



Geneva Science and
Diplomacy Anticipator Foundation

Science Anticipation

Use the future to build the present

Technology Foresight and Technology Assessment for Sustainable Development

UNCTAD-CSTD 28th session, April 8, 2025

Maricela Muñoz, Director External Affairs

Why anticipate?

“ By projecting ourselves into possible futures, we aim to detect in **advance the major scientific** and technological advances that will change the ways we live, think, and behave. Consequently, society should have the time it needs to prepare for these changes with the best plausible **transitions**. ”

PETER BRABECK-LETMATHE

Chairman of the Board of Directors, GESDA

Why do foresight and anticipation matter?

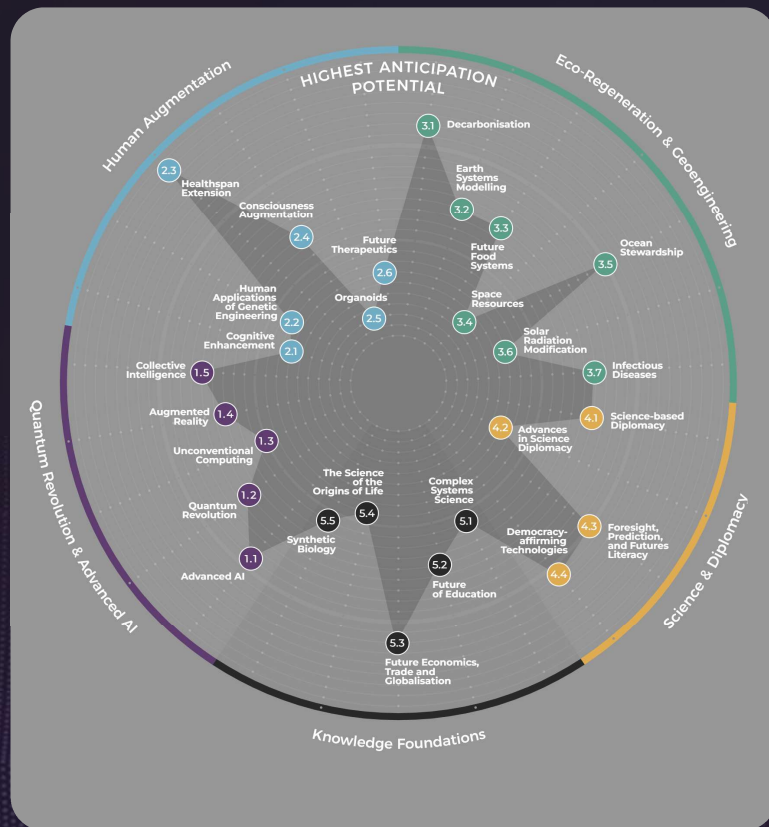
GESDA's methodology

1. Anticipating
2. Accelerating the dialogue between science, diplomacy, philanthropy, industry and society
3. Translating into action



- Identifying **opportunities** for SDG use cases on the global emerging technologies landscape (incl. underserved regions)
- Identifying **access**, implementation and **capacity building support needs**
- Using global platforms such as the **Open Quantum Institute** and the **GESDA Summit** to act and to identify the multilateral efforts required to harness the technology responsibly, equitably and at scale
- Using quantum and other emerging technologies as tools for **inclusive innovation** rather than creating a quantum divide or **technological divide**
- Ensuring that all of humanity can benefit from rapid scientific advances requires **anticipatory governance**
- Advancing international cooperation and knowledge-sharing initiatives
- There is a **high / multi-layered cost** for not anticipating !

First step: Taking the pulse of science



The Science Breakthrough Radar®

The GESDA Science Breakthrough Radar® aims to identify emerging research and map major science advances at 5, 10 and 25 years. Those advances will potentially have a significant impact on who we are as humans, how we are going to live together and how we can ensure the sustainability of our planet.



