INTERNATIONAL YEAR OF Quantum Science and Technology

Q-STAR: Driving Innovation with Collaborative Standardization

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Chair of the Standardization Recommendations & Alliances WG of
Quantum STrategic industry Alliance for Revolution (Q-STAR)

November 4, 2025

Q-STAR Overview

Quantum STrategic industry Alliance for Revolution

Established	**September 1, 2021 (Incorporated on May 9, 2022)**
Purpose	**Create industries & businesses based on quantum technology**
Membership	**137 members(as of October. 2025) Including 69 Members from User Companies**
Scope	**Materials、Quantum Materials、Quantum Life, Medicine and Biotechnology、Measurement Technology、Quantum Computers、Expansive Data、Quantum Key Distribution、Quantum AI、Devices、Quantum Sensors、Application Software**

Q-STAR Progress

2021
Establishment

September 2021
Establishment of Q-STAR

24 Members
6 Working Groups
4 Subcommittees

2022
Discussion and use case creation

May 2022
Became General Incorporated Association

65 Members
8 Working Groups
5 Subcommittees

2023
Demonstration Stage

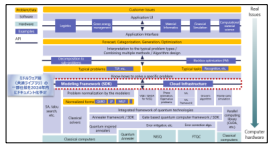
MOU signed to establish International Council of Quantum Industry Associations

ICQIA
INTERNATIONAL COUNCIL OF QUANTUM INDUSTRY ASSOCIATIONS

89 Members
8 Working Groups
6 Subcommittees

2024
Materializing the Foundation for Social Implementation

Materializing Software Infrastructure

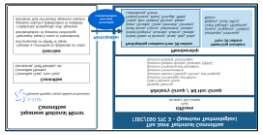


Collaboration with G-QuAT

106 Members
8 Working Groups
6 Subcommittees

2025
Accelerating Initiatives Toward International Standardization

Starting Initiatives as Japan's National Mirror Committee for IEC/ISO JTC 3 – Quantum Technologies



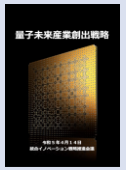
MOU signed to Strengthen UK-Japan Collaboration

UKQuantum × Q-STAR

137 Members
(as of October. 2025)
9 Working Groups
7 Subcommittees

Our Contributions to National Strategies

Vision of Quantum Future Society



Strategy of Quantum Future Industry Development

Promotion Measures for Development of Quantum Industries

Promotion Measures for the Development of a Quantum Ecosystem

Toward Global Leadership in the Future Quantum Industry

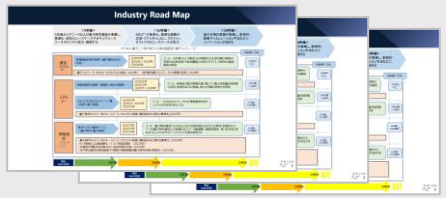
Q-STAR contributes to establishing Japan's leadership in global standards and the global supply chain by advancing three strategies.

Use Cases

Vendor and user companies collaborate to discuss and validate use cases.

A wide range of use case discussions

Selected use cases from the discussions were incorporated into the industry roadmap.



Test Beds

Working toward early social implementation by demonstrating use cases in a real-world environment through collaboration on a testbed with G-QuAT.

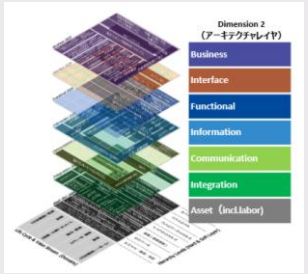
Source: https://unit.aist.go.jp/g-quat/index.html

Standardization

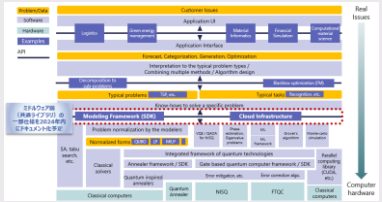
Frameworks that connect technology to business.

