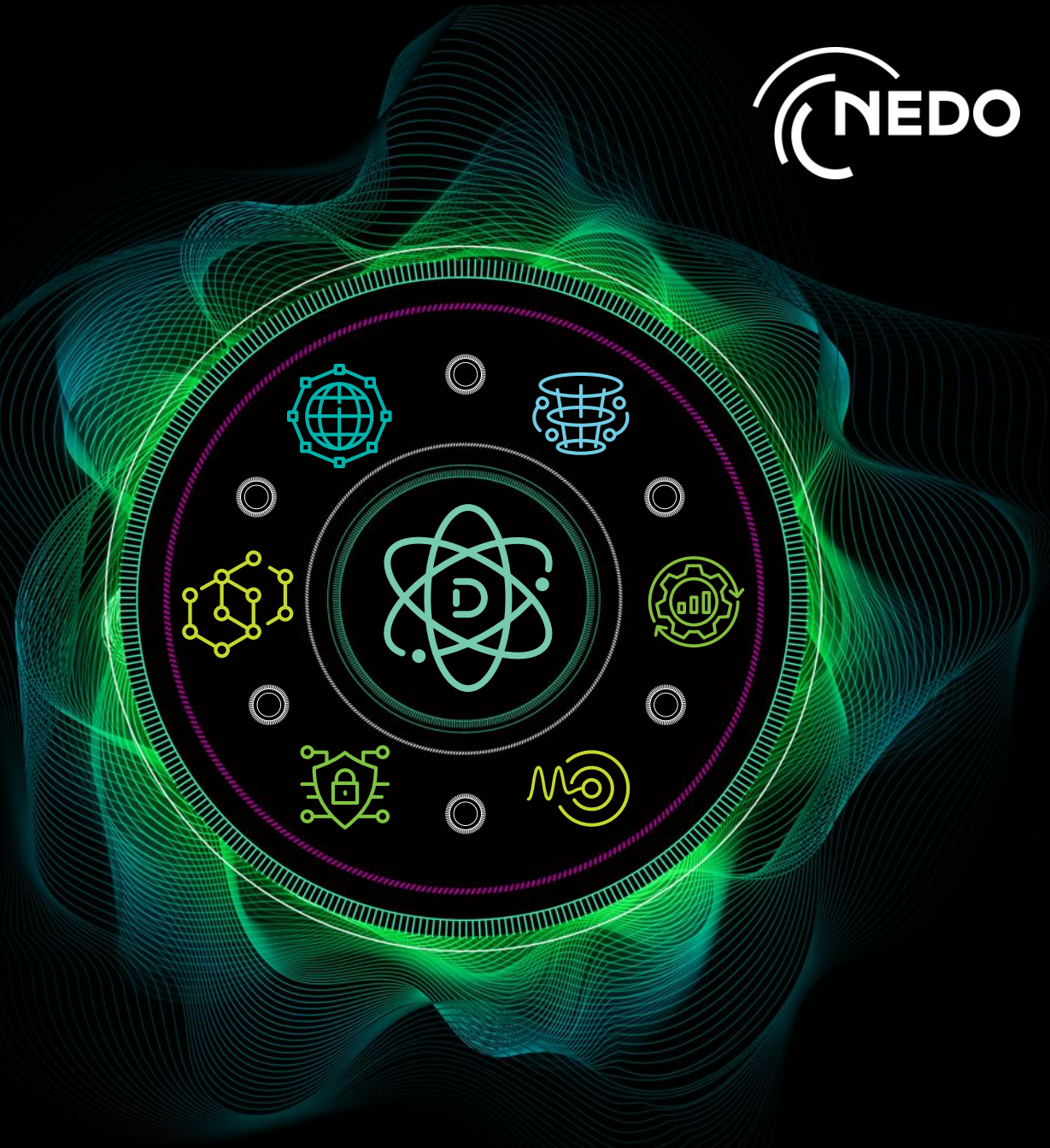
Quantum Computing Use Cases

Optimizing Collaborative Shift between Humans and Robots

Maxvalu Tokai Groovenotes



New Energy and Industrial Technology Development Organization (NEDO)

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Validation

Industry	Discrete Manufacturing
Process	Production
Method	combinatorial optimization
Category	Ising*

Background

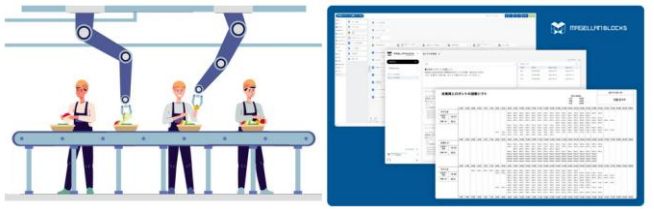
- In production plants, robots are introduced into some of the production processes, and robots and workers are assigned to repeat certain tasks, thereby improving work efficiency.
- On the other hand, **In food factories that produce prepared foods, the objects to be handled are often amorphous, and the introduction of robots is difficult due to the large variety of small lots, and most of the work depends on human hands.**
  - ✓ It is necessary to display irregularly shaped side dishes in a good appearance, but mechanization has not progressed because it is difficult for the same machine to hold sticky potato salad and vinegared dishes with a lot of water to display the specified amount.
- However, amid a labor shortage, **there is a growing need to introduce robots into some of the production processes at delicatessen factories to solve labor shortages through automation and improve production efficiency.**
- The problem lies in **creating optimal shifts for human-robot hybrids.**
  - ✓ **Until now, work shifts at the deli plant have been manually created by plant managers based on their experience.**

