Japanese and US Quantum Partnerships: JV versus Acquisition Economics

A Transaction Framework for Access, Control, Talent and Industrial-Customer Pathways

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September 2026

Abstract

Japanese and US quantum partnerships sit at the intersection of scientific collaboration, industrial adoption and economic security. A Japanese participant can contribute advanced manufacturing, materials, high-performance computing, industrial customers and public-programme access. A US participant can contribute quantum hardware, software, cloud distribution, capital and a wider commercial ecosystem. The transaction question is how to combine those assets while allocating control, intellectual property, talent, security obligations and future investment.

This paper develops an evidence-led framework for choosing among a research alliance, contractual joint venture, equity joint venture, minority investment and acquisition. It compares market access, decision rights, technical control, background and foreground intellectual property, talent mobility, public-programme eligibility, industrial-customer pathways, regulatory exposure, capital commitment and exit flexibility. The framework treats the legal form as an operating-system decision rather than a label.

The evidence includes Japan's quantum strategies, the US National Quantum Initiative, bilateral US-Japan policy statements, NIST measurement work, Japan's foreign-investment and export-control framework, US investment screening and export controls, and public information concerning the University of Tokyo-IBM partnership and IBM's installation with RIKEN. The evidence establishes sustained public and commercial cooperation alongside controls over sensitive capability and information. Company statements are identified as company-reported information and are not treated as independently verified operating results.

A wholly hypothetical transaction illustrates the method. A Japanese industrial group evaluates an equity joint venture or acquisition of a US quantum platform using an enterprise-value reference of JPY 96 billion. Management attributes JPY 31 billion to verified technology and rights, JPY 19 billion to specialist talent and know-how, JPY 16 billion to industrial-customer access, JPY 13 billion to Japanese deployment and public-programme pathways, JPY 10 billion to software and data assets, and JPY 7 billion to other assets and strategic options. Under an acquisition structure, JPY 54 billion would be payable at closing, JPY 18 billion against technical milestones, JPY 13 billion through retention instruments and JPY 11 billion against customer and regulatory continuity. Every amount is a management assumption created solely to demonstrate the framework; it is not an observed transaction term, valuation, forecast or market benchmark.

The central conclusion is that a joint venture is strongest when both parties need continuing access to locally anchored capability, customer relationships or public programmes and when the contribution can be governed through auditable interfaces. An acquisition is strongest when integrated control is essential to product architecture, capital allocation and customer delivery and when screening, retention and contract-transfer risks are manageable. Price, ownership and reserved matters should follow verified *contributions and milestone evidence. The parties should preserve an escalation path from alliance to joint venture or acquisition where uncertainty remains material.*

JEL Classification: F23, G34, L22, L86, O32, O33, O38

Keywords: quantum computing, Japan, United States, joint ventures, mergers and acquisitions, cross-border partnerships, intellectual property, industrial customers, foreign investment screening, valuation

Introduction

Japan and the United States have built overlapping quantum ecosystems through national laboratories, universities, public programmes and commercial platforms. Japan's policy architecture links research, testbeds, industrial use cases, supply chains and talent. The United States combines the National Quantum Initiative, federal research agencies, national laboratories, cloud platforms and venture-backed companies. Bilateral policy statements place quantum technology among the capabilities expected to support economic and strategic cooperation.

The practical decision is whether a partnership creates access and capability that either party cannot obtain efficiently through an ordinary supply contract. The answer depends on control of hardware and software roadmaps, intellectual-property boundaries, Japanese industrial-customer relationships, US cloud and capital channels, talent, public-programme eligibility, export controls, investment screening and continuing capital needs. A joint venture can preserve local participation and ring-fence sensitive assets. An acquisition can unify direction and financing while increasing regulatory, integration and continuity risk.

This paper treats access, control and reversibility as distinct value dimensions. It provides a diligence and structuring method for boards, corporate-development teams, investors, universities and technical advisers evaluating Japanese-US quantum partnerships. The analysis does not express a preference for either country's technology or for one transaction form in every case.

1 Define the partnership decision

The board should state the constraint the partnership is intended to remove. A Japanese participant may seek proprietary access to a US hardware or software platform, a faster route to applications, or a position in global cloud distribution. A US participant may seek Japanese industrial customers, manufacturing depth, local facilities, patient capital or access to government-supported programmes. Each objective requires different rights, evidence and capital.

The decision statement should identify the capability expected after signing and the counterfactual. Management should compare a research agreement, commercial alliance, contractual joint venture, equity joint venture, minority investment, acquisition, licensing and internal development. The comparison should include time, capital, exclusivity, control, regulatory exposure, termination rights and the cost of unwinding shared systems.

Market-growth projections provide limited support for transaction logic. The decision should rest on a measurable change in capability, customer conversion, development time, capital intensity or strategic access. The transaction case should specify the evidence that would disprove the thesis, the rights each party receives and the milestones that trigger investment, control changes or exit.

2 Separate access value from control value

Access value arises when the structure gives a party reliable use of capability it cannot obtain on equivalent terms. It can include dedicated hardware, fabrication, materials, test infrastructure, cloud capacity, algorithms, industrial-customer channels, local deployment, public-programme participation and specialist teams. Access is valuable only when capacity, priority, duration, service level, data use and improvement rights are enforceable.

Control value arises when one party can set the roadmap, allocate capital, appoint leadership, protect security boundaries and resolve conflicts among products, customers and jurisdictions. Acquisition provides the broadest formal control, subject to law and negotiated protections. An equity joint venture divides control through ownership, reserved matters and board mechanics. A contractual joint venture relies on covenants and remedies while assets remain with their original owners.

Access and control interact. A party may obtain sufficient access without owning the asset. A controlling owner may still lack practical access if key rights, people, facilities or customer contracts cannot transfer. The board should model them separately and identify where local anchoring, public funding or customer trust makes shared control more valuable than formal ownership.

3 Compare modalities through transaction requirements

Superconducting systems use fabricated electrical circuits at cryogenic temperatures and can support fast gate operations and semiconductor-style process learning. They can require complex cryogenic, packaging, calibration and interconnect systems. Trapped-ion systems use atomic ions controlled through electromagnetic and optical techniques, often with high-fidelity operations and flexible connectivity, while facing engineering questions around speed, optical control and scale.

