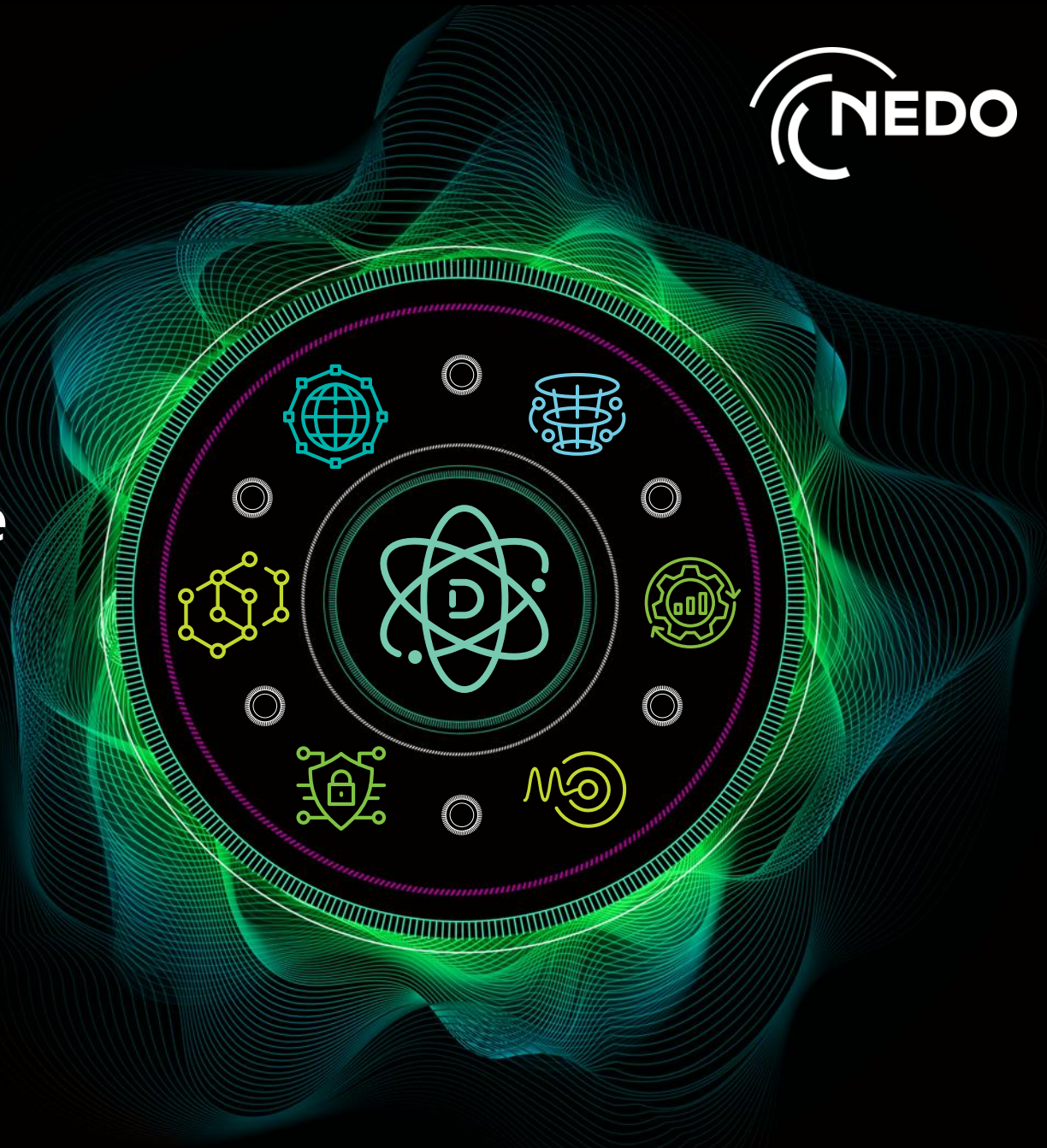
Quantum Computing Use Cases

Development of POD Readout, a New Technology for Reducing the Number of Measurements of Quantum Computing Results

Quemix × SCSK



New Energy and Industrial Technology Development Organization (NEDO)

Quemix × SCSK : Development of POD Readout, a New Technology for Reducing the Number of Measurements of Quantum Computing Results [2026/6] 1/3

Validation

Industry	Others
Process	Others
Method	Simulation
Category	Gate*

Background

- In modern society, **advanced simulation and analysis are becoming increasingly important,** and large-scale, **high-precision computations are required** in a wide range of fields such as power grid stabilization, fluid and heat transfer analysis, and molecular-level chemical simulation
- In such computations, **the computational load increases rapidly as the scale of the target system and the required precision grow**, and conventional **classical computers are beginning to show their limitations**. As a result, **expectations are rising for quantum computers as next-generation computational accelerators**
- At the same time, **readout (measurement) after computation had become a major challenge** to the practical use of quantum computers. Although computation itself can be performed rapidly on a quantum computer, **extracting the results accurately as numerical values incurs enormous cost, making it a bottleneck that dominates overall processing time**
- Against this background, SCSK and Quemix focused on the “number of measurements,” which strongly affects the value of quantum computing, and worked on the research and development of a more efficient readout method that does not require a large number of measurements

