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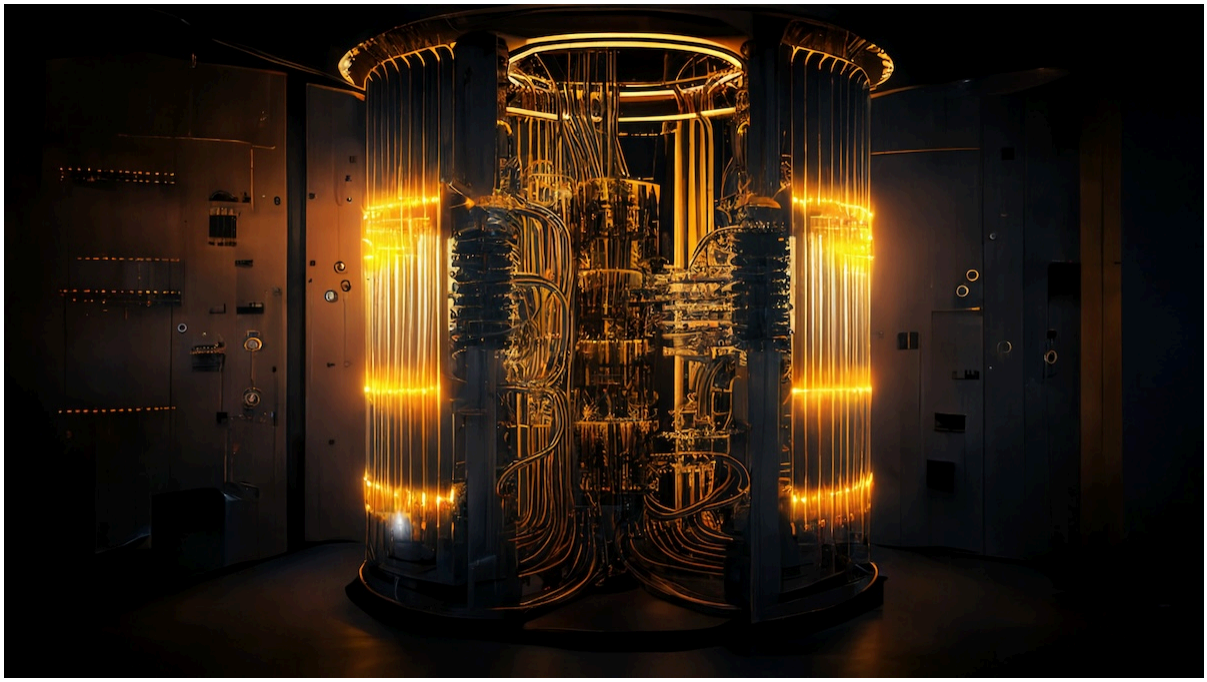
DISRUPTIVE INNOVATION

Are Businesses Ready for Practical Quantum Computing?

by Carl Dukatz and Laura Converso



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Why forward-looking companies must prepare now for quantum computing that could redefine the boundaries of competitive advantage.

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Companies can, and do, use quantum computing for operations today. However, for most use cases, engineers, mathematicians, and business operators still have trouble justifying quantum over classical for cost, speed, and ease of use. This leaves decisions makers with

a quandary – (1) wait for quantum computers to have definitive advantage benchmarks, (2) take small actions to prepare for quantum, (3) bet big on quantum being a major disruptive force.

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In just four months, global leaders—IBM, Google, Microsoft, Amazon and the University of Science and Technology of China—unveiled new quantum chip prototypes, each targeting core hardware obstacles: error rates, coherence and scalability. These advances suggest practical quantum advantages may emerge in years, not decades. The United Nations has underscored the moment by proclaiming 2025 the International Year of Quantum Science and Technology.

