

# Post-Quantum Computing and Artificial Intelligence

## STRATEGIC INTELLIGENCE BRIEFING

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# Executive summary



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These days, it's a real challenge to keep track of everything. Schrödinger's cat is taking shape, and all the superpositions and entanglements make you quite dizzy. The hype around artificial intelligence and the advances in quantum computers with their impressive properties create a feeling of extreme curiosity in me on the one hand, but also a hitherto intangible uncertainty on the other. Despite all this, it is fascinating to observe how these technologies are developing.

The combination of quantum computers with artificial intelligence (AI) and robotic systems offers exciting possibilities and opens up new perspectives for our future development. At the same time, we as machine manufacturers, now face the exciting challenge of making our products quantum safe.

The rapid development of quantum technology presents both opportunities and challenges. While quantum computers are capable of performing certain calculations exponentially faster, research is still needed to understand their full potential and assess potential impacts on existing systems and infrastructure. It is important that we approach these new technologies prudently and look closely at the security aspects. With a careful approach and continuous research, coupled with genuine political will, we can harness this fascinating combination of quantum computing, artificial intelligence and robotics to shape a promising future not only for our mechanical engineering sector.

The key issues shaping and influencing Post-Quantum Computing and Artificial Intelligence are as follows:

### Post-Quantum Computing Security

Quantum computers could crack current cryptography with relative ease

### Drones and Artificial Intelligence

AI is expanding what drones can do, and how captured data can be analysed

### Generative AI\*

Generative AI is a type of artificial intelligence that creates new content based on patterns and data it has learned from

### The Geopolitical Impacts of AI

The geographical concentration of the technology could aggravate international rivalries

### AI for What Purpose?

We should consider whether some applications of the technology should be banned entirely

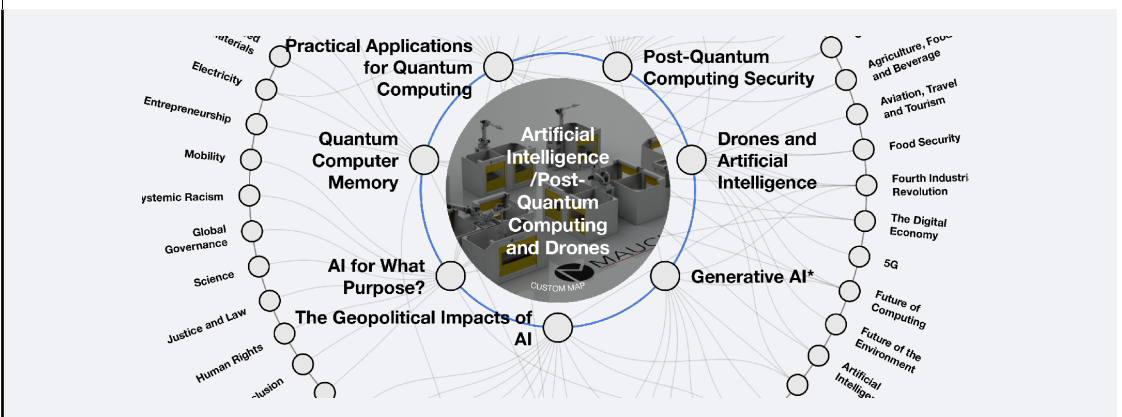
### Quantum Computer Memory

Using 'qubits' instead of the traditional method involving 'bits'

### Practical Applications for Quantum Computing

From financial markets to fertilizer, the technology could prove immensely useful

Below is an excerpt from the transformation map for Post-Quantum Computing and Artificial Intelligence, with key issues shown at the centre and related topics around the perimeter. You can find the full map later in this briefing.



# 1

# Latest insights

A synthesis of the most recent expert analysis.

Below are your latest updates on the topic of Post-Quantum Computing and Artificial Intelligence spanning 15 different sources.