Neutral-atom systems arrange atoms with lasers and can offer large, reconfigurable arrays and application-specific analogue operation. Their path to universal fault-tolerant computation depends on control, gate, error-correction and continuous-operation progress. Photonic approaches use light and integrated optical components, with potential manufacturing and networking advantages alongside demanding source, detector, loss, switching and system-integration requirements.

The transaction comparison should connect each modality to the target's actual product and evidence. Public roadmaps and demonstrations describe direction; they do not guarantee reproducibility, scale, cost or commercial timing. The buyer should compare the acquired system against the buyer's intended workloads, manufacturing base, cloud model and capital plan.

4 Build a capability map rather than a qubit league table

A qubit count can describe system size without describing useful performance. The buyer should map physical qubits, logical qubits, gate fidelity, connectivity, circuit depth, error-detection and correction, uptime, calibration burden, job throughput, latency, software compatibility and workload results. Each measure should state test conditions, date, version and independent verification.

The map should distinguish scientific demonstration, engineering prototype, available product and contracted service. A result obtained on a selected device under laboratory conditions may be strategically important. Its transaction value depends on whether the target can reproduce it across devices, maintain it over time and expose it through an operable service.

Cross-modality comparison requires caution because native operations, compilation, analogue versus gate models and performance metrics differ. The buyer should use workload-level tests and resource estimates where possible. A conclusion should explain the trade-off rather than compress unlike systems into a single score.

5 Test the path to fault tolerance

Fault tolerance is a programme of architecture, codes, logical operations, decoding, control, fabrication and system engineering. The target should show how physical performance converts into logical capability, which error model applies, what overhead is expected and which milestones have been demonstrated. The buyer should examine the assumptions behind resource estimates and the sensitivity to fabrication yield, loss, crosstalk, control error and decoder performance.

Company roadmaps can support diligence when reconciled with published results, internal test data and engineering plans. Google's Willow announcement emphasised below-threshold error correction on increasing surface-code arrays. IBM's roadmap describes fault-tolerant modules and a longer-term system path. QuEra's roadmap emphasises neutral-atom error-correction demonstrations and continuous operation. Those statements concern different architectures and milestones.

The transaction model should value achieved evidence separately from future milestones. A large portion of modality value may depend on a fault-tolerance claim that remains unproven at the required scale. Contingent consideration can align payment with independently defined demonstrations.

6 Diligence the full hardware stack

The target's moat may sit outside the qubit device. Control electronics, lasers, cryogenics, vacuum systems, packaging, photonics, calibration software, firmware, compilers, test methods and manufacturing recipes can determine performance and cost. The diligence team should identify each critical component, its owner, supplier, replacement time and qualification status.

The buyer should request a system bill of materials and dependency graph. It should identify single-source items, export-controlled components, custom tooling, university licences, foundry agreements and long-lead equipment. Supply agreements should be reviewed for change-of-control rights, volume commitments, price resets, exclusivity and access to failure analysis.

Capital expenditure should be linked to roadmap milestones. A target may need a new fabrication line, cleanroom, cryogenic facility or optical assembly capability before it can deliver the forecast system. The purchase price and integration budget should include that requirement rather than treating it as ordinary post-close growth investment.

7 Verify reproducibility and manufacturing evidence

The buyer should distinguish one high-performing device from a repeatable process. Evidence can include yield, variation, calibration time, failure modes, component life, rework, acceptance testing and performance distribution across systems. The diligence sample should cover multiple devices and production periods where available.

Manufacturing plans should identify which steps are internal, outsourced or shared with research institutions. Intellectual property may protect device design while manufacturing know-how remains concentrated in a small team. The buyer should assess whether process records, tooling, supplier relationships and quality systems can survive staff turnover or a site disruption.

Reproducibility can be made a closing or payment condition. An independent team can build or qualify a device using controlled documentation. The test should protect sensitive technology while demonstrating that the acquired capability is organisational rather than personal.

8 Diligence intellectual property by dependency

Patent counts do not show freedom to operate, enforceability or operational importance. The buyer should map patents, applications, trade secrets, copyrights, licences and know-how to the product architecture and roadmap. It should identify inventors, assignees, prosecution status, geographic scope, government support, university rights and encumbrances.

The map should show which claims protect the current system and which address future architectures. It should also identify design-around risk and blocking rights held by others. Where the moat depends on trade secrets, the buyer should examine access controls, employee agreements, laboratory records and the extent to which knowledge is documented.

Government-funded and university-originated work may carry licence, reporting, march-in or data-rights considerations depending on the instrument. Qualified counsel should confirm the applicable rights. The transaction should not value an asset as exclusive until ownership and third-party rights are clear.

9 Assess talent as a technical system

Quantum hardware companies can depend on a small number of physicists, device engineers, control specialists and application leaders. The buyer should identify who owns each critical decision, relationship and undocumented method. An organisation chart should be supplemented by a capability and succession map.

Retention design should reflect the work required after closing. Founders may be essential for architecture, but senior engineers, technicians, programme managers and customer scientists can carry equally important knowledge. Retention instruments should use service, transfer and milestone conditions that are achievable and consistent with employment law.

The buyer should evaluate cultural and scientific governance. A large corporate process can improve quality and scale while slowing experimentation. Integration should preserve protected research paths with accountable milestones, peer review and access to shared engineering resources.

10 Define customer access precisely

Customer access can mean a signed contract, cloud listing, reservation, funded research award, pilot, application partnership, reseller arrangement or informal relationship. Each category has different economics and transferability. The buyer should classify the portfolio and avoid treating all named counterparties as revenue customers.

For each material relationship, diligence should cover legal counterparty, product, term, committed and optional value, cancellation, acceptance, pricing, renewal, data rights, intellectual property, exclusivity, security, change of control and required personnel. Usage data should show jobs, reservations, support demand and movement from experimentation toward recurring workloads.

Customer access is valuable when it shortens the buyer's path to paid, repeatable use. A relationship that depends on the target's independent status, founder or modality may weaken after acquisition. The buyer should validate transfer through contract language and customer conversations conducted under an approved process.