QRAMI

- Overview of the entire pathway toward social implementation
- Shared understanding among stakeholders



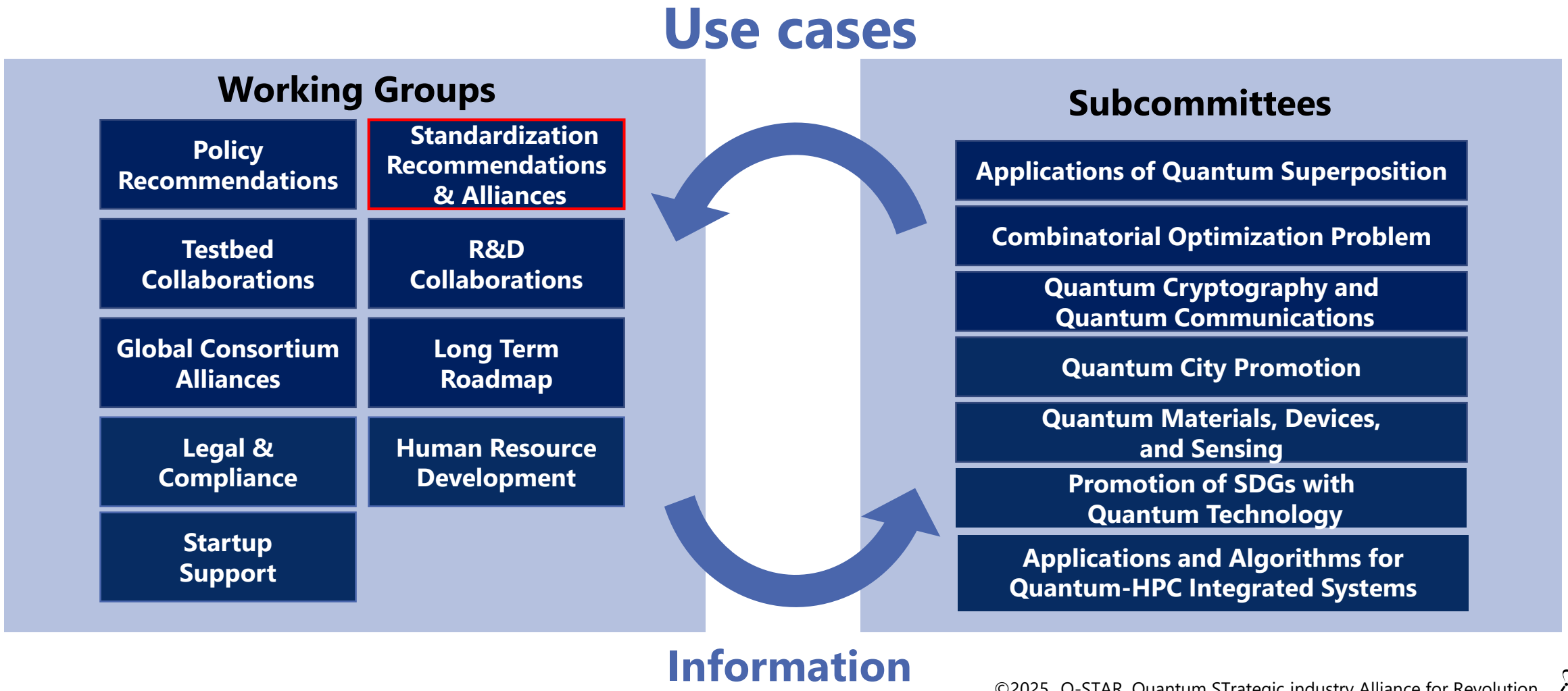
Software Stack Diagram



- Exploring quantum solutions to societal challenges
- Identifying potential use cases

Creating Use Cases

Members from a wide range of fields participate in subcommittee activities and create use cases



Examples of Use Cases

Logistics

- Verification of CO2 emission reduction by quantity optimization by carbon neutral x quantum inspired technology (Toshiba)
- Responding to increasingly complex shipping plans due to increased numbers and variety with fluctuating demand（NEC)
- NEC Fielding's maintenance parts delivery efficiency and optimization (NEC)

Manufacturing

- Adapting to high-mix low-volume production with increasingly complex production (NEC)
- Production Planning Optimization（NEC ）
- Optimize the production sequence of automobiles（Fujitsu, Toyota）

