D:WAVE

Hundreds of early quantum applications have been built with D-Wave technology.
What industries are using annealing quantum computing?

Manufacturing

Ford Otosan, a joint venture between Ford Motor Company and Koç Holding in Turkey, simplified elements of its Ford Transit van manufacturing processes to reduce the scheduling time of 1,000 vehicles per run from 30 minutes to less than five.

DENSO Corporation, a leading supplier of advanced automotive technology, systems, and components developed a proof-of-concept aimed at optimizing control of automated guided vehicles on their factory floors finding 15% efficiencies.

GE Research (now GE Vernova) built a logistics management application that can ultimately help with preventive maintenance and scheduling repairs for equipment.

Retail & Scheduling

Pattison Food Group, a western Canadian grocery retailer, successfully used a quantum-hybrid solver to find solutions for complex grocery optimization problems. They reported being able to reduce time needed for one optimization task from 25 hours to just 2 minutes per week, saving time and money.

Momentum Worldwide, part of the Interpublic Group of marketing agencies, created a hybrid-quantum solution to automate and optimize promotional tour logistics routing, reducing the process from weeks to less than an hour.

Sigma-I, a Tokyo-based start-up, used quantum hybrid technologies to build a powerful personnel management tool to optimize staffing during the COVID-19 pandemic.
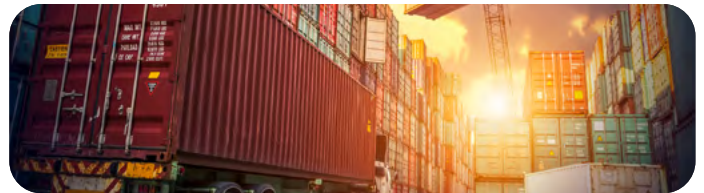
Infrastructure, Logistics & Supply Chain

SavantX built a quantum application to optimize Pier 300 at The Port of Los Angeles. Their Hyper Optimization Nodal Efficiency (HONE) quantum-powered AI engine increased the capacity and velocity of cargo movement at the port where it doubled cargo handling equipment productivity and produced more predictable cargo flows. With the quantum application, the port was able to see increased efficiencies of crane delivery and utilization by 60% and reduced turn times for trucks.

Groovenauts, Inc., a Japanese technology company using AI and quantum computing, has built a proof-of-concept quantum-hybrid application to optimize construction sites. By looking at GPS tracking, they were able to analyze the truck movement, speed, and other behaviors to increase the amount of dirt moved by roughly 10%, thereby providing the ability to speed up construction projects. They also built an application to efficiently plan staff schedules for logistics companies.

Staque and Verge have built an application to increase efficiencies for agricultural operations using autonomous farming equipment. The quantum-powered optimization has shown significant speed-up over classical approaches.

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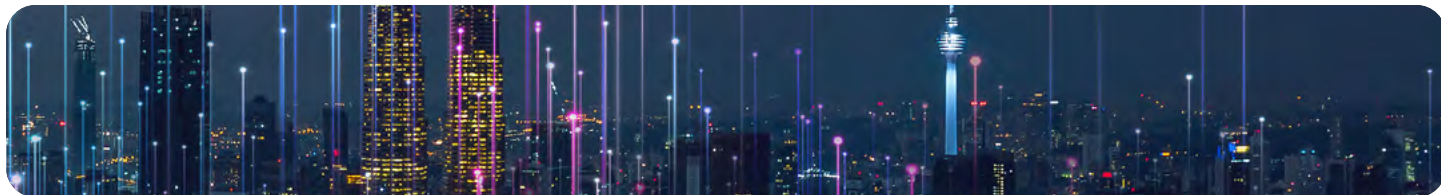
Telecommunications

NTT Docomo has shown that its hybrid-quantum solution [can reduce the load](#) on base stations and ease congestion during times of high call volume. Experiments at base stations in the Tokai, Chugoku, and Kyushu areas of Japan confirmed that paging signals were reduced by up to 15%.

Telecom Italia built a proof-of-concept that found quantum computing helped to [optimize 4G and 5G radio planning in Italy](#), by finding a solution 10x faster with classical computing alone.