11 Separate cloud distribution from customer ownership

Cloud platforms broaden access and reduce the need for customers to procure each provider directly. Amazon Braket documents access to trapped-ion, superconducting and neutral-atom systems, with task, shot and reservation economics. Azure Quantum has also provided access to multiple hardware providers. These channels can create discoverability, workflow integration and billing infrastructure.

A listing does not by itself create a defensible customer asset. The platform may control the billing relationship, usage data, placement and commercial terms. Customers can compare or switch providers. The target's value depends on contractual rights, differentiated performance, support relationships and the ability to convert platform usage into durable demand.

The buyer should map who owns customer identity, workload metadata, application code, results and support records. It should test whether the acquisition creates a conflict with a platform or other hardware participants. Channel continuity and equal-treatment provisions can matter to valuation.

12 Evaluate Japanese public infrastructure and industrial access

Japanese quantum activity can depend on Cabinet Office strategy, research institutions, NEDO-supported projects, university facilities, testbeds and industrial consortia. The Japan-IBM Quantum Partnership and the IBM-RIKEN installation illustrate structures that combine foreign technology with Japanese academic, public and industrial participation. These examples are partnerships rather than transaction templates; their public features show why rights to facilities, service capacity, research results and local participation should be mapped precisely.

The contract schedule should state the public or industrial counterparty, instrument, funding status, deliverables, acceptance tests, intellectual-property and data provisions, location conditions, eligibility and change-of-control requirements. Participation in a programme can validate technical relevance without establishing recurring revenue. The parties should distinguish funded development, procurement, research access, announced collaboration and paid production service.

Eligibility can depend on establishment, ownership, personnel, facilities, cybersecurity, supply-chain resilience and continuing Japanese capability. The parties should confirm whether a joint venture, minority investment or acquisition changes programme access, site use, information handling, procurement status or consent requirements. Strategic-access value should reflect termination, budget, milestone and replacement risks.

13 Map public-funding, data and intellectual-property rights

Publicly funded work can create value and restrictions simultaneously. Technical data, software, reports, interfaces, patents and test results may be subject to grant terms, consortium agreements, procurement clauses, university rights or negotiated licences. The target may own foreground intellectual property while another participant or authority holds access, use or dissemination rights.

The diligence team should trace each material capability to its funding source and executed instrument. It should examine background rights, foreground ownership, access rights, publication obligations, exploitation commitments, location conditions, reporting, repositories, subcontractor flow-downs and change-of-control provisions. Inconsistent records can weaken the assumed exclusivity or transferability of an asset.

The buyer should identify rights needed to reproduce, improve and commercialise the technology. A public customer's or consortium partner's rights may facilitate alternative suppliers or constrain exclusivity. The resulting asset may remain valuable, with a different durability, pricing and integration path from wholly proprietary technology.

14 Analyse revenue quality and concentration

Quantum revenue can include hardware sales, cloud usage, reservations, consulting, development contracts, grants and milestone awards. The buyer should separate each stream by margin, cash conversion, recurrence, cancellation and technical dependency. Reported growth can be driven by a small number of awards or acquisitions.

Public partnership announcements describe access to advanced systems, research programmes and industrial collaboration. They do not disclose complete unit economics, customer conversion or profitability. The transaction model should therefore value contracted revenue, funded work and evidenced customer usage separately from announced ecosystem participation.

The buyer should build customer cohorts and contract waterfalls. It should identify how much revenue depends on one agency, platform, research partner or application team. Concentration can be acceptable when the relationship creates technical learning and renewal evidence; it should still be reflected in scenario analysis and liquidity planning.

15 Test application evidence and willingness to pay

The transaction thesis should name the workloads that the combined system is expected to serve. Chemistry, materials, optimisation, machine learning and security are broad categories. The buyer should identify the problem instance, classical baseline, quantum resource requirement, accuracy, total workflow cost and decision value.

Scientific advantage, computational advantage and commercial value are separate tests. A benchmark can show performance beyond a classical method under defined conditions without establishing a paid workflow. An application pilot can show customer interest without establishing scalability or renewal.

Customer diligence should ask what decision changed, what classical method was displaced or complemented, which budget funded the work and what evidence would support expansion. Willingness to pay should be based on contracts and observed behaviour where available. Future application value should remain a scenario until supported.

16 Build the Japanese-US regulatory perimeter

Japanese-US quantum transactions can involve Japan's Foreign Exchange and Foreign Trade Act, US CFIUS review, merger control, export administration, sanctions, public-funding conditions, government contracting, research-security rules and cybersecurity. The perimeter depends on ownership, technology, end use, customers, location, source of funding and information access. Qualified counsel should confirm the current requirements for the specific transaction.

Technology classification affects diligence access, engineering collaboration, cloud environments, employment, technical assistance and future sales. The transaction timetable should include classification, licensing and screening analysis before broad data-room access. The parties should map which people may view source code, device designs, process data and customer information and should design clean teams where access is restricted.

The structure should protect sensitive capability while allowing the partnership to operate. Potential mitigation should be converted into facility, governance, access, capital-expenditure, delay and reporting costs before the board approves value. A joint venture can create regulatory exposure when it grants substantive access or control.

17 Evaluate competition and ecosystem foreclosure

Competition analysis should examine current products, research capabilities, future product pathways, talent, essential inputs, cloud distribution and industrial channels. Direct revenue overlap can understate competitive significance in a market where technical programmes have long development cycles and customers may depend on a small number of credible providers.

The parties should map competing research paths, critical inputs, suppliers, platforms, public programmes and potential customers in both countries. They should identify whether the structure could restrict access to scarce hardware, fabrication, materials, control technology, data or customer channels; expose a partner's competitively sensitive information; or create incentives to favour one ecosystem. Patent citation, engineering-team overlap, R&D expenditure and technical dependency can inform the assessment when interpreted with scientific context.

Efficiency claims require evidence, timing and a credible implementation path. Shared facilities, software, engineering and sales can support the case when compatibility and capacity are demonstrated. Information barriers, non-discrimination, supply commitments, interoperability and preservation of independent research paths may address specific concerns. Their cost should be included in the transaction model.

