



CSTD



ADAMUN'26

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Committee: United Nations Commission on Science and Technology for Development (CSTD)

General Theme: International Governance of Artificial Intelligence , The Advancement of Quantum Technology for Humanity

Topic: Integrating AI governance with quantum technology advancement ensures responsible innovation for humanity.

Letter From Secretary General

Dear Esteemed Participants,

It is with great honor and sincere appreciation that we welcome you all to ADAMUN'26.

Bringing individuals together in an environment where ideas and perspectives can be shared carries a value that extends beyond the moment itself. In a world where communication often takes place at a distance, creating such a space allows for more direct, thoughtful, and meaningful interaction. It is within this setting that understanding can grow, shaped by the contributions and viewpoints each of you brings.

Your presence at ADAMUN is what gives this experience its true significance. The willingness to engage, to listen, and to actively participate reflects a shared commitment to making the most of this opportunity. Each of you plays a role in shaping the discussions and into an atmosphere where ideas can be exchanged with both respect and purpose.

We would like to extend our sincere gratitude to you for being here and for the effort you have dedicated to taking part in this conference. What makes this experience meaningful is not only the structure of the program, but the exchange of ideas and the connections formed throughout the process.

We hope that your time at ADAMUN will be both engaging and enriching, and that it provides you with the opportunity to explore new perspectives and to take part in meaningful discussions.

Once again, we are honored to welcome you, and we wish you a productive and rewarding experience.

Sincerely,

Secretary-General Deniz ÖZKUBAT & Su AĞBAL '26

Letter From Under Secretary General's

Distinguished Delegates,

We are CSTD kommities usg, and we are so honored to serve at our conference. We are so proud to be a part of Adamun'26 and to take part in the CSTD Committee.

This study guide, which focuses on the impact and development of artificial intelligence in today's world, will serve as a guide for you. Throughout this conference, we will discuss both the positive and negative aspects of this topic and seek answers to questions such as whether artificial intelligence will make our lives easier.

We would like to thank everyone who contributed to the preparation of this conference. We hope we will all have an enjoyable and productive experience. We are very much looking forward to meeting you all.

Best regards,

Ece Demirhan, Duru Koparan, Ela su Bürü

Under Secretary of the CSTD

I. Introduction to the Committee

The **Commission on Science and Technology for Development (CSTD)** is a subsidiary body of the United Nations Economic and Social Council (ECOSOC), established to provide high-level guidance on science, technology, and innovation (STI) issues as they relate to development. The CSTD serves as a forum where member states, experts, and stakeholders examine how emerging technologies can be harnessed to promote sustainable development, reduce global inequalities, and support inclusive economic growth. By bridging the gap between technological advancement and policy-making, the Commission plays a critical role in shaping international cooperation in an increasingly digital and interconnected world.

In today's rapidly evolving technological landscape, the international community faces both unprecedented opportunities and complex challenges. Artificial Intelligence has transformed decision-making processes, economies, security structures, and social systems, while quantum technologies promise revolutionary breakthroughs in computing, communication, and scientific research. However, without effective governance frameworks and equitable access, these technologies risk deepening existing global disparities and raising serious ethical, legal, and security concerns. The CSTD is uniquely positioned to address these challenges by fostering dialogue, sharing best practices, and promoting responsible innovation that aligns with the United Nations' development goals.

During this session, the CSTD will focus on two crucial agenda items: **International Governance of Artificial Intelligence** and **Advances of Quantum Technologies for Humanity**. Delegates are expected to evaluate current global governance gaps, consider the implications of these technologies for both developed and developing nations, and propose policy-oriented solutions that emphasize inclusivity, ethics, capacity-building, and international cooperation. Through constructive debate and collaborative problem-solving, the Commission aims to ensure that cutting-edge technologies serve humanity as a whole and contribute meaningfully to sustainable development worldwide.

II. Key Terms

Artificial Intelligence (AI): The ability of computer systems to perform tasks that normally require human intelligence, such as learning, analysis, and decision-making.

Quantum Technology: Advanced technologies that operate based on the principles of quantum mechanics, enabling breakthroughs in computing, communication, and sensing.

Governance:The frameworks, rules, and policies that guide and regulate how technologies are developed, deployed, and monitored.

International Cooperation:Collaboration among states, international organizations, and stakeholders to address global challenges and manage technologies collectively.

Ethics:Moral principles that ensure technologies are used in a fair, safe, and responsible manner, respecting human dignity and rights.

Sustainable Development:Development that meets present needs without compromising the ability of future generations to meet their own needs, balancing economic, social, and environmental goals.

