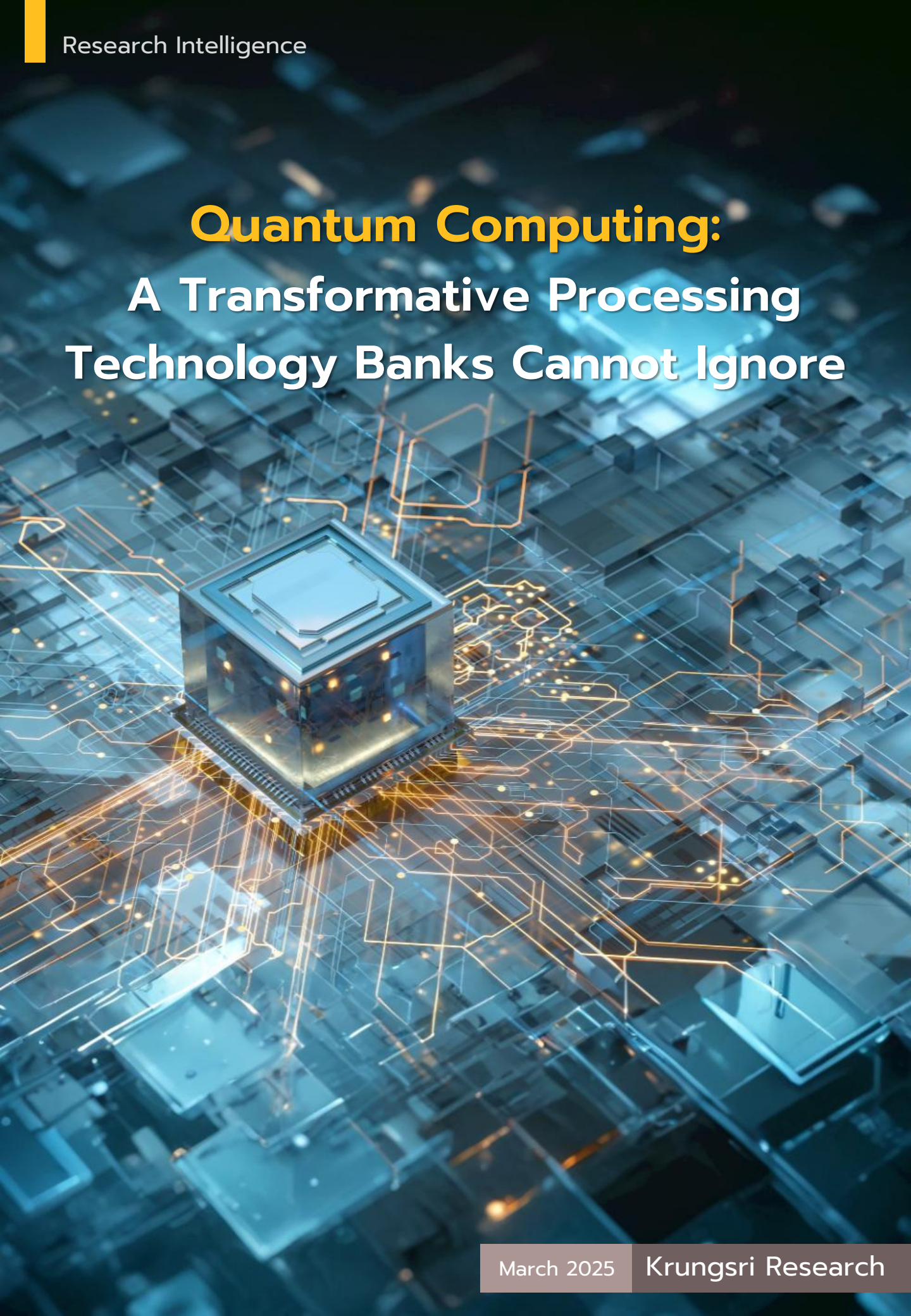
Research Intelligence

Quantum Computing: A Transformative Processing Technology Banks Cannot Ignore



March 2025 Krungsri Research

krungsri Research

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Introduction

Quantum technology has been gaining increasing attention, especially after the United Nations declared 2025 as the International Year of Quantum Science and Technology.[1/] This initiative aims to raise awareness of the potential applications of quantum technology. The most discussed quantum technology is **quantum computing, which allows computers to process large amounts of data in a fraction of a second.** In the future, as this technology becomes more widely adopted, industries including the banking sector are expected to reap significant benefits. These include faster and more accurate financial data analysis, along with the development of groundbreaking innovations.

While quantum computing promises to revolutionize processing capabilities in unprecedented ways, the widespread application of this technology still faces significant challenges, such as understanding quantum principles and developing skilled workforces. The banking sector must therefore begin planning to leverage quantum computing, similar to artificial intelligence (AI) technology has made a transformative impact over the past one to two years.



Parinya Mingsakul

Analyst

parinya.mingsakul@krungsri.com

+662 296 2980

Dr. Pimnara Hirankasi

Head of Research Division and Chief Economist

pimnara.hirankasi@krungsri.com

+662 296 6457



1/ https://quantum2025.org/endorsing-organizations/

What is Quantum Computing, and How Will It Revolutionize Computing?

