creates a sovereignty gap for high-consequence national applications.
- [INFERENCE] Intelligence-led hybrid produces the highest weighted capability score in the base case and remains consistent with all seven quantified falsification criteria; none is presently triggered. It achieves the best balance across capital efficiency, sovereignty, commercial viability, and talent fit.
- [SOURCE-REPORTED] Accelerated post-quantum cryptography implementation and enforcement converts India's existing DST Task Force roadmap and MeitY whitepaper into binding regulatory timelines. It ranks first in the policy prioritisation matrix with a score of 320. It creates an estimated Rs 1,800 to 8,000 crore domestic market at near-zero additional government fiscal cost [2][3].
- [CALCULATION] The proposed Quantum Intelligence Fellowship Programme at Rs 90 crore per year produces retained researchers at an all-in estimated cost of approximately Rs 41 to 50 lakh per India-resident researcher. This is roughly 3 to 5 percent of the cost of training abroad and losing the researcher.
- [ESTIMATE] A proposed Rs 2,000 crore Quantum Intelligence Fund structured as a Fund-of-Funds is modelled to support a seed-to-Series B pipeline for 33 to 46 surviving quantum intelligence companies by Year 5, with an estimated 2:1 private leverage ratio. These are model outputs, not market forecasts.

Phase III Central Finding

The intelligence-led hybrid strategy combines broad domestic capability in quantum software, algorithms, error correction, orchestration, and security with selective domestic quantum processing unit development and multi-provider cloud access. It produces the best modelled outcomes across capital efficiency, sovereignty, commercialisation, and talent fit for India. This conclusion is an inference from the model and cited evidence. It is supported by the current evidence base; it is not an empirically proven strategic inevitability. The conditions under which it should be revised are quantified in Section 13.

2 Data Foundation

Every material input to this model carries an evidence classification applied consistently throughout. Evidence status codes: [FACT] verified against primary source; [CALCULATION] mathematically derived from stated inputs; [SOURCE-REPORTED] stated by a cited source and not independently verified; [ESTIMATE] analyst estimate from comparable data or benchmarks; [ASSUMPTION] modelling assumption with stated rationale; [DATA GAP] required but unavailable; [INFERENCE] logical conclusion drawn from evidence.

TABLE T1. Master Quantitative Input Table

Variable	Value	Unit	Evidence Status	Source	Confidence
NQM total mission allocation	6,003.65	Rs crore (2023 to 2031)	[FACT]	[1]	HIGH
NQM FY 2024-25 allocation	86	Rs crore	[FACT]	[1]	HIGH
NQM FY 2024-25 disbursement	43.07	Rs crore	[FACT]	[1]	HIGH
NQM FY 2024-25 utilisation	32.77	Rs crore	[FACT]	[1]	HIGH
NQM FY 2024-25 utilisation rate of allocation	38.1%	Calculation: 32.77 / 86 x 100	[CALCULATION]	Derived	HIGH
Cumulative NQM utilisation as % of total mission	0.546%	Calculation: 32.77 / 6,003.65 x 100	[CALCULATION]	Derived	HIGH
NQM annual average needed for even draw-down	750.5	Rs crore per year; Calculation: 6,003.65 / 8	[CALCULATION]	Derived	HIGH
NQM FY 2025-26 planned allocation	1,260.98	Rs crore	[FACT]	[1]	HIGH
NQM FY 2025-26 two T-Hub releases (to approx. Nov 2025)	273.98	Rs crore; Calculation: 101.28 + 172.70	[SOURCE-REPORTED]	[4]	MEDIUM
NQM startup allocation: initial 8-startup cohort	Rs 68 crore total; Rs 8.5 crore per startup	Rs crore; Calculation: 68 / 8	[FACT] for total; [CALCULATION] for per-startup	[1]	HIGH (requires DST clarification; Rs 30 crore cited elsewhere may reflect multi-year planned support)
Global pure-play quantum workforce	16,500	professionals (2025)	[SOURCE-REPORTED]	[5]	HIGH
India NQM researchers	152	persons	[FACT]	[6]	HIGH
India NQM researchers as % of global pure-play	0.92%	Calculation: 152 / 16,500 x 100	[CALCULATION]	Derived	MEDIUM
India mid-level quantum engineer salary (MNC)	25 to 45	Rs LPA	[SOURCE-REPORTED]	[7]	MEDIUM
US quantum researcher base salary	145,000 to 250,000	USD per year	[SOURCE-REPORTED, compiled]	[8]	MEDIUM

Variable	Value	Unit	Evidence Status	Source	Confidence
India to US salary ratio (mid-level)	3 to 8 times	Corrected from prior estimate of 5 to 10 times	[ESTIMATE]	Calculated	MEDIUM
QpiAI Kaveri domestic QPU	64	physical qubits	[FACT]	[9]	HIGH
NQM 8-year hardware target	50 to 1,000	physical qubits	[FACT]	[6]	HIGH
RSA-2048 minimum physical qubits: best current range	10,000 to 1,000,000	physical qubits; architecture-dependent	[PEER-REVIEWED ESTIMATES, range]	[10] [11] [12]	HIGH for range; not for any single value
QpiAI CEO-reported gross margins	approximately 60%	percent	[SOURCE-REPORTED: company-reported, unaudited]	[9]	LOW
Global PQC market 2025 (commercial estimate)	0.42	billion USD	[SOURCE-REPORTED: market forecast]	[3]	MEDIUM
Global PQC market 2030 (projected)	2.84	billion USD at CAGR 46.2%	[SOURCE-REPORTED: market forecast]	[3]	MEDIUM
US federal PQC migration cost 2025 to 2035	7.1	billion USD	[SOURCE-REPORTED]	[2]	MEDIUM
India quantum startup capital (total verified rounds)	approx. 57	million USD	[VERIFIED from disclosed rounds: QpiAI USD 38.5M + QNu USD 12M + BosonQ USD 6.6M]	Multiple corroborated sources	HIGH
India quantum patent count (G06N10, 2015 to 2026)	DATA GAP	N/A	[DATA GAP: no CGPDTM database query conducted]	None	N/A

The most reliable inputs are the NQM government budget figures (all [FACT] from Tier 1 parliamentary record) and the India verified startup funding totals. Market forecast figures, salary ratios, and talent pipeline estimates carry MEDIUM or LOW confidence and produce corresponding uncertainty in model outputs that depend on them.

3 Four-Strategy Economic Model: 10-Year Assessment

3.1 The Hardware Capital Constraint

The Fundamental Scale Problem

India's NQM allocation of Rs 6,003.65 crore across eight years is [FACT]. For comparison: Japan committed approximately USD 7.4 billion to quantum in 2025 alone [SOURCE-REPORTED]; the UK committed GBP 2.5 billion over ten years [FACT]; France committed EUR 1.8 billion over five years [SOURCE-REPORTED]. The US estimated federal PQC migration alone at USD 7.1 billion [SOURCE-REPORTED]. India's NQM budget is approximately 5 to 10 times smaller than the UK commitment on an annual basis, and 20 to 100 times smaller than the US, China, or Japan. Any hardware-first strategy costing more than Rs 6,000 crore over ten years would, at current funding levels, require either crowding out all other NQM objectives or securing substantially new appropriations. This is a capital constraint, not a capability constraint.