## 1.1 Current perspectives



SpringerNature

**Evaluation of SEBS and SEBAL algorithms for estimating wheat evapotranspiration (case study: central areas of Khuzestan province)**

22 May 2023

Abstract

This study aimed to accurately estimate daily wheat evapotranspiration using two remote sensing algorithms, Surface Energy Balance System (SEBS) and Surface Energy Balance Algorithm for Land (SEBAL), in central Khuzestan province during 2019–2020. The results of two algorithms were compared with lysimeter (as a direct method), FAO-Penman–Monteith (FAO-PM), two temperature-based methods (Hargreaves-Samani and Blaney-Criddle), two radiation-based methods (Priestley–Taylor and Doorenbos–Pruitt), and two mass transfer-based methods (Mahringer and World Meteorology Organization) (as indirect methods). Coefficient of Determination ( $R^2$ ), Root-Mean-Square Error (RMSE), Percentage of Bias (PBIAS), Mean Bias Error, Mean Absolute Percentage Error, and Nash–Sutcliffe indicators used for comparing the results. According to the results, both SEBAL and SEBS algorithms showed the highest compatibility with lysimeter data ( $R^2 = 0.92$  and  $0.96$ ,  $RMSE = 2.15$  and  $1.53$  mm/day, respectively). Comparing both algorithms with the FAO-PM method, resulted in RMSE and  $R^2$  of  $2.42$  mm/day and  $0.87$  for SEBS and  $3.14$  mm/day and  $0.79$  for SEBAL. The Hargreaves-Samani method ( $R^2 = 0.72$ ,  $RMSE = 16.4$  mm/day) and ( $R^2 = 0.8$ ,  $RMSE = 10.4$  mm/day) among temperature-based methods, Doorenbos–Pruitt ( $R$

$R^2 = 0.71$ ,  $RMSE = 3.33$  mm/day) and ( $R^2 = 0.79$ ,  $RMSE = 2.63$  mm/day) among radiation-based methods,...



Wired

**Buffalo Mass Shooting Victims' Families Sue Meta, Reddit, Amazon**

15 May 2023

+++lead-in-text

The families of four people killed at a mass shooting in a Buffalo, New York, supermarket have filed a sweeping lawsuit against a slew of major internet companies, weapon vendors, the family of the perpetrator, and a Japanese toy company.

In a lawsuit filed Friday, the families name internet giants Meta, Amazon, and Alphabet, including social media they own; smaller platforms like Reddit and Snapchat; image board 4chan and its Japanese partner the Good Smile Company; three firearm companies; and the parents of the shooter, Payton Gendron.

While the suit does not set specific dollar amounts—the complaint says it will do so at trial—it attempts to hold this wide array of companies liable for the losses suffered during the May 14, 2022, massacre. It also seeks an order from the court requiring the social media companies “to stop the harmful conduct ... [and] remedy the unreasonably dangerous recommendation technologies in their social media products.”



The Conversation (French)

### « Random Access Memories » : le coup de maître des Daft Punk fête ses 10 ans

11 May 2023

Avec « Random Access Memories », les Daft Punk ont signé un album qui fait déjà partie des classiques du répertoire de la musique pop et électronique.

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Harvard Business Review

### There's No Silver Bullet for Cybersecurity

26 April 2023

Governments are incapable of fixing the insecurity of the internet by themselves, and businesses are unlikely to do it until the economic pain of ignoring the insecurity of the internet becomes greater than the profits it can earn from it. There are no silver bullets beyond restructuring the internet to rely more on new secure private networks, particularly for the operation of critical infrastructure. That will require businesses, governments, and users in democratic nations to act together to transform the internet into networks that rely on the authentication of people rather than IP addresses, mandate strict rules of online behavior, and maintain cyber police (human or machine) to enforce them.



Oliver Wyman

### How To Create The Perfect Seating Plan Using Analytics

13 April 2023

Let me set the scene. For the first time in a few years, your organization has decided to plan a major corporate event with attendees from various regions around the world. You want to spark networking between individuals and groups that are typically siloed and never, or rarely, interact. The challenge you face is not only arranging the seating for a large number of people, many of whom approach such interactions with trepidation, but also doing so in a way that will maximize the diversity of the guests at each table. Thankfully there is a solution.



Sci Dev Net

### Algorithm could hold key to child TB diagnosis

24 March 2023

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[NEW DELHI] An international team of researchers has devised an algorithm to help doctors in

resource-limited settings diagnose tuberculosis (TB) in children and decide on the right treatment.

Algorithms – sets of computer instructions to be followed to solve problems – are increasingly being used in healthcare to predict whether a patient will get sick or not by comparing their data to thousands of others.