Understanding Quantum Technology

To understand quantum computing, we should begin by exploring the concept of "quantum," which is a branch of physics. Quantum science studies phenomena at the atomic scale,[2/] where objects exhibit behaviors or properties governed by physical laws that are unfamiliar to human intuition. For instance, an atom can exist in multiple places simultaneously, pass through barriers, interact with each other despite being separated by vast distances.

Quantum knowledge can be developed and applied to create technologies that impact both daily life and business. For example, transistors,[3/] which are essential components within the Central Processing Unit (CPU) of smartphones and computers, and MRI scanners,[4/] which are utilized in medical applications, both leverage quantum principles. In the future, quantum principles could significantly enhance the efficiency of technologies that are deeply integrated into our everyday lives.

There are three main types of quantum technology applications, namely (1) Quantum Sensing, such as quantum navigation systems that can measure motion with greater precision than current GPS systems. (2) Quantum communication, which applies quantum principles to enhance communication[5/] making data encryption more secure. In 2024, the UK government allocated funding for research and development in this new communication method, recognizing its potential in public health data exchange and its ability to enhance AI technology.[6/] (3) **Quantum Computing, the most widely applied type of quantum technology.** According to McKinsey, the market value of quantum computing is expected to reach $131 billion by 2040.[7/]

2/ An atom is the smallest fundamental unit or particle of matter that retains the chemical properties of an element.

3/ Transistors function as switches that control the flow of electrical current in a circuit, utilizing the principles of semiconductors and quantum theory to represent values in a binary system, which consists of the digits 0 and 1.

4/ MRI (Magnetic Resonance Imaging), or imaging using electromagnetic waves, is a medical technology that employs magnetic fields and radio waves to generate detailed and accurate images of the human body's interior. Quantum principles help explain phenomena such as the diffraction of tiny particles, like light and electrons, as they pass through obstacles.

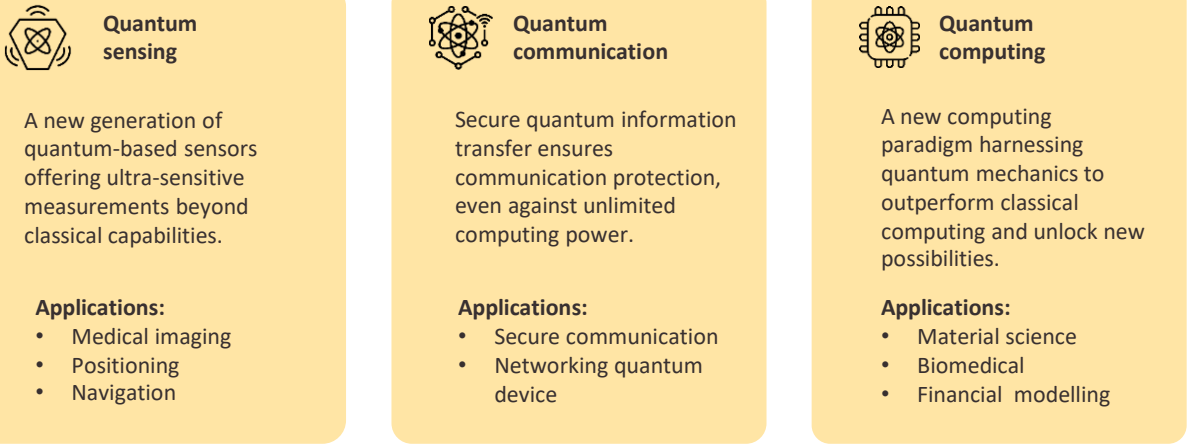
5/ Quantum communication relies on the property of quantum entanglement, utilizing quantum particles as a modern tool for transmitting information. This serves as a fundamental basis for cutting-edge communication techniques.

6/ Research and development in quantum communication is one of five quantum technology projects to which the UK government has allocated over £100 million (4.4 billion THB). https://www.gov.uk/government/news/over-100-million-boost-to-quantum-hubs-to-develop-life-saving-blood-tests-and-resilient-security-systems

7/ By 2040, the market value of quantum communication and quantum sensing is projected to reach $36 billion and $6 billion, respectively. https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/steady-progress-in-approaching-the-quantum-advantage

Figure 1

Three main types of quantum technology applications



Source: McKinsey, China Power Project, Krungsri research

Differences Between Classical Computing and Quantum Computing

The key difference between classical computing and quantum computing lies in their fundamental processing and storage units. Classical computers, which are widely used in daily life, rely on classical computing principles, where **the smallest unit of data storage and computation is the bit.[8/] A bit can exist in only one of two possible states, 0 or 1, at any given time. Each bit operates independently,** representing electrical signals within a computer circuit to indicate binary conditions (e.g., on-off, true-false). This enables classical computers to process data and execute instructions with precision.

In contrast, quantum computing leverages principles of quantum mechanics, such as quantum superposition[9/] and quantum entanglement,[10/] to develop a **new fundamental unit of processing and data storage known as a "quantum bit" or "qubit."** Unlike classical bits, **a qubit can exist in a state of 0, 1, or both simultaneously. Moreover, qubits can interact and correlate their states with one another**. Consequently, quantum computers, which operate based on quantum computing principles, are capable of processing or solving complex problems with remarkable speed.