TABLE T2. Four-Strategy 10-Year Economic Model (India-Specific Estimates)

Variable	A: Hardware-First	B: Application-First	C: Intelligence-First	D: Intel-Led Hybrid
10-year capital: Low case [ESTIMATE]	Rs 8,000 crore (sub-competitive 200-qubit system)	Rs 500 crore (cloud access, algorithms, talent)	Rs 2,000 crore	Rs 4,000 crore (Rs 1,500 hardware plus Rs 2,500 intelligence layer)
10-year capital: Base case [ESTIMATE]	Rs 25,000 crore (partially competitive 500-qubit; comparable to UK scale)	Rs 2,000 crore	Rs 6,000 crore	Rs 10,000 crore (Rs 3,000 hardware plus Rs 7,000 intelligence layer)
10-year capital: High case [ESTIMATE]	Rs 60,000 crore or more (competitive 1,000-qubit; approaching Japan/US scale)	Rs 5,000 crore	Rs 12,000 crore	Rs 18,000 crore (Rs 5,000 hardware plus Rs 13,000 intelligence layer)
NQM (Rs 6,003.65 crore) as % of base-case need [CALCULATION]	24%: insufficient even for Low case	300%: NQM alone covers base case	Approximately 100%: matches NQM budget	Approximately 60%: requires additional private and government capital
Annual cloud QPU access cost [ESTIMATE]	Not required; on-premises maintenance Rs 150 to 400 crore per year from Year 5	Rs 8 to 80 crore per year	Rs 15 to 120 crore per year	Rs 15 to 120 crore per year
Talent requirement [ESTIMATE]	3,000 to 8,000 hardware physicists and fabrication engineers (profile largely absent in India today)	500 to 2,000 algorithm and domain specialists	2,000 to 5,000 quantum AI, QEC, algorithm, and software engineers (closest to India's existing talent pool)	2,500 to 6,000 (intelligence layer) plus 500 to 1,000 hardware physicists for selective domestic system
India talent supply match [INFERENCE]	Very low: India has fewer than 100 fabrication-grade quantum physicists today; rapid scale-up is not feasible	Moderate: algorithm and domain expertise exists in India's computing and physics community	High: directly leverages India's existing AI, software, ML, and optimisation talent base	Moderate to high: intelligence layer is a strong fit; hardware component requires a new specialist pipeline
Time to useful commercial capability [ESTIMATE]	8 to 15 years for competitive hardware; no meaningful commercial return before then	3 to 7 years for first NISQ-era applications	5 to 8 years for competitive intelligence-layer capability	4 to 6 years (intelligence layer commercial); 7 to 10 years (domestic hardware operational)
Expected 10-year commercial revenue: Base [ESTIMATE]	Rs 0 to 1,000 crore (hardware sales to government only unless globally competitive)	Rs 500 to 2,000 crore (quantum services and consulting)	Rs 1,500 to 5,000 crore (QaaS, IP licensing, PQC services)	Rs 2,000 to 8,000 crore (intelligence layer plus hardware strategic sales)

Variable	A: Hardware-First	B: Application-First	C: Intelligence-First	D: Intel-Led Hybrid
Sovereignty achieved [INFERENCE]	High if hardware target is reached; near zero if programme falls behind	Low: depends entirely on foreign hardware and algorithms	Moderate: controls intelligence layer; residual dependence on foreign QPU access for high-consequence workloads	High: domestic QPU for critical applications; intelligence layer for commercial and decision-logic sovereignty
Failure and stranded-capital risk [INFERENCE]	Severe: most of Rs 8,000 to 60,000 crore is stranded if hardware programme misses targets; no intermediate return	Moderate: applications commoditise; some commercial return survives failure	Moderate: cloud access denial mitigated by multi-provider access; intelligence layer retains value across QPU scenarios	Low to moderate: two independent value streams reduce total programme failure risk
Government fiscal exposure: Base case [ESTIMATE]	Rs 18,000 crore (assuming 75% government share of hardware)	Rs 1,200 crore (30% government share)	Rs 4,500 crore (50% share)	Rs 7,500 crore (50% hardware, 50% intelligence layer)

Hardware-first is the only strategy that cannot be adequately funded within the NQM budget even at the Low case. This single arithmetic finding substantially shapes the rest of the strategic assessment. India's practical choice is among intelligence-first, application-first, and intelligence-led hybrid.

4 Strategic Quantum Capability Efficiency

4.1 Metric Definition

The Strategic Quantum Capability Efficiency (SQCE) is a decision-support construct developed for this analysis. It is not an industry-standard empirical index. It measures modelled quantum capability output per rupee of total investment. All weights and scores are [ANALYST-PROPOSED] and require expert calibration before being used in binding resource allocation decisions.

SQCE equals the sum of weighted capability scores divided by total 10-year investment in Rs crore. [ASSUMPTION: linear aggregation across capability dimensions.]

TABLE T3. SQCE Capability Dimensions, Weights, and Scores (Illustrative; Analyst-Proposed; Not Empirically Validated)

Dimension	Weight	A: Hardware	B: Application	C: Intelligence	D: Hybrid	Basis of Differentiation
Domestic QPU capability	12%	0.60 to 0.90 if hardware works; 0.05 if fails (binary outcome)	0.05: no domestic hardware	0.10: reliant on cloud and QpiAI	0.40 to 0.70: selective domestic hardware	Presence and scale of domestic QPU
Retained quantum researchers	20%	0.30 to 0.50: hardware draws specialists but software talent may not follow	0.20 to 0.40: weak mission pull	0.60 to 0.80: strong mission pull across AI, QEC, and software careers	0.50 to 0.80: widest career pathways; strongest retention pull	How well each strategy activates India's existing talent base
IP creation	15%	0.40 to 0.80 if programme succeeds; near zero if it fails	0.15 to 0.30: applications are defensible but limited	0.40 to 0.70: algorithms, QEC decoders, orchestration	0.50 to 0.80: intelligence layer IP plus hardware IP	IP type and defensibility
Commercial revenue	18%	0.10 to 0.60: binary hardware success dependency	0.05 to 0.30: services without IP ceiling	0.15 to 0.50: QaaS, IP licensing, PQC services	0.20 to 0.80: hardware sales plus intelligence layer revenue	Revenue model defensibility
Sovereignty	15%	0.70 to 0.90 if hardware achieved; near zero if not	0.10 to 0.20: foreign hardware and algorithms throughout	0.30 to 0.50: intelligence control; QPU access residual risk	0.60 to 0.80: domestic QPU for critical; intelligence layer for decisions	Control of decision logic and physical hardware in high-consequence applications
Export revenue potential	12%	0.05 to 0.30: hardware export requires competitive scale	0.10 to 0.30: application services; limited IP protection	0.30 to 0.70: IP licensing, QaaS, intelligence services fully exportable	0.40 to 0.80: intelligence exports plus hardware for sovereign-export-as-a-service	Exportability of output without physical asset transfer
Defence and space usefulness	8%	0.50 to 0.80 if domestic hardware achieved	0.10 to 0.20: foreign hardware required; no classified domestic capability	0.20 to 0.40: intelligence layer only; hardware access for classified is problematic	0.60 to 0.80: domestic QPU for classified plus intelligence layer for optimisation	Ability to serve classified national security workloads

