Protecting Quantum Innovation As The Sector Commercializes

By **Michael Schallop** (July 16, 2026)

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Quantum technologies are transitioning from primarily academic research programs into commercially focused enterprises, attracting substantial public and private investment.

On May 21, the U.S. Department of Commerce announced letters of intent for $2 billion in proposed incentives for quantum companies, including quantum foundries and quantum computing developers, to support the development of domestic quantum capabilities.

The program reflects growing recognition that quantum technologies may have strategic importance for national security, advanced manufacturing, scientific discovery and economic competitiveness.[1]

Congress is likewise considering reauthorization and expansion of the National Quantum Initiative, originally enacted in 2018. Legislation introduced in the U.S. House of Representatives in April, H.B. 8462, would extend federal efforts beyond basic research to encompass workforce development, commercialization, manufacturing, supply chain resilience and deployment of practical quantum applications.[2]

Simultaneously, private capital continues to flow into quantum startups, publicly traded quantum companies and strategic partnerships among technology companies, universities and government laboratories.[3]

As quantum technologies move from the laboratory to the marketplace, intellectual property is increasingly becoming an important consideration for quantum technology startups and an area of potential competitive differentiation for private capital investment and marketplace advantage.[4]

Quantum Computing: Real Opportunities and Persistent Hype

The conceptual origins of quantum computing are commonly traced to Richard Feynman's landmark 1982 paper "Simulating Physics with Computers," which argued that quantum systems may be uniquely suited for simulating other quantum systems.[5]

One of the principal drivers of governmental investment remains the prospect that

sufficiently advanced quantum computers could execute Shor's factoring algorithm and potentially compromise public-key cryptographic systems, e.g., public-key cryptography is central to key exchange, authentication and digital signatures, while bulk data encryption typically uses symmetric cryptography. Such concerns have contributed significantly to global competition in quantum technologies.[6]

At the same time, practitioners should resist overstating the technology's capabilities. For example, quantum computers are not expected to replace conventional classical computers, and we will not have a quantum processing unit integrated into our laptops or smartphones in the foreseeable future. Rather, quantum computers may deliver polynomial or exponential computational advantages only for specific classes of problems, including:

- Quantum chemistry;
- Materials discovery;
- Drug development;
- Optimization;
- Selected machine learning tasks; and
- Certain cryptographic applications.[7]

Most observers expect hybrid environments where cloud-accessible quantum resources operate alongside traditional high-performance computing systems. Likewise, the growing catalog of known quantum algorithms demonstrates that quantum advantage is highly application-specific, rather than universal.[8]

For IP purposes, patent portfolios grounded in practical and strategic technical advances are generally more durable than those built around speculative promises or short-term, stopgap solutions to current technological implementation challenges.

Quantum and Artificial Intelligence: Accelerating Innovation

The intersection of quantum computing and artificial intelligence has generated significant excitement.[9] Several practical use cases, however, are emerging.

First, machine learning is increasingly being explored for calibration, error characterization, decoding and quantum error correction systems.[10]

Second, quantum simulations may eventually produce training data unavailable or prohibitively expensive to obtain through classical methods. Potential applications include rare-disease modeling, novel materials discovery and complex physical simulations.

Third, quantum machine learning seeks to leverage quantum-mechanical phenomena, such as superposition and entanglement, to accelerate selected machine learning workloads.

The broader implication is an accelerating pace of technological innovation. As AI and ML tools and quantum systems become increasingly integrated, organizations may experience shorter innovation cycles and larger volumes of potentially patentable inventions, raising new questions regarding inventorship, ownership, disclosure obligations, timing and pace of patent filings, and portfolio management.

Government Funding and Bayh-Dole Considerations

Many quantum technologies have been developed and, in the future, will continue to be developed with public funding, given the current U.S. federal public investment strategy.

Patent applications arising from federally funded research frequently contain government-support statements identifying grants from agencies, such as the National Science Foundation, Defense Advanced Research Projects Agency, Office of Naval Research and Army Research Office.

The Bayh-Dole Act and implementing regulations require disclosure/election obligations and government-rights statements where inventions are conceived or first actually reduced to practice under federal funding agreements.