RAND Corporation

### Organizing and Training Airfield Operations Capabilities for Emerging Expeditionary Operations

16 March 2023

The authors identify ways to enable the airfield operations (AO) career fields to respond to the needs created by the Dynamic Force Employment concept and the USAF implementation of Agile Combat Employment.



Frontiers

### An integrated convolutional neural network for classifying small pulmonary solid nodules

02 June 2023

Achieving accurate classification of benign and malignant pulmonary nodules is essential for treating some diseases. However, traditional typing methods have difficulty obtaining satisfactory results on small pulmonary solid nodules, mainly caused by two aspects: (1) noise interference from other tissue information; (2) missing features of small nodules caused by downsampling in traditional convolutional neural networks. To solve these problems, this paper proposes a new typing method to improve the diagnosis rate of small pulmonary solid nodules in CT images. Specifically, first, we introduce the Otsu thresholding algorithm to preprocess the data and filter the interference information. Then, to acquire more small nodule features, we add parallel radiomics to the 3D convolutional neural network. Radiomics can extract a large number of quantitative features from medical images. Finally, the classifier generated more accurate results by the visual and radiomic features. In the experiments, we tested the proposed method on multiple data sets, and the proposed method outperformed other methods in the small pulmonary solid nodule classification task. In addition, various groups of ablation experiments demonstrated that the Otsu thresholding algorithm and radiomics are helpful for the judgment of small nodules and proved that the Otsu thresholding algorithm is more flexible than the manual thresholding algorithm.



GovLab - Living Library

### AI-assisted diplomatic decision-making during crises – Challenges and opportunities

15 May 2023

Article by Neeti Pokhriyal and Till Koebe: “Recent academic works have demonstrated the efficacy of employing or integrating “non-traditional” data (e.g., social media, satellite imagery, etc) for situational awareness tasks...

Despite these successes, we identify four critical challenges unique to the area of diplomacy that needs to be considered within the growing AI and diplomacy community going ahead:

First, decisions during crises are almost always taken using limited or incomplete information. There may be deliberate misuse and obfuscation of data/signals between different parties involved. At the start of a crisis, information is usually limited and potentially biased, especially along socioeconomic and rural-urban lines as crises are known to exacerbate the vulnerabilities already existing in the populations.



SpringerOpen

### **A high-accuracy and low-energy range-free localization algorithm for wireless sensor networks**

02 May 2023

As the backbone of the Internet of Things, wireless sensor networks are widely applied to perceive the physical world. Most applications need to associate perception information with a position to generate physical significance. This paper proposes WRCDV-Hop, which has quadruple improvements of the well-known DV-Hop. First, the hop count between a pair of sensor nodes is measured as a continuous value rather than a discrete value. Second, the unknown nodes calculate the average distance per hop by the weighted method. Third, each sensor node only records and relays limited but sufficient beacons of the anchors. Fourth, the unknown nodes apply the whale optimization algorithm to estimate positions. The first two improvements ensure that the distance estimation between a pair of sensor nodes is highly accurate, and the third improvement reduces the energy consumption. The last improvement makes the position estimation more precise. The simulation results show that WRCDV-Hop performs well in terms of localization accuracy and energy consumption.



Raconteur

### **Can floating 5G keep Britain connected?**

29 March 2023

Can floating 5G keep Britain connected?

As the rollout of 5G networks gets underway on the ground, another dimension of the cellular network is gaining momentum: so-called non-fixed 5G. That is, non-terrestrial technology that can expand mobile coverage into areas where fibre-optic cables and cellphone towers aren't viable.

Non-fixed 5G promises to end mobile dead zones and to usher in the age of ‘connectivity absolutely everywhere’. Most notably, it should also enable businesses to reap the benefits of the network in some unexpected places.



Science Daily

### **Propellers are louder over ground**

24 May 2023

The effects of the ground on propeller noise have been measured experimentally for the very first time by researchers in the Aeroacoustics research team at the University of Bristol.

In findings, published in the Journal of Sound and Vibration, the team found clear differences in the noise characteristics of propellers when over ground, known as ‘Ground Effect’, compared to when operated normally. They noted an overall noise increase when measuring at angles above the ground, with hydrodynamic and acoustic interaction effects being a key factor to the overall noise trends.