TABLE T4. SQCE Composite Scores: Base Case (Illustrative)

Strategy	10-yr Base Investment (Rs crore)	Weighted Capability Score (Base)	SQCE per Rupee (Base)	Ranking by Weighted Capability Score	Ranking by SQCE per Rupee	Risk-Adjusted Assessment
A: Hardware-First	25,000	0.39 [binary: 0.60 if hardware succeeds; approximately 0.08 if it fails]	0.0000156	4th	4th	Worst risk-adjusted position: high potential if hardware succeeds; binary failure risk and severe capital exposure at India's funding level
B: Application-First	2,000	0.15	0.0000750	4th by weighted capability	3rd by per-rupee efficiency	Fast commercial returns but insufficient capability across sovereignty, IP, and defence dimensions
C: Intelligence-First	6,000	0.47	0.0000783	2nd by weighted capability	1st by per-rupee efficiency	Highest capital efficiency; best choice if funding is severely constrained; sovereignty gap is the principal limitation
D: Intel-Led Hybrid	10,000	0.60	0.0000600	1st by weighted capability	2nd by per-rupee efficiency	Highest total weighted capability; second in per-rupee efficiency; best choice when sovereignty and defence requirements are weighted alongside commercial considerations

Intelligence-Led Hybrid produces the highest total weighted capability score in the base case but not the highest per-rupee efficiency. The choice between Intelligence-First and Hybrid depends on the weight India assigns to sovereignty and defence usefulness.

5 Minimum Sovereign QPU: Workload-Based Definition

The domestic quantum processing unit requirement is defined by the workloads India needs its own hardware to serve. It is not defined by adversarial cryptanalysis capability (RSA-2048 cracking), which is both far beyond any realistic NQM hardware target and the wrong framing for India's quantum sovereignty requirements.

TABLE T5. Minimum Domestic QPU Requirements by National Workload Category

Workload	Required Physical Qubits	Domestic vs International	India Current Status	NQM Target Adequacy	Evidence Basis
Quantum algorithm research (unclassified)	20 to 100 (NISQ era)	International cloud acceptable; domestic preferred for classified algorithm development	64-qubit QpiAI Kaveri meets this floor. [FACT]	NQM 3-year target (20 to 50 qubits) meets lower bound	QpiAI Kaveri March 2026; NQM official targets
QEC research and decoder development	50 to 200 (distance-3 through distance-7 surface codes)	International acceptable for academic; domestic required for classified decoder development	Distance-5 (49 physical qubits for 1 logical qubit) demonstrated by QpiAI [FACT]. Distance-7 (approximately 105 physical qubits) is not yet met by Indian hardware.	NQM 5-year target (50 to 100 qubits) meets distance-5; NQM 8-year target reaches distance-7 range	QpiAI hardware decoder March 2026; Nature Willow distance-7 demonstration
Quantum chemistry and classified materials simulation	100 to 500 (depending on molecular system)	Classified materials: domestic required; unclassified academic: international acceptable	Not met by current 64-qubit Kaveri for complex molecular systems	NQM 8-year target (up to 1,000 qubits) covers this	Molecular simulation qubit requirements: academic literature consensus
Defence logistics and network optimisation	50 to 200 (NISQ variational algorithms)	Domestic required for classified networks	Not met at current 64-qubit scale for large logistics problems	NQM 5-year target begins to cover this range	[ESTIMATE] from academic QAOA literature; no India-specific benchmark published
Space mission planning and orbit optimisation	50 to 200 (trajectory optimisation)	Domestic preferred for strategic missions; international acceptable for unclassified ISRO workloads	Not met definitively; NQM 5-year target approaches it	NQM 5-year target is within range	[ESTIMATE]: no published ISRO quantum planning workload specification [DATA GAP]
RSA-2048 cryptanalysis	10,000 to 1,000,000 physical qubits depending on architecture	Not applicable as a sovereign QPU design target: India's cryptographic response is accelerated PQC implementation, not domestic CRQC development	Not applicable	Far beyond NQM 8-year target of 1,000 qubits	Gidney 2025 (below 1M qubits); Pinnacle Architecture 2026 (approximately 100,000 qubits); Cain et al. 2026 (10,000 to 14,000 neutral-atom qubits at extended runtime)

Derived sovereign QPU floors:

- [CALCULATION] Minimum research sovereignty floor: 50 to 100 physical qubits. QpiAI Kaveri at 64 qubits currently meets the lower bound. Distance-7 QEC research requires approximately 105 physical qubits: approaching but not yet met by Indian hardware.
- [CALCULATION] Minimum defence and space sovereignty floor: 100 to 200 physical qubits. This covers NISQ-era defence optimisation and space workloads. Achievable within the NQM 5-year trajectory.

- [ESTIMATE] A proposed domestic target of approximately 256 to 1,000 physical qubits by 2031 exceeds both sovereignty floors and provides headroom for emerging classified workloads. This is a proposed strategic target, not an empirically derived minimum requirement.

India's sovereign QPU programme should be designed around national workload requirements, not around achieving cryptographic relevance for RSA cracking. The NQM 8-year target of up to 1,000 physical qubits is well calibrated to India's near-term national workload requirements.

6 Talent Economics

The global pure-play quantum workforce stood at approximately 16,500 in 2025, growing by approximately 2,000 per year [5]. India's NQM programme supports 152 active researchers across 43 institutions [6], representing approximately 0.92 percent of the global pure-play workforce [CALCULATION]. Total India-resident quantum practitioners including non-NQM researchers is estimated at 500 to 2,000 [ESTIMATE with wide uncertainty; no primary survey conducted (DATA GAP)].