Human Rights:Fundamental rights and freedoms to which all individuals are entitled, and which must be respected in the development and use of technology.

Developing Countries:Countries with lower levels of economic, technological, and institutional development that often require additional support to benefit from emerging technologies.

Capacity Building:Efforts to strengthen the skills, knowledge, infrastructure, and institutions needed to effectively develop, regulate, and use technology.

Global Inequality:Unequal distribution of economic resources, technological access, and opportunities between and within countries.

Agenda A: International Governance of Artificial Intelligence

Introduction to the Agenda item A :

Artificial Intelligence (AI) can be understood as the ability of machines to perform tasks that normally require human intelligence, such as learning and problem-solving. These systems are designed to replicate cognitive functions including problem-solving, decision-making, perception, and language understanding, enabling them to perform tasks that typically require human intelligence.

In practical terms, AI is based on algorithms and computational models that enable machines to analyze data and support decision-making processes. This is commonly achieved through techniques such as machine learning and deep learning, which rely on large datasets and multi-layered neural networks to extract increasingly complex features from data.

Today, AI is commonly used in areas such as digital assistants, online platforms, transportation technologies, and healthcare systems. Through these applications, AI technologies automate tasks, optimize processes, and enhance human capabilities, contributing to improved efficiency, productivity, and decision-making. As an interdisciplinary field, AI draws on computer science, mathematics, statistics, cognitive science, neuroscience, and related disciplines to develop systems capable of exhibiting intelligent behavior.

Despite rapid advancements, achieving human-level artificial intelligence remains a significant challenge. Ongoing research seeks to improve AI capabilities while addressing limitations related to interpretability, scalability, and ethical concerns. As AI continues to evolve, its social, economic, and ethical impacts become increasingly pronounced, highlighting the need for responsible development and deployment.

The potential benefits of AI are considerable, ranging from addressing global challenges such as climate change and disease to improving workplace efficiency. However, these benefits are accompanied by substantial risks, including the spread of disinformation, cyber threats, and the reinforcement of existing inequalities. These debates unfold within a context of intense geopolitical competition and rapid technological change.

At the heart of these discussions lies a central question: how to harness the transformative potential of AI for the common good while minimizing risks and ensuring

equitable access. This balance can only be achieved through effective AI governance at national, regional, and global levels, with compliance with international law serving as the essential foundation.

AI Governance

Governance refers to the frameworks and principles that regulate the development, use, and deployment of artificial intelligence technologies. As AI becomes increasingly integrated into society, effective governance mechanisms are necessary to address its ethical, legal, and social impacts. Understanding the historical development of these regulatory frameworks is important for evaluating current AI policies. Ethical principles form the foundation of AI governance, guiding the responsible and safe development and application of AI technologies.

Military Applications of Artificial Intelligence

Artificial Intelligence has become increasingly significant in the military domain, transforming modern warfare and defense strategies. AI technologies are currently being used in areas such as autonomous weapons systems, intelligence gathering, surveillance, and cyber operations, with more than 70% of modern militaries already utilizing AI for surveillance and intelligence purposes. These systems can process vast amounts of data rapidly, enabling faster and more efficient decision-making on the battlefield. Military AI spending is expected to exceed \$13 billion annually by 2030, while the global defense AI market is projected to reach \$38 billion by 2028, highlighting the rapid expansion of this field. However, the use of AI in military contexts raises serious ethical, legal, and security concerns, particularly regarding the potential loss of human control over critical decisions. Autonomous weapons, often referred to as “killer robots,” have sparked global debate due to their ability to select and engage targets without direct human intervention, with over 30 countries currently developing such systems. While some states argue that these technologies enhance national security and reduce human casualties, others emphasize the risks of misuse, escalation of conflicts, and violations of international humanitarian law. Therefore, the regulation of military AI and the establishment of clear international norms remain essential challenges for global governance.



Principles for the Ethical Use of Artificial Intelligence

Understanding the ethical principles that guide the use of artificial intelligence (AI) systems is essential. A number of these principles have been adopted by the United Nations to regulate the responsible use of AI technologies. Together, they establish a comprehensive framework for international AI governance by identifying key challenges and defining the standards that should be upheld.

Do No Harm

AI systems should be designed and used in a way that avoids harm to individuals or communities and remains consistent with the values and principles of the United Nations Charter. These systems must be designed, developed, deployed, and operated in a manner that respects human rights and fundamental freedoms. Continuous monitoring of both

intended and unintended impacts of AI systems is essential to prevent harm, including potential violations of human rights and freedoms.

