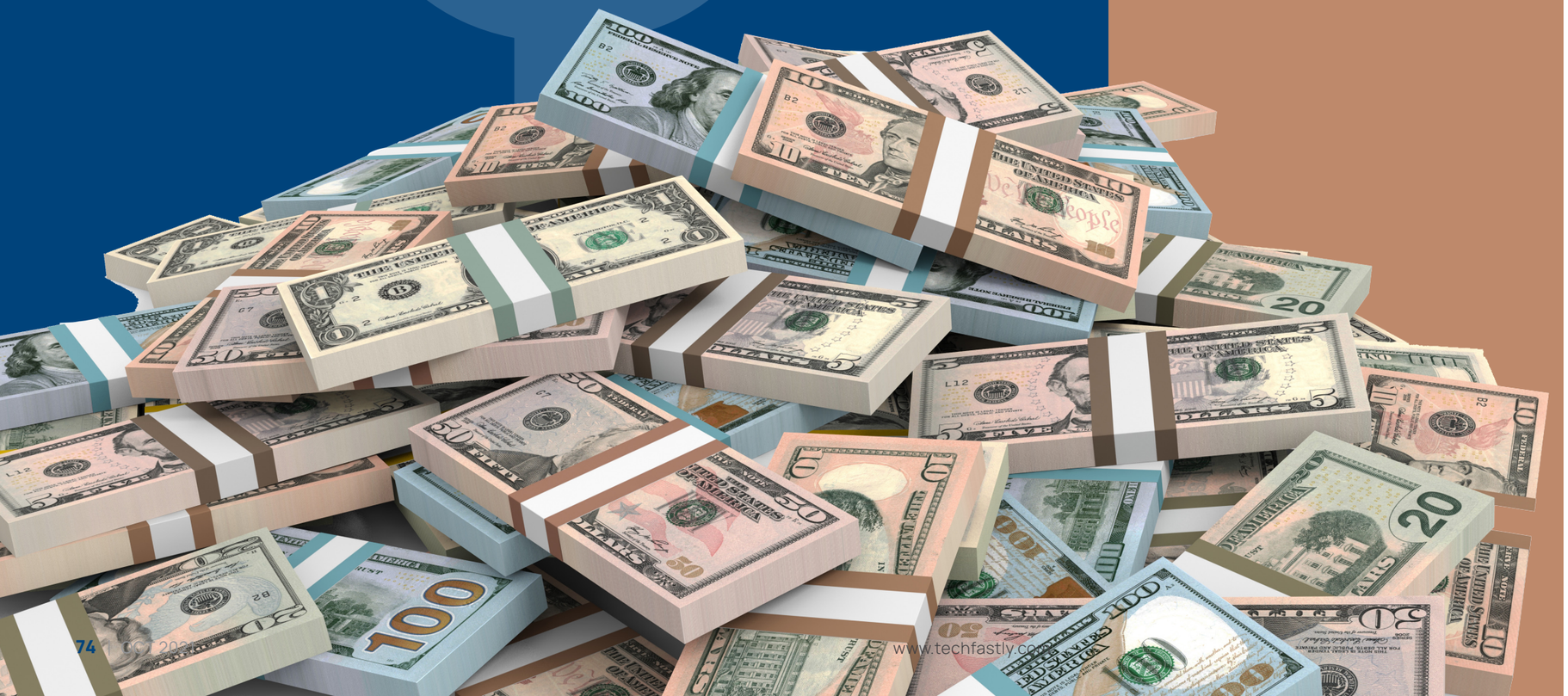
Quantum Computing's

DISRUPTION IN Finance Industry

by Vibha Soni

Did you know that global quantum computing is expected to reach $411.4 million by 2026? Global Industry Analyst Inc. (GIA)'s study shows that quantum computing has already brought changes in the market post-COVID-19.