TABLE T6. Quantum Intelligence Fellowship Programme: Economics and Impact Model

Variable	Current Trajectory (no fellowship)	Intervention: 500 fellows per year	Intervention: 1,000 fellows per year	Evidence Status
Annual fellowship intake	Zero: programme does not exist; no PG quantum seats added despite AICTE curriculum	500 per year (MSc to post-doctoral level; 3-year fellowship)	1,000 per year (same structure; doubled intake)	[PROPOSED TARGET]: not yet authorised or funded
Proposed stipend	Not applicable	Rs 75,000 per month	Rs 75,000 per month	[PROPOSED TARGET]: comparator is Singapore National Quantum Scholarship at approximately S$3,000 per month (approximately Rs 18 to 22 lakh per year); India proposed is Rs 9 lakh per year
Annual programme cost [CALCULATION]	Rs 0	Rs 45 crore per year	Rs 90 crore per year	[CALCULATION]: fellows times Rs 9 lakh per year
10-year programme cost [CALCULATION]	Rs 0	Rs 450 crore	Rs 900 crore	[CALCULATION]
Estimated 3-year retention rate	Not applicable	60 to 70% estimated remain India-resident	60 to 70% estimated	[ASSUMPTION]: primary retention survey is DATA GAP; 60 to 70% is an assumption based on competitive stipend and service expectations
Cost per retained researcher [CALCULATION]	Not applicable	Rs 41 to 50 lakh (Rs 27 lakh cost per fellow divided by 0.65 retention rate)	Rs 39 to 47 lakh	[CALCULATION from stated assumptions]: cost is Rs 9 lakh times 3 years = Rs 27 lakh; adjusted for retention = Rs 27 lakh divided by 0.65 = Rs 41.5 lakh
Comparator: cost of international PhD and post-doc [ESTIMATE]	Rs 125 to 200 lakh equivalent per researcher lost abroad	Fellowship is estimated 3 to 5 times cheaper	Fellowship is estimated 3 to 5 times cheaper	[ESTIMATE]: US PhD stipend plus tuition USD 30,000 to 50,000 per year for 5 years equals approximately Rs 125 to 200 lakh; fellowship achieves equivalent qualification at approximately Rs 40 lakh

Variable	Current Trajectory (no fellowship)	Intervention: 500 fellows per year	Intervention: 1,000 fellows per year	Evidence Status
India-resident practitioners by 2031 (cumulative) [ESTIMATE]	Estimated 800 to 2,500 (slow growth from current base)	Estimated 3,000 to 6,000	Estimated 5,000 to 10,000	[ESTIMATE: wide range; dependent on retention rate assumptions and parallel PhD pipeline growth, both DATA GAPS]

Recommendation: Quantum Intelligence Fellowship Programme

What: Launch a Quantum Intelligence Fellowship funding 1,000 fellows annually at Rs 75,000 per month (proposed) for 3-year tenures at NQM-affiliated institutions, with priority for quantum error correction, AI-quantum integration, and quantum security.

Who executes: Department of Science and Technology as lead authority; Ministry of Education and AICTE for curriculum and seat creation; NQM Governing Board for T-Hub integration.

Timing: Programme design finalised by mid-2027; first cohort enrolled in 2027-28; independent retention audit at Year 3 (2030-31).

Instrument: Dedicated fellowship budget line within NQM at Rs 90 crore per year; alternatively structured within a reformed INSPIRE programme.

Success indicator: 500 verified India-resident quantum practitioners retained from fellowship cohorts by 2030; at least 50 peer-reviewed publications from fellows within 3 years.

Principal risk: If 3-year retention falls below 40%, the programme economics deteriorate. The stipend would need to increase to approximately Rs 18 to 22 lakh per year (matching Singapore) and/or a service obligation of 3 additional India-based years post-fellowship should be introduced.

7 Post-Quantum Cryptography: Near-Term Economic Opportunity

India's quantum security opportunity is commercially real today and exists independent of any quantum computing hardware advancement timeline. NIST published FIPS 203, 204, and 205 in August 2024 [13]. India's DST Task Force published a quantum-safe roadmap with a 2027 to 2029 migration timeline for Critical Information Infrastructure [2]. MeitY and CERT-In published a national PQC migration whitepaper in July 2025 [14]. A formal regulatory mandate from RBI, SEBI, or TRAI had not been issued as of August 2026, representing the principal remaining policy gap [SOURCE-REPORTED].

PQC Is a Near-Term Security Risk, Not a Quantum-Hardware-Era Risk

Harvest-now-decrypt-later attacks, where adversaries collect encrypted communications today to decrypt once quantum capability matures, are active. This risk exists independent of when large-scale quantum computers become operational. The correct organisational response is accelerated PQC implementation and enforcement: converting India's existing policy foundation (Task Force roadmap and MeitY whitepaper) into binding regulatory timelines, sector-specific mandates, and domestic certification capacity.

TABLE T7. India PQC Market Opportunity: Scenario Estimates

Sector	Scale Indicator	Estimated 10-Year Migration Cost	India Domestic Vendor Opportunity	Evidence Status
Banking, financial services, insurance	50+ scheduled commercial banks; 10,000+ NBFCs; NPCI UPI (over 10 billion daily transactions)	USD 500 million to 2 billion [ESTIMATE: scaled from US federal USD 7.1 billion at India cost factor 0.3 to 0.4 times]	5 to 15% domestic share: approximately Rs 1,500 to 8,000 crore for QNu Labs and domestic PQC software vendors	[ESTIMATE]: no India-specific PQC migration cost study identified [DATA GAP]
Telecom	3 major operators; 1.1 billion subscribers; mission-critical core network encryption	USD 200 million to 800 million [ESTIMATE]	10 to 20% domestic share: approximately Rs 700 to 4,500 crore	[ESTIMATE]: no TRAI PQC cost study identified [DATA GAP]
Central and state government	Digital Public Infrastructure (Aadhaar, DigiLocker, UPI), income tax systems, passport databases	USD 300 million to 1 billion [ESTIMATE]	Government systems require domestic certification (L1 to L4 framework); QNu Labs and domestic integrators are positioned	[ESTIMATE]: no official government IT budget for PQC migration released
Defence and intelligence	Classified system count unavailable; encrypted communications infrastructure	DATA GAP	Domestic vendors required; no foreign certification for classified defence systems	[DATA GAP]
Total addressable (all sectors, 10-year) [ESTIMATE]	N/A	Rs 9,000 to 35,000 crore national migration cost	India domestic PQC vendor market: Rs 1,800 to 8,000 crore (estimated 20 to 25% domestic share)	[ESTIMATE: scenario range; wide uncertainty; treat as order-of-magnitude indicator, not forecast]

Recommendation: Accelerated PQC Implementation and Enforcement

What: Convert India's existing DST Task Force roadmap (2027 to 2029 CII timelines) and MeitY whitepaper (July 2025) into binding regulatory mandates by sector, with explicit compliance deadlines and CERT-In enforcement authority. Establish the L1 to L4 domestic testing and certification framework on a firm timeline.

Who executes: CERT-In (lead enforcement authority); Reserve Bank of India for BFSI; TRAI for telecom; Ministry of Defence for defence IT; MEITY for government infrastructure.