18 Design technical diligence around falsifiable tests

Technical diligence should begin with management's most consequential claims. Each claim should have a test, dataset, version, owner, acceptance threshold and failure implication. Examples include a reproducible fidelity level, logical-error trend, calibration time, job throughput, manufacturing yield or workload result.

The buyer should use independent experts who can evaluate the modality without disclosing restricted information improperly. Clean-room or staged access may be necessary. The diligence report should state what was observed, what was reproduced, what was reviewed only as documentation and what could not be verified.

Claims that cannot be tested before signing can move into transaction mechanics. Holdbacks, milestones, access rights and termination provisions can allocate the uncertainty. A generic warranty that all technology works as intended provides limited protection against roadmap risk.

19 Construct a modality-adjusted valuation

Valuation should separate achieved assets from roadmap options. Achieved value can include functioning systems, patents, software, contracts, qualified facilities and reproducible know-how. Option value can include future fault-tolerance milestones, manufacturing scale, application breakthroughs and new markets. The discount rate or probability should reflect technical and commercial dependencies.

The model can use cost, income and market evidence selectively. Replacement cost may support specialised facilities and documented development, although it does not measure the probability of success. Income analysis can support contracts and customer relationships when cash flows are identifiable. Market transactions require careful normalisation because consideration, stage, modality and strategic context differ.

The board should see a value bridge by capability. A single enterprise value can conceal whether management is paying for technology, talent, channel, contracts, strategic defence or market signalling. Each component should have evidence and a post-close owner.

20 Use milestone-based consideration

Quantum roadmaps create a strong case for contingent consideration when milestones are objective, material and controllable. Technical milestones can include independently reproduced performance, a logical-qubit demonstration, manufacturing yield, continuous operation, system delivery or acceptance. Commercial milestones can include funded awards, customer conversion, renewals or gross-margin thresholds.

The agreement should define the test environment, responsible evaluator, permitted changes, data access, timing, dispute process and treatment after integration. A milestone should not depend entirely on the buyer's discretionary resource allocation. Sellers should have visibility into the work needed to achieve it.

Consideration can combine closing payment, milestone shares, retention instruments and customer-conversion payments. The allocation should distinguish purchase price from compensation and consider accounting and tax consequences. Qualified advisers should confirm the treatment.

21 Protect the roadmap through integration governance

The combined company needs one accountable roadmap. Modality teams may retain distinct research programmes, but shared capital, customers and engineering dependencies require explicit governance. The integration plan should identify which architecture remains primary, which capabilities are experimental and which decisions require board review.

A technical integration council can reconcile hardware, control, software, error correction, manufacturing and application priorities. It should own interfaces, resource conflicts and milestone evidence. Commercial teams should not promise capabilities outside the approved roadmap.

Integration should preserve useful scientific independence while removing duplicated corporate functions deliberately. Early consolidation of laboratories, toolchains or supplier relationships can destroy evidence and slow development. Sequencing should follow technical dependencies.

22 Retain customers during the change of control

The buyer should communicate the combined product, support model and data treatment before uncertainty drives customers to alternatives. Material customers may require consent, security review or revised ordering arrangements. Government counterparties may require notification or novation depending on the instrument.

The retention plan should identify customer owner, workload, contract status, technical dependency, change-of-control requirement, next decision and risk. It should protect continuity of cloud access, reservations, support and application teams. Pricing changes should follow evidence of improved capability rather than the announcement alone.

Customer conversion payments can align deal value with retained and expanded business. The metric should use collected or contractually committed value, defined margin and a clear attribution period. Pilots and non-binding collaborations should not receive the same treatment as recurring paid workloads.

23 Govern security and controlled information

Quantum companies can hold controlled technology, government information, customer data, source code, fabrication records and sensitive research. The integration perimeter should classify repositories, identities, laboratories, devices and collaboration tools before broad access is granted.

The buyer should preserve least privilege, export-control restrictions, contractual access limits and incident evidence. Employees and contractors should be mapped by nationality, location, role and authorisation where legally relevant. Sensitive diligence material should not migrate automatically into ordinary integration systems.

The Day One plan should define security authority, incident escalation, key custody, logging and continuity. A transaction can create risk if two strong control environments are connected without a common design. Security integration should follow a documented architecture and regulatory advice.

24 Build the capital and liquidity plan

Purchase price is one part of the capital requirement. The buyer may need to fund facilities, equipment, foundry commitments, component inventory, research programmes, retention, customer support and operating losses. The integrated model should show liquidity under technical delay and customer-conversion scenarios.

Equity can absorb roadmap risk. Debt may suit predictable assets or contracted cash flows when covenants recognise development volatility. Government awards and customer prepayments can support milestones, subject to restrictions and performance obligations. The financing mix should not force a premature technical claim to satisfy a near-term covenant.

The board should approve an acquisition reserve for technical and commercial remediation. It should identify conditions that trigger capital reallocation, partnership or programme closure. Strategic importance does not remove the need for portfolio discipline.

25 Define the first 100 days

The first 100 days should protect evidence, people, customers and roadmap accountability. Day One priorities include security, permissions, payroll, customer continuity, laboratory safety, supplier access and decision rights. The integration team should freeze destructive system changes until baselines are captured.

By Day 30, the company should reconcile the capability map, contracts, intellectual property, controlled information and capital plan. By Day 60, it should approve the combined roadmap, customer ownership and supplier actions. By Day 100, it should publish an internal milestone baseline with accountable owners and board reporting.

The plan should include explicit non-actions. Facilities, code repositories, brands and research programmes may remain separate until evidence supports consolidation. Delay can be a controlled decision when it preserves technical value.

26 Monitor value through a deal dashboard

The board dashboard should connect technical, commercial and financial evidence. Measures can include independently verified performance, system availability, job throughput, manufacturing yield, roadmap spend, critical retention, contract value, customer conversion, gross margin, government eligibility and integration risk.

Each measure should state baseline, target, owner, source and decision threshold. Metrics should remain comparable across periods and system versions. A technical improvement that increases cost or reduces availability should be visible as a trade-off.