Despite differing approaches and technologies, the intent behind these prototypes is clear: to increase commercial relevance of quantum. Yet for most business leaders, the path forward remains unclear. Quantum's unique complexity makes it easy to under, and over, estimate. Its architecture is radically different from classical computing, and its applications aren't simply faster—they are different. And there is no definitive benchmark because there are different ways to build quantum computers.

The allure of simulations that take millennia today could run in seconds is impossible to ignore. These quantum systems could disrupt how we model molecules, predict financial markets, optimize supply chains and simulate entire environments. Their power lies in

solving problems that underpin trillion-dollar industries including pharma, financial services, logistics and aerospace. Google CEO Sundar Pichai in February said practical quantum computers are “5 to 10 years away,” comparing their current development stage to early AI. Nevertheless, most CEOs are asking tough questions today.

How Soon Will Quantum Computing Become Practical?

The pace of advancement in quantum computing has quickened noticeably. Investment continues from both the public and private sectors. But practical implementation still depends on multiple unresolved factors, simply indexed as hardware and algorithms considerations. Hardware innovations show the most promise, as this type of advancement is generally seen as an “engineering” problem, with the scientific and theorical elements defined. While each new hardware advancement must undergo peer review and academic scrutiny, which is a slow process as compared to the pace of business, momentum grows. From hardware progress alone, early-stage use cases are already being piloted in fields like quantum chemistry, optimization and machine learning. Businesses should expect a gradual emergence of commercial applications, rather than a single inflection point. The timeline will likely unfold unevenly by industry, with sectors like pharma and finance leading the curve. Algorithm advancement is more challenging, with some of the most promising variational (hybrid quantum+classical) algorithms now taking a back seat to the older but proven speed-ups proven by “quantum only” algorithms. However, a modification to an existing algorithm, or discovery of the new one, could mean usefulness from even the quantum hardware available today. It is extremely challenging to predict.

What’s the Return on Investment in Quantum Computing?

ROI for quantum computing will not follow traditional metrics—at least not initially. It will depend on a company’s strategic posture, the relevance of quantum to its business model, and its capacity to absorb and act on early insights. Companies in industries where

quantum advantage is nearer-term—such as drug discovery or material design —may begin to see measurable returns within the next 5–10 years. For others, the benefits may be longer-term and harder to quantify in purely financial terms. But waiting for perfect visibility on ROI is a high-risk strategy. The internet and cloud computing both followed similar patterns: unclear short-term returns, followed by sweeping disruption. This is what could happen in financial modeling or supply chain optimization. The cost of delay, in terms of talent readiness, ecosystem positioning and lost innovation opportunities, may be far greater than the cost of early, contained experimentation.

How Secure Is Quantum Computing—and How Secure Are We Against It?

Quantum computing introduces a major cybersecurity risk. Once sufficiently advanced, quantum systems could break widely used encryption protocols such as RSA and ECC, which protect everything from banking systems to government communications. Intelligence agencies and security researchers are already modeling scenarios in which hostile actors harvest encrypted data today, with the intention of decrypting it once quantum capabilities mature, however there is emerging debate on the associated risks and viability of these attacks. Ultimately, many experts are classifying this risk as low. A cryptographically relevant quantum computer is not expected to be readily available in the near term, and the search space based on volume of data decreases the viability of general collection attacks. As a result, targeted attacks would be more viable but are currently more effectively carried out using conventional methods. It’s standards, policies, and compliance, as well as the need to maintain interoperability, which makes quantum security a pressing issue—even before the technology is fully deployed. Organizations, particularly in healthcare, financial services, telecom and government, must begin migrating to post-quantum cryptography (PQC) to achieve the new regulations. This transition will take time, and the window to act before threats become viable is narrowing.

A Strategic Imperative, Not a Technological Curiosity

The question is no longer whether businesses should engage with quantum computing, but how. Quantum computing is widely accepted as a disruptive technology emerging now. Forward-looking leaders are already taking early, measured steps—prioritizing business alignment and readiness. Thankfully, starting a quantum journey does not have to be a multibillion-dollar program, it does not require deploying on-premises quantum machines or setting up an R&D facility with expensive ultra-low temperature conditions. Here're some steps to get started.