Timing: Binding timelines issued by mid-2027 for Phase 1 sectors (BFSI and government); full CII compliance by 2029 consistent with existing Task Force roadmap.

Instrument: Regulatory directive requiring no new government expenditure. Compliance cost is borne by regulated entities. Domestic certification infrastructure requires an estimated Rs 50 to 200 crore in government investment.

Success indicator: By 2028, all major Indian commercial banks have a documented PQC migration plan approved by RBI. By 2030, 50 percent of CII systems are operating on NIST-approved PQC algorithms.

Principal risk: Regulatory coordination across five agencies (CERT-In, RBI, TRAI, Ministry of Defence, MEITY) is structurally complex. Without a designated single coordinating body, implementation will fragment by sector and timelines will slip.

8 Quantum Intelligence Fund: Sizing Model

The Quantum Intelligence Fund is proposed as a Fund-of-Funds structure anchored by government capital and leveraged with private co-investment. Key modelling assumptions [ASSUMPTION]: government provides 50 percent of total fund; private co-investment provides 50 percent at a 2:1 leverage ratio; 55 percent of seed-stage investments remain operational at Year 5; quantum software and intelligence-layer Series A rounds at Rs 50 to 100 crore [ESTIMATE]. The fund should be restricted to intelligence-layer companies: software, algorithms, QEC, orchestration, quantum AI, and quantum security. Hardware startups continue under NQM T-Hub mechanisms.

TABLE T8. Quantum Intelligence Fund: Four-Scenario Portfolio Model

Metric	Rs 500 crore	Rs 1,000 crore	Rs 2,000 crore (Proposed)	Rs 3,000 crore
Government anchor (50%) [ASSUMPTION]	Rs 250 crore	Rs 500 crore	Rs 1,000 crore	Rs 1,500 crore
Private co-investment attracted at 2:1 leverage [ASSUMPTION]	Rs 250 crore	Rs 500 crore	Rs 1,000 crore	Rs 1,500 crore
Seed investments at Rs 10 to 15 crore each; 40% of fund [ESTIMATE]	15 to 20 companies	30 to 40 companies	50 to 70 companies	75 to 100 companies
Series A investments at Rs 60 to 100 crore each; 50% of fund [ESTIMATE]	3 to 5 companies	5 to 8 companies	10 to 15 companies	15 to 20 companies
Series B follow-on at Rs 150 to 200 crore each; 10% of fund [ESTIMATE]	Not feasible	0 to 1 company	3 to 5 companies	5 to 8 companies
Surviving companies at Year 5 at 55% seed survival [ASSUMPTION]	10 to 13 companies	19 to 24 companies	33 to 46 companies	49 to 66 companies
Expected portfolio commercial revenue by Year 10 [ESTIMATE]	Rs 200 to 800 crore	Rs 500 to 1,500 crore	Rs 1,000 to 4,000 crore	Rs 2,000 to 7,000 crore
Government net fiscal exposure in downside [ESTIMATE]	Rs 75 to 100 crore	Rs 150 to 200 crore	Rs 300 to 400 crore	Rs 450 to 600 crore
Assessment	Too small for ecosystem self-reinforcement; adequate for a signal cohort	Adequate for seed-to-Series A; insufficient for Series B independence	Approximately correctly sized for seed-to-Series B pipeline	Adds Series C capability; increases fiscal governance complexity

Recommendation: Rs 2,000 Crore Quantum Intelligence Fund

What: Establish a Fund-of-Funds anchored at Rs 1,000 crore government commitment, attracting Rs 1,000 crore in private co-investment from institutional investors, SIDBI Ventures, and strategic corporate investors, targeted exclusively at quantum intelligence-layer companies.

Who executes: SIDBI Ventures as operational fund manager; DST and NQM Governing Board as technical advisors; Ministry of Finance for tax incentive design (200% income-tax deduction on quantum R&D equivalent to Section 35(2AB) treatment, as proposed).

Timing: Fund structure and SIDBI mandate established by 2027; first close by 2028; investment period 2028 to 2033; harvest period 2033 to 2038.

Instrument: Fund-of-Funds under the Startup India framework; government commitment via NQM capital or Atmanirbhar Bharat technology funds; private leverage through SEBI Alternative Investment Fund registration.

Success indicator: Rs 2,000 crore total corpus closed by 2028; 50 portfolio companies funded by 2031; at least 5 companies with commercial revenue above Rs 50 crore by 2032.

Principal risk: If private co-investment does not reach the 2:1 leverage target, the fund either shrinks or requires a larger government anchor. Quantum software's long commercialisation cycle of 5 to 8 years to revenue makes LP patience a structural requirement.

9 Quantum Valley Self-Reinforcement Index

The Quantum Valley Self-Reinforcement Index (QVSRI) measures whether an ecosystem has transitioned from government-programme dependency to self-sustaining commercial dynamics. Eight dimensions are proposed with [ANALYST-PROPOSED] thresholds. No threshold is empirically derived from quantum-specific cluster literature; all draw on general tech-cluster research (Saxenian, Porter, Feldman) and comparable deep-tech ecosystem benchmarks.

TABLE T9. QVSRI: Dimensions, Thresholds, and India's Current Position

Dimension (equal weight 12.5% each)	Stage 2: Emerging Ecosystem	Stage 3: Self-Reinforcing	India Current Position	Threshold Basis
1. Private to public capital ratio	Greater than 0.5:1	Greater than 1:1	Well below 0.1:1 [INFERENCE]: NQM dominates all quantum capital; total verified private Indian quantum raises approximately USD 57 million vs NQM Rs 6,003.65 crore	[ANALYST-PROPOSED]: self-reinforcing tech clusters internationally tend to be private-capital-led
2. Commercial revenue ratio	Greater than 10% of ecosystem expenditure from commercial revenue	Greater than 50%	Near zero [INFERENCE]: QpiAI is EBITDA profitable (self-reported, unaudited); ecosystem-wide commercial revenue is DATA GAP	[ANALYST-PROPOSED]: conservative threshold
3. Researcher retention rate	Greater than 60% of trained quantum researchers remain India-resident for 3+ years	Greater than 75%	DATA GAP: no primary survey; qualitative evidence and salary differential suggest below 50% for elite institutions [INFERENCE, LOW CONFIDENCE]	[ANALYST-PROPOSED]: consistent with Singapore quantum scholarship design targets
4. Startup survival at 5 years	Greater than 40% of funded quantum startups operational at 5 years	Greater than 55%	DATA GAP: NQM startup cohort is less than 2 years old; insufficient history for assessment	[ANALYST-PROPOSED]: benchmarked against Israel deep-tech and India general startup survival data
5. IP commercialisation	At least one India-developed quantum IP asset generating licence revenue	Greater than 5 IP assets generating licence revenue	Near zero [INFERENCE]: QpiAI hardware decoder (March 2026) is the first identified significant India quantum IP asset; patent status not confirmed; no licensing revenue identified	[ANALYST-PROPOSED]
6. International quantum revenue	At least Rs 50 crore annually	At least Rs 500 crore annually	Near zero [INFERENCE]: no Indian quantum exports identified	[ANALYST-PROPOSED]
7. Corporate quantum R&D	At least 3 large corporations with internal quantum R&D teams (not only MoUs)	At least 10 corporations with dedicated quantum R&D	Approximately 2 to 3 approaching Stage 2 threshold: TCS Quantum CoE (verified); Tech Mahindra (MoUs, not full R&D teams); QNu Labs government customer [INFERENCE]	[ANALYST-PROPOSED]

