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UNLOCKING THE POTENTIAL OF SCIENCE FOR PEACE AND SECURITY THE GESDA EXPERIENCE

Remarks to the Council by Henrietta Fore, Member of GESDA Board of Directors

Check against delivery

Science and technology are evolving fast. They are changing the ways in which we live, think, and behave.

These advances are like two sides of a coin: whilst they carry enormous potential for international development and prosperity, they are also transforming how wars are being fought – and will be key in defining the future of conflict, peace, and global security.

Let me illustrate this with three concrete examples: Advanced Artificial Intelligence; Quantum Computing; and Neurotechnology.

- *In the next five years*, **Advanced AI's** military applications have the potential to radically alter conventional, nuclear, and cyber weapons strategies; to increase the pace and complexity of warfare; and to exacerbate risks of unintended conflict escalation. On the other hand, AI-enhanced mediation will advance peaceful outcomes by helping facilitators learn from the past, identify areas of convergence, and simulate scenarios.
- *Ten to twenty years from now*, **Quantum computing** capable of breaking even the most advanced encryption algorithms currently in use could deeply disrupt global cybersecurity. Other quantum technologies carry enormous potential to save lives – by identifying tiny amounts of chemical and biological agents, for instance, or detecting and neutralizing land and sea mines. Quantum computing will likely also dramatically improve logistics, mission planning, and long-range communication – for military, peacekeeping and humanitarian actors alike.
- *In less then twenty five years*, maybe even more swiftly, experts anticipate that developments in **Neurotechnology** will augment soldiers' capabilities by improving their precision, response to pain, and ability to overcome sleep deprivation. Brain-computer interfaces such as implants and non-invasive sensors will open the door to reading opponents' thoughts and altering their senses and movements, in other words: *brain hacking*. At the same time, vast improvements in the understanding and treatment of trauma (PTSD) could help break cycles of violence.

These examples are no science fiction.

This is the knowledge you gain when asking scientists from all over the world about what is cooking in their labs, now. Doing it again and again is the best way to increase our preperadness for such emerging breakthroughs.

Anticipating these trends in turn allows us to create **the space for preventive action and guidance**: by gaining a better understanding of what the future holds, we can act more effectively and wisely in the present. Unfortunately, developments in science and technology have also become the objects of **speculation and polarization**. Without a sound knowledge base, anticipation and action are ineffective at best, and counterproductive at worst.

The GESDA Science Breakthrough Radar® aims precisely at tackling this challenge of anticipation in a fast evolving, science-driven world. It was coined to serve as a **trusted foundation for effective anticipatory action.**

Drawing on the views of roughly 2000 leading scientists hailing from 73 countries across every continent, the GESDA Science Breakthrough Radar® offers **a running, objective, unique global overview on the upcoming developments in 5-10-25 years**. It currently covers five fields of science: Advanced AI and Quantum Revolution, Human Augmentation, Eco-regeneration and Geoengineering, Science and Diplomacy as well as Knowledge Foundations.

The first three editions of the Radar identified 37 emerging topics and 336 possible breakthroughs. Step-by-step, we are including not only how science is evolving, but also how it is being used in diplomacy, business and civil society – creating a new kind of Situation Room.

On this basis, GESDA **incubates solutions** and develops **concrete tools**.

In 2023, we started harnessing the unprecedented precision and speed of quantum computing to tackle global challenges such as fragile food supply chains, pandemics and climate change.

Today, we stand ready to embed GESDA's data in **new toolkits for conflict prevention and resolution.** We are exploring applications of advanced AI to support the peaceful settlement of disputes as per **Chapter 6 of the UN Charter**. These include:

- Analyzing past peace practice, identifying patterns and drawing lessons-learned;
- Anticipating new conflicts by detecting weak signals or early warning signs, and;
- Opening options to strengthen current conflict resolution avenues – based on best cases for prevention, mediation and results.

Excellencies,

As the pace of science and technology accelerates, so must our science literacy and our collective efforts to use it to promote peace and prevent conflict.

Together with our partners, GESDA Foundation is striving to contribute to a more peaceful and secure future.