It is hoped this research, tested in the National Aeroacoustic Wind Tunnel facility, can inform strategies to reduce the noise of aircraft while taking off or landing, by either changing the design of the landing pads or by changing the design of proposed aircraft architectures.

Lead author Liam Hanson explained: “In light of the need for greener aviation, there has been a push in the aviation industry to develop electrified aircraft.



Frontiers

### **Advice from “pracademics” of how to apply ecological dynamics theory to practice design**

24 May 2023

There has been an increase interest in knowing and enacting pedagogical approaches such as the Constraints-led Approach (CLA) and Nonlinear Pedagogy (NLP) which are underpinned by Ecological Dynamics in recent years among practitioners. While there seems to be a perceived uptake of such pedagogical approaches that encourages exploratory learning and the development of individualised movement solutions, there are still concerns on how these pedagogical approaches are enacted on the ground. In this paper, we the authors, as “pracademics”, attempted to address some of the common concerns that we are aware of from our regular interactions with academics and practitioners. In brief, we highlighted some of the common challenges related to sense making concepts from Ecological Dynamics and building connections to practice. We stressed the need to invest time to think differently to create representative learning environment, rethink how assessment is to be done, finding a balance between theoretical jargon

and practical application as well as intentionally situating coach development and support. We may not have all the answers, but we hope this paper could provide a useful starting point on how to apply Ecological Dynamics Theory to practice design.

Chemistry World  
**Lessons from Lieber**  
15 May 2023

The scientific community was shocked when Charles Lieber, who chaired Harvard's chemistry department and was a faculty member for almost 30 years, was convicted of hiding his links to China in December 2021. More than three years after the nanoscience pioneer's arrest, he has finally been sentenced and avoided jailtime. With this case closed, researchers in the US and abroad are left asking whether and how they should partner with foreign scientists and institutions.

Lieber faced up to 26 years in prison and \$1.2 million (£960,000) in fines for six convictions involving concealing from federal authorities his affiliation with the Chinese government's so-called 'Thousand Talents' recruitment programme and the Wuhan University of Technology, as well as failing to report income he received from that Chinese university.

He was an incredibly prolific researcher and mentor of young scientists.



War on the Rocks  
**Thinking Big with Small Drones: An Allied Approach to Swarming - War on the Rocks**  
23 March 2023

Thinking Big with Small Drones: An Allied Approach to Swarming

NATO has taken a combined approach towards defending against drones. Now, it should show the same collaborative effort in deploying them.

Enabling interoperable drone swarms across the alliance could yield immediate benefits for the Department of Defense while simultaneously strengthening allies with rapid information sharing and common operating pictures. It would create

increased opportunities to deploy rapid, lethal, and non-lethal effects without the need for billion-dollar programs of record, bureaucratically controlled program offices, and significant infrastructure upgrades.



World Economic Forum  
**The quantum security era is coming – here's how leaders can prepare for it**  
14 April 2023

Quantum computers provide transformational opportunities but could threaten the security surrounding everyday computational tasks and sensitive data

Mitigating the cybersecurity risks from quantum computers will require organizations to implement quantum-secure cryptography over several years, although there are steps that can be taken now.

Three transition approaches are likely to be adopted by most organizations to enable the quantum transition.

When it comes to certain types of complex computational problems – advanced statical modelling in the financial sector, accelerated research and development for pharmaceutical companies or a more efficient supply chain in the automotive industry – quantum computers promise organizations transformative power.

For maximum transformative gains, quantum computers must manage a particular risk: the cryptography used to secure many of our daily digital tasks, such as browsing the internet or online banking, will be broken by sufficiently powerful quantum computers.



Science Daily  
**Researchers create a tool for accurately simulating complex systems**  
05 May 2023

A new technique eliminates a source of bias in a popular simulation method, which could enable scientists to create new algorithms that are more accurate and boost the performance of applications and networks.





hackers and corporate rivals, whether it relates to the R&D in a pharmaceutical business, geological surveys in the energy industry, trading data in financial services, or budgeting plans and employees' personal data. And while blockchain and cryptocurrencies have been hailed as revolutionary means to securely store data and financial information, they were built on existing public key encryption - which may not be a match for quantum computers. In general, many of the security algorithms used to keep our information safe could be cracked relatively quickly by a quantum computer, which is able to factor large numbers more efficiently than the sort of classical computer used to build current encryption standards.