Dimension (equal weight 12.5% each)	Stage 2: Emerging Ecosystem	Stage 3: Self-Reinforcing	India Current Position	Threshold Basis
8. Exit and capital recirculation	At least one significant quantum exit (acquisition above Rs 500 crore or IPO)	At least 3 exits that recycled capital into new ventures	Zero quantum exits in India as of August 2026 [FACT: no exit event has been publicly announced]	[ANALYST-PROPOSED]

India currently meets Stage 2 criteria on approximately 1 to 2 of 8 dimensions (corporate quantum R&D participation approaching threshold; PQC commercial demand beginning). India is in Stage 1 (government programme). Transition to Stage 2 requires at minimum: one significant exit event, commercial revenue above 10 percent of ecosystem expenditure across multiple companies, and researcher retention above 60 percent for the first fellowship cohort.

10 Four-Strategy Comparative Scorecard

Thirteen criteria are scored on a 1 to 5 scale, where 5 is best for India. All scores are [ANALYST ESTIMATE]. Each score that differs materially from adjacent strategies is supported by an evidence rationale in Section 3 or the dimensional analysis above.

TABLE T10. Four-Strategy Comparative Scorecard (1 = Worst for India; 5 = Best)

Criterion	A: Hardware	B: Application	C: Intelligence	D: Hybrid	Basis
Capital efficiency	1	5	4	3	[CALCULATION] from 10-year cost model vs NQM budget
Talent fit to India capabilities	1	3	5	4	[INFERENCE] from Phase II talent analysis
Time to useful commercial capability	1	5	4	3	[ESTIMATE] from hardware and software precedents
Sovereignty achieved	4	1	3	5	[INFERENCE] from Phase II sovereignty framework
IP capture potential	3	2	4	4	[ESTIMATE] from IP architecture analysis
Commercialisation path	2	4	4	5	[ESTIMATE] from QpiAI precedent and commercial model
Export revenue potential	2	3	5	5	[INFERENCE] from exportability of outputs
Foreign dependency risk	5	1	3	4	[INFERENCE] from QPU stress test, Phase II
Failure and stranded-capital risk	1	3	4	4	[INFERENCE] from failure scenario analysis
Defence and space usefulness	4	1	2	5	[INFERENCE] from sovereignty analysis
Quantum Valley potential	3	2	4	5	[INFERENCE] from QVSRI analysis
Capability per Rs 1 crore invested	1	4	5	3	[INFERENCE] from SQCE model
Alignment with India's comparative advantage	1	2	5	5	[INFERENCE] from talent, cost-structure, and AI capability analysis
TOTAL SCORE (out of 65)	31 of 65 (47.7%)	36 of 65 (55.4%)	53 of 65 (81.5%)	56 of 65 (86.2%)	Sum
Overall Ranking	4th	3rd	2nd	1st	

Intelligence-Led Hybrid ranks first (86.2 percent) primarily because it scores highest on sovereignty, defence usefulness, Quantum Valley potential, and commercialisation. Intelligence-First ranks second (81.5 percent) with higher capital efficiency but lower sovereignty and defence scores. If India's government assigns lower priority to classified workloads and defence sovereignty, the gap between C and D narrows and C becomes the recommended strategy.

11 Policy Prioritisation: Sequenced Intervention Programme

Five interventions are prioritised using a structured matrix: Impact multiplied by Urgency multiplied by Feasibility, divided by Cost. Each dimension is scored 1 to 10. All scores are [ANALYST ESTIMATE]. A higher composite score indicates greater policy priority given India's current constraints.

TABLE T11. Policy Prioritisation Matrix

Intervention	Impact (I)	Urgency (U)	Feasibility (F)	Cost (C)	Score (I x U x F / C)	Rank	Rationale
1. Accelerated PQC implementation and enforcement	8	10	8	2	320	1st	Near-zero new fiscal cost (regulatory mandate); existing framework (MeitY whitepaper, Task Force roadmap) requires only binding timelines and enforcement authority. Market creation: Rs 1,800 to 8,000 crore [ESTIMATE].
2. NQM execution reform (multi-year accounts, procurement reform, absorption capacity building)	9	10	5	3	150	2nd	Unlocks Rs 6,003.65 crore already committed: the highest-leverage action requiring no new capital. Procurement reform is politically complex but necessary.
3. Quantum Intelligence Fellowship (1,000 fellows per year)	8	9	7	7	72	3rd	Addresses the most critical structural constraint: the quantum talent pipeline is effectively zero from dedicated training. AICTE curriculum exists; seat creation and stipend are the remaining gaps. Rs 90 crore per year is within NQM budget if execution improves.
4. Dedicated government QPU access programme	7	7	7	5	68.6	4th	Transforms research quality; Singapore's Quantinuum Helios model is a direct precedent. Partial implementation exists (Amaravati IBM Quantum System Two announced); access terms require formalisation.
5. Quantum Intelligence Fund (Rs 2,000 crore)	9	5	5	8	28.1	5th	Highest long-term strategic impact; lowest urgency relative to other interventions; requires Finance Ministry engagement and SIDBI structure; 24 to 36 month build process.

The sequencing implication is clear. PQC enforcement and NQM reform should be initiated within 12 months, as both require no new capital and address current constraints. The Fellowship and QPU access programmes are 12 to 24 month builds. The QIF requires 24 to 36 months for institutional arrangements. This sequencing is evidence-driven and operationally realistic.

12 Phase-Sequenced Roadmap: 2026 to 2036

Each milestone is classified by commitment level: Committed (existing policy); Under Development (announced but not finalised); Proposed (recommended in this research, not yet committed); Projected (model output); Speculative (5 to 10 year horizon; high uncertainty).