Defined Purpose, Necessity and Proportionality

The deployment of AI systems must be justified, necessary, and proportionate to achieve legitimate objectives. Their use should be consistent with the mandates, governing instruments, rules, regulations, and procedures of United Nations system organizations.

Safety and Security

Safety and security risks associated with AI systems should be identified, addressed, and mitigated throughout their entire lifecycle. This approach aims to prevent or minimize potential and actual harm to individuals, the environment, and ecosystems wherever possible. The development and operation of safe and secure AI systems should be supported by robust and effective governance frameworks.

Fairness and Nondiscrimination

International law requires United Nations system organizations to promote fairness and ensure the equitable distribution of benefits, risks, and costs associated with AI systems. Measures must be taken to prevent bias, discrimination, and stigmatization, and AI systems should neither deceive individuals nor undermine human rights and fundamental freedoms.

Right to Privacy, Data Protection and Data Governance

The use of AI systems must respect individual privacy and the rights of data subjects. This includes the establishment of appropriate data protection frameworks and governance mechanisms that are aligned with the United Nations Personal Data Protection and Privacy Principles, ensuring the integrity and responsible use of data.

Transparency and Explainability

This means that the decisions produced by AI systems should be understandable to humans and not function as unexplained 'black boxes'. Individuals should be informed about decisions that affect their rights, fundamental freedoms, entitlements, services, or benefits, and should have access to the underlying reasons and logic behind those decisions.

Responsibility and Accountability

The United Nations should establish impact assessment mechanisms and legal frameworks to ensure accountability for the use of AI systems across their lifecycle. These mechanisms should include protections for whistle-blowers and clearly defined ethical and legal responsibilities for decisions supported or made by AI systems. In cases where harm occurs, appropriate investigations and corrective actions should be undertaken, while also promoting shared knowledge and institutional capacity-building.

Inclusion and Participation

A participatory approach is essential for identifying underlying assumptions and potential risks in AI systems. This approach involves engaging relevant stakeholders in defining the purpose of AI systems, assessing their benefits and harms, and determining possible adverse impacts. It also includes the implementation of effective prevention and mitigation measures to address identified risks.

Legal and Regulatory Considerations

Legal frameworks for AI governance vary across jurisdictions, encompassing a wide range of laws, regulations, and policies aimed at addressing issues such as data privacy, cybersecurity, and algorithmic transparency. Challenges in AI regulation include balancing innovation with risk mitigation, ensuring accountability and transparency, and addressing ethical concerns in AI development and deployment.

Approaches to AI governance differ from country to country due to variations in legal systems, economic priorities, and levels of technological development. These frameworks encompass a wide range of laws, regulations, and policy guidelines designed to address key issues such as data protection, cybersecurity, algorithmic transparency, and liability for AI-driven decisions. Some countries have adopted comprehensive AI-specific regulations, while others rely on adapting existing laws related to consumer protection, human rights, and digital governance. One of the main challenges in regulating AI is balancing innovation with effective risk mitigation. Overly strict regulations may slow technological development and discourage investment, while insufficient oversight can lead to serious harms, including discrimination, privacy violations, and misuse of AI systems. Ensuring accountability is particularly complex, as AI decision-making processes are often opaque, making it difficult to determine responsibility when harm occurs.

Transparency and explainability are also central concerns in AI governance. Legal frameworks increasingly emphasize the need for developers and users to understand how AI systems function, especially in high-risk applications such as healthcare, law enforcement, and finance. In addition, ethical considerations—such as fairness, non-discrimination, and respect for human rights—must be integrated into legal approaches to AI governance. Given the global nature of AI technologies, regulatory fragmentation across countries poses further challenges. This has increased the need for international coordination and harmonization of AI regulations to prevent regulatory gaps and ensure consistent standards. Effective legal frameworks for AI governance should therefore be adaptable, inclusive, and aligned with both technological advancements and fundamental societal values.