The future of advanced AI

5 YEARS

- Deep learning dominance, multimodality and ubiquitous simple AI models

10 YEARS

- Scaling limits and hybrid systems. Multimodal AI systems understand the physical world and scientific acceleration

25 YEARS

- Generally intelligent AI systems exhibiting adaptability, generalizability, common sense, and advanced reasoning

1.1

EMERGING TOPIC
Advanced AI

ANTICIPATION COMMITTEE CHAIRS



Emmanuel Abbé
Chair of Mathematical Data Science / Full Professor
EPFL



Rüdiger L. Urbanke
Professor of Communication and Information Theory
EPFL

AI*

Overview

Connections (1)

Resources (41)

Committee (5)

Artificial Intelligence (AI) aims to produce intelligence using algorithms and machines. This means, in particular, machines that are able to behave in ways we associate with human activity: perceiving and analysing our environment, taking decisions, communicating and learning. AI systems have achieved some impressive milestones in the last decade, and could prove disruptive to societal norms in the near future.

ASSOCIATED SUB-FIELDS:



SUB-FIELD
1.1.1
Deeper Machine Learning



SUB-FIELD
1.1.2
Multimodal AI



SUB-FIELD
1.1.3
Intelligent devices



SUB-FIELD
1.1.4
Alternative AI

gesda

Maricela Muñoz

4

Healthspan extension

5 YEARS

- Standardized diagnostics for biological age
- Clinical trials for age-delaying drugs and regimens (metformin, rapamycin, ...)
- AI-based personalized exercise and diet interventions to maximize healthspan

10 YEARS

- Understanding ageing mechanisms through machine learning
Personalized age profiles and prevention strategies (identification of individual agetypes and targeted gene or pathway-based therapies)

25 YEARS

- Reversing of (some) age-related processes through gene therapy and epigenetic reprogramming

2.3

EMERGING TOPIC
Healthspan Extension

ANTICIPATION COMMITTEE CHAIRS



Brian Kennedy
Distinguished Professor,
Department of
Biochemistry and
Physiology, Yong Loo Lin
School of Medicine
National University of
Singapore



Vera Gorbunova
Co-director
Rochester Aging Research
Center

 Overview **Connections (2)** Resources (18) Committee (3)

Rather than accept the ageing process as a natural facet of life, scientists and regulators are working out how to treat the process as a risk factor for disease in its own right and target it for treatment. ① This pursuit is being formalised into the discipline known as fundamental geroscience.

ASSOCIATED SUB-FIELDS:



SUB-FIELD
2.3.1
Fundamental Geroscience



SUB-FIELD
2.3.2
Diagnostics, hallmarks and biomarkers



SUB-FIELD
2.3.3
Healthspan therapies and interventions



SUB-FIELD
2.3.4
Lifespan extension and rejuvenation

5

Synthetic biology

5 YEARS

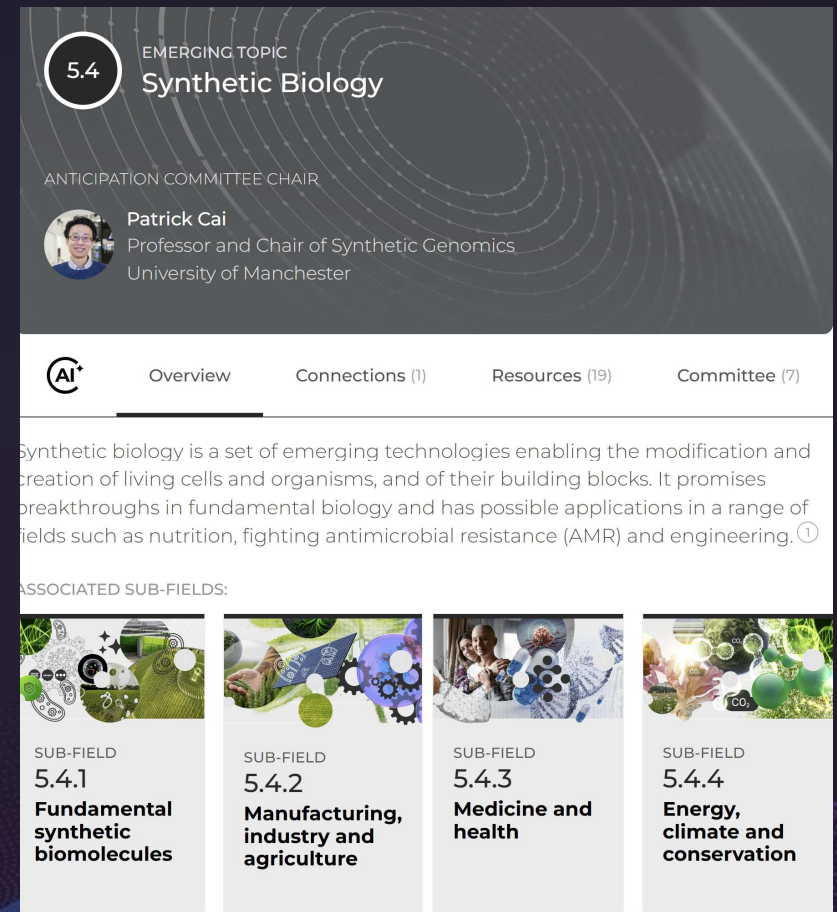
- Cost-effective synthesis of longer DNA sequences, spanning hundreds of kilobases
- Expansion of applications (manufacturing of chemicals, agriculture, medicine,...)