TABLE T12. India Quantum Intelligence Strategy Roadmap

Phase	Period	Priority Actions	Target Milestones	Commitment Level
Phase 1: Foundations	2026 to 2028	(1) CERT-In issues binding PQC migration timelines for CII sectors, building on the existing Task Force roadmap. (2) DST implements NQM execution reforms: multi-year research accounts, import facilitation channel, and programme management capacity. (3) DST and MoE launch the Quantum Intelligence Fellowship at 500 per year as a minimum viable start. (4) NQM negotiates government QPU access contracts with at least two providers. (5) SIDBI structures the Quantum Intelligence Fund for first close.	NQM FY 2025-26 utilisation rate above 50%. PQC migration pilots active in banking and government. 500 fellows enrolled at NQM-affiliated institutions. Government QPU access contract operational. QIF first close at Rs 1,500 crore minimum.	PQC: Under Development (Task Force roadmap exists; binding mandate not yet issued). NQM reform: Proposed. Fellowship: Proposed. QPU access: Partial (Amaravati announced). QIF: Proposed.
Phase 2: Build	2028 to 2031	(1) Fellowship scaled to 1,000 per year; first cohort 3-year retention audited. (2) QpiAI or NQM successor achieves 256-qubit domestic QPU. (3) NQM T-Hubs producing peer-reviewed QEC publications and patent filings. (4) QIF funds first Series A investments. (5) PQC migration 50% complete across CII sectors. (6) At least one international quantum research collaboration at lab-exchange level.	1,000 India-resident quantum practitioners measured by primary survey. First Indian quantum company with annual revenue above Rs 100 crore. 50 or more peer-reviewed publications from NQM researchers annually. 20 or more quantum patents filed by Indian entities. A proposed domestic target of approximately 256 to 1,000 physical qubits by 2031 achieved or in commissioning.	Projected: conditional on Phase 1 completion. All milestones are [PROPOSED TARGET].
Phase 3: Scale	2031 to 2036	(1) Domestic QPU at 500 to 1,000 physical qubits operational. (2) QIF first exits; capital recirculating into new ventures. (3) Indian quantum intelligence services exported to ASEAN and GCC partners. (4) PQC migration 90% complete nationally. (5) First Indian Quantum Valley cluster achieves QVSRI Stage 2 (emerging ecosystem). (6) 3,000 or more India-resident quantum practitioners.	India-resident quantum practitioners exceeding 3,000. At least one quantum exit above Rs 500 crore. International quantum intelligence revenue above Rs 500 crore annually. India producing more peer-reviewed QEC publications than Singapore. NQM cumulative expenditure above Rs 4,000 crore.	Speculative: depends entirely on Phase 1 and Phase 2 execution, which are currently uncommitted.

13 Falsification Criteria: Conditions for Strategy Revision

The intelligence-led hybrid strategy is supported by the current evidence base. It is not permanently proven. The following seven criteria, if triggered, would indicate the strategy requires material revision. All criteria are measurable and time-bound.

TABLE T13. Quantified Falsification Criteria

Criterion	Hypothesis Tested	Condition That Would Falsify	Measurement Date	Data Source	If Triggered: Response
A. Capital efficiency	Hybrid produces competitive ecosystem at lower capital cost than hardware-first	QpiAI is the only Indian quantum company reaching USD 50 million or more in total funding by 2030 despite QIF creation, suggesting capital efficiency is company-specific rather than ecosystem-wide	31 December 2030	Company MCA filings; press releases; QIF portfolio reporting	Investigate whether QIF allocation requires increase or a second dedicated hardware co-investment stream is needed alongside the intelligence-layer fund
B. NQM execution	NQM execution reform enables utilisation above 70% of annual allocation	FY 2025-26 utilisation rate falls below 50% despite the planned allocation ramp-up to Rs 1,260.98 crore, indicating systemic institutional constraints that procurement reform alone cannot fix	March 2027	DST annual report; Rajya Sabha question; RTI	NQM governance structure requires fundamental redesign; consider converting T-Hubs to autonomous research institutes with multi-year budgets outside annual GFR constraints
C. International licensing	Intelligence layer generates exportable, licensable intellectual property	No quantum intellectual property developed by Indian entities generates any international licensing revenue by 2032, including a nominal transaction of Rs 1 crore	31 December 2032	Company disclosures; CGPDTM patent database; QIF portfolio reporting	Revise thesis toward quantum-as-a-service revenue model rather than IP licensing; assess whether India's IP creation is structurally insufficient or only delayed
D. Domestic QPU sovereignty	Hybrid strategy's sovereignty floor is operationally adequate	A major QPU provider restricts access and India cannot operate 100 or more physical qubit computation domestically within 90 days of the restriction	Triggered by a restriction event	NQM hardware milestone reporting; QpiAI operational status	Accelerate domestic hardware programme; define minimum viable domestic hardware below which the sovereignty floor of the intelligence-led strategy becomes operationally untenable
E. IP creation	Intelligence-first strategy generates defensible intellectual property	No Indian entity files a quantum patent under IPC G06N10 by end of 2028	31 December 2028	CGPDTM database query	Mandate IP filing as a condition of NQM T-Hub funding; establish a national quantum IP programme with patent filing incentives and legal support for startups
F. Fellowship retention	Fellowship programme retains quantum talent in India at economically viable rates	The 3-year retention rate of Quantum Intelligence Fellows falls below 50% at the first cohort's anniversary, indicating the stipend is insufficient to overcome emigration pull	2030 (if fellowship launched 2027)	DST fellowship programme registry; annual independent review	Increase stipend to approximately Rs 18 to 22 lakh per year (matching Singapore) and/or introduce a 3-year post-fellowship service obligation tied to India-based positions

Criterion	Hypothesis Tested	Condition That Would Falsify	Measurement Date	Data Source	If Triggered: Response
G. Commercial replication	QpiAI's commercial model is replicable across the intelligence-layer ecosystem	No Indian quantum company other than QpiAI achieves EBITDA-positive status by 2030 despite QIF deployment, indicating that the commercial model may be QpiAI-specific rather than ecosystem-wide	31 December 2030	MCA filings; QIF portfolio reporting; independent audits where available	Revise commercial revenue projections downward; reassess whether QaaS delivery is the more replicable India model; reduce commercial revenue weight in SQCE accordingly

14 Final Strategic Conclusion

A. What the Evidence Shows

The following points are established from primary sources or direct calculation. [FACT] India's NQM allocation of Rs 6,003.65 crore across eight years has seen Rs 32.77 crore utilised in the first two operational years: 0.546 percent of total [1]. FY 2025-26 T-Hub releases suggest acceleration is occurring (Rs 273.98 crore in two hubs by approximately November 2025), though full-year utilisation data are not yet available [4].

[FACT] QpiAI's Kaveri 64-qubit processor (operational November 2025) with a custom hardware union-find decoder achieving 1.5 microsecond cycle latency (March 2026) is India's most advanced and independently verified quantum intelligence-layer technical achievement [9].

[SOURCE-REPORTED] The global pure-play quantum workforce is approximately 16,500 professionals (QED-C 2026) [5]. India's 152 NQM researchers represent approximately 0.92 percent of this workforce [CALCULATION].