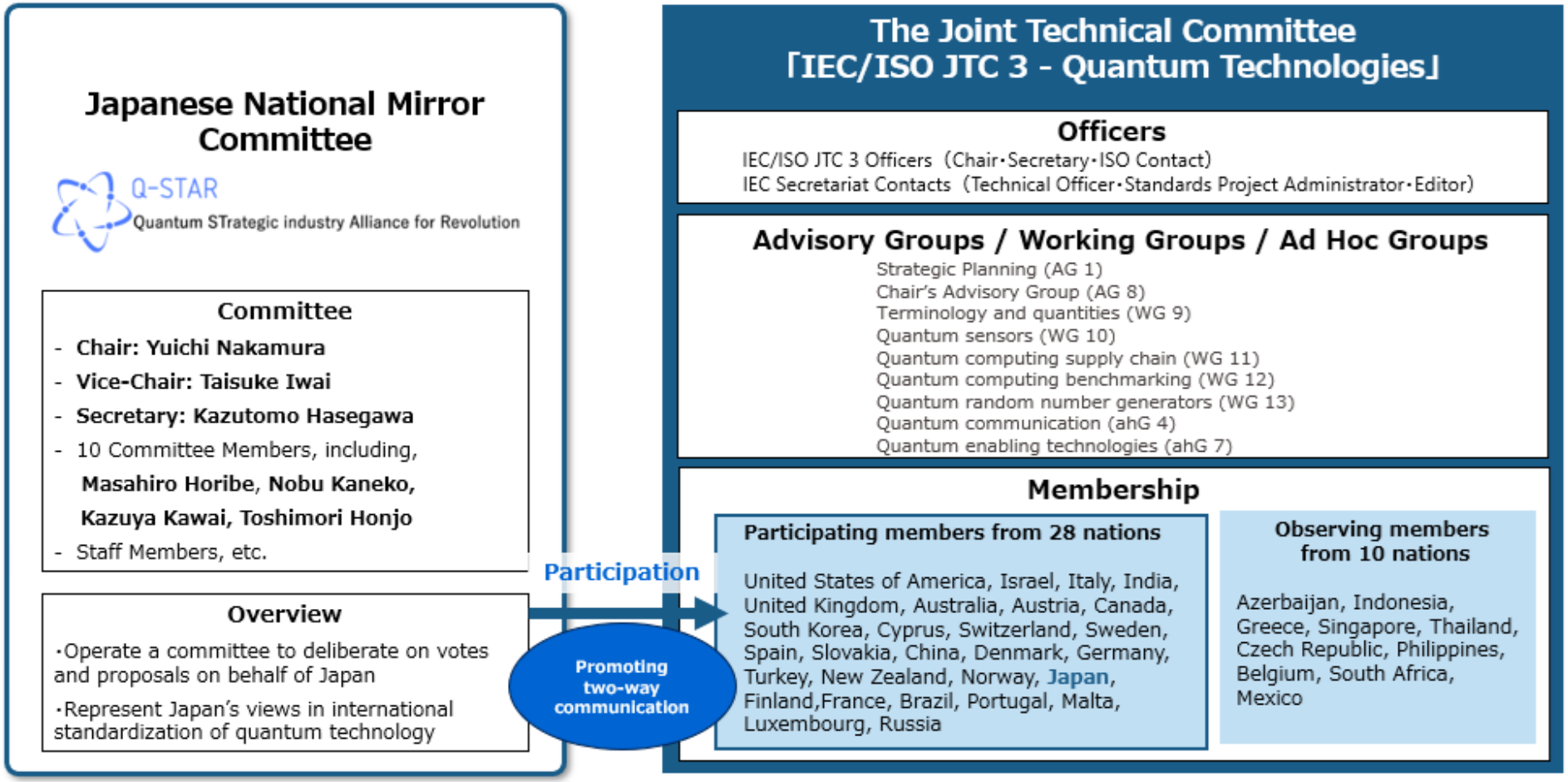
Finance

- Demonstrating the effectiveness of high-speed, high-frequency trading strategies using pseudo-quantum technology (Toshiba & Dharma Capital)
- CMOS Annealing Machine: Began use in insurance underwriting operations（Hitachi）
- Portfolio risk & return analysis contributing to steady growth of asset management (Fujitsu & Melco Investments)