Issues and motivation to be solved

- In a factory where humans and robots work together, **it is difficult for humans to create optimal work shifts based on a huge combination of various conditions, such as different working hours and holidays for each employee, differences in work speeds among employees, and robot work capabilities,** and **even a classical computer requires a huge amount of computing resources.**
- Maxvalu Tokai and Groovenotes are working together to **use quantum computer technology to create work shifts combining humans and robots** and to **reduce the workload of employees and improve productivity without increasing the number of employees**.

Expected business benefits

- **Using Magellan Blocks, a quantum cloud platform, we can create an optimal human-robot hybrid work shift in approximately 10 minutes from a vast array of human-robot parameters.**
  - ✓ **The processing time of the quantum computer itself is about 1/100,000 of a second, and the time including the front and back processes such as data acquisition and conversion to shift tables is about 10 minutes.**
  - ✓ Although it has not been put into practical use, the result is not so different from the previous manual shift.



Creating Mixed Man-Robot Work Shifts Using Magellan Blocks Shift Optimization Solution

Reference: Sankei Shimbun "Quantum computing could transform work in 10 minutes with cutting-edge technology" (https://www.sankei.com/article/20230602-SRG2QXNDJRJONPFKBPBJKB3FJ4/), Groovenotes Co., Ltd. "Maxvalu Tokai and Gourmet Delica start using shift creation service using quantum computer | Nissay Delica uses AI to predict order volume" (https://www.magellanic-clouds.com/blocks/2022/03/29/robot-friendly-2/), Impress Co., Ltd. "Maxvalu Tokai uses quantum computers to create shifts for deli production" (https://it.impress.co.jp/articles/-/24608)
*Ising: A computing approach, mainly associated with quantum annealers and simulators specialized for the Ising model, in which a problem is first formulated as an Ising model and then solved computationally. It is particularly well suited to problems that involve finding the optimal combination from a vast number of possibilities.

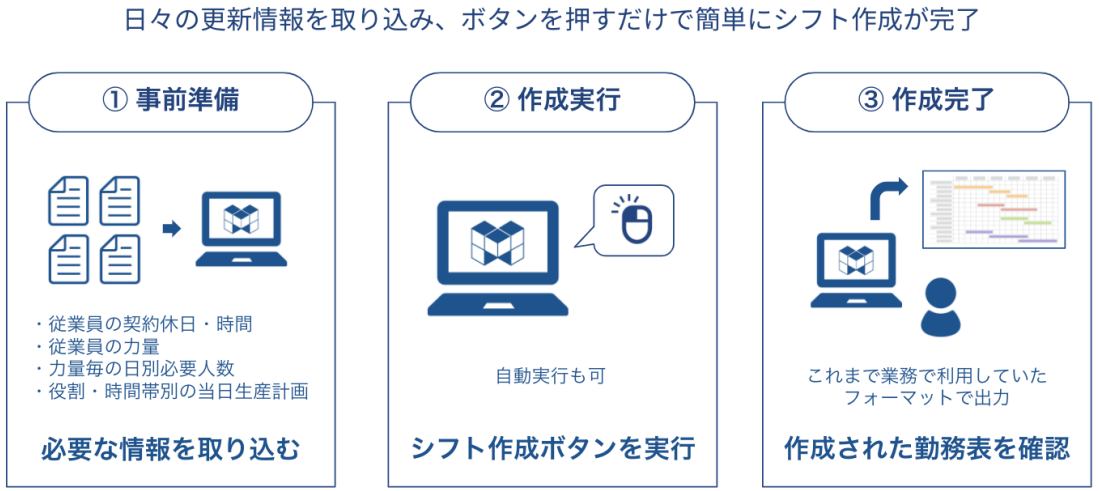
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Expected business benefits

- Maxvalu Tokai's delicatessen factory needs to deal with a variety of delicatessens
  - ✓ In the case of potato salad with various shapes, softness, and quantity of side dishes handled, it is necessary to deal with multiple cases such as small, medium, large, and increased quantity.
- In the demonstration, **the goal was to automate work shift creation for approximately 50 people, including a potato salad robot line** and **extract industry-common requirements and create an optimization model based on standardized requirements**.
  - ✓ Input data include **the number of employees required by contract hours, holidays, and days, and the amount of prepared food produced per hour as an indicator of employee productivity (the amount that can be served).**
- **Applying the quantum cloud platform 'Magellan Blocks' developed by Groovenotes** to the creation of human-robot hybrid work shifts
  - ✓ Magellan Blocks is a **quantum optimized solution for supply chain management, including production planning, factory logistics, and work shifts.**
  - ✓ The operating environment **utilizes solvers specialized in optimization calculations using D-wave quantum annealing machines and SQBM+ (Toshiba) simulated branching machines**.



Leveraging Magellan Blocks shift optimization solutions
Creation of human-robot mixed work shift

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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".