Broad adoption of quantum computing might still be far in the future, but significant progress has been made. In 2019, IBM and Google each published studies claiming their quantum computers performed a task not possible with even the strongest traditional computers (though they differed on the value of their respective results). Meanwhile government agencies and industry groups have expressed a growing sense of urgency when it comes to transitioning to a quantum-safe future. It is expected to take a considerable amount of time to develop, standardize, and deploy post-quantum cryptographic techniques. Researchers are working on new algorithms resistant to the strength of a quantum computer but also able to meet business objectives. In order to ensure that everyone's data is safe in a quantum future, and to secure international support, it is crucial that the development of quantum-resistant cryptosystems is transparent - carried out in full view of cryptographers, governments, organizations, and the public. While it might not be an immediate threat, everyone should start considering potential implications of this impending reality.

Related topics: [Values](#), [Corporate Governance](#), [Digital Identity](#), [Internet Governance](#), [Oil and Gas](#), [Blockchain](#), [Cybersecurity](#), [Biotechnology](#), [Banking and Capital Markets](#), [International Security](#), [Agile Governance](#), [Global Risks](#)

## 2.2 Drones and Artificial Intelligence

*AI is expanding what drones can do, and how captured data can be analysed*

Artificial intelligence - the ability of machines to reason, solve problems, and learn - is a key enabler of drone flight operations and data analysis. While a great deal of popular interest in AI is related to developing robots that think like humans, the specific value of AI in the drone world is delivered through using algorithms to navigate and turn data into knowledge. AI is already being used to help small drones operate without direct human control. Companies like Wing, Skydio, and Matternet have developed drones that can independently avoid obstacles, laying the foundation for routine autonomous operation. Eventually, autonomous machines should be able to make their own decisions about flight planning and navigation - both in cooperation with one other and together with automated air traffic service providers. Sensors, computing power, and AI algorithms are now robust enough to enable small consumer drones to follow a target throughout an obstacle course using real-time 3D mapping and motion planning; however, secure and reliable communication networks must be established to enable drones to interact with ground stations.

AI will ultimately enable air traffic control services for drones that could overwhelm human operators; safely integrating drones into the airspace used by manned aircraft is critical, so developing adequate AI-enabled air traffic control should be a priority. Ensuring that AI can be used to safely coordinate manned and unmanned aircraft will require more research - one related challenge involves certifying AI-enabled flight controllers or traffic management systems in ways that civil aviation authorities deem sufficient. Even as AI is poised to increasingly impact how drones are flown, it has already changed how drone data is being used. Drone imaging and AI-enabled data processing can help farmers identify problems with crops, reduce pesticide use, protect fields, and cut costs, while in terms of infrastructure inspection AI-enabled drone flights and data processing can save hours of time otherwise spent subjecting workers to potentially unsafe conditions as they access powerlines, pipelines, and wind turbines. While AI's potential contribution is considerable, successfully incorporating it into drone operations will ultimately require regulatory changes related to aircraft certification, product liability, and privacy protection.

Related topics: [Agriculture](#), [Food and Beverage](#), [Aviation](#), [Travel and Tourism](#), [Food Security](#), [Fourth Industrial Revolution](#), [The Digital Economy](#), [5G](#), [Cybersecurity](#), [Future of Computing](#), [Future of the Environment](#), [Artificial Intelligence](#), [Future of Work](#)

## 2.3 Generative AI\*

*Generative AI is a type of artificial intelligence that creates new content based on patterns and data it has learned from*

Unlike other forms of AI that are designed to perform specific tasks, such as recognizing objects in an image, generative AI creates new and unique outputs, such as images, texts, music, or even computer code. The opportunities provided by generative AI are numerous and exciting. For example, it has the potential to revolutionize many creative industries, such as graphic design, writing, and music composition, by automating tasks and freeing up more time for human creativity. In healthcare, generative AI can assist in drug discovery and disease diagnosis. In education, it can help generate personalized study materials for students. The potential for generative AI is vast and varied, and its applications are limited only by our imagination. However, despite its potential benefits, there are also key concerns about generative AI.