As such, practitioners working with quantum technology entities should evaluate:

- Bayh-Dole obligations;
- Invention-reporting requirements;
- Government licenses;
- March-in rights considerations;
- Data-rights provisions; and

- Funding-related diligence issues during acquisitions and licensing transactions.

Failure to address these issues early can create complications later during investment, financing or exit transactions.

Quantum Deep Tech: University Spinouts and Technology Transfer

A significant portion of today's quantum industry originated within university research laboratories.

The commercialization trend is increasingly evident. At the 2026 Quantum Error Correction Conference in Santa Barbara last month, participation appeared to reflect a meaningful presence of both academic researchers and private sector companies, suggesting that the quantum computing space is reaching an important commercialization inflection point.

University-originated startups frequently encounter issues involving:

- Exclusive licensing arrangements;
- Faculty consulting;
- Student inventorship;
- Sponsored research agreements;
- Publication rights; and
- Ownership and prosecution control of university-research-developed intellectual property.

Carefully structured technology-transfer agreements can help avoid future disputes concerning ownership and commercialization rights.

Inventorship and Ownership in Collaborative Research

Quantum technology-related innovation often arises through collaborations involving startups, universities, national laboratories and large technology companies.

Accordingly, inventorship should receive heightened attention.

Organizations should maintain rigorous invention-disclosure processes and contemporaneous technical documentation. Incorrect inventorship can affect patent ownership, validity, enforceability and standing.

Joint ownership presents additional concerns. Unless modified by agreement, under U.S. patent law, each joint owner may generally practice, license or otherwise exploit the patent without accounting to the other joint owners. Moreover, all co-owners are generally needed for infringement standing unless rights are contractually structured.

Because the default U.S. law provisions may not align with commercial expectations, collaboration agreements should address licensing rights, enforcement authority, revenue sharing and prosecution control. Finally, AI/ML usage during research and development can also present complications that should be properly resolved prior to patent filings.[11]

Patent Eligibility

Patent eligibility under Title 35 of the U.S. Code, Section 101, remains an issue facing quantum patent applicants.

Many quantum innovations involve algorithms, mathematical techniques, optimization approaches and physical principles that could invite Section 101 scrutiny.

Applicants should focus claims on, for example:

- Specific technological improvements that have well-defined practical applications, such as improving gate fidelity, reducing error rates, improving qubit control, reducing calibration time or improving quantum circuit execution of a quantum computer;
- Novel quantum hardware architectures or quantum networking interconnects;
- Enhanced quantum error correction or QEC decoding;
- Quantum sensing implementations; and
- Practical technological applications, e.g., quantum cryptography.

Patent claims directed merely to nontechnical fields and/or abstract mathematical concepts or scientific laws are likely to face increased eligibility challenges.[12]

The claims should therefore be anchored to concrete hardware, control, calibration, sensing, networking or data-processing improvements, rather than framed solely as mathematical transformations or desired quantum outcomes.

Written Description and Enablement

Because quantum technologies remain scientifically complex and relatively unpredictable, enablement and written-description requirements deserve particular attention. As an example, while it is important to pursue broad patent claim coverage, overly broad functional claiming may be vulnerable where the disclosure does not enable the full scope without undue experimentation.[13]

Patent specifications should consider including:

- Experimental data;
- Detailed architectures;
- Device parameters;
- Fabrication techniques;
- Calibration methodologies;
- Operational examples; and
- Performance measurements.

Emerging technologies frequently receive greater scrutiny than mature engineering disciplines, making robust disclosures especially important.

Publication Timing and International Patent Rights

Publication culture remains deeply embedded within quantum technology research fields. Conference presentations, preprints, dissertations, journal articles and open-source releases can significantly affect patent rights, particularly outside the U.S.

As such, organizations should establish publication-review procedures that evaluate:

- Patent-filing readiness;
- Foreign-filing implications;

- Trade secret considerations;
- Competitive risks; and
- Defensive-publication opportunities.

The coordinated balance between academic publication and proprietary protection is an important consideration in safeguarding quantum innovation and IP strategies.