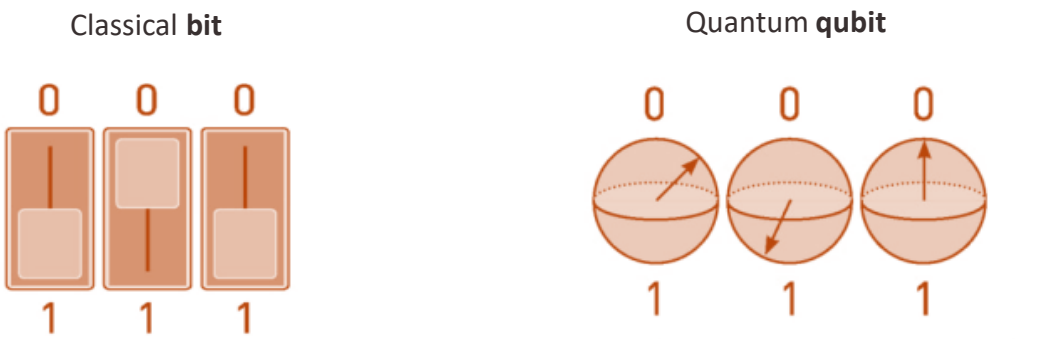
8/ The term "bit" is derived from the combination of "binary" and "digit," referring to the fundamental unit of digital information, which consists of either a 0 or a 1. In terms of data measurement, one megabyte is equivalent to eight million bits.

9/ Superposition is a phenomenon in which a particle can exist in multiple states simultaneously. For example, it can appear in multiple locations at the same time. This contrasts with intuition, where objects are typically perceived to exist in only one position at any given moment.

10/ Quantum entanglement is a phenomenon in which a pair of particles become interconnected, meaning that any change in the state of one particle is instantly reflected in the other, regardless of the distance between them

Figure 2

Bit and Qubit



Bits can exist in only one state (0 or 1) at any given time and are independent of each other.

Qubits can exist in multiple states of 0 and 1 simultaneously and are in a combined state together.

Source: World Economic Forum, Quantum Poet, Krungsri Research

Figure 3

Quantum computers developed by the world's leading technology companies.

Google



IBM



Source: The Atlantic, Cloudwars

The Benefits of Quantum Computing

Quantum computing has distinct characteristics that set it apart from classical computing, as follows:

Accelerated Processing Speed

Quantum computers can process highly complex tasks significantly faster than classical computers. For instance, "Sycamore," a quantum computer developed by Google, can solve a complex problem in a fraction of a second. In contrast, "Frontier," a supercomputer[11/] ranked as the second most powerful in the world,[12/] a classical computer, would take 47 years to solve the same problem.[13/] This demonstrates that **quantum computing has the potential to surpass the capabilities of classical computing in processing power**.

Better Analysis of Big Data

Classical computing has limitations when processing massive amounts of data. As a result, only about 1% of global data is stored and can be utilized effectively. Frost & Sullivan (2024) predicts that by 2025, data from various sources such as customer behavior, healthcare, and supply chain management could reach 181 zettabytes (ZB), equivalent to 181 trillion terabytes (TB).[14/] As data continues to grow in complexity and volume, quantum computing can help analyze and identify relationships between variables in large datasets quickly, unlocking the potential for further utilization and insights.

More Accurate Estimations

Classical computers may have an error margin of about 5%-20% when processing complex tasks such as optimization, simulation, or machine learning. However, BCG (2024) predicts that quantum computers will be able to provide more accurate calculations with lower error margins compared to classical computing.[15/] Additionally, Kea et al. (2024) found that stock price predictions could be 10% more accurate when quantum computing is combined with classical computing.[16/] Despite this potential, quantum computing may still face higher error rates due to quantum noise, which will be discussed further.

Enhancing AI Intelligence

Quantum computing accelerates AI's ability to handle complex tasks and generates high-quality synthetic data[17/] for training generative AI (GenAI)[18/] models and other types of AI, such as predictive AI.[19/] This can significantly reduce both the cost and time required for AI model development, including large language models (LLMs)[20/] that power GenAI, which rely on massive amounts of data for training.

11/ A supercomputer, also known as a high-performance computer (HPC), is a computing system with significantly higher processing power than a conventional computer. It is designed for complex computations, making it suitable for applications such as scientific research, aerospace, oil exploration, and space exploration.

12/ During the testing phase, Frontier was the world's most powerful supercomputer. However, in November 2024, El Capitan surpassed it to become the world's leading supercomputer. https://top500.org/lists/top500/2024/11/

13/ https://www.sciencealert.com/google-quantum-computer-is-47-years-faster-than-1-supercomputer

14/ Emerging Markets Quantum Computing Growth Opportunities (Forst & Sullivan, 2024)

15/ https://www.bcg.com/publications/2024/long-term-forecast-for-quantum-computing-still-looks-bright

16/ This study predicts stock prices using machine learning techniques https://www.mdpi.com/1099-4300/26/11/954

17/ Synthetic data refers to datasets generated by AI systems that have been trained to learn the characteristics and relationships of real-world data. These systems then create new simulated datasets based on predefined conditions.

