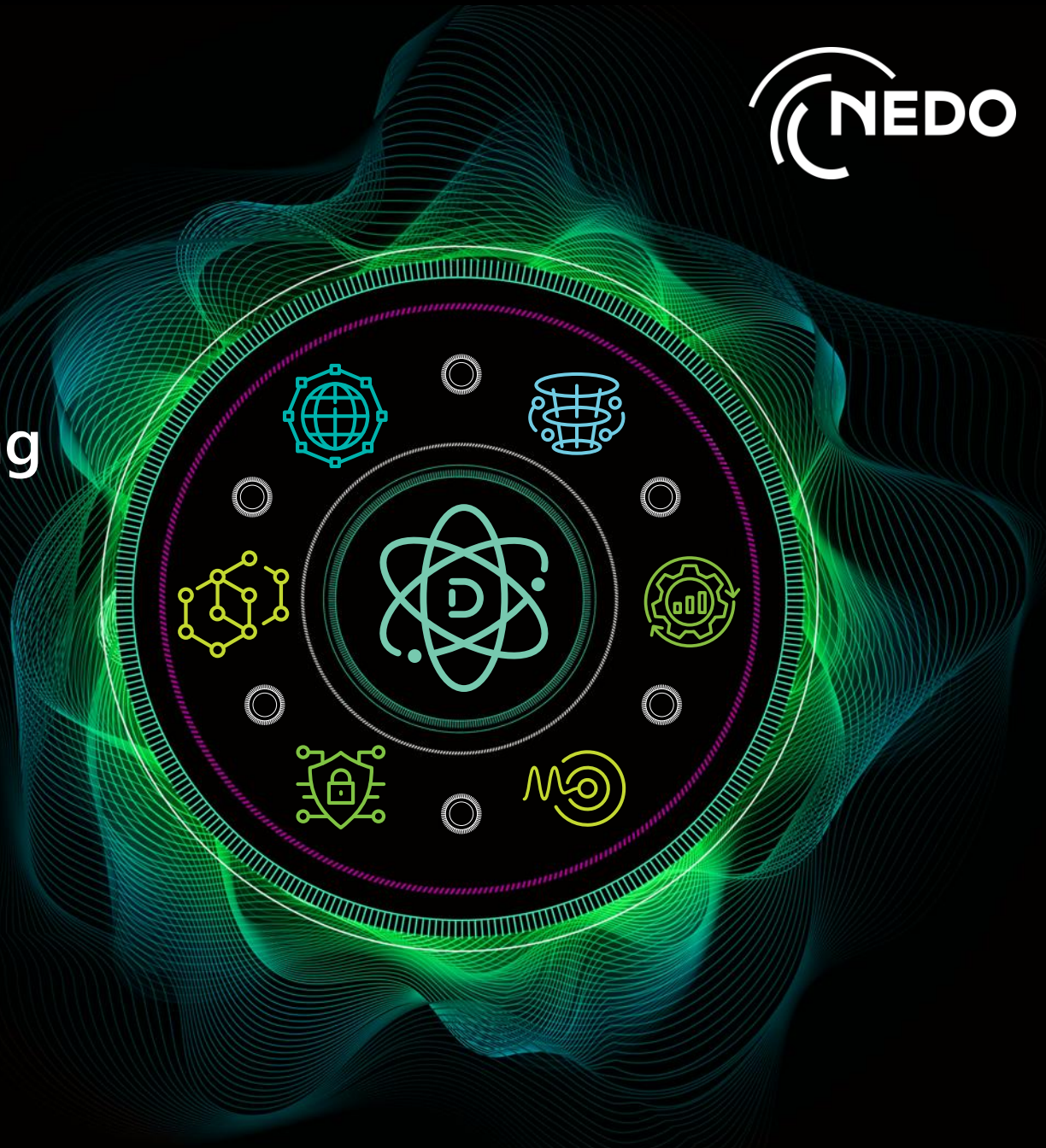
Quantum Computing Use Cases

Efficiency of preparation of loading plans for car carriers

Nippon Yusen



New Energy and Industrial Technology Development Organization (NEDO)

Nippon Yusen: Efficiency of preparation of loading plans for car carriers [2021/09] 1/2

Operational Use

Industry	Discrete Manufacturing Transportation
Process/Means	Shipping and sales/shipping
Method	combinatorial optimization
Category	Ising*

