



QUANTUM COMPUTING: THE NEXT LEAP IN AUTOMOTIVE INNOVATION

Abstract

Computational power and accuracy of quantum solutions deliver pervasive value across the automotive value chain. From optimizing vehicle design, improving battery technology, and streamlining manufacturing processes to boosting the efficiency of global supply chains and dealer networks, quantum systems provide a competitive advantage.

Quantum computing

Standard computers and supercomputers process bits represented by ones and zeros to solve computational problems. Quantum computers, on the other hand, apply quantum bits (qubits) representing combinations of ones and zeros simultaneously. Consequently, the compute power and potential of quantum computers is exponentially greater than the most powerful classical computers.

Quantum algorithms enable faster processing of information, accurate simulation of chemical and physical systems, and instantaneous solving of extremely complicated statistical problems. Further, quantum computing enhances machine learning (ML) and optimization techniques.

Quantum computing can be applied to a wide range of industries and applications, including energy storage, chemical engineering, materials science, finance, transportation, and cryptography. Figure 1 articulates the advantages of quantum computing.

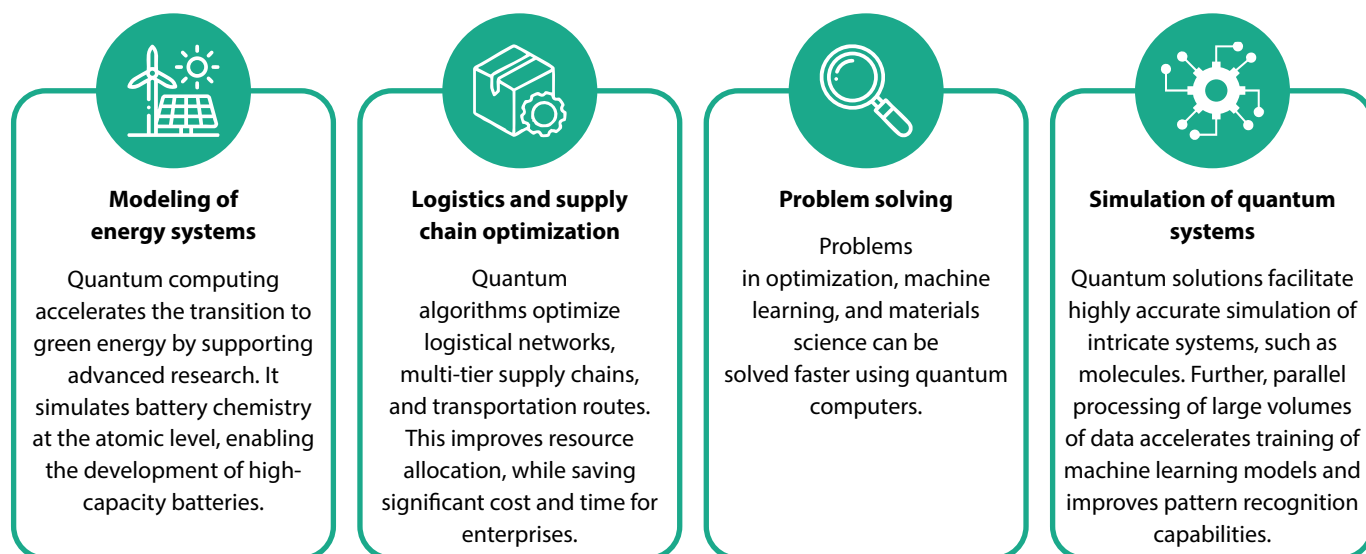


Figure 1: Benefits of quantum computing



Quantum computing in the automotive industry

Quantum operations can transform multiple dimensions in battery plants and assembly units – from engineering and production to dealer management and cybersecurity. The ability of quantum algorithms to address complex optimization challenges and simulate molecular behavior uncovers opportunities in materials discovery, battery development, autonomous driving systems, and supply chain management.

Vehicle design

Quantum computing accelerates 'energy transition' by supporting research and development, battery chemistry, and energy optimization. Quantum simulation enables modeling of atomic-level interactions, simulation of material behavior, and analysis of chemical compounds. It empowers materials science researchers to explore millions of potential molecular configurations, and develop sustainable materials for vehicle chassis and body, batteries and tires. Similarly, the simulation of new solid-state battery electrolytes and hydrogen fuel cell catalysts with quantum precision helps improve energy efficiency and reduce costs. Moreover, quantum algorithms optimize battery energy density, charging speed, and thermal stability, enabling engineers to design lighter and more robust automobiles.

Manufacturing and supply chain operations

Volkswagen and BMW have piloted quantum route optimization for traffic flow and delivery logistics. Quantum optimization minimizes production downtime, optimizes assembly line configuration, and streamlines logistics routing. Quantum algorithms account for constraints in thousands of interconnected processes, from cost to the carbon footprint, for achieving goals such as path planning to optimize factory floors or global supply chains, rationalize manufacturing costs, and reduce cycle time for parts sourcing.

Mobility services

Quantum computing boosts ML models by optimizing neural network parameters and improving fusion of LiDAR / radar data. It helps reduce latency and augments real-time decision making in autonomous driving systems. Notably, shared mobility service providers and connected fleet operators can capitalize on quantum optimization to dynamically manage EV infrastructure, ride sharing, charging station allocation, and vehicle-to-grid (V2G) energy balancing.

Dealer management

Quantum algorithms enhance ML models used for predicting orders, identifying fraud and risk patterns in financial transactions, and other use cases. Accurate insights strengthen the dealership network by growing sales and personalizing loan portfolios as well as service offerings. Figure 2 showcases how quantum technology impacts dealership operations.





Figure 2: Impact on dealers

Challenges in adoption

Quantum computing is an emerging multidisciplinary technology. Pervasive commercial applications will take several years. In fact, fault-tolerant quantum computers may be available only by 2035, according to a McKinsey survey . The cost of hardware and limited software expertise are some of the challenges in developing quantum computing technology (Figure 3).



However, quantum computing is getting increasingly mature and gaining momentum. Google, Microsoft and Amazon are offering quantum computing services in the cloud. It allows auto OEMs to address business challenges by leveraging quantum technology.



Introducing Infosys Quantum Living Labs

Infosys has rich experience in incubating emerging technologies to accelerate innovation. Infosys Quantum Living Labs; powered by Amazon Braket - a fully managed quantum computing service, Infosys Cobalt cloud offerings, and a global partner ecosystem; builds, tests and implements quantum applications.

As an AWS Premier Consulting Partner, Infosys accesses pre-installed developer tools to design quantum algorithms and visualize results. It enables automotive companies to develop quantum computing capabilities and explore a range of use cases for rapid experimentation.

Infosys Quantum Living Labs offers consulting services and undertakes technological landscape assessment. It helps identify potential use cases and develop proof of concept quantum solutions. Infosys Quantum Living Labs has developed prototypes for vehicle route optimization, credit card fraud detection, and quantum-safe client-server communication.

Success stories

A German automotive company partnered with Infosys to adopt quantum computing for supply chain optimization. Our solution streamlined routing across the global supply chain spanning thousands of parts from hundreds of suppliers.

Infosys implemented a quantum system for materials simulation at an EV manufacturing plant in Germany. Our algorithms simulate aging and degradation of lithium-ion batteries, which offers insights to improve performance.

<https://www.mckinsey.com/featured-insights/mckinsey-explainers/what-is-quantum-computing>

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