Role of International Organizations in AI

International organizations are important actors in promoting coordination on AI governance and reducing the risk of inconsistent national regulations. Because AI technologies often transcend national borders, no single state can effectively regulate them alone. Organizations such as the United Nations, UNESCO, the OECD, and the World Economic Forum contribute by developing international guidelines, ethical frameworks, and policy recommendations for the responsible development and use of AI. For example, UNESCO's global AI ethics framework emphasizes human rights, inclusivity, and sustainability, while the OECD focuses on trustworthy and human-centered AI. At the same time, international organizations provide platforms for dialogue and cooperation among governments, private companies, researchers, and civil society. Through conferences, working groups, and reports, they help share best practices, reduce regulatory gaps, and promote consensus on global AI norms. In practical terms their involvement is crucial for fostering international trust, preventing misuse of AI technologies, and ensuring that AI development aligns with shared global values. Many international organizations play an active role in AI governance. UNESCO has adopted the Recommendation on the Ethics of Artificial Intelligence, while the ITU focuses on technical standards and applications in telecommunications. UNCTAD and UNDP address AI from a development and capacity-building perspective. As a subsidiary body of ECOSOC, the CSTD provides policy-oriented analysis on emerging technologies and facilitates dialogue among Member States on the developmental implications of AI.

Human Rights Implications of AI

The increasing use of artificial intelligence raises important questions regarding the protection of human rights at the international level. From one perspective, AI can enhance human rights by improving access to essential services such as healthcare, education, and social protection. On the other hand, unregulated or poorly designed AI systems can threaten fundamental rights, including the right to privacy, freedom of expression, and the right to non-discrimination. Surveillance technologies, facial recognition systems, and data-driven profiling tools may enable mass monitoring and misuse by both state and non-state actors. Moreover, algorithmic bias can reinforce existing social and economic inequalities, disproportionately affecting marginalized and vulnerable groups. These risks highlight the need for strong legal safeguards, transparency requirements, and accountability mechanisms. International governance frameworks must ensure that AI systems comply with international human rights law and that human rights impact assessments are conducted before deploying high-risk AI technologies. The human rights implications of artificial intelligence involve the potential impact of AI systems on fundamental rights such as privacy, equality, freedom of expression, and access to information. In the context of CSTD, these implications are examined with a focus on development, inclusion, and digital equity.

Security Risks of Artificial Intelligence

Artificial Intelligence also presents significant security challenges that extend beyond traditional cybersecurity concerns. AI systems can be exploited for malicious purposes, including the creation of deepfakes, automated cyberattacks, and large-scale disinformation campaigns, with over 80% of cyberattacks now involving some form of automation or AI. Deepfake content has increased by more than 900% in recent years, posing a serious threat to information integrity and public trust. These technologies can undermine democratic processes, manipulate public opinion, and destabilize societies. In addition, AI can be used to target critical infrastructure such as energy systems, financial networks, and healthcare services, with attacks on such systems increasing by 30% globally, raising the risk of large-scale disruptions. Around 60% of organizations also report experiencing AI-related security risks, highlighting the growing vulnerability of institutions. The integration of AI into security systems further raises concerns about system reliability, as highly complex AI models may be difficult to control or predict. Therefore, ensuring the security, reliability, and resilience of AI systems is essential, requiring stronger international cooperation and more effective regulatory frameworks.

Capacity Building in Developing Countries

Capacity building in developing countries is essential to achieving equitable and inclusive global AI governance. Many developing nations face structural challenges such as limited digital infrastructure, insufficient access to data, a shortage of skilled professionals, and weak regulatory institutions. As a result, they risk being excluded from the benefits of AI while remaining vulnerable to its risks. International cooperation is necessary to address these disparities through technology transfer, financial assistance, education, and training programs. Capacity-building initiatives can empower developing countries to design and implement their own AI strategies, establish effective regulatory frameworks, and use AI to support sustainable development goals such as poverty reduction, healthcare improvement, and climate resilience. Moreover, strengthening local expertise enables these countries to actively participate in international decision-making processes related to AI governance. Ensuring that developing states have a voice in shaping global AI norms is crucial for creating a fair, balanced, and representative international AI governance system. The human rights implications of artificial intelligence involve the potential impact of AI systems on fundamental rights such as privacy, equality, freedom of expression, and access to information. In the context of CSTD, these implications are examined with a focus on development, inclusion, and digital equity.

2015: Capacity Building in the Paris Agreement

The Paris Agreement (Articles 11 and 12) emphasized increasing the capacity of developing countries, particularly Least Developed Countries and Small Island Developing States, to take effective measures against climate change. This includes, among other things, facilitating the implementation of adaptation and mitigation actions, the development, dissemination and use of technology, access to climate finance, relevant aspects of education, training and public awareness, and transparent, timely and accurate information communication. It also called on developed countries to increase their support for capacity-building actions in developing countries.

Technology Transfer

The sharing of AI technologies and technical knowledge from developed to developing countries to reduce the digital divide and support local innovation.

Education and Skills Development

Training programs and academic initiatives aimed at developing local AI expertise, including data science, ethics, and policy-making skills.