[British Telecom](#) and [Accenture](#) have each looked at quantum computing applications to help solve some key problems facing the telecommunications industry, including cellular network optimization, faster fault detection and improved operational efficiencies.
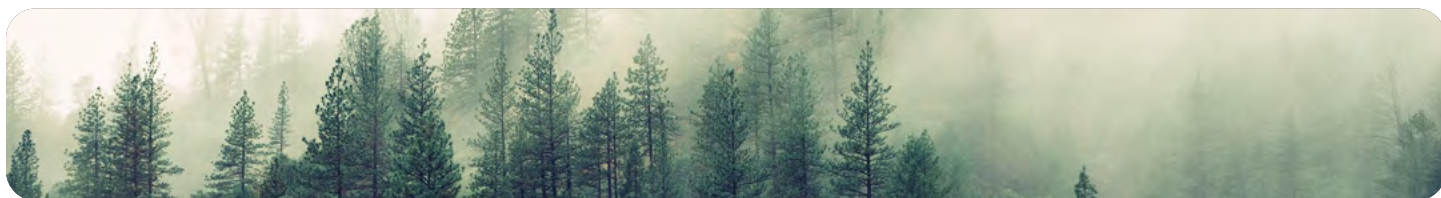
Energy & Environment

The Aramco Research Center in Delft, Netherlands, has achieved [performance improvements](#) over classical computers in both time-to-solution and scalability when tackling complex optimization challenges for computationally-intensive seismic imaging work, this can impact oil and gas exploration and extraction.

Quantum Quants and the **Netherlands Organization for Applied Scientific Research (TNO)** explored electrical grid optimization using quantum computing to address the complex challenges of modern decentralized power grids influenced by climate change and geopolitical factors. They efficiently [managed surplus energy in decentralized grids](#), outperforming classical methods, especially in complex scenarios requiring multiple partitions.

Mitsubishi Estate worked with **Groovenauts, Inc.** to enable AI with D-Wave's quantum computing techniques to solve the problem of labor shortages for waste collection staff, while also lowering overall CO_2 emissions for Tokyo. This proof-of-concept [optimized waste collection routes and reduced CO_2 emissions](#). Optimized routes and scheduling were built and showed a 57% reduction in CO_2 emissions, reduced the number of vehicles needed by 59%, and total work time by 38%.

E.ON, a Germany utility, is looking at [quantum computing for](#) decentralized power production. Quantum computing technology could allow for real-time operation electrical grids, something which is outside the reach of today's AI capabilities. Other potential applications which E.ON hopes to address with quantum applications include the development of improved climate models to guide the deployment of renewables, materials design for batteries and grid infrastructure.

Researchers at **Artificial Brain Tech Inc.** and the **Indian Institute of Information Technology** have been looking at quantum-hybrid applications for [EV charging station placement](#), a growing area of concern with the expanded adoption and support of electrical vehicles use.
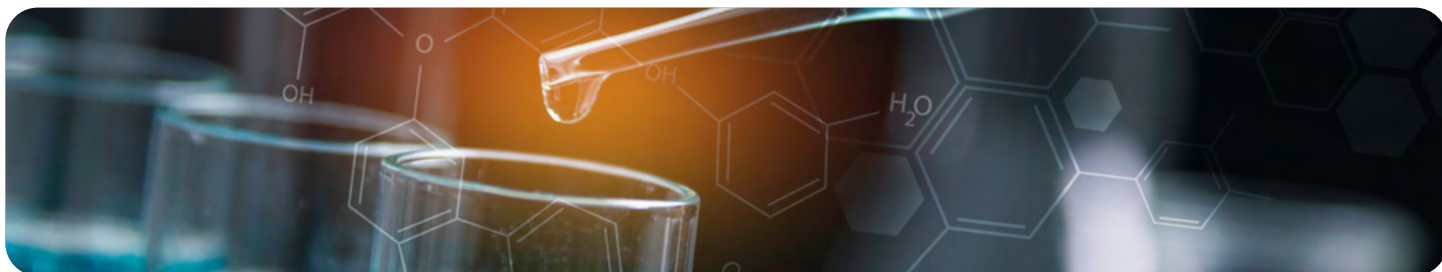
Life Sciences

Japan Tobacco is using D-Wave's advanced quantum computing solutions to optimize the AI training process for drug design, aiming to increase the speed and quality of drug discovery.

POLARISqb turned to hybrid quantum technology to expedite the drug discovery process by identifying thousands of lead molecules that can fulfill a set of stringent criteria, all in a fraction of a second.

SAS has explored annealing quantum computing combined with advanced analytics to address long kidney transplant wait times. The solution aimed to optimize the kidney exchange program with annealing quantum computing, potentially help better match donors with tens of thousands of people in need.

GlaxoSmithKline found that its work on mRNA codon optimization problems were a good fit for quantum annealing.

University of Southern California and their research partners applied quantum annealing to ML approaches for several problems in the life and physical sciences, including TF-DNA binding, cancer classification, and solving a Higgs boson optimization problem.