18/ Generative AI is a type of artificial intelligence (AI) that can generate new, never-before-seen outcomes based on existing data. https://www.krungsri.com/en/research/research-intelligence/generative-ai-2023

19/ Predictive AI is an AI that specializes in forecasting the likelihood or probability of events to support business decision-making.

20/ Large Language Model (LLM) refers to a type of foundation model that is trained on vast amounts of text, enabling AI to understand and communicate with us using human language.

Figure 4

Differences Between Classical Computing and Quantum Computing

Quantum computing	Classical computing
Calculates using qubit, which can be 0 or 1 at the same time.	Calculates using bits, which can be 0, 1, but not at the same time.
Speed has the potential for exponential growth in proportion to number of qubits	Speed increases linearly with the number of transistors
Need to operate in ultracold conditions	Can operate at room temperature
Suits for complex problems in cryptography, optimization, and scientific simulations	Suits for everyday tasks
Has higher error rates*	Has lower error rates

Note: *In case quantum noise occurs
Source: CB Insights, Krungsri Research

Limitations of Quantum Computing

Quantum noise, or interference in quantum systems, is a significant limitation in the application of quantum computers. This noise can result from temperature fluctuations, vibrations, or magnetic fields. Even slight disturbances can cause qubits to lose their quantum properties, leading to **errors in quantum processing and reducing the system's ability to handle complex or large amounts of data.** Therefore, quantum computers need to operate in environments that minimize quantum noise, such as maintaining temperatures near absolute zero. (−273.15◦C).[21/] The controlled environments for quantum computers may require spaces as large as a car to accommodate the necessary cooling and shielding systems**.**

Additionally, the development of quantum software and quantum algorithms to fully optimize quantum computer performance necessitates **new programming languages.**[22/] Furthermore, **the manufacturing process for quantum computers is significantly more complex than that of classical computers**. These factors collectively pose substantial limitations to the widespread adoption and application of quantum computing.[23/]

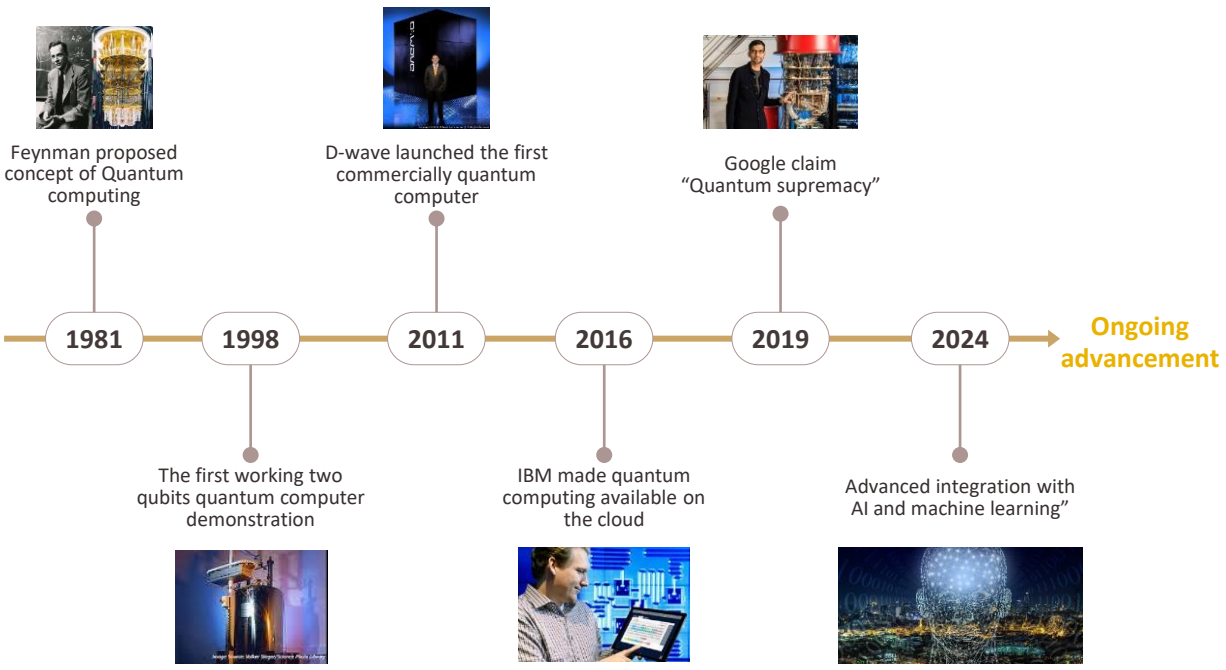
21/ Absolute zero refers to the theoretical temperature at which all particles cease to vibrate or move entirely.
22/ https://thequantuminsider.com/2023/03/24/quantum-computing-challenges/
23/ https://www.mckinsey.com/featured-insights/mckinsey-explainers/what-is-quantum-computing