The dashboard should separate observed results from management forecasts. It should also show milestone consideration and liquidity exposure. The purpose is to support capital allocation and intervention rather than to present a favourable narrative.

27 Prepare downside and exit paths

The buyer should plan for technical delay, modality reprioritisation, customer loss, regulatory restrictions and key-person departure. The downside plan can include licence structures, asset sales, team carve-outs, partnerships, research discontinuation and preservation of transferable intellectual property.

Transaction documents should secure access to records, source, tooling, suppliers and personnel needed to maintain acquired assets. Contingent consideration should adjust when milestones fail for defined reasons. Retention packages should avoid trapping capital in a programme that the board has rationally discontinued.

Exit value depends on clean ownership and separability. The integration design should record which assets and contracts belong to each programme. Excessive technical entanglement can make a future sale or partnership difficult.

28 Set the board decision agenda

The board should ask whether the deal removes a defined constraint, whether the target's capability has been reproduced, whether proposed shared inputs are technically compatible, whether independent failure paths remain valuable, whether regulatory paths are viable and whether the combined roadmap can be funded. It should understand the portion of value attributable to achieved evidence, realised scale and future modality options.

Approval conditions should include technical tests, intellectual-property confirmation, material contract consents, regulatory analysis, retention, security controls and a funded integration plan. The decision record should identify unresolved matters and the mechanism that prices or controls each one.

The final question is accountability. One executive should own shared infrastructure, each retained modality should have a named technical owner, one executive should own customer conversion and one board process should reconcile capital with evidence. The governance system should state which choices remain independent, which resources are shared and which evidence triggers concentration or withdrawal.

Conclusion

A Japanese-US quantum partnership should be valued as a system of evidenced rights, capabilities and customer pathways. Access matters when capacity, priority, duration and improvement rights are enforceable. Control matters when integrated decision-making materially improves product development, capital allocation or customer delivery. Reversibility matters while technical, regulatory and commercial uncertainty remains high.

The transaction should separate those value pools, test their dependencies and connect investment or consideration to technical, commercial and regulatory milestones. Technical diligence should be falsifiable. Access diligence should identify the exact resource, capacity and rights provided. Regulatory diligence should shape information access, structure and timetable. Operating design should preserve scientific value while establishing explicit decision rights and an evidence-based capital-allocation process.

Boards can then make a disciplined choice among research alliance, contractual joint venture, equity joint venture, minority investment, acquisition and internal development. The objective is a structure with a higher probability of technical and commercial success at a sustainable capital cost, supported by evidence that can be reviewed after signing and at each funding gate.

Appendix A Access-and-control test

The access-and-control test asks whether the structure changes either party's customer reach, technical capability, time to evidence, capital requirement or decision authority. Each claimed benefit should identify the right granted, scope, duration, priority, implementation cost, regulatory dependency and responsible team.

The test should compare alliance, contractual joint venture, equity joint venture, minority investment, acquisition, licensing and internal build. It should state which assets and contracts are transferable and which depend on individuals, suppliers, universities, public programmes or government permissions. A benefit that depends on unverified access or future utilisation should remain contingent value.

The test should be repeated after material changes in roadmap, regulation, supply chain or technical evidence.

Appendix B Joint-venture quality test

The joint-venture quality test asks whether each party contributes assets or access that the other cannot obtain efficiently through an ordinary contract. It should identify background rights, foreground ownership, exclusive and non-exclusive licences, people, facilities, customers, funding and decision authority. A vehicle with few dedicated assets and no enforceable access rights provides limited strategic value.

Each contribution should be classified as transferred, licensed, seconded, supplied, funded or conditional. Value should reflect durability, exclusivity, remaining capital, regulatory permissions, time to decisive evidence and the cost of replacing the contribution.

The test should use executed agreements, reproduced technical results and documented resource dependencies. Future performance should remain a scenario until supported by defined evidence.

Appendix C Quantum partnership data room

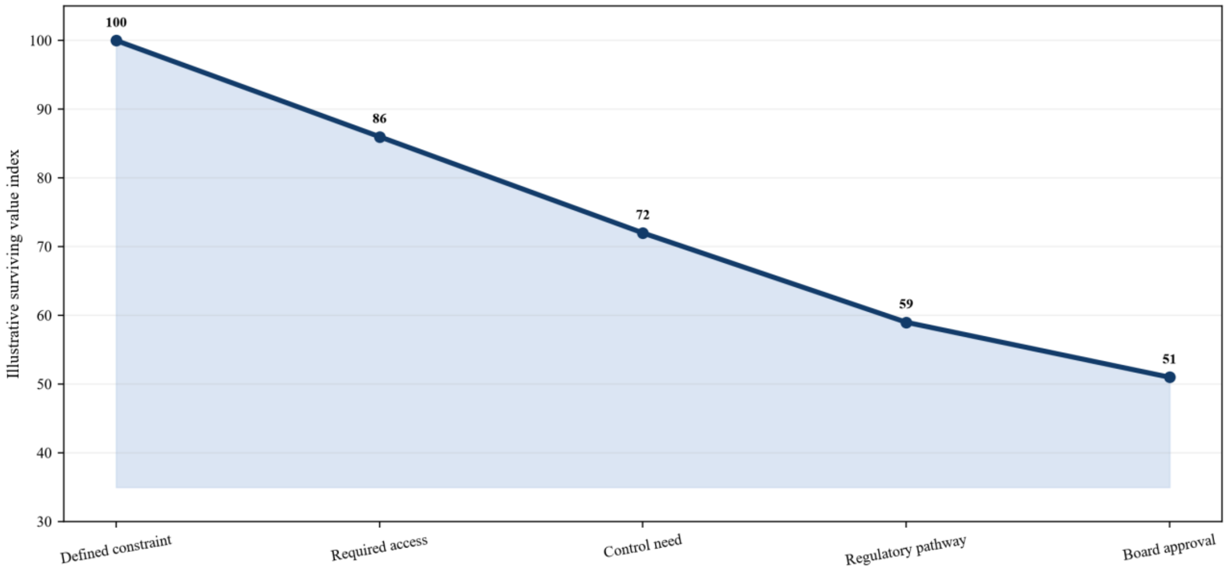
The data room can contain architecture, performance evidence, test protocols, device history, error-correction plans, manufacturing records, bills of materials, supplier agreements, software repositories, patent schedules, invention records, university and government rights, employee agreements, customer contracts, cloud arrangements, public-programme instruments, regulatory classifications, security documentation and financial models.