Strategic Patent Portfolio Development

A successful quantum portfolio should emphasize quality over quantity.

Effective claim strategies may include:

- Hardware and device claims that may cover different quantum computing modalities and architectures (e.g., superconducting, trapped-ion, neutral-atom and photonic platforms, where applicable, as the underlying physics for distinct modalities and architectures may be quite different);[14]
- Process and system claims covering calibration, optimization, control, QEC, mitigation and suppression;
- System claims directed to hybrid classical-quantum architectures;
- Software-related claims where appropriate; and
- Application-specific claims tied to commercial implementations.

Accelerating key patent filings through the U.S. Patent and Trademark Office's Track 1 acceleration program, the Patent Prosecution Highway or foreign patent jurisdiction acceleration programs should be used to advance strategically important patent filings for startups.

Also, fostering a strategic continuation and divisional practice, Patent Cooperation Treaty/foreign patent filings, and targeted defensive publications can provide additional flexibility.

Importantly, portfolio strategy should reflect business objectives. For example, a cloud quantum computing company may prioritize error correction, QEC and orchestration technologies, while a quantum sensing company may focus on sensor architectures and

application-specific deployments.

Illustrative Examples

Neutral Quantum Computing and QEC

Neutral-atom platforms have become increasingly prominent due to their scalability and connectivity potential. Patent opportunities frequently arise from atom transport, coherence preservation, optical-trap architectures and QEC implementations.

Some inventions may be well suited for patent protection, while manufacturing knowledge, calibration parameters and custom operational tuning may be better maintained as trade secrets.

Photonic Quantum Computing

Photonic platforms often rely on specialized optical components, fabrication methods, integrated photonics and networking capabilities. Device architectures may warrant patent protection, while manufacturing tolerances, fabrication recipes and packaging techniques may provide stronger competitive advantages as trade secrets.

Quantum Sensing Applications

Quantum sensors are increasingly being explored for navigation, positioning, medical diagnostics, geophysical mapping and defense applications. In many cases, value resides not only in the sensor itself, but also in signal processing, calibration, deployment methodologies and application-specific implementations. A layered IP strategy can protect multiple aspects of a single commercial product.

Trade Secret Protection Strategies

Trade secrets are also strategically important IP assets for quantum companies.

Particularly suitable subjects include, for example:

- Fabrication processes;
- Proprietary calibration parameters;

- Error-mitigation techniques;
- Internal control software and firmware;
- Manufacturing recipes;
- Customer-specific implementations; and
- Operational know-how that cannot readily be reverse-engineered.

Trade secret protection under the Defend Trade Secrets Act and analogous state laws generally requires that information derive independent economic value from not being generally known and that reasonable secrecy measures be maintained.

Quantum organizations should implement confidentiality programs tailored to their risk profile, including nondisclosure agreements, access controls, laboratory security, employee-exit procedures, cybersecurity measures, audits and documentation protocols. The current and significant competition for talent in the quantum technology fields and high workforce mobility make these protections particularly important.

Hybrid IP Strategies and Enforcement Challenges

Most quantum organizations will benefit from combining patents, trade secrets, copyrights, trademarks and, where appropriate, defensive publications.

For example:

- Patents may protect quantum computing architectures, qubit implementation and control techniques, and quantum-error-reduction technologies for fault-tolerant quantum computing.
- Trade secrets may protect manufacturing know-how.
- Copyright may protect software expression and source code for quantum controllers.
- Trademarks may protect commercial identity.

In addition, regular freedom-to-operate analyses, competitor monitoring and portfolio reviews are becoming increasingly important as patent activity expands across the quantum technologies sector.

Regulatory and International Considerations

Quantum technologies also exist within a broader legal and geopolitical framework.

Export controls, foreign-filing licenses that govern filing patent applications abroad, technology-transfer restrictions and supply chain considerations can materially affect IP strategy. Many quantum technologies also possess dual-use characteristics relevant to national security.