Developments in Quantum Computing

In the past 1-2 years, major global tech companies have been rapidly advancing AI technologies alongside quantum computing innovations. For instance, Nvidia, a leading chip manufacturer, has collaborated with Google, leveraging Nvidia's supercomputers to create models of quantum computing systems aimed at enhancing efficiency and addressing limitations in quantum processing.[24/] Additionally, several other tech companies have been focusing on quantum error correction. IBM, for instance, has developed quantum error correction processes that are 10 times more efficient than before.[25/] Meanwhile, Google has employed AI to analyze and pinpoint the causes of errors with greater precision.[26/] In December 2024, Google unveiled its "Willow" quantum chip, which uses a new method of qubit interconnection to reduce errors even as the number of qubits increases.[27/] This development is a key milestone in paving the way for practical applications of quantum computing, offering potential benefits across various fields.

Figure 5

Developments in Quantum Computing



Source: BIS, IBM, The Guardian, Krungsri Research

24/ https://nvidianews.nvidia.com/news/nvidia-supercharges-google-quantum-processor-design-with-simulation-of-quantum-device-physics
25/ https://www.ibm.com/think/topics/quantum-computing
26/ https://technologymagazine.com/articles/how-google-is-tackling-quantum-computing-challenges
27/ https://www.tnnthailand.com/tech/183374/?fbclid=IwY2xjawHFGApleHRuA2FlbQIxMAABHStRbqIwcU5yMOp1zEQfOPjsyfdXW2sdWB8Su10uu2kJXfClXsODcxHcbg_aem_fM8swj5DgTY4yF9IAvCgww

Businesses are beginning to plan and implement quantum computing in various areas. For example, Airbus is exploring the use of quantum computing in the design of aircraft, focusing on fluid dynamics[28/] to enhance performance and support the sustainability goals of the aviation industry, such as developing fuel cells as a replacement for aviation fuel.[29/] Meanwhile, in Thailand, Paypoint, a rewards management platform, has adopted quantum technology to calculate accumulated points among partners in real time.[30/]

The examples mentioned above are just a few applications of quantum computing that can be leveraged in business. **In the future, quantum computing will play a significant role in driving innovation across various fields**. For instance, it can be used to create complex chemical reaction models, which will be beneficial for pharmaceutical research and drug development. Additionally, it has the potential to design lightweight, fast-charging batteries for electric vehicles, extending their range per charge.[31/]

The application of quantum computing is gaining significant attention.

Currently, both the technology and business sectors are closely monitoring developments and projections related to the widespread adoption of quantum computing. A survey conducted by McKinsey in 2023 revealed that **over 72% of technology executives, investors, and quantum computing experts anticipate that quantum computers will achieve full fault tolerance by 2035**, while the remaining 28% believe this milestone will be reached after 2040.[32/]

It is anticipated that the demand for quantum computing will grow in the future, driven by the continuous advancements in this technology, while its limitations are progressively reduced. According to McKinsey (2024), the global market value of quantum computing is projected to reach 131 billion USD by 2040, a 14.6-fold increase from 9 billion USD in 2023.[33/] This corresponds to a compound annual growth rate (CAGR) of 17%.

28/ It is a branch of science that studies the motion of fluids, including liquids and gases. For example, it involves calculating or studying the flow of air over an aircraft to determine lift and drag forces.

29/ https://www.iotworldtoday.com/quantum/airbus-looks-to-quantum-computing-for-decarbonization

30/ Paypoint utilizes quantum technology to process loyalty points developed by Quantum Technology Foundation (Thailand) Co., Ltd. : https://www.bangkokbiznews.com/tech/gadget/1153566

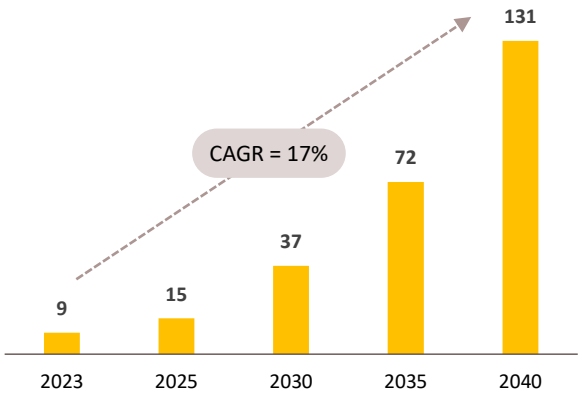
31/ https://www.forbes.com/councils/forbesbusinessdevelopmentcouncil/2024/11/26/how-quantum-computing-can-drive-innovation-in-the-automotive-industry/

32/ https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/tech-forward/is-winter-coming-quantum-computings-trajectory-in-the-years-ahead

33/ quantum-technology-monitor-april-2024.pdf (mckinsey.com)

Figure 6

Quantum Computing Market Value Forecast (Billion USD)



Source: McKinsey, Krungsri Research

Despite the remarkable capabilities of quantum computers, they currently need to be used in conjunction with classical computers. For example, data must be prepared using classical computers before being processed by quantum computers, or classical computers are required to access quantum computing resources via cloud-connected quantum computing. Moreover, fundamental computing tasks that are widely familiar, such as browsing the internet through web browsers, writing or reading emails, and working with documents, still rely on classical computers.[34/]