Digital Infrastructure Development

Investments in internet access, computing power, and data infrastructure to enable the effective deployment of AI systems.

Institutional and Regulatory Capacity

Strengthening government institutions to design, implement, and enforce AI-related laws and regulations.

Access to Data and Research Resources

Supporting open, fair, and secure access to high-quality data and research tools necessary for AI development.

International Partnerships and Cooperation

Collaboration between states, international organizations, and private actors to share resources, best practices, and funding.

Local Innovation and Context-Specific Solutions

Encouraging AI solutions that address local challenges and are adapted to cultural, social, and economic conditions.

Block positions

- **China:** China supports a state-centered approach to artificial intelligence governance, emphasizing national sovereignty and control over data and technology. It believes that each country should regulate AI according to its own political and social systems without external interference. While supporting international cooperation, China prioritizes cybersecurity, social stability, and economic development, and rejects frameworks that impose Western values, particularly regarding human rights and data governance.

- **South Korea:** South Korea focuses on innovation-driven AI development while supporting international cooperation. It prioritizes economic growth and technological competitiveness but also recognizes the importance of ethical considerations. South Korea supports flexible governance models that do not limit rapid technological progress.
- **European Union:** The European Union advocates for strong, binding international regulations on artificial intelligence, focusing on human rights, data protection, and ethical standards. It supports transparency, accountability, and explainability in AI systems, and promotes a human-centered approach aligned with existing frameworks like GDPR. EU believes that global AI governance should be coordinated through international organizations to ensure fairness, safety, and the protection of fundamental freedoms.
- **Brazil:** Brazil advocates for fair and inclusive AI governance that prioritizes social impact and reduces inequality. It supports a stronger role for the United Nations in coordinating global AI policies and emphasizes the need for equal access to technological resources. Brazil highlights the importance of ensuring that AI benefits developing nations and does not deepen existing disparities.
- **Türkiye:** Türkiye supports a balanced approach to artificial intelligence governance, combining ethical considerations with the need for technological innovation. It emphasizes regional and international cooperation while also prioritizing digital sovereignty and national development. Türkiye positions itself as a bridge between developed and developing countries, supporting inclusive and fair AI governance frameworks.
- **Germany:** Germany strongly supports strict regulation of artificial intelligence, particularly within the framework of the European Union. It prioritizes ethical standards, accountability, and transparency, especially in industrial applications of AI. Germany believes that robust legal frameworks are necessary to prevent risks and ensure responsible technological development

- **Japan:** Japan promotes a human-centered approach to artificial intelligence, focusing on its role in improving quality of life, particularly in areas such as healthcare and aging populations. It supports international ethical standards and cooperation but prefers soft regulations that do not hinder innovation. Japan emphasizes the peaceful and beneficial use of AI for society.

Questions To Be Asked

- **What forms of international support are most effective in empowering developing countries in AI governance, and what mechanisms can ensure fair access to AI-related resources for them?**
- **How can international cooperation reduce inequalities in AI development, and to what extent should governments limit AI innovation in order to protect human rights?**
- **Should transparency and explainability be mandatory for all AI systems, even if it limits performance?**
- **To what extent should privacy rights override the benefits of AI-driven public security systems?**
- **What role should the United Nations play in enforcing global AI governance standards?**