We welcome your inputs and suggestions and would be honored to support you in these areas.

Our value proposition is: **let us utilize the future of science to build a present of peaceful prosperity for all.**

Thank you very much.

ADDENDUM ONE
NAVIGATING QUANTUM COMPUTING

How does Quantum Computing work?

Quantum computers exploit quantum mechanics: the laws of physics that govern the behavior of matter at the tiniest of scales. Quantum mechanics defy all our intuitions about how the physical world operates.

It is a world of probabilities rather than clear cause and effect, and it upends our understanding of time and space.

At the most basic level, all information in a classical computer is encoded as sequences of bits – 1s and 0s that represent the flicking on and off of tiny electrical switches known as 'transistors'.

Qubits are the quantum equivalent of bits, but because they represent quantum systems rather than simple switches, they have unusual properties that classical bits don't. That allows them to store and process much more information. Because quantum computers can perform millions of operations *simultaneously*, they are orders of magnitude faster than classical computers, which operate sequentially.

The unusual properties of quantum computers stem from three main quantum effects:

- Superposition – While in a classical computer, bits exists as either 0 or 1, qubits, the fundamental information processing units in a quantum computer, can exist as a complex combination of the two, in which each outcome has a certain probability of being true. This state, known as superposition, can be maintained until the qubit is measured, at which point it will settle on one of the two values. Bits are like a flipped coin that is either heads or tails, while a qubit in superposition is like a coin spinning on its side.
- Entanglement – When two quantum systems are entangled, changing the state of one instantaneously changes the state of the other, no matter the distance between them. This is what Einstein called "spooky action at a distance." Entanglement makes it possible to connect multiple qubits together so that all their fates are intertwined. The result is a single superposition of all the possible outcomes encoded in each individual qubit. Reading one of these qubits provides information about the states of all the others, which means a quantum computer can process information exponentially faster than a classical one.
- Interference – How qubits are linked up matters. The probabilities that govern the outcome of each qubit can interfere with those of its neighbors, amplifying or canceling each other out. To go from all possible outcomes to the one that is the solution to a problem, a quantum algorithm is needed that carefully choreographs a pattern of interference that leads to the correct solution. There are several options for how to arrange the qubits. The most popular model involves organizing them into circuits, like in classical computers. These circuits are built from a sequence of operations on smaller subsets of qubits that together help to solve whatever problem the quantum computer has been set to take on.

What can Quantum Computing be used for?

Quantum technology's expected timeline to maturity is approximately 10-20 years.

While this technology and its applications are still under development, there is a consensus in the quantum community that quantum computing holds an advantage over classical computing for problems related to material science and chemistry.

Identified potentialities include developing new carbon capture materials, filters to remove micropollutant compounds from wastewater, and novel ways to produce fertilizers.

What implications for global peace and security?

Ten to twenty years from now, quantum computing, capable of breaking even the most advanced encryption algorithms currently in use could deeply disrupt secure communication and global cybersecurity.

Other quantum technology applications carry enormous potential to save lives: quantum detection systems could identify tiny amounts of chemical or biological agents; quantum sensing could lead to the detection and neutralization of land and sea mines; and quantum internet could facilitate secure, long-range communication in challenging environments, such as in space.

Finally, quantum computing could dramatically improve areas such as logistics, mission planning, and resource allocation – for military, peacekeeping and humanitarian actors alike.

About GESDA & the Open Quantum Institute

The Geneva Science and Diplomacy Anticipator (GESDA) aims to provide a neutral platform to reflect on and anticipate how future scientific breakthroughs will impact people, society and the planet. In so doing, it seeks to create the conditions to use technology for the benefit humankind.

By translating these opportunities into action, we use the future to build the present.

In 2023, GESDA and its partners launched the Open Quantum Institute (OQI).

The OQI aims to:

- Accelerate the exploration of use cases of quantum computing geared towards the achievement of the UN's Sustainable Development Goals (SDGs) and other beneficial applications for humanity, linking industry and academic researchers and developers to SDGs experts and UN organizations;
- Widen the circle of beneficiaries and users of quantum technologies by providing global, inclusive and equitable access to a pool of public and private computers and simulators available via the cloud;
- Level the playing field by developing the capacity building instruments for all bright minds to contribute to the development of the technology, notably those in currently underserved geographies;
- Provide a neutral forum for diplomatic discussions to frame the future quantum computing multilateral governance.