Japanese National Mirror Committee for IEC/ISO JTC 3

Q-STAR was accredited as the Japanese National Mirror Committee for IEC/ISO JTC 3 – Quantum technologies

～Leads Japan's Contribution to the International Standardization of Quantum Technologies～



JTC 3 Plenary Meetings

	5, 2024	6	7-8	9	10	11-12	1-4, 25	5	6-9	10	11
IEC / ISO JTC 3	**1st Plenary** 5/28-30 Seoul		**Ad-hoc Group meetings**		**2nd Plenary** 10/21-22 Edinburgh		**ahG meetings**	**3rd Plenary** 5/26-29 Tokyo			**4th Plenary** 11/11-14 Copenhagen

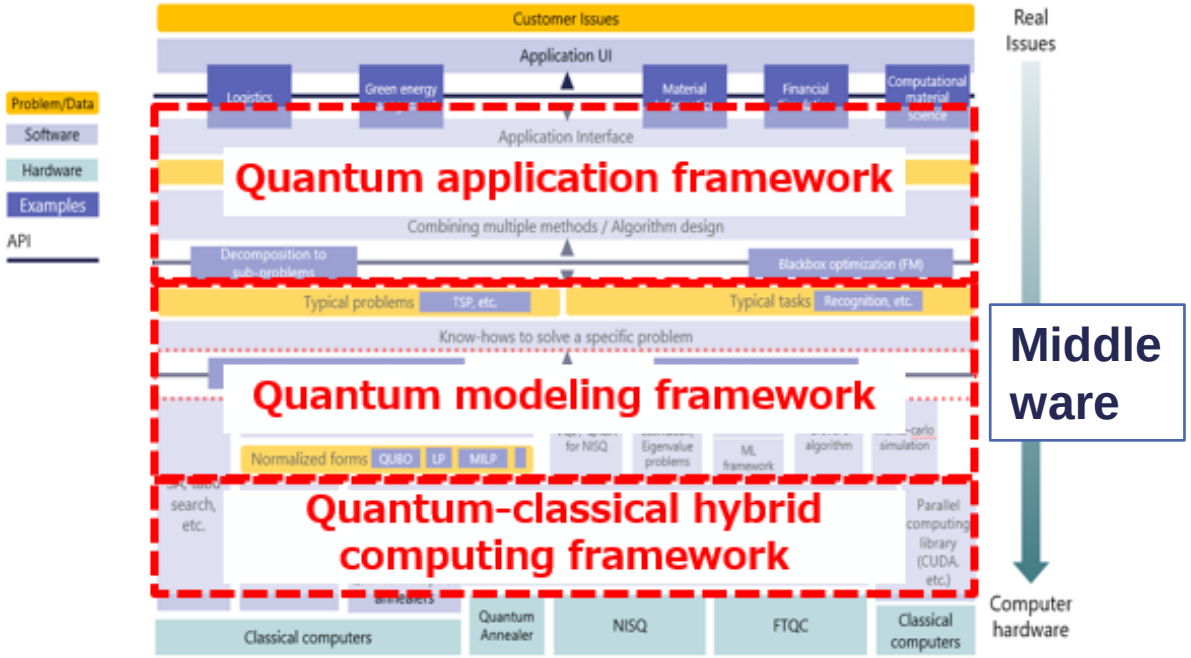
We welcomed 66 experts from 16 countries (and 33 remote participations)

Key Standardization Areas for Q-STAR

1. **Conducting benchmarking at the industrial use case level**
   - evaluation of the effectiveness for social implementation of the use cases
2. **Standardization of the middleware layer** (under consideration)
   - utilizing quantum-inspired machines and quantum simulators to promote the social implementation of the use cases ahead of the quantum computers era

Five maturity indicators for social implementation
TRL : Technology Readiness Level Indicator of the degree of technological development compared to the level of technological demand from society.
BRL : Business Readiness Level Indicator of the degree to which a technology-based business can create sustainable business value
GRL : Governance Readiness Level Indicator of the degree of institutional and regulatory development necessary for the diffusion of the technology
S(C)RL : Social (Communal) Readiness Level Indicator of the degree to which a technology can be demanded by society and business markets
HRL : Human Resources Readiness Level Indicator of the abundance of human resources needed for technology diffusion in society and business.