10 YEARS

- Cost reduction in DNA synthesis and development of generic synthetic biology platforms
- Advancements in complex rational design

25 YEARS

- AI-facilitated synthesis for example by providing instructions in natural language for molecular construction
- Programmable organ production from stem cells for human transplantation



The screenshot shows a webpage for 'Synthetic Biology' under the 'EMERGING TOPIC' category. It features a circular icon with '5.4' and a profile of Patrick Cai, Professor and Chair of Synthetic Genomics at the University of Manchester. The page has a navigation bar with 'Overview', 'Connections (1)', 'Resources (19)', and 'Committee (7)'. The main text describes synthetic biology as a set of emerging technologies for modifying and creating living cells and organisms. Below this, a section titled 'ASSOCIATED SUB-FIELDS:' lists four sub-fields with corresponding images: 5.4.1 Fundamental synthetic biomolecules, 5.4.2 Manufacturing, industry and agriculture, 5.4.3 Medicine and health, and 5.4.4 Energy, climate and conservation.

5.4 EMERGING TOPIC
Synthetic Biology

ANTICIPATION COMMITTEE CHAIR

Patrick Cai
Professor and Chair of Synthetic Genomics
University of Manchester

AI* Overview Connections (1) Resources (19) Committee (7)

Synthetic biology is a set of emerging technologies enabling the modification and creation of living cells and organisms, and of their building blocks. It promises breakthroughs in fundamental biology and has possible applications in a range of fields such as nutrition, fighting antimicrobial resistance (AMR) and engineering. ①

ASSOCIATED SUB-FIELDS:

SUB-FIELD	SUB-FIELD	SUB-FIELD	SUB-FIELD
5.4.1 Fundamental synthetic biomolecules	5.4.2 Manufacturing, industry and agriculture	5.4.3 Medicine and health	5.4.4 Energy, climate and conservation

Second step: Accelerating dialogue

Technological foresight and anticipation can help in driving multistakeholder-agreements and understandings to:

- Develop technologies and applications that **meet national** and global goals
- Accelerate STI developments that are critical for **future competitiveness**
- Prepare for future uncertainties
- Enhance participatory policies that benefit from **diverse views** and perspectives
- Foster citizen's awareness and public policy-oriented dialogue
- **Align R & D** with national developmental priorities

Third step: Translating into action

Knowing the expected short, medium and long term impacts of current and future technologies, enables actionable policies and activities that are fit for purpose, and could be translated into:

- Strategic planning for STI investments
- Future-fit infrastructure allocations
- Maximizing international cooperation, including South-South
- Developing and maintaining data science initiatives
- Fostering access to science and technological offerings (in-house and external)
- Develop a knowledge-based economy that profits from futures-literacy
- Democratizing access to knowledge
- Strengthening education and capacity building platforms (human capital)
- Enabling local, bottom-up innovation

GESDA as a global collaborative platform

Geneva Science and Diplomacy Anticipation Summit



Knowledge Products - Scientific Trends

GESDA Science Breakthrough Radar®
Top 8 anticipated scientific trends in 2024

- Unconventional computing
- Neuro-augmentation
- Healthspan and lifespan extension
- Eco-augmentation
- Orbital environment
- Behavioural science of groups
- Synthetic biology
- Archaeology



GESDA Publications



Science Diplomacy Use - cases

Quantum for All Initiative



New Initiatives



The Open Quantum Institute (OQI)



OQI - 4As

A1 Accelerating applications for humanity

Realising the full potential of quantum computing by accelerating the use cases geared towards achieving the SDGs, thanks to the combined forces of researchers and developers, entrepreneurs, the United Nations, and large NGOs.