FIND OUT MORE

Intelligence Report
on the multilateral governance of quantum computing for the SDGs
October 2023

ADDENDUM TWO

NAVIGATING NEUROTECHNOLOGY

How does neurotechnology work?

Neurotechnology is advancing our abilities to understand the human brain, and human experience better, as well as alleviate suffering from injury and disease. It also has the potential to redefine our understanding of who we are as humans, challenging our ideas of what it means to have freedom of thought and free will. While these technologies could provide major societal benefits, their development raises security, economic, legal and ethical concerns.

Neurotechnology encompasses a wide range of technologies that use neural interfaces to investigate, modulate, repair, or improve the nervous system. The nervous system is made up of the brain, spinal cord, and a complex network of nerves. Neurons are the fundamental units of the brain and nervous system: they the send messages that allow us to do everything from breathing to talking, eating, walking, and thinking.

Neurotechnologies can be invasive when penetrating the skull, or non-invasive when used at its surface. They include technologies that can:

- Record and measure brain activity through sensors or electrodes, giving researchers insights into how thoughts, feelings, and mental states are encoded in the brain and allowing users to control external devices.
- Modify brain activity transiently or permanently by interfering with neuronal functioning. These methods alter, enhance, or inhibit specific brain functions, and are used for research and treatment.
- Simultaneously record and modulate brain activity. Such techniques often combine different methods with algorithms to interpret the activity.

Although neurotechnologies now allow brain data to be recorded with great precision, researchers are still working on fully understanding these signals: establishing causal links between brain activity and mental states or behaviors remains difficult. Experts believe that thanks to recent advancements in computing power and data analysis, establishing these causal links is on an accelerated upward trajectory.

What can Neurotechnology be used for?

Neurotechnology already has various applications in the medical field, with at least 200,000 patients worldwide living with a neural implant, mainly deep brain stimulation electrodes to reduce the effects of Parkinson's disease.

These technologies also have likely implications in courts and workplaces, as well as for wellness, education, and entertainment.

Some current and future applications include:

- Enabling paraplegics to regain movement with spine-implanted electrodes.
- Restoring hearing through cochlear implants (possible since the 1980s). Restoring eyesight is currently being explored.
- Allowing paralyzed patients to communicate using brain-machine interfaces.
- Monitoring employees' fatigue in risk-prone industries, like aviation or construction.
- Enhancing the depth and quality of sleep through non-invasive stimulation.

Brain-monitoring devices, brain-machine interfaces, and other ways of reading and modulating the electrical signals of the nervous system are on the cusp of wide adoption across society.

The potential for neurotechnology increases as it is combined with other emerging technologies like AI, Virtual Reality, and increasingly sophisticated engineering and computing capabilities.

What implications for global peace and security?

In twenty five years, experts anticipate that developments in neurotechnology could augment soldiers' capabilities by improving their precision, response to pain, and ability to overcome sleep deprivation.

Brain-computer interfaces (implants/chips and non-invasive sensors) will open the door to reading opponents' thoughts and altering their senses and movements, also known as brain hacking.

At the same time, vast improvements in the understanding and treatment of trauma and post-traumatic stress disease (PTSD) could help break cycles of violence.

About GESDA Neurotech Observatory

The Geneva Science and Diplomacy Anticipator (GESDA) aims to anticipate future developments in science, reflect on their potential impact and develop inclusive and global solutions for a sustainable future with global partners, be it academics, politicians, diplomats, entrepreneurs, philanthropists and citizens from all over the world.

GESDA has been working with them to identify the resources that would allow policymakers and leaders to harness the full promise of emerging neurotechnology while preventing its potential for unintended and intentional misuse.

On this basis, GESDA is currently developing the *Neurotech Observatory*, a digital platform to enable diplomats and policymakers to anticipate developments in the field of Neurotechnology and make informed choices for its governance.

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