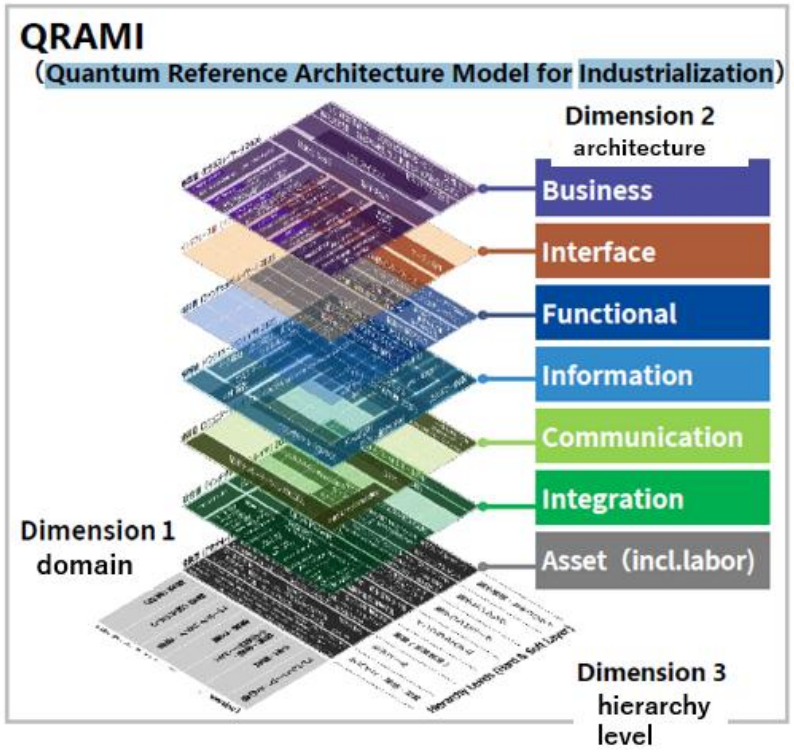
Ref: https://www8.cao.go.jp/cstp/gaiyo/sip/taskforce/smartbousai_3/siryo5.pdf