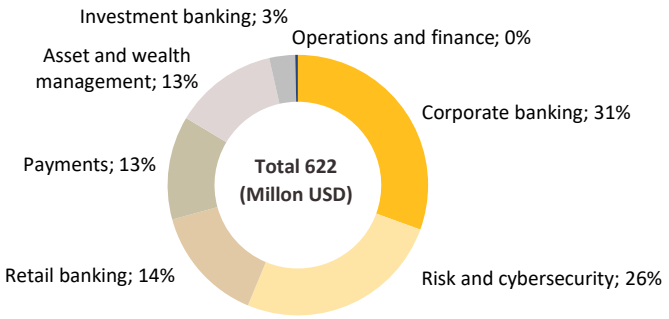
34/ For quantum computers and classical computers to work together, they rely on the process of quantum decoherence. This phenomenon occurs when a quantum system loses its entangled state, causing its quantum properties to degrade

How Can Banks Leverage Quantum Computing?

The financial sector is poised to be one of the key beneficiaries of quantum computing. According to McKinsey (2023), **by 2035, quantum computing is projected to generate a global value of $622 million USD (approximately 20 billion THB) for the financial sector.**[35/] Notably, in corporate banking, quantum computing is expected to contribute up to $190 million (approximately 6.6 billion baht) (Figure 7). Moreover, the financial sector has shown increasing interest in investing in quantum computing. Deloitte (2023) estimates that by 2032, global financial institutions will spend approximately $19 billion on quantum computing investments, an increase of over 233 times compared to $80 million in 2022, representing a 72% compound annual growth rate (CAGR) (Figure 8).[36/]

Figure 7

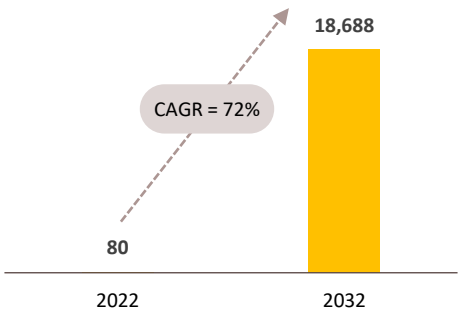
Value of Quantum Computing in Financial Sector in 2025 (Million USD)



Source: McKinsey, Krungsri Research

Figure 8

Quantum Computing Investment in the Financial Sector (Million USD)



Source: Deloitte, Krungsri Research

35/ https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/tech-forward/quantum-technology-use-cases-as-fuel-for-value-in-finance

36/ https://www2.deloitte.com/us/en/insights/industry/financial-services/financial-services-industry-predictions/2023/quantum-computing-in-finance.html

Quantum computing provides significant benefits to the banking industry across various applications, with the following notable examples of implementation.

Modelling and simulation

Quantum computing helps manage complex and large volumes of data or variables, enabling banks to make more accurate and faster predictions or models. Examples of quantum computing applications in banking include stress testing, liquidity forecasting, risk management, target customer segmentation, and branch expansion or ATM placement planning to align with customer density and demand in specific areas.

Portfolio optimization

Classical computers may require significant time to process portfolio management tasks due to the need to handle multiple data types. Quantum computing, however, serves as a powerful tool that enables banks to swiftly adjust the composition of investment portfolio such as stocks and bonds, to maximize returns while minimizing risk. Currently, leading financial institutions, such as Citi[37/] and JPMorgan,[38/] are exploring the use of quantum computing in this area by partnering with technology companies to enhance portfolio management efficiency.

Fraud detection

In the process of identifying abnormal or potentially fraudulent transactions, banks must process vast amounts of data, including behavioral patterns, transaction formats, and location details. Quantum computers facilitate the processing of both structured and unstructured data,[39/] resulting in faster and more accurate detection of suspicious transactions.

Enhancing Customer Experience

Banks can integrate quantum computing with AI to elevate customer service by analyzing customer data and behavior to offer hyper-personalized financial products and services in real time.[40/] As quantum computing enhances AI intelligence, banks can also develop smarter chatbots that respond to customer needs more efficiently and accurately, resulting in an improved customer experience.

37/ Citi has partnered with Classiq: https://fintechmagazine.com/articles/citi-explores-quantum-computing-for-portfolio-optimisation

38/ https://thequantuminsider.com/2024/11/05/quantum-scientists-say-better-portfolio-management-might-be-in-the-decomposition-pipeline/

39/ Structured data refers to datasets that are systematically organized and readily usable, such as data in tables with rows and columns, whereas unstructured data consists of unorganized datasets that cannot yet be processed, such as text, images, videos, or audio files

40/ https://www.krungsri.com/en/research/research-intelligence/ai-hyper-personalization-2024

Box 1 Examples of Banks' Preparations for Quantum Computing

- In 2023, **MUFG**[41/] invested in Groovenauts, acquiring an 18% stake in the Japanese startup specializing in AI and quantum computing. MUFG aims to leverage quantum computing capabilities to enhance transaction efficiency, such as derivatives trading and asset risk management, including advancing AI applications. Notably, MUFG is the first Japanese bank to make a direct investment in a quantum computing startup.