A2 Access for all

Providing global, inclusive and equitable access to a pool of public and private quantum computers and simulators available via the cloud



A3 Advancing capacity building

Developing educational tools to enable everyone around the world to contribute to the development of quantum computing and make the most of the technology.



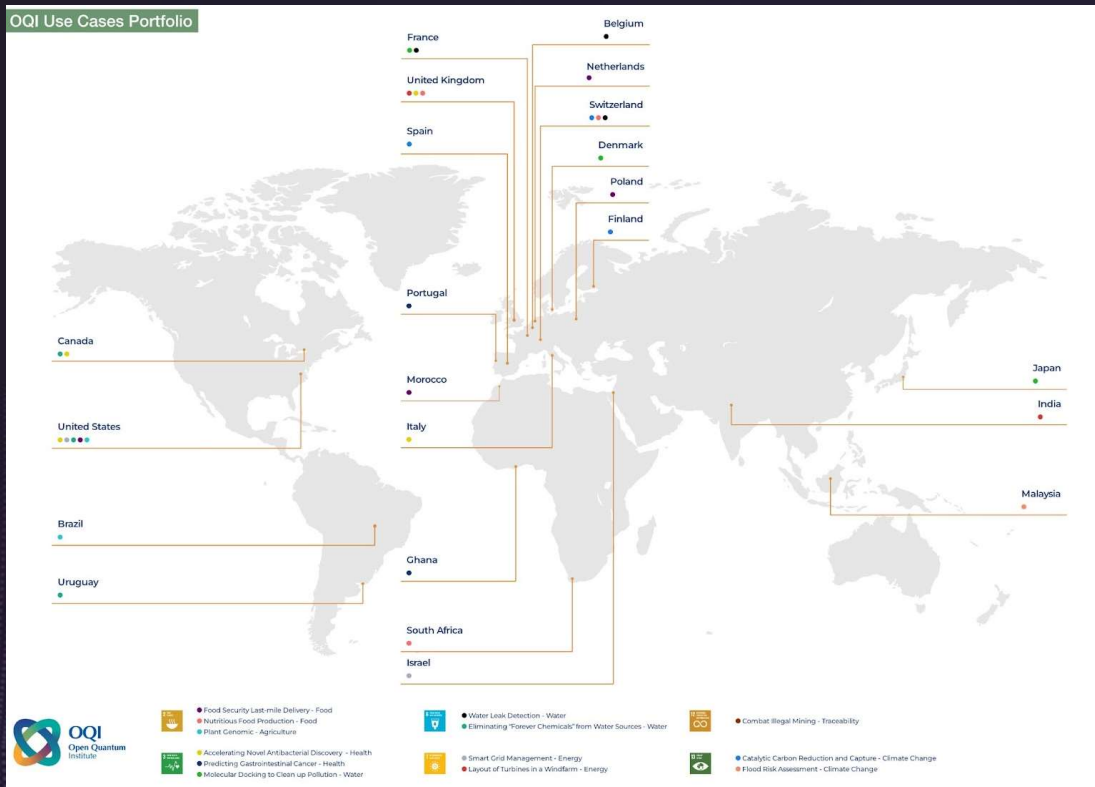
A4 Activating multilateral governance for the SDGs

Providing a neutral forum to help shape multilateral governance of quantum computing for the SDGs





A1 - Accelerating applications for humanity



Use case examples:



- Nutritious Food production
- Food Security – Last mile food delivery
- Plant Genomics



- Accelerating Novel Antibacterial Discovery
- Molecular Docking
- Predicting Gastro- intestinal Cancer



- Water Leak Detection
- Eliminating forever chemicals from water sources



- Laying out turbines in a windfarm
- Smart grid management



- Carbon Capture
- Flood risk assessment



UC-105 Molecular docking to clean up pollution



Use Case Team:

QUNASYS

UN Agency:



Quantum Approach:
Machine Learning

This use case proposes the use of quantum computers to **model enzymes/catalysts** that could break down phenol into **less harmful substances**.