Software stack diagram developed by Q-STAR

The Role of Benchmarking | Quantum Computing

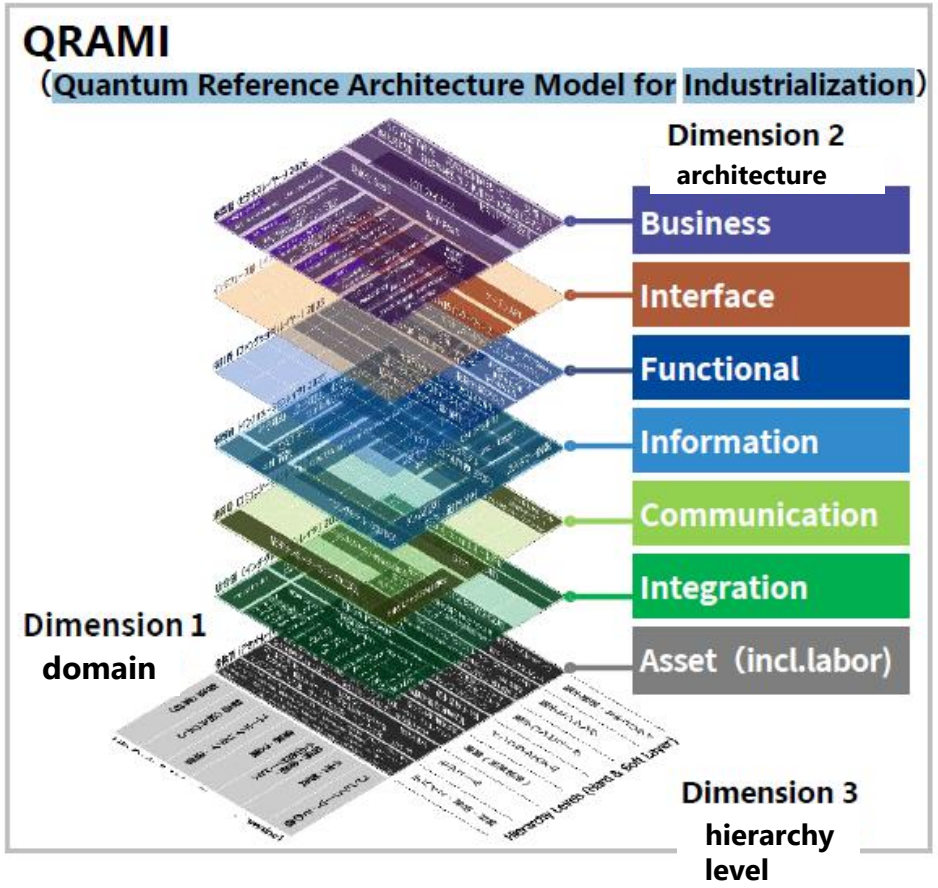
- **The use of benchmarks is expected as means of social implementation and R&D promotion**
- **Approach**
  1. Identify target use cases for social implementation
  2. Use QRAMI to identify technologies and applications required to realize the use cases
  3. Set benchmarks step by step to accelerate development
  4. Execute PDCA cycles, including benchmark review



Our aim is to develop industrial use case-based benchmarks that are practical for assessment and crucial for social implementation

QRAMI | A Tool for Use Case Development

QRAMI is a three-dimensional model and is used as a tool to support the development of quantum-related use cases



Dimension 1 : Industry Domains involved in Quantum technology
Dimension 2 : Layers in architecture
Dimension 3 : Technology hierarchy level
(from material/device to total system)

Evaluating the values of use cases

Technological maturity is insufficient for social implementation; business models and return on investment also need to be addressed

Five maturity indicators for social implementation
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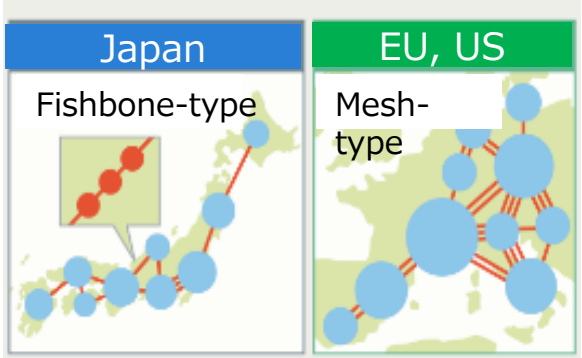
Ref: https://www8.cao.go.jp/cstp/gaiyo/sip/taskforce/smartbousai_3/siryo5.pdf

- While TRL (Technology Readiness Level) is key for R&D, **social implementation demands broader readiness indicators:**
  - BRL: for business potential
  - SRL/HRL: for social acceptability
  - GRL: for legal & regulatory barriers

- **Example: Power Networks**
  - BRL: Cost allocation remains a key challenge for the new quantum-enabled power network solutions
  - SRL: Incomplete IoT integration of network equipment and regional disparities need to be addressed

Differences in Electricity Networks between Europe, the U.S. and Japan



Ref : https://www.fepc.or.jp/enelog/focus/vol_28.html

JTC 3/WG 12 | Quantum computing benchmarking

- **Dr. Masahiro Horibe has been appointed as the convenor for WG 12**
- **WG 12 has established Three Projects** * Project Leaders (PL) to be formally appointed