[FACT] India's DST Task Force published a quantum-safe PQC roadmap with a 2027 to 2029 migration timeline for Critical Information Infrastructure [2]. MeitY and CERT-In published a national PQC migration whitepaper in July 2025 [14]. No formal sector regulator mandate from RBI, TRAI, or SEBI had been issued as of August 2026.

[FACT] RSA-2048 cracking requires an estimated 10,000 to 1,000,000 physical qubits depending on architecture, per peer-reviewed preprints from 2025 to 2026. India's NQM 8-year target of up to 1,000 physical qubits is not designed for and cannot approach cryptographic relevance for adversarial cryptanalysis.

B. What the Model Infers

[INFERENCE] Hardware-first is capital-infeasible at India's current funding level. The low-case 10-year cost of Rs 8,000 crore exceeds the entire NQM allocation. A base-case partially competitive programme requires four times the NQM budget.

[INFERENCE] Intelligence-Led Hybrid produces the highest weighted capability score in the base-case model (0.60) and ranks first in the 13-criterion strategy scorecard (56 of 65, 86.2 percent). Pure Intelligence-First produces higher SQCE per rupee invested (0.0000783 vs 0.0000600) but lower total capability in sovereignty and defence dimensions.

[INFERENCE] Accelerated PQC implementation and enforcement is the highest-priority near-term intervention (policy matrix score 320 of 400) because it creates an estimated Rs 1,800 to 8,000 crore domestic market at near-zero new government fiscal cost, using existing regulatory frameworks.

[INFERENCE] The Quantum Intelligence Fellowship Programme at Rs 90 crore per year is economically justified: estimated cost per retained researcher of Rs 41 to 50 lakh is 3 to 5 times cheaper than the international alternative of training abroad and losing the researcher.

[INFERENCE] Intelligence-Led Hybrid remains consistent with all seven quantified falsification criteria; none is presently triggered. This does not mean the strategy is proven: it means the current evidence has not yet falsified it.

C. What India Should Do

India should pursue an intelligence-led hybrid quantum strategy: broad domestic capability in quantum software, AI, algorithms, quantum error correction, orchestration, and security as the primary commercial vehicle; selective domestic quantum processing unit development (targeting a proposed domestic target of approximately 256 to 1,000 physical qubits by 2031) for sovereignty in high-consequence national applications; multi-provider cloud QPU access for research and commercial workloads; and accelerated PQC implementation and enforcement as the highest-leverage near-term intervention.

The strategy should be executed in three phases. Phase 1 (2026 to 2028): accelerated PQC enforcement, NQM execution reform, Fellowship launch, QPU access contracts, and QIF structuring. Phase 2 (2028 to 2031): Fellowship scale-up to 1,000 per year, 256-qubit domestic QPU, NQM research output targets, and QIF Series A investments. Phase 3 (2031 to 2036): 500 to 1,000 qubit operational system, QIF exits, international quantum intelligence exports, and QVSRI Stage 2 achievement.

Three priority execution constraints will determine whether this strategy succeeds or remains an aspiration: NQM utilisation (currently 0.546 percent of total in two years, requiring structural reform to unlock); quantum talent pipeline (zero dedicated training seats despite existing AICTE curriculum, requiring the Fellowship as the primary instrument); and commercial capital (no dedicated quantum venture capital fund, requiring the QIF as the primary instrument).

D. What Would Falsify This Strategy

This strategy should be materially reassessed if any of the following are observed by the stated dates: no Indian quantum company other than QpiAI reaches USD 50 million or more in funding by 2030 despite QIF (questions capital efficiency hypothesis); NQM utilisation stays below 50 percent despite reforms by March 2027 (suggests systemic, not bureaucratic, constraint); no international quantum licensing revenue by December 2032 (questions the IP-export model); QPU access restriction occurs without a domestic fallback above 100 qubits (questions the sovereignty floor); no quantum patents filed by Indian entities by December 2028 (questions whether IP creation is an ecosystem behaviour); fellowship retention falls below 50 percent at the first cohort's third year (stipend is insufficient); or no Indian quantum company other than QpiAI achieves EBITDA-positive status by December 2030 (commercial model may not be replicable).

Final Statement

The intelligence-led hybrid strategy is supported by the evidence and the model constructed in this research. It is the best-available strategy for India given its capital, talent, infrastructure, and sovereignty constraints as understood in August 2026. It is not an empirically proven inevitability. Its success requires executing five specific interventions in sequence. Its validity should be assessed against seven measurable, time-bound conditions. It will require revision if any of those conditions is triggered.

QA Note: Unresolved Issues for Author Review

The following issues could not be safely resolved from source material alone. Each requires author confirmation before external circulation.

- [QA-1] Rs 30 crore per startup vs Rs 8.5 crore. Rajya Sabha Q. 3160 (Tier 1) records Rs 68 crore allocated to eight startups, equating to Rs 8.5 crore per startup [CALCULATION]. Swarajya May 2026 cites Rs 30 crore per startup without identifying the budget line. Author should obtain DST clarification before using either figure as primary evidence.
- [QA-2] FY 2025-26 T-Hub releases. The Organiser (December 2025) reports Rs 101.28 crore (Communication Hub) and Rs 172.70 crore (Computing Hub) in FY 2025-26. Whether these are full-year planned releases or partial-year actual releases to approximately November 2025 is ambiguous in the source. Author should verify with DST or the NQM programme office before citing as confirmed disbursement figures.
- [QA-3] QpiAI total funding: USD 38.5 million vs USD 65.6 million. Verified disclosed rounds total approximately USD 38.5 million. Swarajya May 2026 states USD 65.6 million total. The higher figure may include non-dilutive NQM grants or other instruments. Author should obtain QpiAI or NQM confirmation.
- [QA-4] QpiAI financial performance. EBITDA profitability, 60 percent gross margins, and 20 to 30 percent net margins are CEO-reported in a TechCrunch interview and have not been independently audited. If QpiAI's IPO prospectus or audited accounts become available before external circulation, those should replace the TechCrunch citation.
- [QA-5] India quantum patent count. No CGPDTM database query under IPC G06N10 was conducted in any phase of this research. All claims about India's near-zero quantum patent stock are [INFERENCE]. A direct CGPDTM or Espacenet database query should be conducted before external publication.
- [QA-6] Salary ratio. The India to US salary ratio of 3 to 8 times is calculated from QuantumJobsList India (Tier 3) and The Quantum Insider compiled salary data (Tier 3). Neither is a peer-reviewed salary survey. Replace with a primary salary survey where possible before high-stakes policy citation.
- [QA-7] FY 2023-24 NQM allocation. Kashmir Life reports Rs 704.10 crore as the FY 2023-24 planned allocation. If true, this changes the cumulative allocation picture. The 0.546 percent figure in this document refers to utilisation as a share of total 8-year mission (Rs 6,003.65 crore), which is precise regardless of year-by-year allocation pattern. Author should verify the FY 2023-24 actual vs planned allocation with DST and clarify the cumulative allocation to date in the text.

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