Jülich Supercomputing Centre used D-Wave's quantum technology to develop a ML tool that predicts protein-DNA binding with greater accuracy than traditional methods. The team integrated quantum computing with support vector machines to achieve improved results in various metrics, significantly enhancing classification performance.

Menten AI, a protein design start-up, has been leveraging synthetic biology, ML and quantum computing to design proteins not found in nature for diverse applications in the pharmaceutical and chemical industries. Their work in de novo protein design has advanced to live-virus testing for COVID therapeutics.

The **Jülich Supercomputing Centre, in collaboration with researchers from Lund University**, tackled the complex problem of protein folding, demonstrating the viability of quantum computing for intricate research tasks where classical computing struggles. Protein folding involves complex interactions as proteins form specific three-dimensional shapes essential for their functions. The annealing quantum computing system showed superior performance, achieving a 100% success rate in identifying the lowest energy structures, compared to the 80% success rate of classical methods.
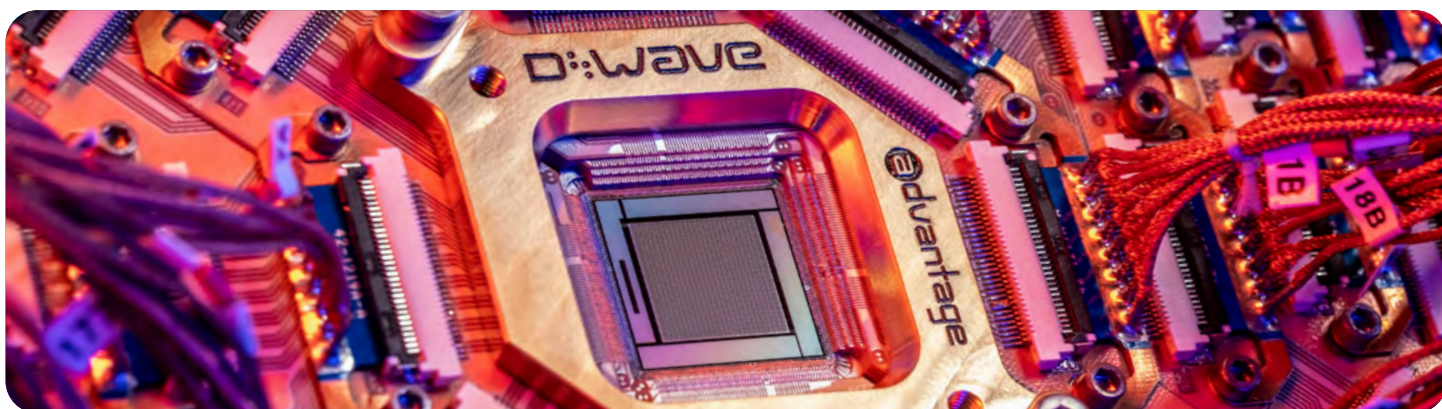
Financial Services

Yapı Kredi Teknoloji, a subsidiary of one of Turkey's largest banks, tackled the challenge of estimating financial crashes for a network of 4,500 firms—a problem that classical computing estimated would take 13.7 billion years to solve. The quantum solution achieved this in just 7 seconds.

Multiverse Computing, a quantum applications company, used quantum-enhanced algorithms for fraud detection portfolio optimization. They found they could identity fraud around 100x faster and were able to provide significant portfolio performance improvements with quantum hybrid applications.

CaixaBank Group in Spain, has found that quantum-hybrid applications have significantly decreased compute time by up to 90% to solve complex financial problems, improving investment portfolio optimization, increasing a bond portfolio internal rate of return by 10%, and minimizing the capital needed for hedging operations. What normally took several hours to compute was reduced to just minutes and facilitates the ability to increase modeling complexity.