Organizations should further monitor differences among jurisdictions regarding:

- Patent eligibility and AI-assisted invention issues;
- Trade secret protection;
- Enforcement mechanisms;
- Government-funding rules;
- Open-source controls, e.g., especially for quantum software development kits, compilers, decoders and control software; and
- Antitrust and competition law considerations, e.g., especially in multiple entity collaborations, and standards setting participation.[15]

As the industry matures, these regulatory considerations may become as strategically significant as the underlying technology itself.

Conclusion

Quantum technologies are rapidly transitioning from scientific research programs into commercially significant businesses. Recent U.S. federal funding initiatives, U.S. congressional efforts to expand the National Quantum Initiative and growing private sector investment all underscore the increasing strategic importance of the field.

For practitioners, the key point is not that every quantum advance should be patented. Rather, companies should make deliberate, early decisions about which technical improvements merit patent protection, which know-how should remain confidential and how publication, funding, collaboration and international constraints affect those strategic IP choices.

As commercialization accelerates, organizations that effectively integrate patent protection, trade secret management, publication controls, inventorship procedures, funding-related compliance and international IP strategies will be better positioned to capture long-term value. In the emerging quantum economy, IP is increasingly serving as a core competitive asset rather than merely a legal formality.

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[1] U.S. Department of Commerce, "Department of Commerce Announces Letters of Intent With 9 Companies for $2 Billion to Accelerate U.S. Leadership in Quantum Computing" (May 21, 2026), https://www.nist.gov/news-events/news/2026/05/department-commerce-announces-letters-intent-9-companies-2-billion; see also https://fedscoop.com/commerce-2-billion-quantum-incentives-nine-companies/. See also Law360, Trump EOs Pair Quantum Push With Cyber Defense Overhaul (July 2, 2026), https://www.law360.com/ip/articles/2495094. See also "NIST Launches Center to Drive the Manufacture of Quantum Technologies," (June 29, 2026), https://www.nist.gov/news-events/news/2026/06/nist-launches-center-drive-manufacture-quantum-technologies.

[2] National Quantum Initiative Reauthorization Act, H.R. 8462 (119th Congress), https://www.govtrack.us/congress/bills/119/hr8462/text and https://science.house.gov/2026/4/h-r-8462-national-quantum-intiative-reauthorization-act. See also Senate Commerce Committee, "National Quantum Initiative Reauthorization Act Unanimously Passes Commerce Committee" (Apr. 14, 2026), https://www.commerce.senate.gov/press/dem/release/led-by-cantwell-and-young-national-quantum-initiative-reauthorization-act-unanimously-passes-commerce-committee-on-world-quantum-day/.

[3] See, e.g., https://www.fticonsulting.com/insights/articles/quantum-entering-credibility-era.

[4] See Quantum Index Report (QIR) https://qir.mit.edu/patents/ (analyzing recent quantum technology patent filing trends).

[5] Richard P. Feynman, "Simulating Physics with Computers," 21 International Journal of Theoretical Physics 467-488 (1982). See also John Preskill, "Quantum computing 40 years later," (6 June 2021), https://arxiv.org/pdf/2106.10522. Paul Benioff's earlier work provides the first quantum mechanical model of a Turing machine, see Paul Benioff, "The computer as a physical system: A microscopic quantum mechanical Hamiltonian model of computers as represented by Turing machines," Journal of Statistical Physics, 22(5):563-591 (May 1980), https://www.researchgate.net/publication/226754042_The_computer_as_a_physical_system_A_microscopic_quantum_mechanical_Hamiltonian_model_of_computers_as_represented_by_Turing_machines.

[6] Antonio Sanches, "The $2 Billion Signal: Q-day Is No Longer Theoretical," Quantum Xchang (29 May 2026), https://quantumxc.com/blogs-podcasts/q-day-quantum-investment-accelerating/. Also, recent developments have intensified discussion regarding the timing of cryptographically relevant quantum computers — often referred to as 'Q-Day' which is when quantum computers become powerful enough to crack current public-key encryption standards, such as RSA and ECC. See, e.g., https://arxiv.org/abs/2603.28627 and https://arxiv.org/abs/2603.28846. However, ongoing NIST post-quantum cryptography (PQC) standardization efforts and industry adoption/transition to PQC may mitigate the eventual impact of Q-Day.