The drastic transformation demanded by the pandemic in banking & finance, healthcare, transporting, space, defence, and other sectors has given an edge to the quantum computing market. Google has already got a quantum computer that can perform a calculation in 200 seconds only, while a traditional supercomputer would need 10000 years to solve the same problem.



Two main characteristics of quantum computers,

SUPERPOSITION,

AND **ENTANGLEMENT**

do things simultaneously and can transform anything. Because of high performance and speed, quantum computers can run complex algorithms and simulations. This feature is rising the quantum computing usages in various industries, especially finance.

Various Aspects Related to Quantum Computing and Finance

Let's discuss what problems took the attention of experts to initiate uses of quantum computing, how quantum computers are assisting the industries in solving their complex issues, how the industry is benefitted after adopting quantum computing, and if any banks are using and benefitting from it.

Why does finance/banking need high power quantum computers?

Do you know, a quantum computer needs 1.3 hours (10 12 steps) to run a million operations per second using a quantum walk algorithm, whereas a classical computer needs 5 billion years (10 29 steps) to run trillion operations per second using a best classical computer or a cluster computer.

Globalization within finance industry has tremendously increased the number of daily business operations. Banks are expanding their networks and services around the world. Ordinary people become dependent on mobile banking, internet banking, and digital transactions. More than 50% of financial transactions occur over the internet today.

The applications of big data, artificial intelligence, and the cloud in finance have been improving with time. It is not only bringing transformation but also bringing challenges in different applications: investment banking, asset management, corporate banking, and retail banking.

Classical computer features provide ordinary business solutions. It's one main limitation: "Doing one operation at one time" has been decreasing its usages. Solving real-world banking problems need high power and time. Classical computers can't solve this intractable problem, but quantum computers can do that more accurately and faster.

Simulation, Machine Learning (ML), and optimization are the three most common concepts used in finance to implement various financial services and operations. All these support banks in different aspects including, risk management, economical pricing instruments, finding the best investment strategy, managing cash in ATM networks, capital management, credit scores, and fraud detections.

A recent paper, "Quantum Computing for Finance: State of the Art and Future Prospects" published in 2020 has highlighted problems, benefits, and various challenges. The authors of the paper have also pointed out the issues in these three categories. The following table shows multiple problems during the stage of the customer life cycle:

Customer life cycle	Simulation problems	Optimization problems	Machine learning problems
Customer identification	How to obtain new revenue sources?	How to improve supply chain efficiency, minimize risks, avoid late payment, and enhance liquidity?	Refining customer ratings, KYC, and how to avoid non-compliance annual penalties.
Financial products	Better management of value at risk, balance sheets, etc.	How to reduce operation costs, capital requirements, and systematic risks?	How to perform non-performing loan, improve recommendations systems, and customer retention?
Monitor transactions	How to optimize risk using a more precise calculation process?	How to keep relevancy in the portfolio based on market changes?	How to assess false alerts and suspicious notifications?
Customer retentions	How to improve risks analysis?	How to avoid customer churns?	How to maximize customer engagement?

In short, dependency on classical computers for the execution of operations linked with optimization, prediction, and simulation is not a good idea. Because it needs high power and high performance, and classical computers are unable to provide both. Finance industry needs supercomputers like quantum computers to process accurate data within seconds.

