Expert Insights

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Exploring quantum computing use cases for financial services

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Classical computers limit the potential of machine-learning to solve specific financial services problems, whereas quantum computing promises higher quality solutions."[8]

Talking points

Quantum for speed and accuracy

Financial services institutions are exploring quantum computing to enable calculations that are not possible with traditional computing technology.

Experimental systems

Experimental quantum systems are already being used to test and develop financial services use cases in such applications as targeting and prediction, asset trading optimization, and risk profiling, three areas that have been shown to have the highest potential.

The time is now

Engaging now is important, as financial institutions that adopt quantum computing early will be able to take advantage of arbitrage potential that is impossible for those who remain solely on traditional computing.

Financial services and quantum computing

Financial services has a history of successfully applying physics to help solve its thorniest problems. The Black-Scholes-Merton model, for example, uses the concept of Brownian motion to price financial instruments – like European call options – over time.[1]

Applying emerging quantum technology to financial problems—particularly those dealing with uncertainty and constrained optimization—should also prove hugely advantageous for first movers. Imagine being able to make calculations that reveal dynamic arbitrage possibilities that competitors are unable to see. Beyond that, greater compliance, employing behavioral data to enhance customer engagement, and faster reaction to market volatility are some of the specific benefits we expect quantum computing to deliver.

What gives quantum computing this enormous advantage? The solution space of a quantum computer is orders of magnitude larger than traditional computers—even immensely powerful ones. That's because doubling the power of a classical computer requires about double the number of transistors working on a problem. The power of a quantum computer can be approximately doubled each time only one qubit is added.

While broad commercial applications may remain several years away, quantum computing is expected to produce breakthrough products and services likely to successfully solve very specific business problems within three-to-five years.[2]

Bits and qubits

Quantum computers leverage quantum mechanical phenomena to manipulate information, by relying on quantum bits, or Qubits. This emerging technology computes more efficiently when generating probability distributions, mapping data, testing samples, and iterating. Quantum computing provides exponential power to mathematically challenging problems, improving accuracy, shortening computation runtimes, and tackling previously impenetrable calculations.

Quantum computing can also enable financial services organizations to re-engineer operational processes, such as:

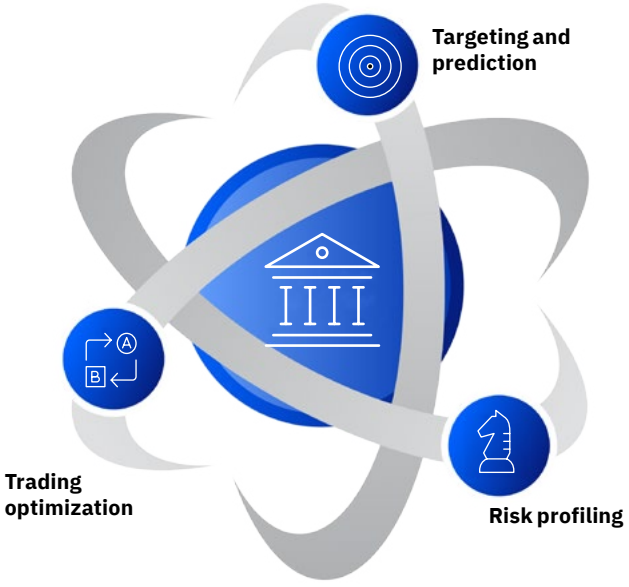
- Front-office and back-office decisions on client management for "know your customer," credit origination, and onboarding,
- Treasury management, trading and asset management,
- Business optimization, including risk management and compliance.

Powerful quantum use cases

Quantum computing's specific use cases for financial services can be classified into three main categories: targeting and prediction, trading optimization, and risk profiling (see Figure 1).

We explore potential use cases in each of these categories, providing examples that apply to three main industries in financial services: banking, financial markets, and insurance.

Figure 1
Expected quantum computing use cases in financial services



Because combinatorial optimization problems in trading and portfolio management scale exponentially, quantum computers have the potential to find faster, more cost-effective and better-tailored solutions than classical machines.[13]

Targeting and prediction

Today's financial services customers demand personalized products and services that rapidly anticipate their evolving needs and behaviors. Twenty-five percent of small- and medium-sized financial institutions lose customers due to offerings that don't prioritize customer experience.[3] It's difficult to create analytical models that sift through mounds of behavioral data quickly and accurately enough to target which products are needed by specific customers in near real-time. This constrains financial institutions from providing preemptive product recommendations with optimal feature selection in an agile manner, missing opportunities to expand current customer share of wallet or reaching the 1.7 billion adults worldwide who are unbanked.[4]

A similar problem exists in fraud detection. It is estimated that financial institutions are losing between USD 10 billion and 40 billion in revenue a year due to fraud and poor data management practices.[5] Fraud detection systems remain highly inaccurate, returning 80 percent false positives, causing financial institutions to be overly risk averse.[6] To help ensure proper credit scoring, the customer onboarding process can take as long as 12 weeks.[7] In today's digital age, where 70 percent of banking takes place digitally, consumers are just not willing to wait that long.[9] Financial institutions too slow in engaging effectively with new customers are losing them to more nimble competitors.

For customer targeting and prediction modeling, quantum computing could be a game changer. The data modeling capabilities of quantum computers are expected to prove superior in finding patterns, performing classifications, and making predictions that are not possible today because of the challenges of complex data structures.