Restricted technical material should use a controlled review process. The diligence report should record information that could not be reviewed and the resulting decision limitation. Missing evidence should become a condition, holdback or milestone.

The final data room should support integration and future financing. Records required to reproduce claims, operate systems and evidence rights should move into controlled repositories with named owners.

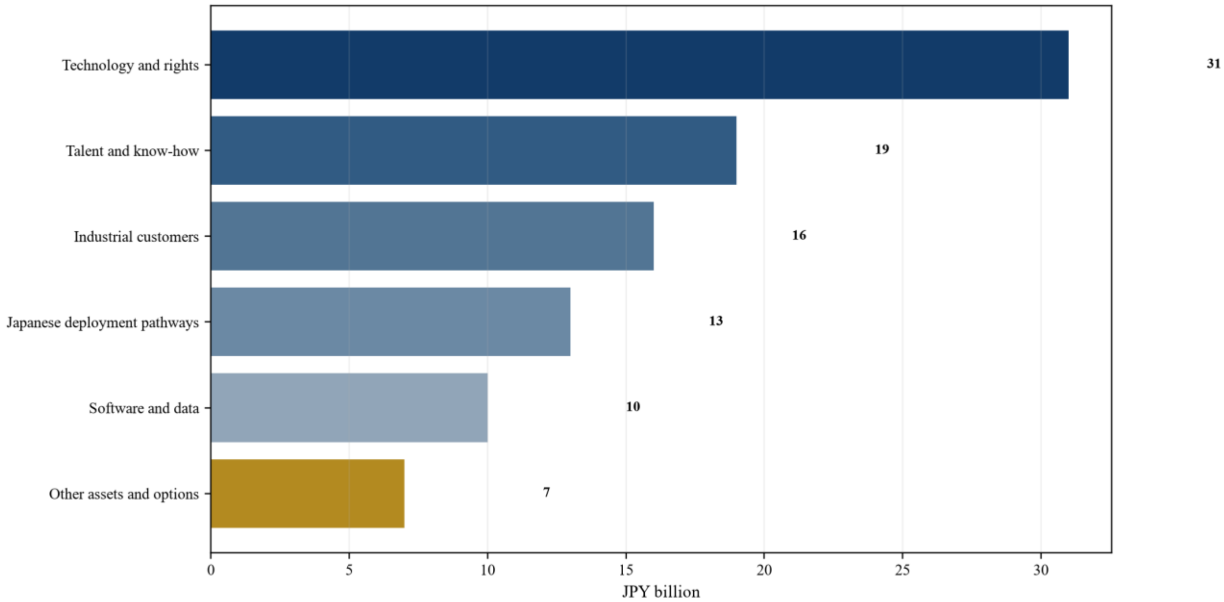
Appendix D Decision figures and tables

Figure 1. Access-control transaction decision path



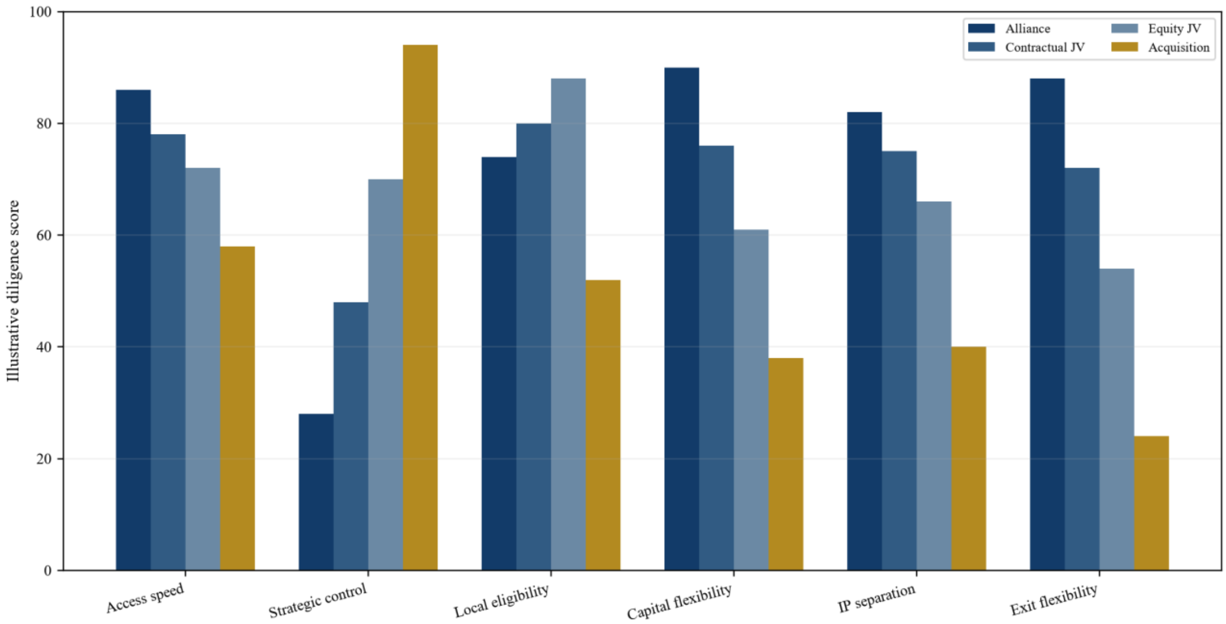
Proposed sequence for selecting alliance, joint venture, minority investment or acquisition.

