Current state of quantum computing algorithm developments

QED-C® has a unique vantage—as an industry driven consortium with a broad set of stakeholders—to discuss, analyze and communicate the status of quantum technology development and commercialization, including offering perspective on where the industry is and where the collective wisdom can illuminate the paths of progress.

QED-C recently completed the widest known review of the current state of quantum computing algorithm development across the emerging industry. Quantum algorithms are the building blocks that run on top of the foundation of quantum computers and, we find, are anticipated to unlock a wide variety of use cases for a broad set of industries. The analysis gathered information from numerous sources—from publicly available information to in depth interviews with those on the front lines of developing and adopting quantum algorithms.

Algorithms for quantum computers and hybrid quantum-classical approaches are likely to impact many industries (see figure). Other findings of the QED-C review include:

- Quantum computing algorithm development is being explored by a wide variety of industries including aerospace, finance, chemicals, materials, pharmaceuticals, life sciences, telecommunications and manufacturing, which speaks to the fundamental impact this technology could bring to the market.
- Machine learning, simulation and optimization projects currently dominate the exploration of applications across industries.
- Gate-based quantum computers appear in 70% of the use cases and were generally expected to be more flexible in discussions with stakeholders. Adiabatic systems, or quantum annealers, made up the balance primarily to solve optimization problems, although those could also be run on gate-based systems.
- Quantum computing hardware requires further development and scaling; however, the end users and other early adopters are not waiting to begin the exploration.
- The IT workforce trained in classical computing architecture requires new skills and modalities to develop quantum algorithms. As a matter of competitiveness, early adopters—at the company, regional or national level—could have substantial advantages as the quantum computing market matures.

QED-C's members continue to find value in the data compiled in this review and understand it to be representative of the global ecosystem.

QED-C members are collaborating to build upon this review, including exploring deep dives into industry verticals. For example, in 2022 QED-C partnered with DOE to evaluate quantum computing applications for the electric grid and a detailed report is forthcoming. Future topics include supply chain and chemistry.

Acknowledgement: This effort is led by Mark Danchak, Chair of the QED-C Use Cases Technical Advisory Committee and Carl Dukatz, Chair of the Computing Subcommittee.

2022 Publicly Shared Projects Using Quantum Computing

QED·C

The Data

We found **100 publicly shared quantum projects** from business, and this is what we learned.

Top insights

It's surprising to see such an even distribution between QML, Simulation, and Optimization.

Gate based quantum computers accounted for **70%** of the experiments.

There are more examples of running applications than research publications.

Public sharing from 20 industries is a great start, however, we expect this to grow in 2023.