Trading optimization

Complexity in financial markets trading activity is skyrocketing. For example, the valuation adjustments model for derivatives, the XVA umbrella, has greatly increased in complexity, now including credit (CVA), debit (DVA), funding (FVA), capital (KVA) and margin (MVA).[10] Due to greater transparency requirements from regulations, stricter validation processes are applied to trading, impacting risk-management calculations that need to align counterparty credit exposures with credit-limit utilization of derivatives portfolios.[11] Furthermore, significant investment frameworks and vehicles have changed. For example, bond exchange traded funds (ETFs) are projected to reach USD 2 trillion by 2024, and environmental, social and government (ESG) investments are gaining traction, with USD 35 trillion invested in this asset taxonomy in 2019.[12]

In this complicated trading landscape, investment managers struggle to incorporate real-life constraints, such as market volatility and customer life-event changes, into portfolio optimization. Ideally, money managers would like to simulate large numbers of potential scenarios and investment options to validate sensitivities when estimating expected returns. Currently, rebalancing investment portfolios that keep up with market movements is significantly constrained by computational limitations and transaction costs.

Quantum technology could help cut through the complexity of today's trading environments. Quantum computing's combinatorial optimization capabilities may enable investment managers to improve portfolio diversification, rebalance portfolio investments to more precisely respond to market conditions and investor goals, and more cost-effectively streamline trading settlement processes.

Risk profiling

Financial services institutions are under increasing pressure to balance risk, hedge positions more effectively, and perform a wider range of stress tests to comply with regulatory requirements. Liquidity management, derivatives pricing, and risk measurement can be complex and calculations difficult to perform, making it hard to properly manage the costs of risk on trades. Today, Monte Carlo simulations—the preferred technique to analyze the impact of risk and uncertainty in financial models—are limited by the scaling of the estimation error.

Looking forward, we expect continual waves of overlapping amendments to regulations, directives, and standards, such as Basel III and its revisions.[14] They will require a much larger array of risk-management stress scenarios. As a result, compliance costs are expected to more than double in the coming years, including regulatory penalties and remediation in cases of non-compliance.[15]

In the face of more sophisticated risk-profiling demands and rising regulatory hurdles, the data-processing capabilities of quantum computers may speed up risk scenario simulations with higher precision, while testing more outcomes.

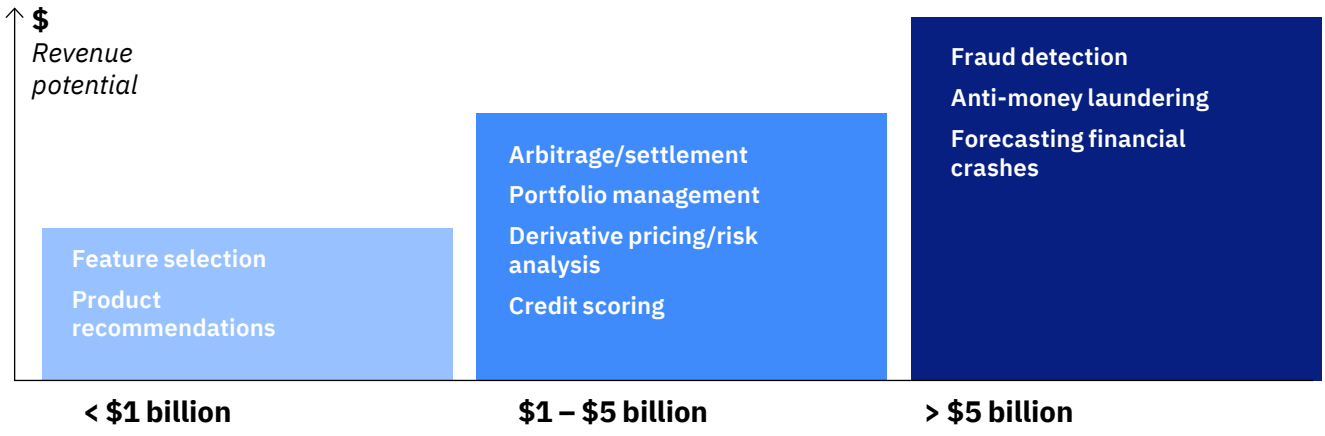
Benefits of the Quantum Era

Quantum computing's business value for financial services institutions result from four main scenarios:

- Enhancing investment gains
- Reducing capital requirements
- Opening new investment opportunities
- Improving the identification and management of risk and compliance.

Figure 2

Financial services activities potentially benefiting from quantum computing[17]



Risk analysis calculations are hard because it is computationally challenging to analyze numerous scenarios. Quantum computers have the potential to sample data differently, providing a quadratic speed-up for these types of simulations.[16]

To get started

Quantum computing will begin significantly transforming the financial services landscape over the next five years. Financial institutions that adopt quantum early can seize major competitive advantages, including the potential to leapfrog competitors to become market leaders. So, what steps should financial services institutions take today to begin exploring quantum computing?

1. Appoint and charge quantum champions in your organization to experiment with actual quantum computers and explore the potential applications of quantum computing for your industry.[18]
2. Test quantum algorithms to understand their potential advantages and evaluate how they may impact your business. For example, an artificial intelligence classifier and an option-pricing finance simulator are already available.[19]
3. Consider partnering with like-minded institutions, providers, application developers, and coders, start-ups with supporting technologies, and organizations with similar challenges to gain end-to-end access to an entire quantum computing ecosystem.[20]

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Key questions to consider

- Which quantum computing use cases might best advantage your financial services business?
- Should your institution invest in quantum computing directly or via an ecosystem?
- What is the potential opportunity cost if you don't begin exploring quantum computing now?

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