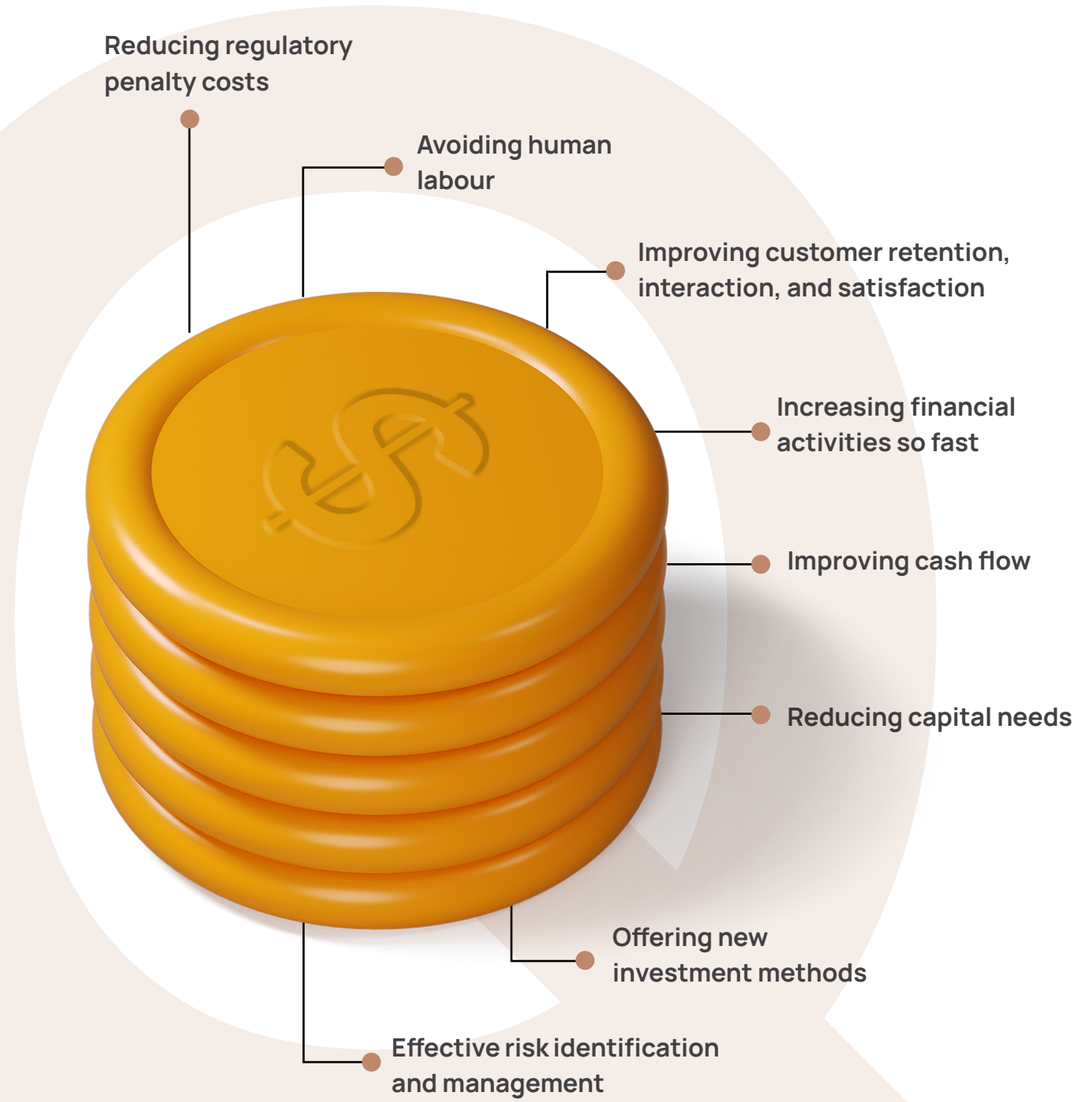
In a recent live discussion, a panel of experts discussed the value of quantum computing, quantum strategies, and the industry's quantum readiness to adopt it. SGInnovate had initiated the session with the support of the High Commission of Canada.

Quantum computers have the potential to solve real and complex problems by offering better solutions.

Various algorithms and methods have been used to provide specific solutions based on each problem. For instance, sampling methods are the best way to resolve the simulation problems as quantum computers need fewer samples than classical samples. Similarly, other algorithms have been used along with quantum computers to solve problems related to optimization, simulation, and machine learning.