One of the most pressing concerns is the potential for AI-generated content to spread misinformation, particularly in areas like fake news or deepfake videos. Another concern is the impact that generative AI may have on job markets, as automation could potentially displace human workers. Additionally, there are ethical concerns around the use of AI-generated content, such as questions around who is responsible for its creation and the potential for it to be used in harmful ways. In conclusion, generative AI is a fascinating and rapidly evolving field that has the potential to bring about many positive changes in various areas of society. However, as with any new technology, it's important to approach it with caution and carefully consider the potential consequences of its use. By balancing the potential benefits and risks of generative AI, we can ensure that it is used in a responsible and ethical manner, for the greater good of society as a whole.

\*The text for this key issue was entirely generated by OpenAI's ChatGPT chatbot using the following prompt: "Write a 300 word text providing a non-technical description of generative AI, its opportunities, and key concerns about it."

Related topics: [Internet Governance](#), [Future of Work](#), [Arts and Culture](#), [Future of Media](#), [Entertainment and Sport](#), [Education, Skills and Learning](#), [Future of Computing](#), [Health and Healthcare](#), [Fourth Industrial Revolution](#), [Civic Participation](#), [Economic Progress](#)

## 2.4 The Geopolitical Impacts of AI

*The geographical concentration of the technology could aggravate international rivalries*

Artificial intelligence has the potential to deepen divides both within and between countries, as a result of the distribution of related benefits and know-how. According to a report published by PwC, North America and China are likely to be home to 70% of the global economic impact of AI, with other developed countries in Europe and Asia capturing much of the rest (North America is expected to see as much as a 14% GDP boost from AI by the year 2030, while China is expected to see a GDP boost of as much as 26% by that point). This situation risks spawning both a competitive race between countries for AI dominance, and the widening of a knowledge gap that will leave much of the rest of the world even further behind. AI competition entails not only battles over talent and computing infrastructure, but also over access to - and control of - data. The ability of data to flow across borders means that early movers in AI can gain global influence that may make it difficult for initiatives elsewhere to catch up.

A second geopolitical concern related to AI concerns the role the technology can play - both unintentionally and intentionally - in exacerbating political divisions and polarizing societies. There is a growing awareness of the ways social media can contribute to polarization, and AI-driven recommendation algorithms play a significant role. In addition to potentially keeping users trapped in bubbles of content that match their own worldview, thereby limiting access to other perspectives and possibly hardening misperceptions, these systems can have the often-unanticipated effect of actively pushing users towards more extreme content.. For example, YouTube has drawn a significant amount of criticism for the ways in which the video streaming service's recommendation algorithm can nudge users in the direction of extremist political and views and conspiracy theories based on their browsing behaviour. AI is also frequently being intentionally used to manipulate and polarize viewpoints, most notably through the creation of "deepfake" video and audio content designed to deceive the public and denigrate public figures (experts fear that an ability to fake large-scale historical events could one day irreparably damage the public's trust in what it sees).

Related topics: [Geo-economics](#), [Data Science](#), [Manufacturing](#), [Trade and Investment](#), [Fourth Industrial Revolution](#), [Innovation](#), [Retail](#), [Consumer Goods and Lifestyle](#), [Civic Participation](#), [Geopolitics](#), [Migration](#),

## 2.5 AI for What Purpose?

*We should consider whether some applications of the technology should be banned entirely*

While current artificial intelligence algorithms may be limited to learning a single task, the technology's underlying principles and techniques are applicable to a surprisingly wide range of uses. Indeed, almost every sector of the economy and society has been affected by AI - or will be soon. Given this broad applicability, and the current shortage of AI-related talent, it is necessary to consider how we should develop and use this new tool to its maximum positive benefit. We should also consider whether some AI systems create such a high risk of potential misuse that they should not be allowed at all. Facial recognition, for example, is one area of AI that has come under particularly intense public scrutiny, both because of related privacy concerns and due to the technology's potential use as a tool of oppression; it therefore serves as a particularly thorny test case for when and how a particular area of AI both can and should be shut down entirely, and whether it is possible to use such technology responsibly and benevolently.