Background

- Nippon Yusen is developing a global automobile transportation business by carrying thousands of vehicles on a single automobile carrier to connect Japan with other parts of the world.
- On a car-only ship, **cars are loaded one by one at fixed intervals according to a predetermined loading plan, but the number of possible loading methods is enormous.**
  - ✓ For example, when a car carrier with a maximum loading capacity of approximately 7,000 vehicles and 12 floors calls at more than 10 ports and loads and unloads more than 60 types of vehicles of different heights and widths, **the number of candidate vehicle loading methods is 10 to the power of 2,000 or more.**
- **It is a very complex task to create a stowage plan that meets the constraints,** such as loading vehicles at a loading rate close to the maximum capacity of the ship and ensuring safe space for loading and unloading.

Issues and motivation to be solved

- Conventionally, specialized planners made a stacking plan by mastering stacking patterns and arrangement methods through experience.
- **Various issues have long been involved in the efficient preparation of stowage plans.**
  - ✓ Individual differences in the quality of the stacking plan occur depending on the experience and skill of each planner.
  - ✓ Planning time per ship is up to about six hours.
  - ✓ The change of the stacking schedule due to the sudden change of the situation causes a heavy workload.





car ship

Reference: FUJITSU CORPORATION "Digital Anilla" to Improve Efficiency of Preparation of Loading Plans for Automobile Carriers "(https://pr.fujitsu.com/jp/news/2021/09/2.html)
*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.

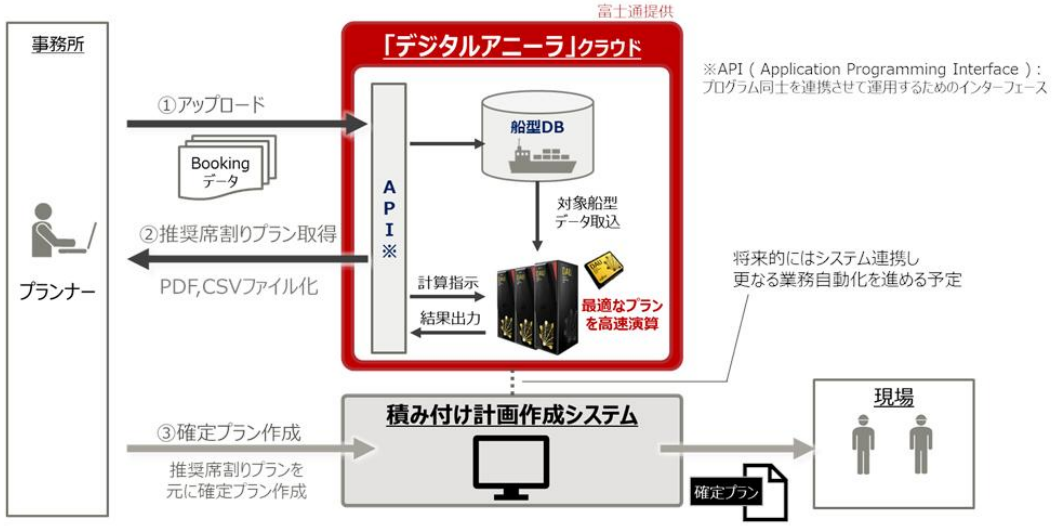
Nippon Yusen: Efficiency of preparation of loading plans for car carriers [2021/09] 2/2

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Problem setting as a quantum computer

- **We take in information about the size of the vehicle to be loaded and the port to be unloaded from Nippon Yusen's internal system, and use a digital annealer to make the best fit.**
  High-speed calculation of loading position was performed.
- As a result, **a system has been constructed on the cloud that automatically completes in about 30 minutes** the most important task of creating a stowage plan, which is to plan the optimal loading position of a vehicle in consideration of various conditions.
- The machine uses **Fujitsu's quantum-inspired digital annealer**



system schematic diagram

Expected business benefits

- Veteran planners **reduced the number of hours needed to prepare a loading plan (manpower) from a maximum of about 6 hours to about 2.5 hours** per ship.
- This saved planners **more than 4,000 hours a year** in stowage planning time
- As a side effect of the time reduction, the following is expected
  - ✓ Expanding business opportunities with faster decision making
  - ✓ Realize more efficient response to sudden changes in plans
  - ✓ Reduce variations in the quality of stacking plans due to differences in planners' experience

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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

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