Positive Impacts of Quantum Computing

After discussing the problems and understanding that quantum-based solutions can solve these real-world banking problems, you can measure the benefits of quantum computing in finance. Here are some of the benefits quantum computing could offer the finance industry:



IBM has also pointed out these benefits after adopting quantum computing. The company has classified the use cases for finance industries into three areas: targeting and prediction, trading optimization, and risk profiling. We can consider these benefits, a positive impact of quantum computing, which lowers the risks in finance industry because of uncertainties.

Side Effects of Quantum Computing in Finance

Cryptography is a well-known security method in finance. Symmetric keys, asymmetric keys (public keys), and hashing cryptography algorithms have protected sensitive banking data and provided integrity security checks. All these are unbreakable and secured if it is used through conventional computers and advanced hardware systems. Although, the same security algorithms become vulnerable and risky if superpower quantum machines would use them.

The quantum computer's one characteristic: solving mathematical problems exponentially faster than the conventional computer, makes the standard cryptographic algorithms outdated and reduces the strength of public keys and hashes. In other words, a quantum computer is threatening the most regulated industry and asking to compromise in all aspects: client data, software/websites used for transaction and interaction with clients, and hardware that perform authentications during the payment process.

The leading magazine, Global Banking and Finance Review has pointed that quantum computing threat to cybersecurity. The National Security Agency had already warned of this quantum computing threat in 2016. After this, the agency has started researching new encryption algorithms and data protection methods to defeat the quantum threat. After spending four years, the National Institute of Standards and Technology's post-quantum cryptography program has been chosen as the first standard to counter quantum decryption threat. This global effort would support overcoming the challenge of quantum threats.

How Are Real Banks Leveraging Quantum Computing

You have already seen how diverse segments in banking & finance have increased not only data & operations but also realistic problems. When realistic banks found that investment in quantum computers and technologies could solve the intractable problems, they started making decisions. To date, many banks have already leveraged quantum computing to make their complex computing easy.

The leading global resource about quantum technology, The Quantum Daily, has revealed how 11 global banks have adopted quantum technologies. The list covered banks in US, UK, and Japan. JPMorgan Chase & Co., HSBC, Citi group, Barclay, Goldman Sachs are some names of those financial services firms. Some of them are in the initial stage of quantum programs, whereas some banks have completely adopted to quantum computing methods. According to their study, quantum technologies can solve problems like portfolio volatility optimization and value at risk calculation.

> The Royal Bank of Canada (RBC) announced a $1.78 million investment for developing advanced cybersecurity systems and privacy tools in 2018.

The study is taking place at the University of Waterloo. An enhanced education program, CrypotWorks21, is a part of this research to bring post-quantum cryptosystems to their bank.

Multiple companies and working groups are developing quantum computing systems to support the finance industry. The working group, Multiverse Computing, is one of those companies that has already acquired working experience with various banks like Bankia, BBVA. The big names like Forbes, McKinsey, IBM, The Economist, and Boston Consulting Group have already declared this company a world leader in quantum computing service offering.

The company brought Singularity, the first quantum & quantum-inspired toolbox for this industry. Recently, the company has resolved a real-world problem, dynamic portfolio optimization, faced by Bankia using D-Wave quantum computers. We can say the problem was known as quantitative finance in simple language, and classical computers could not resolve it. The experts find an optimal trading trajectory for an investment portfolio of assets over time by considering constraints and account transactions.

Final Thought

Various experts have declared that the era needs quantum computing to solve intractable problems faster. The director of the Quantum Alliance Initiative, Arthur Herman, has also highlighted that Q-Day is on a threshold, and it is taking place of classical computers in his recent article. Here, Q-day refers to a term when large-scale quantum computers can easily calculate prime numbers used in public encryption systems to protect sensitive data of banking, finance, and other significant sectors. Implementing quantum-based solutions is a time-taking and complex process. Multiple software and interfaces are available in the market, which might confuse experts; thus, experts must understand the specific problems first. And then decide the appropriate quantum application to solve the problem. They must be ready to handle challenges as soon as quantum-based solutions would take place at a high level.