Phenol is a chemical substance that is present in wastewater from petrochemical and pharmaceutical industries. It is classed as dangerous in **drinking water** by the World Health Organization and is related to health concerns such as tracheal ulcerations, corneal damage and blindness among other things.

Better Simulation of
Enzymes and
Catalysts

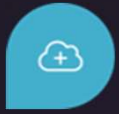


Improved Ability to
Break Down Phenol
Molecules



Reduced Phenol in
Soil and Wastewater





A2 - Access for all

- OQI as the center for expertise on the applications of quantum computing for the SDGs (and their future succeeding framework)
- Development of qualitative benchmarks and best practices
- Leveraging human talent worldwide
- Multistakeholder platform for dialogue and action





A3 - Advancing capacity building - a joint mission



Educational Consortium

55+ institutions contributing, with 17 official member institutions, and 80 experts involved in the Education Consortium

All activities aligned and relayed as part of the UN Year of Quantum Science and Technology

Best-practices

- Educational Consortium Workshops
- Extended Educational Repository
- Foundational Trainings

Future quantum ecosystems

- Hackathons
- Training for host institutions of OQI supported hackathons
- Pre-hackathon training programme for participants
- OQI mentorship programme
- OQI internship programme
- Regional quantum community events
- OQI inspired activities

Quantum diplomacy

- Quantum Diplomacy Game
- Quantum Diplomacy Game facilitator programme



A3 - Advancing capacity building – activities in 2025

OQI educational consortium

- Share experience and best practices and co-develop tools
- Feed OQI Edu Repository which will feature e.g. an Arxiv Paper on Regime of Quantum Advantage



Quantum hackathons focusing on SDGs

- Support 6 hackathons in quantum-underserved geographies in all continents
- Deployment of OQI's Hackathon in a Box



Quantum Diplomacy Game

- 2025: Deployment of this role play on the geopolitical implications of quantum computing as an emerging technology around the globe



International Year of Quantum Technology and Science (IYQ)

- OQI representation on the IYQ Steering Committee
- Contribution to the IYQ global events calendar





A4 - Activating multilateral governance for SDGs



Quantum Diplomacy engagement through informal discussions with Permanent Representations in Geneva and abroad, with input from a diverse community of practice (industry and science)

- Digital and economic inclusivity
- Technology for the SDGs
- Global Security
- Interoperability
- Trade
- Environment
- Talent
- Human Agency



2025: Upcoming Quantum Series Briefs in partnership with U.N. organizations (ITC-ILO, UNIDIR, ITU, UNESCO, etc.)

In a nutshell: why foresight and anticipation?

- Enhancing Policy and Decision-Making fit for the future
- Navigating Technological Disruptions while maximizing their positive impacts
- Strengthening Resilience and Adaptability against uncertainties
- Encouraging Inclusive and Participatory Governance - sustainable solutions do not happen in a vacuum
- Fostering Innovation and Competitive Advantages to ensure prosperity and security
- Supporting contextualized/bottom-up solutions for Sustainable Growth



How to enhance foresight and anticipation at the national level?

- Institutionalize foresight and anticipation units close to decision making levels (e.g. Parliaments, Ministers' cabinets, President's/Prime Minister Office, etc.)
- Foresight and futures units must remain independent and act as “honest brokers” to gain legitimacy and trust
- Identify champions who have the vision and are empowered to act
- Develop a culture of evidence-based decision-making and futures-shaping through a whole of government approach
- Develop knowledge/data of how specific technologies will impact vulnerable populations, including women; as STI developments have a social dimension
- Invest in education that values innovation, from primary school thru STEM careers
- Actively participate in international platforms to benefit from global use-cases and cooperation



Call for action

Integrating **scientific anticipation** and technological foresight into how individuals and societies address future challenges and opportunities is crucial in a world driven by rapid advancements. As science and technology evolve at an unprecedented pace, adaptive governance is essential to ensure progress remains inclusive, equitable, and sustainable.





Geneva Science and
Diplomacy Anticipator Foundation

Thank you

Maricela Muñoz
Director External Affairs

<https://gesda.global>

info@gesda.global