[7] See Simons Institute for the Theory of Computing, Quantum Circuits and Algorithms for Cryptography, Summer Cluster on Quantum Computing 2026, UC Berkeley, July 9–10, 2026, workshop schedule. The workshop addressed recent advances in quantum circuits and algorithms for factoring and discrete logarithms, including resource estimates and improvements relevant to Shor-type attacks on IFP/RSA and ECC. A recurring practical theme was the responsible-disclosure conundrum: how to promote public awareness and timely migration to post-quantum cryptography while avoiding disclosure of technical implementation details that could accelerate misuse or conflict with legal, regulatory, export-control, or national-security constraints. One discussed middle ground involved using zero-knowledge proofs, see, e.g., https://quantumai.google/static/site-assets/downloads/cryptocurrency-whitepaper.pdf, or similar verification mechanisms to substantiate the existence of lower-cost quantum attacks without fully

revealing quantum circuit details.

[8] Quantum Algorithm Zoo, catalog of known quantum algorithms, https://quantumalgorithmzoo.org/. See also Babbush et al, The Grand Challenge of Quantum Algorithms, arXiv:2511.09124, which discusses the continuing challenge of discovering new quantum algorithms capable of providing meaningful computational advantages beyond the relatively limited set of currently known application domains.

[9] See, e.g., NSF's Discovery Files Podcast, Quantum Cryptography, June 29, 2026, https://podcasts.apple.com/us/podcast/nsfs-discovery-files-podcast/id1129406149?i=1000774657262 (recent interview of U.S. National Science Foundation-supported professor Vinod Vaikuntanathan discussing quantum cryptography and the future of encryption, which Professor Vaikuntanathan refers to the "hype2" characterization of quantum AI).

[10] At the QEC 2026 conference, which I attended this year in Santa Barbara, CA, AI/ML for quantum error correction was a recurring topic. See QEC26 schedule at https://qec-conference.org/2026/schedule/.

[11] See, e.g., Revised Inventorship Guidance for AI-Assisted Inventions, 90 FR 54636, https://www.federalregister.gov/documents/2025/11/28/2025-21457/revised-inventorship-guidance-for-ai-assisted-inventions.

[12] See, e.g., Ex parte Yili Zhang (Appeal No. 2025-000614; App. No. 17/651,277; TC 3600) (e.g., a PTAB decision that maintained a 35 U.S.C. 101 patentability rejection, because the claims, which recited, in relevant part, "generating, over an evolution time interval starting at the first time, respective stochastic quantum values for each factor from the deterministic values, wherein each factor is represented by a respective N-qubit quantum circuit, wherein each qubit represents a risk level" were found to be directed to "an abstract method of organizing human activity — namely, the fundamental economic practice of determining a credit risk rating" and were not integrated into a practical application).

[13] See, e.g., Ex parte Osama Nayfeh (Appeal No. 2023-000069; App. No. 16/513,387; TC 2800) (e.g., a PTAB decision that maintained a 35 U.S.C. 112(a) lack of enablement, in which applicant subsequently abandoned this U.S. patent application directed to a superconductor-based quantum computing device, and specifically, the PTAB found that the claimed "semiconductor vacancy qubit structure" covered all vacancies of a

semiconductor and all vacancies in a semiconductor usable as a qubit, but found that the Specification enables only "nitrogen vacancy centers in SiC or diamond" and "does not reasonably provide enablement of any semiconductor vacancy in any material or for any vacancy in any semiconductor material that forms a qubit", and, thus, fails to "teach those skilled in the art how to make and use the full scope of the claimed invention without undue experimentation" (emphasis in original)).

[14] For an overview of the still evolving myriad of quantum computing modalities, see, e.g., PostQuantum, "Taxonomy of Quantum Computing: Modalities & Architectures," (November 1, 2023), https://postquantum.com/quantum-modalities/taxonomy-modalities/.

[15] Law360, "As Quantum Computing Evolves, So Do Antitrust Risks," (June 26, 2026), https://www.law360.com/ip/articles/2491623.