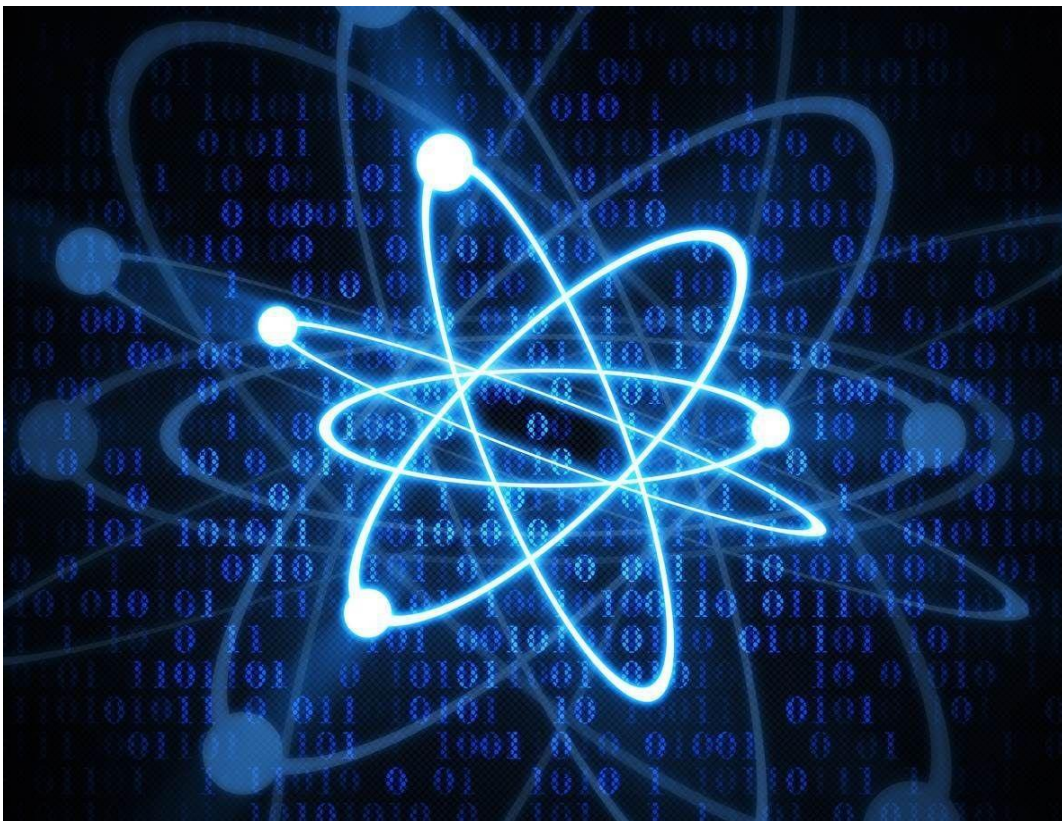
Agenda B : The Advancement of Quantum Technology for Humanity

Introduction to the Agenda item B :

The event aims to prepare governmental, societal, and economic stakeholders for the immense opportunities and challenges posed by quantum technology. It will highlight the various fields likely to be transformed by this new technology and outline the expected nature of these changes. In doing so, it will also lay the groundwork for potential discussions within the UN and its member states on necessary and meaningful governance and monitoring programs.

What is Quantum Technology ?

Quantum computers work very differently from the classical computers we use today. Instead of processing information one step at a time, quantum computers can consider many possibilities at once, making them incredibly powerful for certain tasks. Imagine doing a jigsaw puzzle when every piece can be tried in every possible position and orientation simultaneously. This means a quantum computer could potentially solve more complex problems much faster than traditional computers.



Opportunities and Risks of Quantum Technology for Human Development :

Quantum technology holds immense potential to transform multiple aspects of human life. While its opportunities are vast, it also presents significant risks that must be managed.

Opportunities

Quantum Computing:

Quantum computers have the potential to solve highly complex problems that are currently beyond the capabilities of classical computers. This technological breakthrough could significantly accelerate drug discovery, allowing researchers to analyze molecular interactions more efficiently and develop new treatments faster. In addition, quantum computing can improve climate modeling by processing vast amounts of environmental data with greater accuracy, leading to better predictions and more informed climate policies. It can also optimize supply chains by identifying the most efficient routes and resource allocations, reducing waste and costs. In the context of human development, these advancements can strengthen healthcare systems, support more effective responses to climate change, and improve resource management, particularly in developing countries where efficiency and access to technology are critical.

Quantum Sensing and Meteorology:

Quantum sensors are reaching extremely high levels of sensitivity, enabling major advancements across various fields. In medical imaging, they can improve the precision of diagnostics, allowing earlier detection of diseases. In navigation systems, quantum sensing can enhance accuracy in environments where traditional GPS signals are weak or unavailable. These sensors are also valuable in earthquake detection and environmental monitoring, as they can identify very small changes in physical conditions. Such capabilities make it possible to develop early warning systems for natural disasters, strengthen infrastructure safety, and support better environmental protection. Overall, these applications have a direct impact on quality of life by helping societies prepare for and respond to potential risks more effectively.

Quantum Communication:

Quantum communication technologies, particularly quantum encryption and quantum key distribution (QKD), offer a level of data security that is theoretically unbreakable. This makes them especially important for protecting sensitive information such as medical records, financial data, and government communications. By reducing the risk of data breaches and cyberattacks, quantum communication can help build stronger and more reliable

cybersecurity infrastructures. As a result, trust in digital systems can increase, supporting the development of secure e-government services and digital healthcare platforms. In the long term, these technologies also contribute to the protection of fundamental human rights, especially privacy and data security, in an increasingly digital world.

