Quantum R&D to Strategic ROI

Idea In Short

Quantum computing has moved past the lab-curiosity stage and the leaders who win will be the ones who fund it like any other capital project rather than a science experiment. The decision in front of executives is not whether to explore quantum computing, it is how to structure that exploration so spending converts into return on investment [ROI]. That means running small, bounded pilots against a defined business problem, tracking a stage-gate budget instead of an open-ended research grant and treating early investment as insurance against a competitor gaining a multi-year head start. Companies that wait for the technology to mature before committing resources will find themselves buying capability at a premium once quantum advantage becomes commercially obvious. The businesses already testing quantum computing in finance, logistics and pharmaceuticals are not chasing hype, they are buying position.

Quantum computing has spent a decade as a subject for physicists and a curiosity for chief technology officers and that era is ending. Companies with genuinely hard optimization and simulation problems are now running quantum pilots against production data, tracking specific cost and performance baselines and deciding whether to fund a second round. This article is not another primer on qubits and superposition, it is a working guide to the harder question sitting in front of executives today, namely how to convert quantum computing [research and development, or R&D] spending into a defensible return on investment [ROI] case that survives a board review.

Why Quantum Value Is Different From Other Emerging Technology Bets

Quantum computers process information through qubits rather than the binary bits that power conventional systems and a qubit can represent 0, 1 or a combination of both through a property called superposition. Paired with entanglement, where qubits influence each other's state even at a distance, this lets quantum machines evaluate enormous numbers of possibilities simultaneously rather than working through them one at a time. That structural difference is precisely why quantum computing suits certain problems and not others, it excels at optimization across millions of variables, at simulating molecular behavior and at searching solution spaces too large for classical hardware to brute-force.

The financial case for paying attention is not speculative anymore. Boston Consulting Group [BCG] has forecast that quantum computing could create up to USD 850 billion in economic value by 2040, while separate analysis from McKinsey projects trillions of dollars in cumulative value by 2035 as commercial applications scale across sectors.1 Global capital committed to quantum technology has grown accordingly, with enterprise spending now a meaningful share of total investment alongside academic and government funding. That trajectory does not mean the technology is mature, most deployed use cases today are pilots rather than production systems, but it does mean the investment case has shifted from speculative to strategic.

What makes quantum different from a typical emerging-technology wager is the narrowness of its near-term value. Unlike artificial intelligence [AI], which touches nearly every business function almost immediately, quantum computing today delivers value only where a problem is genuinely combinatorial or simulation-heavy. A retailer optimizing a delivery network or a bank running portfolio risk models across thousands of correlated assets has a real quantum use case. A company looking for a general productivity boost does not, at least not yet. Executives who understand this distinction avoid the two most common mistakes, funding quantum research with no specific target problem, or dismissing it entirely because the wrong use case failed to show returns.

From Pilot Budget to Board-Level Business Case

The Harvard Business Review has argued that leaders should treat quantum computing the way they would any other capital-intensive technology bet, by identifying a bounded problem, setting a measurable baseline and deciding in advance what success looks like before funds are released.2 That discipline is the difference between a program that survives a downturn in the technology hype cycle and one that gets cut the moment a board asks for results. The most effective structure in practice is a stage-gate model, where a company commits a small, low-cost budget to a single well-defined pilot, evaluates the outcome against the baseline it set at the start and only unlocks further funding once the pilot clears agreed thresholds.

Framing the Investment as Insurance, Not a Gamble

The strongest argument for early quantum investment rarely comes from the upside case alone, it comes from the cost of being late. If a competitor gains a working quantum advantage in portfolio optimization, fraud detection or supply chain routing, the gap it opens is not easily closed, because quantum talent, tooling and institutional know-how take years to build. Framing quantum spending as insurance against that scenario reframes the conversation from a research grant to a defensible risk-management decision, which is a much easier case to make in a capital allocation meeting.

A useful reference point is Deloitte's guidance to business leaders, which notes that most organizations still lack a formal quantum roadmap even as competitors quietly build one.3 That gap is itself informative, it suggests the companies moving first are not doing so because the technology is finished, they are doing so because waiting carries its own cost. Executives should treat the absence of a roadmap as a decision in itself, one with real opportunity cost attached, rather than a neutral default.

Where Quantum Computing Is Already Producing Measurable Results

Several companies have moved past theoretical modeling into pilots with real operational data and their results offer the clearest evidence available today of where quantum computing earns its budget.

1. JPMorgan has tested quantum computing for trading strategy design and portfolio risk analysis, working to process market data faster than classical methods allow and while the bank has not yet reported quantum outperforming traditional approaches in production, its early positioning is intended to pay off once hardware capability catches up with the use case
2. Volkswagen ran a live quantum optimization pilot with taxi fleets in Lisbon, adjusting routes in real time using traffic data and while the fleet involved was small, the test demonstrated that quantum-assisted routing could meaningfully cut travel time under real-world conditions
3. Coca-Cola applied quantum computing to vending machine supply chain scheduling, addressing a genuinely complex delivery optimization problem with potential for meaningful annual savings as the approach scales

4. ExxonMobil has used quantum methods to optimize tanker shipping routes, a problem with enough variables that classical solvers struggle to find a true optimum within a practical timeframe

These examples share a common structure, each targeted a specific operational bottleneck rather than attempting a broad transformation and each measured results against a defined baseline before deciding whether to continue. That pattern, more than the technology itself, is what separates the pilots generating real learning from the ones that quietly disappear from a company's technology roadmap.