Appoint a C-level quantum sponsor: Quantum computing operates on principles so radically different from our everyday digital experience that having a "wait and see" attitude as opposed to an experimental mindset might take industry leaders out of business. But no company needs to deploy a quantum machine or build a cryogenic lab to begin. Every large enterprise should identify a C-level sponsor—often the CTO or CIO—to lead quantum readiness efforts, supported by a small team of technical experts focused on identifying areas where quantum may offer competitive advantage. These could include portfolio optimization in finance, molecule simulation in pharma or complex logistics modeling in supply chains. The sponsor's role is to align these explorations with core business goals and keep experimentation anchored to strategic needs. For instance, Clemens Utschig-Utschig, CTO & Chief Architect IT at German pharma Boehringer Ingelheim, initiated drug candidate molecules experiments with Google Quantum AI in 2021. [1]

Think hybrid, not binary: Quantum will not replace classical computing—it will complement it. A hybrid architecture combining CPUs, GPUs, and QPUs (quantum processing units), often enhanced by AI, will power the most advanced use cases. In this model, quantum systems generate high-quality candidate solutions for complex problems, while AI and classical tools refine them for implementation. For example, quantum might identify optimal shipping routes across thousands of variables, while AI adjusts for real-world constraints such as fuel prices or weather disruptions. IBM has already blended quantum and classical computing together, including two data centers, including one in

New York State and another one in Ehningen, Germany, and on-premises client installations. Building this hybrid architecture will require close coordination between IT, data science and business strategy teams. The payoff: dramatically improved efficiency, faster decision-making and competitive differentiation that traditional systems can't match.

Start small experiment via the cloud: Quantum capabilities are already accessible through major cloud providers such as Amazon Braket, Microsoft Azure Quantum, IBM and Google Cloud. These platforms allow businesses to run small-scale experiments and simulations using real quantum hardware or emulators. The pay-as-you-go model reduces risk and builds internal fluency without requiring large upfront investments. Pilot projects might include optimizing a production schedule, modeling molecular interactions for new materials, or testing quantum-enhanced machine learning algorithms. Each of these can help organizations understand where quantum may unlock future advantage—and where it may not. The key is to build a feedback loop between these experiments and enterprise strategy.

Collaborate to de-risk: Avoid falling into the multibillion-dollar trap by seeking mutually beneficial collaborations. Partnerships with academic institutions, research consortia and quantum startups can accelerate learning and reduce risk. For example, HSBC, Rigetti Computing and the University of Edinburgh have partnered to explore quantum machine learning for financial crime detection. These collaborations not only extend internal capabilities but also embed companies within the broader quantum ecosystem—where standards, talent pipelines and breakthroughs will emerge. Governments are also increasing support for quantum R&D, offering incentives and funding for collaborative projects. Business leaders should monitor national quantum strategies and consider participating in public-private partnerships to gain early access to talent, tools and influence.

The future of quantum is not set in stone. We are still years away from seeing a winning architecture every company will converge on. The Quantum Insider estimates that by 2030, 2,800 leading companies will be using Quantum Computing as a Service (QCaaS)[2].

Investing in quantum requires an open mind and the willingness to maneuver as the technology matures. As the global quantum race accelerates, leading businesses must be informed and prepared for the transformative potential it will bring.

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Carl Dukatz Follow

Carl Dukatz is a Managing Director at Accenture leading innovation in Next Generation Compute including development of quantum computing & security and high-performance computing. He is the quantum project sponsor for the Accenture / MIT IDE collaboration.

Laura Converso Follow

Laura Converso is a Thought leadership Principal Director at Accenture Research, leading the Next Generation Compute research agenda. She is also a World Economic Forum fellow for the Quantum applications hub initiative.