Risks

Potential for Breaking Cryptographic Systems:

Many of the encryption methods currently used to protect global communications, financial systems, and critical infrastructure may become increasingly vulnerable with the continued advancement of quantum computing. If the transition toward quantum-resistant cryptographic systems is not planned and implemented in a timely and coordinated manner, this vulnerability could lead to serious consequences. In particular, weaknesses in encryption may pose significant risks to global security, economic stability, and individual privacy by exposing sensitive personal, financial, and governmental data. Therefore, proactive policy planning, long-term investment, and international coordination are essential to ensure the resilience and reliability of cryptographic systems in the emerging quantum era.

Increasing Global Technological Gap:

The development and deployment of quantum technologies require substantial financial investment, highly advanced technological infrastructure, and a skilled workforce with specialized expertise. Consequently, progress in this field is currently concentrated among a limited number of technologically advanced countries and major private sector actors. In the absence of effective international cooperation, comprehensive capacity-building efforts, and inclusive technology transfer mechanisms, developing countries may be excluded from the benefits of quantum technologies. Such an outcome risks reinforcing existing global inequalities and widening the technological gap, rather than contributing to more balanced and inclusive development.

Immediately, although quantum technologies offer considerable potential to advance human development, their benefits are neither automatic nor evenly distributed. The fair, secure, and inclusive realization of these technologies depends on the establishment of effective governance frameworks, sustained international cooperation, and the integration of ethical principles into technological development and deployment. In this context, the role of the CSTD is crucial in guiding quantum technologies in a direction that aligns with sustainable development objectives and broader global interests.

Using Quantum Technology to Improve Quality of Life

The Use of Quantum Technology in Improving Quality of Life:

In recent years, quantum technology has gained attention due to its potential to significantly influence scientific and technological development. By leveraging the principles of quantum mechanics, this technology has the potential to significantly enhance various aspects of human life. From addressing global challenges such as climate change to advancing healthcare and material development, quantum-based solutions offer promising pathways toward a more sustainable, healthy, and efficient future.

Climate Research:

Quantum computing plays a critical role in improving climate research by enabling the processing of extremely large and complex datasets that exceed the capabilities of classical computers. Climate systems are influenced by countless variables, including atmospheric conditions, ocean currents, and human activity. Quantum computers can analyze these variables simultaneously, leading to earlier and more accurate predictions of extreme weather events such as hurricanes, heatwaves, floods, and droughts.

As a result, governments and emergency response organizations can take timely preventive and protective measures, reducing loss of life and economic damage. Improved forecasting also supports long-term climate modeling, helping policymakers develop effective strategies for climate adaptation and mitigation, ultimately contributing to the protection of both the environment and affected communities.

Medical Technology:

Quantum sensing has the potential to revolutionize medical technology by significantly enhancing diagnostic capabilities. Unlike traditional imaging techniques such as computed tomography (CT) and magnetic resonance imaging (MRI), quantum-based imaging methods can detect extremely subtle changes in biological systems with unprecedented precision.

These advanced techniques provide higher-resolution images and more detailed representations of organs and tissues, enabling earlier detection of diseases and more accurate diagnoses. Improved imaging accuracy leads to more effective treatment planning and better

patient outcomes. Furthermore, quantum technologies may reduce exposure to harmful radiation and shorten diagnostic procedures, contributing to safer and more patient-friendly healthcare systems.

Materials Science:

In the field of materials science, quantum simulations enable researchers to model and understand the behaviour of molecules and materials at the atomic and subatomic levels. This capability allows scientists to predict material properties before physical production, greatly accelerating the discovery and development process.

Through quantum simulations, it becomes possible to design materials with superior characteristics, such as higher strength, improved conductivity, or enhanced durability. These advancements can lead to the development of more efficient batteries, innovative pharmaceutical compounds, and advanced industrial materials. Ultimately, such progress supports technological innovation, economic growth, and sustainable industrial practices, all of which contribute to an improved quality of life.

Preparing for Quantum Crises:

A critical risk associated with quantum technology is the gradual obsolescence of traditional encryption methods that currently form the foundation of global digital security. Most widely used cryptographic systems today were developed to resist attacks from classical computers rather than quantum ones. Once sufficiently powerful quantum computers become operational, they are expected to break these encryption schemes within relatively short time frames. As a result, large volumes of data that are currently considered secure could become exposed, including government communications, military and intelligence information, financial records, health data, and sensitive corporate information.