Issues and motivation to be solved

- Similarly, **a major bottleneck to the practical use of quantum computers was that reading out computational results required a large number of measurements**
- With conventional methods that sequentially read out and reconstruct the computational results, the speed advantage of quantum computation is offset by the readout process itself, making it **necessary to rethink the very premise of “assuming a large number of measurements”**
- Accordingly, this initiative aimed not to read out the entire quantum state in detail, **but rather to efficiently extract the information that is important to the solution, so that the quantum state could be reconstructed with the required accuracy while suppressing the number of measurements**

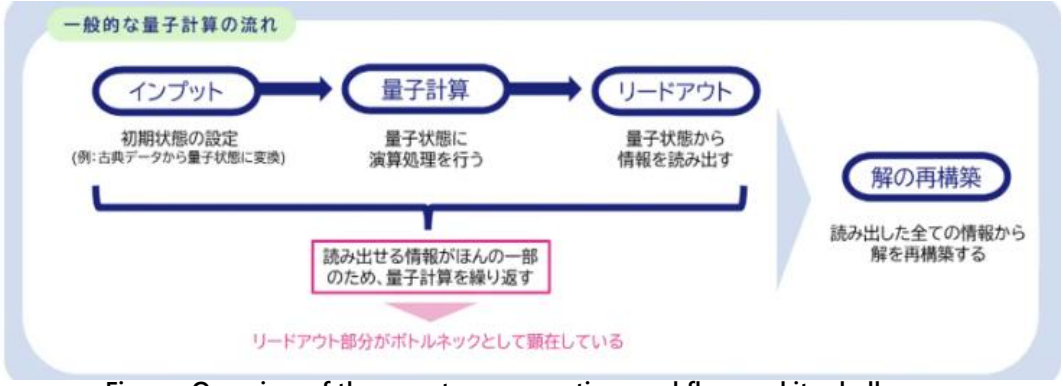


Figure: Overview of the quantum computing workflow and its challenges

Reference: A New Approach to “Measurement,” the Bottleneck in Quantum Computing SCSK and Quemix Develop “POD Readout,” a New Technology That Reduces the Number of Measurements by Up to 1/1000
（https://prtimes.jp/main/html/rd/p/000000253.000009955.html）

*Gate（gate-based）: A computing approach in which operations are applied sequentially to qubits to perform calculations. Similar in concept to logic circuits in classical computers, it can address a wide range of problems.

Quemix × SCSK : Development of POD Readout, a New Technology for Reducing the Number of Measurements of Quantum Computing Results [2026/6] 2/3

Validation

Industry	Others
Process	Others
Method	Simulation
Category	Gate*

Problem setting as a quantum computer

- For this project, **"POD Readout" was adopted as a new technique for efficiently reading out important information from quantum-computing results in fluid calculations**
- Specifically, **a POD basis was constructed in advance from classical computational fluid dynamics results as a reconstruction filter so that representative patterns could be extracted from a large volume of data**
  - ✓ The POD basis is a method for compressing and representing large amounts of data in terms of their important features
- **By embedding the constructed POD basis into a quantum circuit and performing measurement on the quantum state using the POD basis, the main feature components contained in the quantum state can be extracted and efficiently reconstructed**
- This approach aims to reduce the number of measurements while maintaining accuracy, without assuming full sequential readout

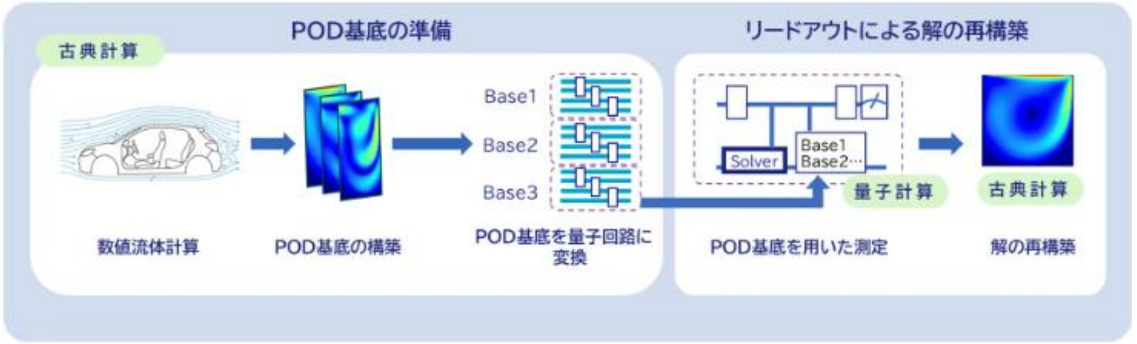


Figure: Overview of POD Readout

- **POD Readout achieves both fewer measurements and high accuracy**

By directly extracting important information from the quantum state, it reduces the number of required measurements while maintaining measurement accuracy