WG 12: Quantum computing benchmarking

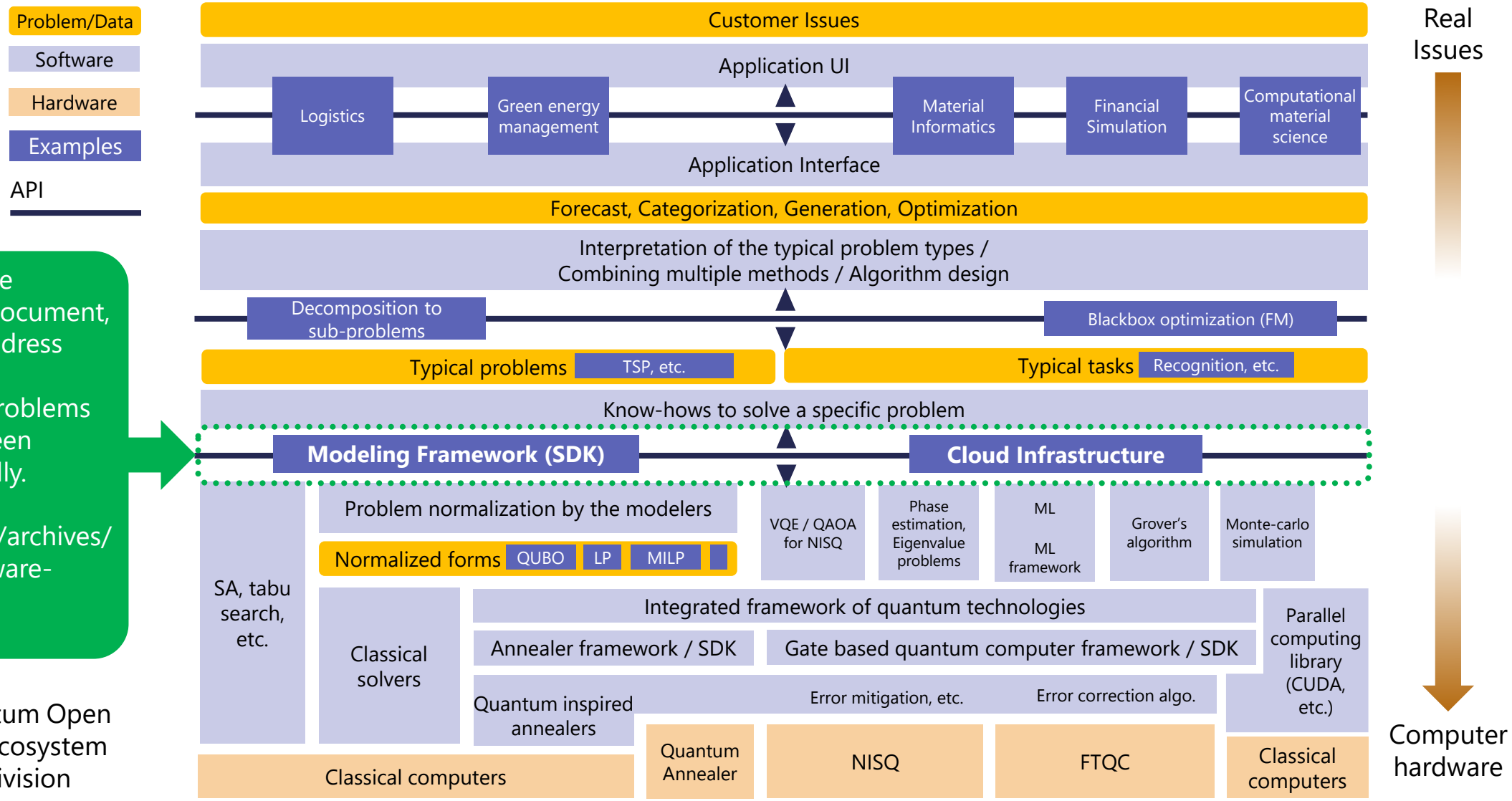
- **Convenor: Masahiro Horibe (JP)**

- TR: Survey and classification of algorithmic and application benchmarking techniques (PL：Casey Myers (AU))
- IS: Algorithmic and application level benchmarks (PL： Harold Herbin (FR))
- IS: Hardware benchmarking (PL：Yuval Rishu Sanders (AU))