In other cases, challenges related to AI lie not with the broad technology itself but with its specific use. Algorithms applied within the criminal justice system, for example, have come under strong criticism - as they not only have potentially huge impacts on individuals' lives, but are also subject to the deeply-embedded biases and historical inequities reflected in the training data and human developers that inform them. In this context, AI systems risk exacerbating existing inequities in consequential and damaging ways. Even among less controversial uses of AI there remains the question of how to best leverage scarce resources. A huge portion of AI-related talent, for example, has been directed at the development of autonomous vehicles and other private, for-profit company endeavours, and military applications - leaving fewer capable people dedicated to deploying AI for the common good. As we foster a technology that many believe has the potential to reshape society, we need to find new ways for it to represent the interests of many different stakeholders, and to play a positive role in our future.

Related topics: [Ocean](#), [LGBTI Inclusion](#), [Global Risks](#), [Human Rights](#), [Justice and Law](#), [Agile Governance](#), [Education](#), [Skills and Learning](#), [Science](#), [Global Governance](#), [The Digital Economy](#), [Digital Identity](#), [Systemic Racism](#), [Mobility](#), [Values](#), [Corporate Governance](#), [International Security](#)

## 2.6 Quantum Computer Memory

*Using 'qubits' instead of the traditional method involving 'bits'*

Quantum memory could be the key to dramatically increasing the amount of information that can be stored on a computer - and making computers much faster at solving certain types of problems. The field of quantum memory, or simply how to store information on a quantum computer, covers everything from the best-suited physical systems to abstract methods that can be used to increase the computer's performance. Quite simply, quantum memory is the quantum-mechanical version of ordinary computer memory because it takes advantage of the strange ability of subatomic particles to exist in more than one state at any given time. Due to the way these tiny particles behave, certain computer operations can be done much more quickly and use less energy than classical computers - where information is traditionally stored as a series of 0s and 1s known as "bits." By way of contrast, quantum memory involves storing data within basic units of quantum information known as "qubits," or "quantum bits." The relative advantage of qubits is that they can have more than two states to process or store information, due to something known as the "quantum superposition" phenomenon.

A quantum computer has a third state, where the qubit can be a mixture of 0 and 1 - relative to the contribution of each of these two states. As a result, greater storage capacity as well as the utilization of sophisticated algorithms to process information may dramatically increase the efficiency of solving particular kinds of computational problems - and could revolutionize modern computing in the process. Several ways to build a quantum computer based on qubits have already been proposed, and researchers are evaluating these proposals experimentally to find out which may be the most promising methods around which to build a fully-functional computer. The use of photons seems, as of now, to be the most promising solution. One recent advancement has been the successful secure storage and retrieval of qubits; while the efficiency rate of optical qubit storage was previously 30%, researchers at Laboratoire Kastler Brossel (LKB) in Paris managed to increase this to 70%. Because quantum memory will be essential to construct a quantum

communication network, this development has been viewed as a significant step forward.

Related topics: [Entrepreneurship](#), [Fourth Industrial Revolution](#), [Electricity](#), [Advanced Materials](#), [Future of Computing](#), [Digital Communications](#), [The Digital Economy](#), [Data Science](#), [Energy Transition](#), [Innovation](#)

## 2.7 Practical Applications for Quantum Computing

*From financial markets to fertilizer, the technology could prove immensely useful*

Quantum Computing has the potential to revolutionize many aspects of our daily lives. While the topic is often over-hyped, quantum computers may prove to be particularly good at solving certain types of problems. Not those related to complex calculations, necessarily, or those related to search engine functionality, or image processing. But quantum computing can drastically improve optimization and artificial intelligence, potentially disrupting a number of industries. AI is the perfect candidate for quantum computation, because it is based on the principle of learning from experience - which in turn is based on calculating the probabilities for many possible choices. Another primary application is the modelling of molecular interactions that can result in innovative products, including pharmaceutical drugs and solar cells. It can also be applied to producing the fertilizer necessary to feed the planet; while current processes for creating fertilizer are incredibly energy-intensive, research suggests quantum simulations could help chemists develop more efficient methods. Cryptography is another area where quantum computers can outperform digital computers, potentially rendering current online security methods obsolete.