Figure 2. Hypothetical Japanese-US quantum transaction value allocation



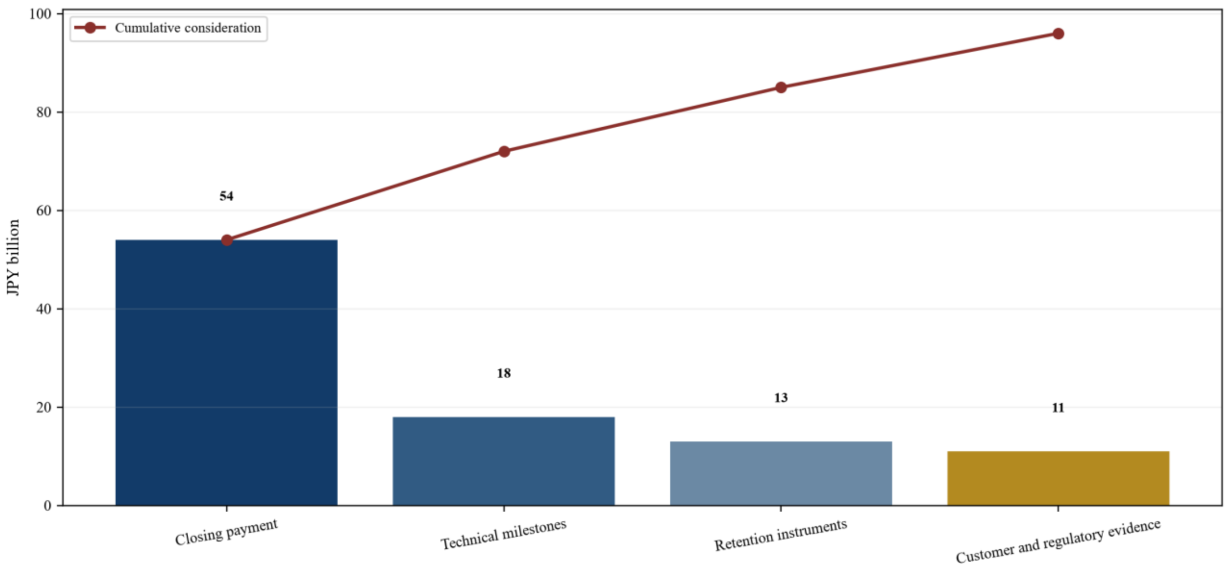
Wholly hypothetical management assumptions; JPY billion.

Figure 3. Illustrative transaction-form profile



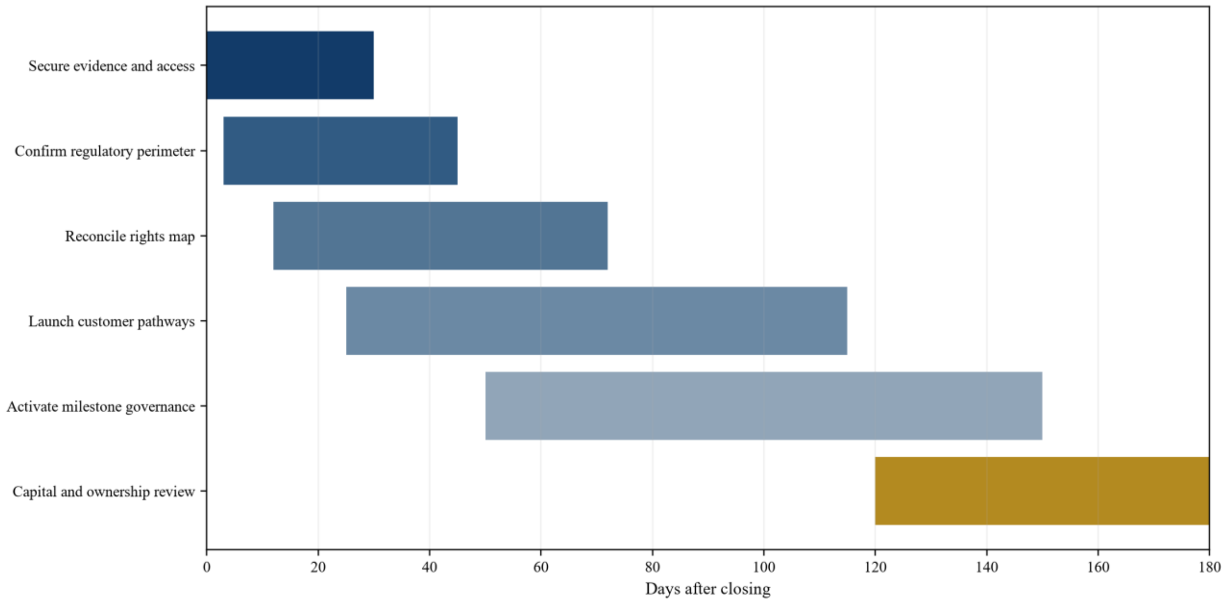
Proposed scoring framework; scores are management assumptions, not observed transaction results.

Figure 4. Hypothetical evidence-based consideration release



Wholly hypothetical acquisition structure; JPY billion.

Figure 5. Proposed 180-day partnership launch and integration sequence



Sequencing should preserve evidence, regulated-access boundaries and customer continuity.

Table 1. Modality diligence matrix

Area	Superconducting	Trapped ion	Neutral atom	Photonic
Core engineering	Cryogenics, fabrication, packaging and calibration	Traps, lasers, optics and control	Atom arrays, lasers, control and continuous operation	Sources, detectors, loss, switching and integration
Scale question	Yield, wiring, interconnect and error correction	Optical control, speed, modularity and manufacture	Gate quality, universal operation and correction	Component loss, fusion, feed-forward and manufacture
Deal evidence	Multi-device performance and process control	Reproducible fidelity and scalable control	Repeated arrays, gates and logical evidence	Manufacturable components and end-to-end loss budget

Area	Superconducting	Trapped ion	Neutral atom	Photonic
Integration risk	Facility and stack duplication	Specialist-team and optical-system dependency	Roadmap and application-model transition	Supply chain and system-assembly dependency

Proposed transaction questions; no modality is universally preferred.

Table 2. Partnership-form evidence

Thesis	Required evidence	Principal dependency	Transaction treatment
Research or commercial alliance	Defined work packages, access rights and service levels	Capacity, priority, data use and renewal	Milestone fees and termination rights
Contractual joint venture	Joint programme, contribution and governance map	Enforceability, interfaces and remedies	Staged funding and escalation rights
Equity joint venture	Transferable contributions, business plan and reserved matters	Deadlock, future funding and exit	Capital tranches and buy-sell mechanics
Acquisition	Reproduced capability and transferable control	Screening, retention, contracts and integration	Milestone consideration and holdback

Proposed minimum evidence by structure.