TR: Technical Report
IS: International Standard

Software Stack Diagram for Quantum Computing Domain

Systematically examine the use of quantum technology to solve social issues



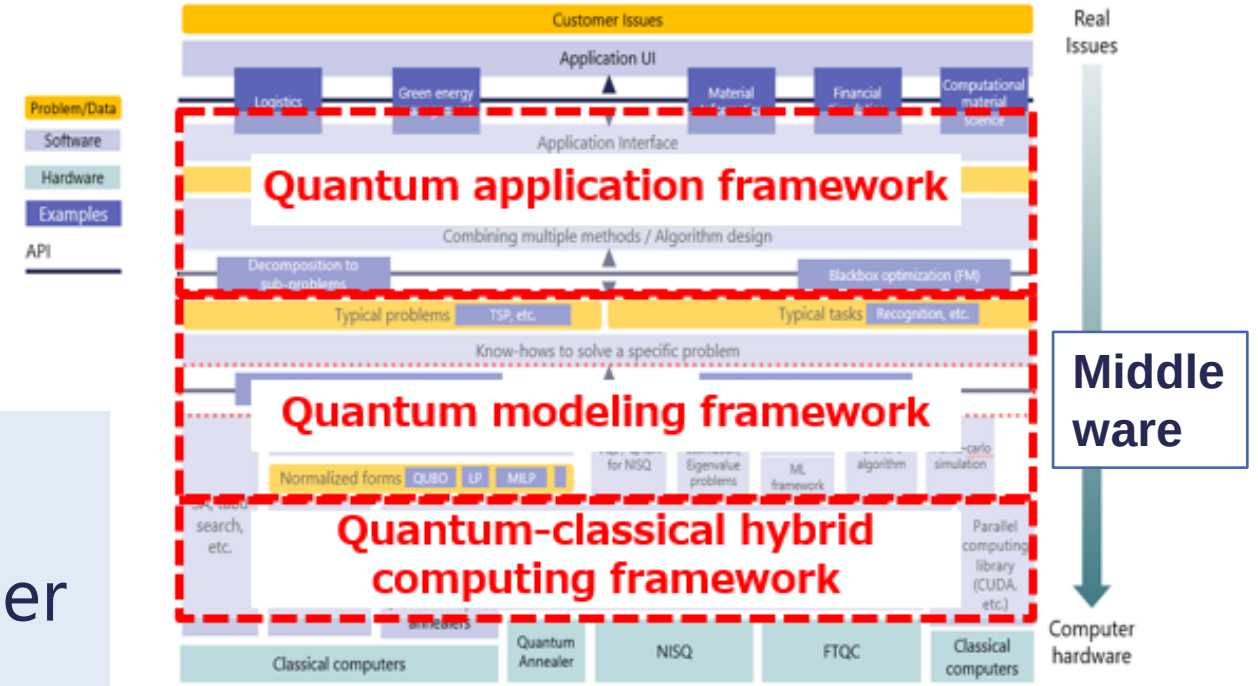
The Middleware Specification Document, designed to address combinatorial optimization problems (QODE), has been released globally.

https://qstar.jp/archives/quantum/software-platform-stack

*QODE：Quantum Open Development Ecosystem Optimization Division

Exploring Standardization of Middleware

- Clarifying the structure of the software layer and identifying technical specifications to be standardized
- By using quantum simulators, software development and social implementation of use cases can be realized in a short period of time, and the results can be used for quantum computers
- **Standardization of middleware** will be key to transitioning these practices to quantum computers (under consideration)
- Such standardization **accelerates use case implementation**, enabling the exploration of broader stack standardization



Summary

1. Integrating Insights from Use Case Development

- Q-STAR believes in a use case-driven approach to accelerate the social implementation of quantum technologies, and then integrating these insights into standardization efforts

2. Collaborative Standardization under International Cooperation

- Q-STAR actively participates in collaborative global discussions, such as IEC/ISO JTC 3, to ensure our efforts to foster a global ecosystem through the international cooperation

3. Working Together with Korea

- Q-STAR values its ongoing working relationship with Korea and looks forward to continuing this collaboration in advancing quantum technologies through joint standardization initiatives

Thank You

Q-STAR's involvement in international standardization of quantum technologies is supported by a project commissioned by the Ministry of Economy, Trade and Industry of Japan.

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