The Finance and Life Sciences Case for Early Movement

Finance and pharmaceuticals remain the two sectors furthest along and for related reasons, both deal with problems that scale combinatorially. In finance, quantum methods applied to fraud detection have shown measurable reductions in false negatives compared with classical models, directly translating into fewer missed fraudulent transactions and lower losses. A collaboration between JPMorgan Chase and QC Ware on deep hedging techniques illustrates how quantum approaches are being tested against genuinely hard derivatives pricing and risk problems rather than toy examples.4

In pharmaceuticals, quantum simulation targets molecular interaction modeling, a task classical computers handle poorly once molecule size grows past a modest threshold. IBM has worked with Daimler on modeling lithium battery chemistry using quantum methods, a use case that generalizes directly to drug discovery, where simulating how a candidate molecule binds to a target protein is the central bottleneck in early-stage research. The market for quantum applications in this space was valued at roughly USD 614 million in 2022 and was projected to approach USD 1.2 billion by 2025, reflecting steady rather than explosive near-term growth.

> The technology is still developing, but its growth is backed by significant investment and companies treating quantum computing as a future cornerstone of business strategy are positioning years ahead of those waiting for certainty

The Engineering Barriers That Still Limit ROI

No honest assessment of quantum computing can skip its unresolved technical problems, because they directly bound what ROI is achievable today. The first is decoherence, a phenomenon where environmental noise and vibration disrupt the delicate quantum state of qubits, introducing errors into calculations before they finish. Researchers are actively developing error correction techniques to address this, but those methods remain computationally expensive and are not yet standard across commercial quantum systems. Any executive evaluating a vendor's roadmap should ask specifically how the vendor plans to manage error rates at the qubit count their use case requires, rather than accepting a general assurance that the problem is being solved.

The second barrier is scalability. Adding qubits to a quantum processor increases its theoretical computing power, but it also multiplies the engineering difficulty of keeping every qubit stable simultaneously. IBM's unveiling of a 433-qubit processor marked a genuine capacity milestone, demonstrating that qubit counts can scale meaningfully while the company continued refining error rates and connectivity across the chip.5 The field also has not converged on a single hardware approach, with superconducting qubits, trapped ions and neutral-atom systems each carrying distinct tradeoffs in stability, cost and scalability, which means a company betting on one vendor's architecture is also betting on that architecture eventually winning the broader technology race.

Reading the Hype Correctly

The gap between marketing claims and delivered capability has already produced expensive lessons. A pharmaceutical company committed USD 50 million to a quantum drug discovery initiative expecting rapid acceleration in its research pipeline and after six months of disappointing results, it reverted to conventional computational methods. That outcome does not mean quantum computing failed as a category, it means the company skipped the staged validation that would have surfaced the mismatch between its problem and the technology's current maturity much earlier and at a fraction of the cost.

McKinsey's own analysis of enterprise readiness makes a similar point, arguing that companies must move beyond experimental pilots to build production-grade pathways with data readiness, systems integration and governance structures before quantum spending translates into value, rather than assuming capability will arrive on schedule.6 Skepticism toward quantum computing is not irrational, given how many technology cycles have overpromised, but dismissing the category entirely means missing the narrow set of problems where returns are already real and measurable.

Building Organizational Support for a Quantum Program

Turning boardroom skepticism into sponsorship rarely happens through a single technical briefing, it happens through a sequence of small, credible proof points. Education is the necessary first step and a short workshop that walks executives through what quantum computing can and cannot do today does more to build informed support than any glossy vendor presentation. The World Economic Forum has highlighted that businesses benefit most when they connect quantum initiatives explicitly to existing strategic priorities rather than treating the technology as a standalone innovation project.7 That connection matters because a quantum pilot framed as solving a known, costed business problem is far easier for a finance committee to evaluate than one framed as pure exploration.

Talent and partnerships compound this effect over time. Companies that engage with quantum hardware providers, cloud platforms offering quantum access, or industry consortiums build institutional knowledge faster than those working in isolation and that knowledge becomes a genuine competitive asset once quantum applications mature further. Leaders should also treat quantum computing's implications for cybersecurity as part of the same strategic conversation rather than a separate track, since future quantum machines could eventually undermine encryption methods widely used today. A handful of trials involving quantum-secured communication networks are already testing how organizations might protect sensitive data against that longer-term threat, giving early movers a further reason to build quantum literacy now rather than later.

Executives who succeed with quantum computing programs tend to share a common approach: they run visible, well-scoped pilots, report results in ordinary financial terms rather than technical jargon and resist the temptation to either overclaim or dismiss what a pilot shows. That discipline, applied consistently across a stage-gate funding structure, is what separates a quantum program that survives budget season from one that quietly disappears after its first disappointing quarter.

- 1Quantum computing on track to create up to $850 billion of economic value by 2040
- 2Quantum computing for business leaders
- 3A business leader's guide to quantum technology

- 4JPMorgan Chase and QC Ware collaborate on quantum finance breakthrough in deep hedging
- 5IBM unveils 400+ qubit quantum processor and next-generation IBM Quantum System Two
- 6McKinsey Quantum Technology Monitor 2026: A commercial tipping point
- 7How businesses will benefit from the quantum revolution

Summary

Quantum computing is no longer a research bet confined to physics departments, it is a capital allocation question that belongs on the same agenda as cloud migration or automation once did. The businesses profiled here, from JPMorgan's trading desks to Volkswagen's taxi fleets, did not wait for a fully mature technology stack before committing budget. They ran bounded pilots, measured results against a defined business problem and scaled only what worked. Decoherence, scalability and inflated vendor promises remain real constraints and any leader ignoring them risks repeating the pharmaceutical company's costly reversal. But the stage-gate discipline, the industry-specific use cases and the cost-of-inaction argument covered above give executives a workable path from R&D curiosity to a defensible ROI case, starting with a single, well-chosen pilot.