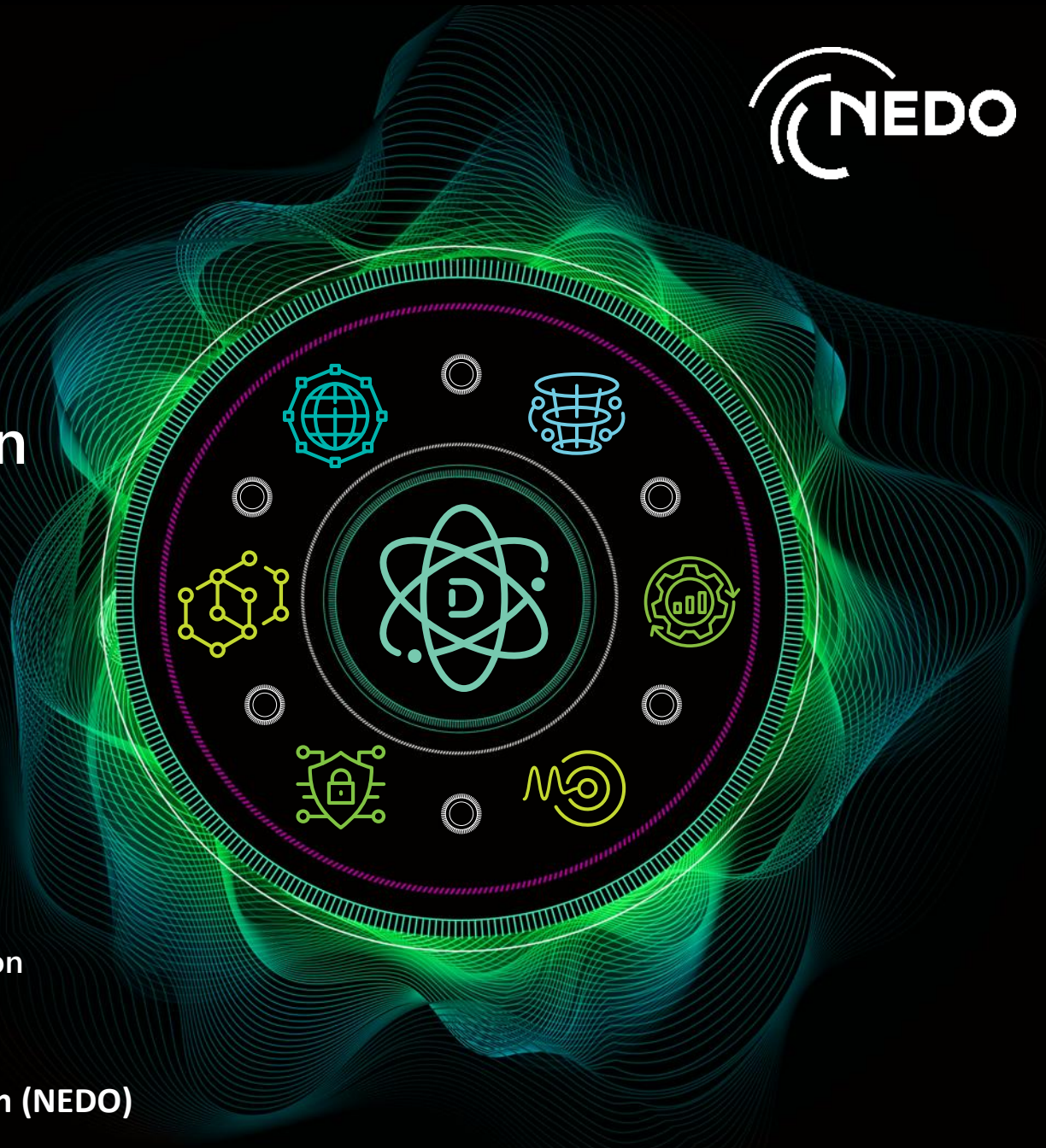
Quantum Computing Use Cases

# High-Mix, Low-Volume Production Planning

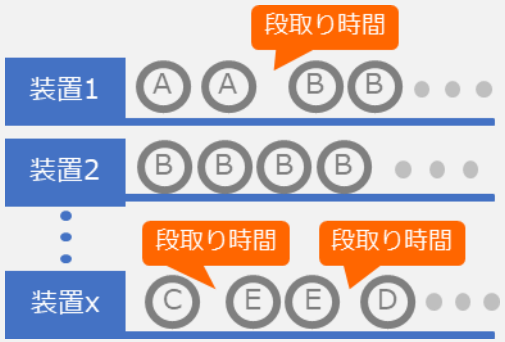


Combinatorial Optimization Problem

©2026 Q-STAR, Quantum STrategic industry Alliance for Revolution

New Energy and Industrial Technology Development Organization (NEDO)

# 【Hypothesis formulation】High-Mix, Low-Volume Production Planning




Factory Production Concept

| | |
|---|---|
| **Use Case Overview** | Production plans are optimized in a high-mix, low-volume manufacturing environment by considering processing times, due dates, utilization rates, workforce requirements, product/customer priorities, inventory levels, and the availability of parts and tooling. |
| **Issues to be addressed and their effects** | • Complex constraints, including setup times for each machine, workforce requirements, and shortages or surpluses of parts and tooling<br>• Ability to respond to customer order changes<br>• Determine the optimal production sequence to minimize delivery delays and total production lead time |
| **Contributions of quantum technology** | Quantum (inspired) computing enables the rapid generation of optimal production plans, even when manual planning or conventional optimization solvers are too time-consuming. |

| | |
|---|---|
| **Expected realization period** | 2030 |
| **Industry classification** | Manufacturing |
| **Related QRAMI layers** | Manufacturing Scheduling ICT |
| **Related quantum technologies** | Quantum Inspired Computer |

| | |
|---|---|
| **Novelty** | Mid |
| **Difficulty of achievement** | Mid |
| **Social contribution level** | Mid |