The consequences of such a shift would be profound. Quantum-enabled decryption could allow cybercriminals, hostile state actors, and terrorist organizations to gain access to highly sensitive state and corporate data. This could lead to large-scale data breaches, financial disruption, a loss of public trust in digital systems, and serious threats to national security. Importantly, the risk is not limited to the future.

For these reasons, immediate and coordinated action is required at both national and international levels. States, international organizations, and private sector actors should

prioritize the transition to quantum-safe, or post-quantum, encryption systems. This process involves sustained investment in research and development, the modernization of regulatory and legal frameworks, and the adoption of cryptographic standards that are resilient to quantum attacks. International cooperation is particularly important to ensure interoperability, global standardization, and fair access to quantum-resilient security technologies.

In addition, critical infrastructure sectors—including finance, logistics, energy, telecommunications, healthcare, and public utilities—must be secured as a matter of urgency. These sectors constitute the backbone of modern societies, and any disruption to their operations could produce cascading economic and social consequences. Governments and private operators should therefore carry out comprehensive risk assessments, modernize legacy systems, and develop robust contingency plans to strengthen resilience against emerging quantum-related cyber threats.

In conclusion, preparing for potential quantum-related crises should not be viewed as a distant or theoretical challenge, but rather as an urgent strategic priority. The decisions and investments made today will play a decisive role in determining whether societies are able to harness the benefits of quantum technologies while effectively managing and mitigating their destabilizing risks in the future.

Quantum Cloud Computing

What is Quantum Cloud Computing?

Quantum cloud computing refers to a model that combines classical cloud infrastructure with quantum capabilities to provide quantum programming resources over the cloud. In other words, it enables users to remotely access quantum processors without needing specialized hardware. The goal is to make quantum scanning, cryptography, visualization, and machine experimentation easy and affordable for individuals, researchers, and developers. With the help of cloud-based quantum programming, researchers and developers can solve complex problems in fields such as finance, healthcare, and cybersecurity.



Advantages of Cloud-Based Quantum Computing

Accessibility

Cloud-based quantum computing provides remote access to quantum processors without the need for quantum computing hardware. By doing so, it removes the barriers to entry, meaning researchers, developers, and businesses can experiment with quantum algorithms from anywhere in the world.

Cost Efficiency

Building and maintaining a quantum computer can be highly expensive, whereas cloud-based systems provide an affordable alternative. Instead of investing millions in quantum infrastructure, users can pay for quantum processing time on demand. This pay-as-you-go model can reduce upfront costs, making quantum computing financially practical for startups, universities, and enterprises. On top of that, cloud providers normally handle system maintenance, cooling, and software updates, minimizing expenses even more.

Challenges of Quantum Cloud Computing

Quantum Hardware Limitations

Quantum computers are still in the development phase, and there are hardware constraints that limit their practical applications. Current quantum processors have short coherence times, high error rates, and limited qubit connectivity, making complex computations unreliable.

Security Risks

While quantum computing has the potential to revolutionize cybersecurity, it also comes with new security risks. Many classical encryption methods, such as RSA and ECC, can be broken by quantum algorithms like Shor's Algorithm. This poses a major threat to data stored on quantum cloud platforms—especially if post-quantum cryptographic methods are not implemented in time. To address these risks, researchers are actively developing quantum-resistant encryption techniques and secure quantum communication protocols, such as Quantum Key Distribution (QKD).

Cryptography and Cybersecurity:

Cloud-based quantum computing has the potential to reshape cybersecurity by both strengthening encryption and introducing new risks to existing cryptographic methods. For example, Quantum Key Distribution (QKD) can enable ultra-secure communication by detecting any eavesdropping attempts using quantum mechanics principles. At the same time, quantum algorithms such as the Shor Algorithm threaten traditional encryption methods like RSA and ECC, which rely on the difficulty of factoring large numbers. Therefore, governments and technology companies like IBM are actively researching post-quantum cryptographic algorithms to protect sensitive data against future quantum attacks.

Development of Quantum Cloud Security Protocols

Security is always a critical concern when it comes to quantum technology, and the development of quantum cloud security protocols will play a key role in protecting sensitive data. Innovations such as quantum key distribution (QKD) and post-quantum cryptography will help protect cloud-based quantum transactions against cyber threats. With the integration of quantum secure encryption, quantum cloud platforms will become more resilient to evolving security challenges.

VI. Questions to be Ask

- **Do the risks or opportunities of quantum technology outweigh each other?**
- **What are the practical applications of quantum advancements in improving quality of life?**
- **What steps are needed to transition to quantum-safe encryption at a national or global level?**
- **How secure is quantum cloud computing?**

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