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Could Quantum Computing be the Next Paradigm Shift for Industrial Applications Soon?

At CES 2025, NVIDIA CEO Jensen Huang stated that useful quantum computers are 20 years away (Nellis, 2025). Despite his retraction, people in various industries began to question their belief in quantum computing's potential as a game changer. Indeed, there is growing evidence to support this skepticism. Quantum computing may fail to become the next paradigm shift for industrial applications in the near future due to its high costs, limited practical applicability, and an insufficient influx of qualified talent.

First, the primary obstacle is the tremendous cost required for its adoption. When companies attempt to implement quantum systems, they face financial barriers for physical infrastructure. For instance, quantum computers require temperatures near absolute zero to maintain stable qubits for calculations (Jones, 2025). Additionally, achieving this environment requires Helium-3 which costs approximately $2,500 per liter and drives the cooling expense for a single device upwards of $100,000 (Jones, 2025). Furthermore, the supply is strictly limited because Helium-3 is primarily harvested as a byproduct of tritium decay from nuclear weapons programs (Narang & Levine, 2025). These compounded factors create a situation where the ROI is unattainable for most general businesses. Consequently, this economic exclusivity weakens the technology's potential to drive an industrial paradigm shift in the near future.

Second, the technology’s limited practical applicability acts as a formidable barrier to an industrial paradigm shift. Despite the anticipation of exponential speedups, the technology's advantages remain more theoretical than practical, constraining its usefulness in everyday computation (Swayne, 2025b). For instance, most quantum computers today cannot outperform classical systems in real-world settings (Swayne, 2025b). Moreover, the technology lacks broad utility because its analog character makes quantum programming challenging and constrains its usefulness in everyday computation given that operations are probabilistic rather than deterministic (Swayne, 2025b). Furthermore, even in high-interest sectors such as logistics and financial modeling, the performance edge of quantum solvers remains unproven because many algorithms require more stable qubits than are currently available (Swayne, 2025b). This reliability gap implies that the technology fails to meet the stringent consistency standards. Consequently, due to these functional limitations, quantum computing remains a specialized scientific instrument rather than a viable platform for industrial transformation.

Last, an insufficient influx of qualified human capital significantly limits the technology's viability in the near future. There is currently a severe shortage of people possessing the specialized skills required for quantum computing to achieve its maximum operational capabilities (Marr, 2025). Quantum industries rely disproportionately on elite, PhD-trained physicists, a restrictive focus that neglects the critical need for a broader workforce capable of handling general operational tasks (Swayne, 2025a). In addition, companies are hesitant to invest in junior talent or reskilling initiatives because such investments do not yield immediate returns given the uncertainty of the commercial timeline (Swayne, 2025a). Furthermore, existing hiring practices lack the flexibility to integrate professionals from diverse engineering backgrounds, risking a scenario where key technical and practical roles remain unfilled (Swayne, 2025a). This structural imbalance creates a bottleneck where the industry lacks the practical manpower for scaling. Consequently, this workforce crisis acts as a severe brake on innovation, ensuring that quantum computing remains an exclusive scientific endeavor rather than a transformative industrial force in the near future.

In conclusion, too many significant hurdles exist to quantum computer adoption in industries, such as financial barriers, restricted functional utility, and a human capital deficit. As the global market continues to demand immediate ROI and operational stability, businesses that recognize these limitations will likely rely on existing computational methods for the near future. While scientific breakthroughs will undoubtedly continue to occur in research labs, the significant gap between theoretical potential and engineering reality postpones commercial adoption. Ultimately, instead of chasing prematurely hyped technology, industries should prioritize proven and practical solutions.

References

Jones, R. (2025, November 21). *All the hottest tech needs to be so, so cold*. Semafor.com. https://www.semafor.com/article/11/21/2025/all-the-hottest-tech-needs-to-be-so-so-cold

Marr, B. (2025, July 23). Quantum Computing Faces 3 Major Barriers Before Going Mainstream. *Forbes*. https://www.forbes.com/sites/bernardmarr/2025/07/23/quantum-computing-faces-3-major-barriers-before-going-mainstream/

Narang, P., & Levine, J. (2025, October 20). *The Supply Chain Chokepoints in Quantum*. War on the Rocks. https://warontherocks.com/2025/10/the-supply-chain-chokepoints-in-quantum/

Nellis, S. (2025, March 20). Nvidia to open quantum computing lab, CEO says. *Reuters*. https://www.reuters.com/technology/nvidia-open-quantum-computing-lab-ceo-says-2025-03-20/

Swayne, M. (2025a, April 14). *RAND Europe: Quantum's Future Workforce Needs More Than Physicists*. The Quantum Insider. https://thequantuminsider.com/2025/04/14/rand-europe-quantums-future-workforce-needs-more-than-physicists/

Swayne, M. (2025b, May 3). *Quantum Tech Remains a Long-Term Bet, Stanford Report Says*. The Quantum Insider. https://thequantuminsider.com/2025/05/03/quantum-tech-remains-a-long-term-bet-stanford-report-says/