Table 3. Modality-option quality ladder

Option type	Evidence	Value support	Main risk
Reproduced programme	Independent test, repeatability and funded roadmap	Achieved capability and cash-flow option	Scale and customer conversion
Funded development path	Approved capital, milestones and accountable team	Probability-weighted option value	Delay and capital overrun
Shared-input adjacency	Demonstrated compatibility and capacity	Measurable cost or time benefit	New bottleneck or switching cost
Exploratory research path	Defined hypothesis and decision gate	Capped learning value	No decisive evidence or budget
Narrative option	Presentation or unsigned collaboration	Limited strategic value	Unsupported probability and duration

Proposed classification for valuation and capital allocation.

Table 4. Hypothetical transaction value allocation

Value component	Illustrative amount	Evidence gate	Downside treatment
Technology and rights	JPY 31 billion	Reproduced system tests and rights confirmation	Milestone shares and holdback
Talent and know-how	JPY 19 billion	Critical-team retention and transfer plan	Service-based retention instruments
Industrial-customer access	JPY 16 billion	Consent, usage and conversion evidence	Customer milestone payments
Japanese deployment and programme pathways	JPY 13 billion	Eligibility, facility and contract evidence	Regulatory and continuity condition

Value component	Illustrative amount	Evidence gate	Downside treatment
Software and data assets	JPY 10 billion	Interface, rights and customer-use evidence	Technical acceptance milestone
Other net assets and option value	JPY 7 billion	Asset verification and board-approved roadmap	Capped upfront allocation

Wholly hypothetical management assumptions; not observed transaction terms.

Table 5. Regulatory and contract gate map

Gate	Diligence question	Evidence	Decision consequence
Export control	What technology and access are controlled?	Classification, licences and access map	Information perimeter and closing timetable
Foreign investment	Does ownership or access create a national screening issue?	Ownership, technology, location and customer analysis	Filing, mitigation or structure
Merger control	Does the deal remove an innovation path or foreclose a scarce input?	R&D, dependency, input and information map	Remedy risk and thesis adjustment
Public programmes	Do awards, rights and eligibility survive change of control?	Instrument, clauses, consents and eligibility	Consent, mitigation and valuation
Data security	Can systems and repositories be combined lawfully?	Classification, architecture and controls	Staged integration and information barriers

Qualified counsel should confirm the current transaction-specific requirements.

Table 6. First 180-day board dashboard

Measure	Day 10	Day 45	Day 90	Day 180
Technical evidence	Baselines secured	Capability map reconciled	Independent paths approved	Milestone results reviewed
Customers	Continuity owners assigned	Consents and risks mapped	Conversion plan active	Retention evidence reported
People	Critical roles confirmed	Retention executed	Succession gaps funded	Capability transfer measured
Regulation	Access controls preserved	Filing and licence map current	Mitigation actions funded	Compliance dashboard active
Capital	Liquidity protected	Integration budget reconciled	Option budgets approved	Portfolio allocation reviewed

Proposed evidence schedule.

Table 7. Board approval thresholds

Decision area	Green evidence	Amber condition	Red condition
Scale	Compatible shared inputs create timed and measurable savings	Material saving remains testable and priced	Claimed saving requires incompatible systems or unavailable capacity
Diversification	Independent path has reproduced evidence and funded gates	Option has bounded capital and a decisive milestone	Path duplicates failure drivers and lacks a decision gate

Decision area	Green evidence	Amber condition	Red condition
Regulation	Viable classification, filing and operating path	Defined approval risk with protected timetable	Required access or ownership is unlikely to be permitted
Integration	One roadmap, owners and funded sequence	Temporary duplication with decision date	Conflicting architectures and no accountable owner
Economics	Value bridge and downside funding are explicit	Option value is capped and milestone-linked	Price depends on unsupported market projection

Proposed decision framework.

Frequently asked questions

Q: Should a buyer choose a quantum target primarily by qubit count? A: No single qubit count establishes useful performance or transaction value. The buyer should evaluate fidelity, connectivity, logical capability, circuit depth, throughput, uptime, reproducibility, manufacturing, workload fit and the full control stack under defined test conditions.

Q: How should superconducting, trapped-ion, neutral-atom and photonic companies be compared? A: Compare each target against the buyer's intended workloads, fault-tolerance plan, manufacturing base, capital capacity and route to market. Use modality-specific tests and workload evidence. Avoid compressing unlike architectures into one unsupported ranking.

Q: When does consolidation create genuine scale economics? A: Scale value requires a specific shared input, demonstrated technical compatibility, sufficient capacity, a timed implementation plan and a measurable reduction in capital, unit cost or delivery time. A broad corporate-overhead estimate provides limited evidence of hardware scale.

Q: How should technical roadmap risk affect consideration? A: Separate achieved capability from future options. Pay a larger portion of uncertain value through objective technical milestones, retention instruments, customer-conversion payments or holdbacks. Define tests, data access, timing and dispute procedures precisely.

Q: What should the parties examine in Japanese public programmes? A: Review the executed instrument, funding, acceptance, security, audit, intellectual-property, data-rights, change-of-control, location and eligibility provisions. Confirm whether the selected structure, facilities and required personnel can continue performance.

Q: When does a second modality provide diversification value? A: A second modality provides diversification when it has materially different failure drivers, supply-chain dependencies, technical evidence and workload applications. The option should have a bounded budget, a decisive milestone and a governance path that preserves technical independence.

Q: What is the principal integration risk in a cross-modality merger? A: The combined company can retain several expensive roadmaps while forcing them through shared resources that are not technically compatible. Named owners, protected evidence paths, explicit interfaces and capital decision gates reduce this risk.

Q: What should the board require before approving a Japanese-US quantum partnership? A: Require a defined constraint, reproduced technical evidence, an access-control map, verified intellectual-property rights, regulatory and competition analysis, programme continuity, retention, a funded operating plan, milestone economics and downside liquidity.

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