- In 2023, **HSBC**[42/] established a quantum computing strategy based on three key approaches: (1) collaborating with external organizations, including technology companies such as IBM and Fujitsu, academic institutions, and government entities, to explore potential applications of quantum computing in developing innovative financial products and services; (2) forming an internal quantum computing research team dedicated to developing specialized use cases and generating quantum-related patents for the bank; and (3) refining and advancing use cases through strategic collaborations with industry partners to prepare for the emerging quantum economy.[43/]

- In 2022, **Rabobank,** a major Dutch bank, partnered with Quantum Computing, a leader in quantum technology, to integrate quantum computing with machine learning for enhancing the speed and accuracy of detecting fraudulent credit card transactions.[44/] Additionally, Rabobank recognizes that quantum computing could support its environmental sustainability goals by enabling more energy-efficient computing methods compared to classical computing.[45/]

41/ https://asia.nikkei.com/Business/Finance/MUFG-aims-to-use-quantum-computer-tech-in-financial-services

42/ https://www.hsbc.com/who-we-are/hsbc-and-digital/hsbc-and-quantum

43/ Economic activities or impacts resulting from the application of quantum technology.

44/ https://thequantuminsider.com/2022/12/08/quantum-computing-inc-to-help-rabobank-fight-fraud-with-entropy-quantum-computing/

45/ https://www.capgemini.com/insights/expert-perspectives/green-quantum-computing/

Challenges for the Banking Sector

Although it may take some time before quantum computing technology is fully ready for commercial use, banks and other financial institutions interested in this technology should prepare early to address the following challenges.

Budget

Quantum computing requires a substantial budget across multiple areas. Hardware costs are particularly high, with Frost & Sullivan (2024) estimating that a quantum computer with thousands of qubits could cost up to $15 million USD[46/] (approximately 523 million THB). Software costs encompass specialized quantum computing applications and their integration with classical computing systems. Infrastructure and management systems also demand significant investment, as quantum computing requires an optimal operating environment, such as dilution refrigerators,[47/] which may have an initial cost of around $500,000 USD (approximately 17.4 million THB).[48/] Additionally, the cost of quantum computing specialists is expected to remain high due to the scarcity of skilled professionals in this emerging field.

Figure 9

IBM's dilution refrigerator for quantum computers



Source: IBM

46/ Emerging Markets Quantum Computing Growth Opportunities (Forst & Sullivan, 2024)

47/ In 2024, IBM developed the largest dilution refrigerator for quantum computing, with a volume of 1.7 cubic meters: https://www.ibm.com/quantum/blog/goldeneye-cryogenic-concept-system?lnk=ushpv18nf2

48/ Global next generation computing market report (Market Research Future, 2024)

Workforce Development

The global shortage of quantum computing talent poses a significant challenge. McKinsey (2022) predicts that by 2025, the number of quantum professionals will be less than 50% of the available job openings.[49/] To address this, banks must begin planning for dedicated quantum computing teams, encompassing both software and hardware development. Collaboration with academic institutions, research centers, and specialized startups is essential for talent development and knowledge exchange. As quantum computing remains an emerging technology, ongoing research and development efforts are crucial for identifying its optimal applications in the financial sector.

Cybersecurity Measures

Quantum computing could enable cybercriminals to accelerate cyberattacks, particularly in decrypting data, posing a threat to financial data security, banks must adopt preventive measures to counter quantum-driven cyber risks. For example, the U.S. National Institute of Standards and Technology (NIST) has introduced the world's first Post-Quantum Cryptography (PQC) standards to safeguard sensitive data in the quantum era.[50/] Similarly, the Monetary Authority of Singapore (MAS) has issued guidelines on quantum-related cyber risks for financial institutions.[51/] These initiatives highlight the growing global focus on cybersecurity preparedness as quantum computing advances across industries, including the financial sector.



49/ https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/five-lessons-from-ai-on-closing-quantums-talent-gap-before-its-too-late

50/ https://research.ibm.com/blog/nist-pqc-standards

51/ https://www.mas.gov.sg/regulation/circulars/advisory-on-addressing-the-cybersecurity-risks-associated-with-quantum

Krungsri Research View

Quantum computing has the potential to become the new standard for computer processing in the near future. The financial sector should closely monitor both the advancements in this technology and its integration with AI, as this convergence could lead to significant technological breakthroughs.

Currently, experts in the technology field have differing opinions on the widespread application of quantum computing. For instance, Jensen Huang, CEO of Nvidia, a leading global chip manufacturer, believes that "quantum computers will not be truly operational for at least 15-20 more years." whereas Alan Baratz, CEO of D-Wave,[52/] asserts that "quantum computers are already applicable for business benefits."[53/] Additionally, Gartner has ranked Post-Quantum Cryptography (PQC) among the top 10 Strategic Technology Trends for 2025,[54/] emphasizing the need for businesses to safeguard data and address quantum-driven cybersecurity threats. Although there is no clear consensus yet, **banks should begin exploring potential use cases of quantum computing that align with their business strategies.** They may start by initiating pilot projects to study the feasibility and investment returns, which will enable banks to fully capitalize on the technology when it becomes practically applicable.