Modern financial markets run on some of the most complicated systems in existence, and investors and analysts may turn to quantum computing to help make them more efficient. Weather forecasting is another potential application that could benefit both the public and private sectors. Just about any country's economic health is directly or indirectly affected by the weather; improved forecasting would benefit food production, transportation, and many other facets of GDP. In addition, better climate models could give us more insight into future climate scenarios. In light of all of these potentially impactful applications, governments and businesses have scaled up research and development efforts. In 2018, the European Commission kicked off the ramp-up phase of its Quantum Technologies Flagship initiative, aimed at using a €1 billion budget to bring together research institutions, companies and public funding. Meanwhile the US is spending about \$1.2 billion between 2019 and 2028 to make its mark on the technology, and China is building a \$10 billion national laboratory for related research. However, while the development of quantum technologies is moving fast, it is still at a relatively preliminary phase.

Related topics: [United States](#), [Food Security](#), [China](#), [Artificial Intelligence](#), [Electricity](#), [Cybersecurity](#), [Data Science](#), [Financial and Monetary Systems](#), [European Union](#), [Biotechnology](#), [Future of Computing](#), [Fourth Industrial Revolution](#), [Energy Transition](#), [Agriculture](#), [Food and Beverage](#), [Banking and Capital Markets](#), [Climate Change](#)

# About Strategic Intelligence

## Our approach

In today's world, it can be difficult to keep up with the latest trends or to make sense of the countless transformations taking place. How can you decipher the potential impact of rapidly unfolding changes when you're flooded with information - some of it misleading or unreliable? How do you continuously adapt your vision and strategy within a fast-evolving global context? We need new tools to help us make better strategic decisions in an increasingly complex and uncertain environment.

This live briefing on Post-Quantum Computing and Artificial Intelligence , harnesses the World Economic Forum's [Strategic Intelligence](#) platform to bring you the very latest knowledge, data and context from our 300+ high quality knowledge sources. Its aim is to help you understand the global forces at play in relation to Post-Quantum Computing and Artificial Intelligence and make more informed decisions in the future.

Each day, our Strategic Intelligence platform aggregates, distills and synthesizes thousands of articles from around the world. We blend the best of human curation with the power of machine learning to surface high-quality content on over [two hundred global issues](#) to our one million users globally. Our hand-picked network of [content partners](#) from around the world means that we automatically exclude much of the noisy clickbait, fake news, and poor quality content that plague the Internet at large. We work with hundreds of think tanks, universities, research institutions and independent publishers in all major regions of the world to provide a truly global perspective and we are confident that our data are well positioned when it comes to the intrinsic biases inherent to open text analysis on uncurated content from the Internet. For further context on our approach, you may be interested to read [Strategic trend forecasting: anticipating the future with artificial intelligence](#) and [These Are The 3 Ways Knowledge Can Provide Strategic Advantage](#).

↓ A leading expert presenting a transformation map at our Davos Annual Meeting



# Transformation maps

Our [Transformation Maps](#) are dynamic knowledge visualisations. They help users to explore and make sense of the complex and interlinked forces that are transforming economies, industries and global issues. The maps present insights written by experts along with machine-curated content. Together, this allows users to visualise and understand more than 250 topics and the connections and inter-dependencies between them, helping in turn to support more informed decision-making by leaders.

The maps harness the Forum network's collective intelligence as well as the knowledge and insights generated through our activities, communities and events. And because the Transformation Maps are interlinked, they provide a single place for users to understand each topic from multiple perspectives. Each of the maps has a feed with the latest research and analysis drawn from leading research institutions and media outlets around the world.

At the centre of each map is the topic itself. This is surrounded by its "key issues", the forces which are driving transformation in relation to the topic. Surrounding the key issues are the related topics which are also affected by them. By surfacing these connections, the map facilitates exploration of the topic and the landscape within which it sits.

## Continue online

Our suite of Strategic Intelligence tools are available to help you keep up to date across over 300 topics.

### On the web

Visit [Strategic Intelligence](#) on your desktop or laptop. All modern browsers supported.



### In the app stores

You can find our [Strategic IQ app](#) on the Apple App Store, Google Play Store or Huawei App Gallery.



You can also follow Strategic Intelligence [on Twitter](#).

# Acknowledgements

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