A large payments provider built a proof-of-concept to look at incorporating quantum-hybrid applications to innovate on feature selection, a critical step in building powerful models to fight sophisticated fraud.
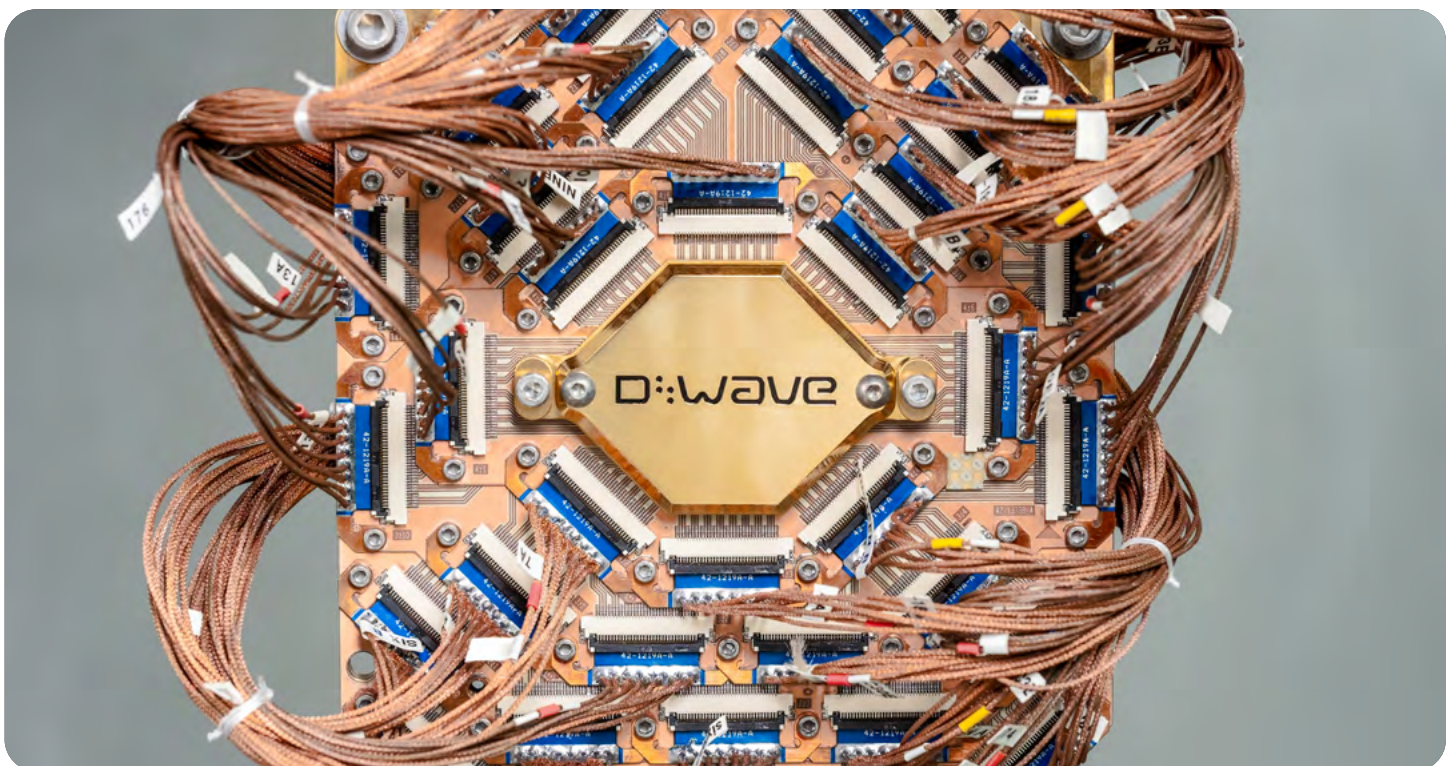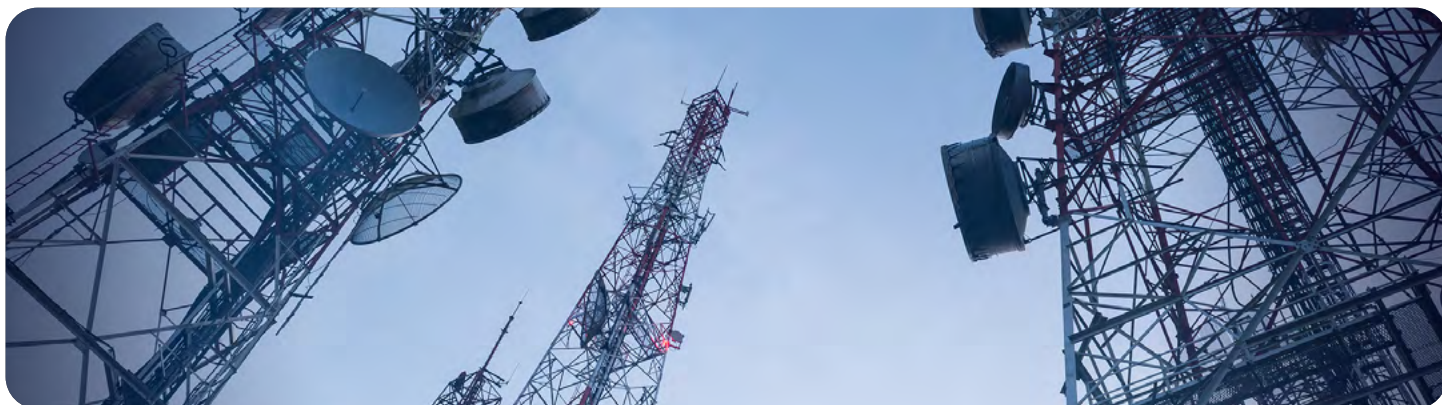
Defense, National Security & Space