| **Market size** | Factory DX Market in JP-FY2024 ¥1.8 trillion |

Details

# High-Mix, Low-Volume Production Planning

## Key Challenges

- Setup times and production losses vary depending on product–equipment combinations
- Quick adaptation to sudden order changes

## Overview of the Use Case

- Provides optimal solutions in a short time, even when manual planning or conventional solvers require excessive computation time
- Considers not only completion times, but also due dates, utilization rates, workforce requirements, product (customer) priorities, inventory levels, and shortages or surpluses of parts and tooling
- Capable of responding to sudden changes in production plans

## Implementation Image

**Target Realization Date：2030**

### Cloud-Based Service for Rapid Production Planning

Input/Output Application
(Constraint Input and Result Output)

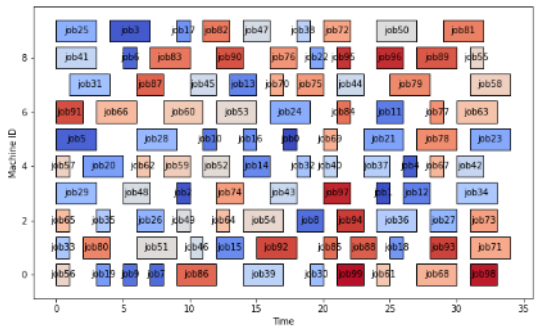
↕

Production Planning Software(Transforms production planning requirements into combinatorial optimization problems)

↕

Quantum (Inspired) Computing(Combinatorial Optimization Processing)

Production Plan




## Expected Benefits

- Increase productivity by reducing production lead times
- Reduce waste and operational costs (materials, labor, etc.)
- Strengthen the competitiveness of manufacturing companies

## Action Plan

| QRAMI | Action |
|---|---|
| Business | Cloud-Based Production Planning Service |
| Function | Production Planning Software |
| Information | Expertise in formulating real-world operational constraints and objectives |
| Integration | Factory Digital Twin |
| Asset | Quantum (Inspired) Computing |

**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 ”.**