While quantum computers will significantly enhance the efficiency of processing highly complex tasks, they are not expected to entirely replace classical computers. Quantum computers are particularly suited for specialized tasks, such as managing vast amounts of data, risk analysis, or even advancing AI capabilities. On the other hand, traditional computers will continue to excel in handling basic, everyday operations. **Therefore, banks adopting quantum computing should prioritize developing systems or software to effectively integrate and coordinate operations between classical and quantum computers.**

Moreover, while quantum computers are more energy-efficient than classical computers for complex, high-precision processing (Figure 10), potentially positioning quantum computing as 'green computing' that supports sustainability goals,[55/] they consume significant electricity in cooling systems.[56/] **Thus, banks adopting this technology should focus on energy use within infrastructure systems designed to maintain optimal temperatures and environmental conditions.**

52/ D-Wave is a leading company in the development of end-to-end quantum computing technology, encompassing software, hardware, and consulting services for quantum applications.:https://www.dwavesys.com/company/about-d-wave/

53/ Alan Baratz stated that leading global companies, such as Mastercard, have already begun leveraging D-Wave's quantum computing technology. https://www.cnbc.com/2025/01/08/nvidia-ceo-jensen-huang-is-dead-wrong-about-quantum-d-wave-ceo.html

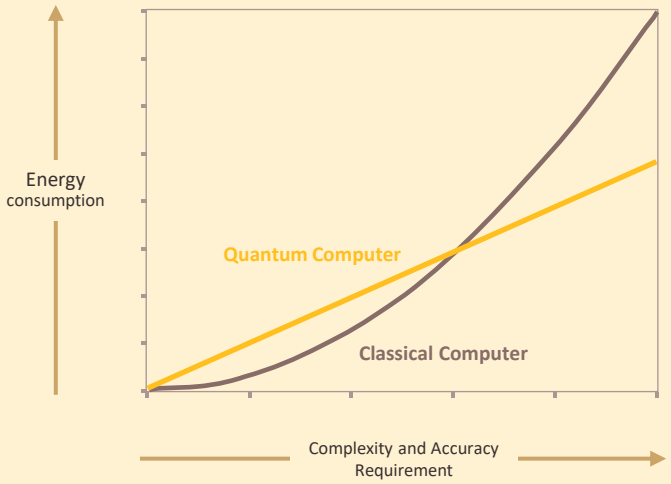
54/ https://www.gartner.com/en/articles/top-technology-trends-2025

55/ For example, the Frontier supercomputer consumes 21.1 megawatts of electricity, whereas a quantum computer with 250 qubits uses less than 10 megawatts. This demonstrates that quantum computers are more energy-efficient when performing the same tasks source: https://insidehpc.com/2023/06/the-energy-advantage-of-quantum-computers/

56/ https://www.wsj.com/articles/glass-chips-offer-hope-of-cleaner-future-for-quantum-computing-9c72a806?utm_source=chatgpt.com

Figure 10

The energy consumption model of quantum computing and classical computing.



Source: Cagemini, Kringsri Research

Ultimately, all sectors, including technology companies, financial institutions, and regulatory agencies, should raise awareness of cybersecurity risks associated with quantum technology by developing standards and practices to ensure robust data security.

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KRUNGSRI RESEARCH

Pimnara Hirankasi, Ph.D.
Head of Research Division and Chief Economist

Macroeconomic Team

Sujit Chaivichayachat
Head of Macroeconomic Research

Wanicha Direkudomsak
Senior Economist

Churailuk Pholsri
Senior Economist (Forecasting)

Thansin Klinthanom
Senior Economist

Krittabhorn Sirichaichingkun
Economist

Supasyn Itthiphatwong
Economist

Analytics & Intelligence Team

Pimnara Hirankasi, Ph.D.
Acting Head of Analytics and Intelligence Research Department

Nathanon Ratanathamwat
Senior Researcher

Narichaya Satafang
Researcher

Parinya Mingsakul
Researcher

Chanatta Thararos
Researcher

MIS and Reporting Team

Thamon Sernsuksakul
Information Analyst

Chirdsak Srichaiton
Information Analyst

Wongsagon Keawuttung
Information Analyst

Industry Team

Taned Mahattanalai
Head of Industry Research

Poonsuk Ninkitsaranont
Senior Analyst (Healthcare, Mobile Operators)

Piyanuch Sathapongpakdee
Senior Analyst (Transport & Logistics)

Thian Thiumsak
Senior Analyst (Energy, Petrochemicals)

Chaiwat Sowcharoensuk
Senior Analyst (Agriculture)

Narin Tunpaiboon
Senior Analyst (Power Generation, Modern Trade, Chemicals, Medical Devices)

Puttachard Lunkam
Senior Analyst (Construction Contractors, Construction Materials, Hotels, Industrial Estate)

Patchara Klinchuanchun
Senior Analyst (Real Estate)

Prapan Leenoi
Analyst (ESG)

Supawat Choksawatpaisan
Analyst (Automobile, Electronics & Electrical Appliances)

Rapeepoom Lapmak
Analyst (Agriculture, Food & Beverages)