Artificial Brain Tech Inc., won the myEUSpace award for using a hybrid-quantum algorithm to optimize scheduling for multiple Earth Observation Satellites (EOS). Integrating EU space data with advanced technologies such as AI and quantum computing tackled complexities that were often thwarted by classical computing methods in optimizing EOS mission schedules. They found that quantum computing significantly enhanced the efficiency and accuracy of EOS mission planning.

Australian Department of Defence worked with D-Wave and NEC Australia to develop a last-mile resupply quantum computing application to showcase the ability to optimize autonomous vehicles that resupply forces. This is important for enhanced automation, a growing area for defense and emergency management.

Davidson harnessed quantum technology to build two applications to advance U.S. national defense efforts: an interceptor assignment application that evaluates complex variables to effectively allocate defense resources against threats, and an optimized radar-scheduling application that manages phased-array radar resources for efficient communication with moving objects. These innovations also support broader mission goals like supply chain optimization and logistics management.

GMV, a multinational technology group rooted in the space and defense industry, is looking at how quantum could be used in space satellite control centers. Through the collaboration of private and public partners, the research team has been exploring data encoding and problem modeling through quantum ML and combinatorial optimization. These techniques were then applied in the context of Earth observation mission planning, an example of a highly complex problem.

Researchers at NASA Ames Research Center, Jet Propulsion Laboratory at the California Institute of Technology, & the Center for Quantum Information Science and Technology, and Information Sciences Institute at the University of Southern California have shown how quantum annealing can be used to map a sampling of the hardest AI problems in space exploration.

Researchers from Booz Allen Hamilton, Los Alamos & USRA have concluded that for problems like satellite optimization, heterogeneous quantum techniques will be required to solve the problem at larger scales.

NASA Quantum artificial Intelligence Lab (QuAIL) spearheaded efforts to demonstrate that quantum computing and quantum algorithms may someday dramatically improve the agency's ability to address difficult optimization and ML problems arising in NASA's aeronautics, Earth and space sciences, and space exploration missions.
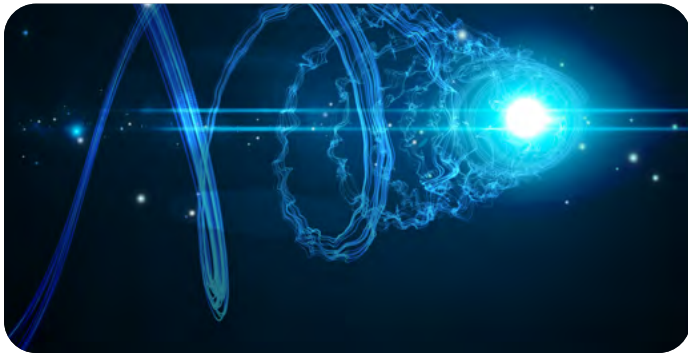
Quantum AI

TRIUMF, Canada's particle accelerator center, and its partner institutions, are showing significant speed-ups of D-Wave's QPU over classical approaches for simulating high-energy particle-calorimeter interactions – potentially leading to major efficiencies where the AI model is used to create synthetic data.

Honda Innovation Lab and Tohoku University developed a method to fine-tune D-Wave's quantum computers to generate highly accurate samples for training restricted Boltzmann machines (RBMs). This approach yielded better results than traditional algorithms and significant improvements in model performance.

Advanced Research on Materials Science

D-Wave, in collaboration with researchers from the **University of British Columbia, Oakridge National Lab, Jagiellonian University, Vector Institute, Boston University, and University of Waterloo**, provided a computational supremacy result on a materials simulation problem, which has implications for the real-world. D-Wave's quantum computer provided an answer back in 20 minutes using significantly less electricity while one of the largest supercomputers couldn't solve the problem for nearly a million years.

Researchers from **Los Alamos National Laboratory and D-Wave** have uncovered new insights into quantum fluctuations and ordered states using annealing quantum computing. Their study focused on the magnetic ordering of qubits, revealing that fluctuations can paradoxically promote order, reducing the total energy of magnetic moments and potentially lowering quantum processing costs.

▮⇨ **Find Out More:**
www.dwavequantum.com/applications

▮⇨ **Contact D-Wave Government:**
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