- **POD Readout preserves the speed of quantum computation**

It alleviates the bottleneck at the quantum–classical interface without compromising the speed of the quantum computation itself

Reference: A New Approach to "Measurement," the Bottleneck in Quantum Computing SCSK and Quemix Develop "POD Readout," a New Technology That Reduces the Number of Measurements by Up to 1/1000（https://prtimes.jp/main/html/rd/p/000000253.000009955.html）

*Gate（gate-based）: A computing approach in which operations are applied sequentially to qubits to perform calculations. Similar in concept to logic circuits in classical computers, it can address a wide range of problems.

Quemix × SCSK : Development of POD Readout, a New Technology for Reducing the Number of Measurements of Quantum Computing Results [2026/6] 3/3

Validation

Industry	Others
Process	Others
Method	Simulation
Category	Gate*

Expected business benefits

- Benchmark experiments showed that, compared with conventional readout methods, **the number of measurements can be reduced by up to 1/1000**, while still **enabling high-precision readout even with a small number of measurements**
- As a result, it is expected to become easier to apply quantum computing to practical simulations and analyses without sacrificing its computational speed, thereby **alleviating the problem of readout processing becoming a bottleneck for the overall computation**
  - ✓ It also contributes to improving the efficiency of the quantum–classical interface
- In addition, this technology is highly compatible with applications that extract important indicators and numerical values from quantum-computing results, and is expected to be used in areas such as computational fluid dynamics for aircraft and automobile design, molecular simulations for new battery materials and new semiconductor materials, financial applications such as derivative pricing and risk analysis, and physics simulations in the CG and digital twin fields
- Going forward, research will advance on generalization performance so that high-precision readout can be achieved with a small number of measurements even for unknown bases, while proof-of-concept experiments combining this approach with quantum computing algorithms will be carried out through co-creation with customers

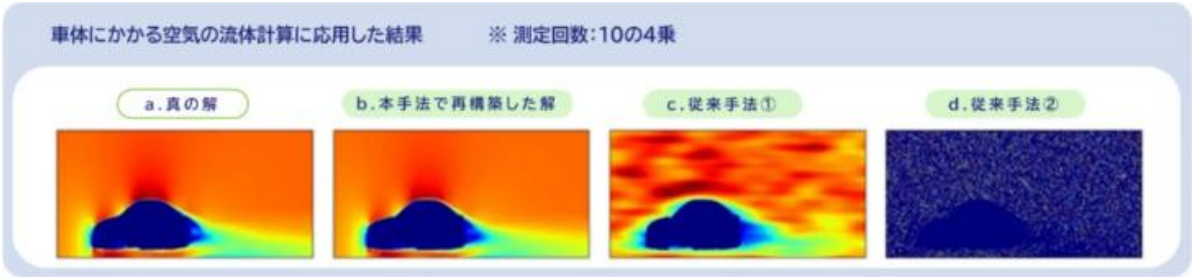


Figure: Results of the benchmark data experiment
Compared with conventional methods, the result obtained with this technology (b) can be reconstructed with high accuracy even with fewer measurements, relative to the true solution (a)

Reference: A New Approach to “Measurement,” the Bottleneck in Quantum Computing SCSK and Quemix Develop “POD Readout,” a New Technology That Reduces the Number of Measurements by Up to 1/1000（https://prtimes.jp/main/html/rd/p/000000253.000009955.html）
*Gate（gate-based）: A computing approach in which operations are applied sequentially to qubits to perform calculations. Similar in concept to logic circuits in classical computers, it can address a wide range of problems.

More use cases are available on our website. We invite you to explore them.
https://www.quantum-computing-use-cases.nedo.go.jp/english/

More Use Cases

New Energy and Industrial Technology Development Organization (NEDO)
AI and Robotics Department (e-mail: quantum_ai@ml.nedo.go.jp)

This collection of use cases was obtained as a result of the work commissioned by the New Energy and Industrial Technology Development Organization (NEDO) "Cyber-Physical Development Business of Quantum/Classical Hybrid Technology/Study of Use Case of Quantum Technology" and the “Post-5G Information and Communications System Infrastructure Reinforcement R & D Project (Quantum Industrialization)/Comprehensive Study for Promoting the Industrialization of Quantum Computers”.