Event highlights

Future in flux?

Global issues and national strategies for responsible quantum technology development

27-28 November 2023 | Virtual event

OECD Global Forum on Technology

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By invitation-only event held in a virtual format on 27-28 November.

Discussions highlighted:

- the **state of quantum technologies**,
- their **promises and pitfalls**,
- the **role of public policies** in advancing their responsible development.

Close to 340 registrants from **50 countries** – including senior **policymakers**, leading **technology experts**, and a wide variety of **stakeholders** – were brought together.

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Keynote address – The second quantum revolution: A brief explainer

Jim Al-Khalili
University of Surrey

- **The Second Quantum Revolution**: As we approach the centenary of quantum mechanics, the Quantum 2.0 revolution is underway, harnessing non-trivial quantum mechanics concepts.
- **Three main application categories**:
  - **Quantum Computing**: Uses qubits, capable of storing and processing information in parallel. The main challenge lies in managing decoherence and maintaining quantum properties in large devices.
  - **Quantum Sensing**: The most mature aspect of Quantum 2.0, quantum sensing offers numerous applications.
  - **Quantum Communication**: Provides novel approaches to security and encryption, potentially rendering our information safe from decryption methods.
- **Investment and Workforce Development**: To ensure the world is equipped to handle and benefit from future quantum technologies, substantial investments and workforce development are essential.

Panel discussion - Quantum computing: From hype to advantage

- **Quantum tech progress**: Rapid advancements are seen in quantum computing, but key challenges remain (e.g., noise). Hybrid architectures that interface classical and quantum devices are likely to drive mid-term progress.
- **Long-term approach**: Quantum tech development needs a long-term vision, aligning quantum capabilities with end-users' needs.
- **Competitive collaboration**: The balance of competition and collaboration will significantly shape quantum technology innovation.
- **Benchmarking**: Ongoing work on defining the correct metrics to compare and measure quantum computing platforms performance.
- **Government role**: Government support is essential for shared infrastructures, cross-country collaborations, and de-risking investments.

Josep M. Martorell
Barcelona Supercomputing Centre

Jungsang Kim
Duke University & IonQ

Sabrina Maniscalco
University of Helsinki & Algorithmiq

Heike Riel
IBM Research

Itamar Sivan
Quantum Machines

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Breakout session - Skills & inclusiveness: The building blocks of our technological future?

- **Training and career paths:** Current paths vary by regions. There is a need for new training models and competency frameworks.
- **Talent training:** Greater efforts are needed to bolster the training of the current & future workforce. Upskilling existing software engineers is also key.
- **Geographic disparity and talent scarcity:** There is geographic disparity in talent & public funding. Developing the talent pipelines earlier and attracting talent globally are crucial.
- **Talent attraction:** Necessary steps include transparency, a top-down push for diversity, appealing language in ads, showcasing diverse staff, and fostering an inclusive culture.
- **Building skills and expertise:** Diverse skillsets needed, incl. technical, trans-disciplinary, and soft skills. Proposals include upskilling STEM talent, interdisciplinary programmes and raising policymakers' quantum awareness.

Araceli Venegas-Gomez
QURECA

John Goold
Trinity Quantum Alliance

Abhilash Mishra
Equitech Futures

Karina Robinson
Multiverse Computing

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Breakout session - From QKD to quantum teleportation: Towards a quantum internet?

- **Quantum communication:** The transfer of quantum information over distances offers additional data processing capabilities & enhanced cryptography. Primary applications in cybersecurity, with commercialization in government services, military, health facilities & industry.
- **Quantum network development:** The development of a mature Quantum Network (QN) will require efforts in physics, computer science, and engineering. It integrates both quantum and conventional technologies.
- **Concerns:** Challenges include competition with post-quantum cryptography, potential hacking by quantum computers, and high costs. Miniaturization and packaging are also issues.
- **National initiatives:** Underway in countries like Korea, India, and Spain, mostly government-driven. There is also work on quantum network simulation to reduce costs, and standards development for QKD.

Eleni Diamanti
CNRS, Sorbonne Université

Katsuyuki Hanai
Toshiba

Jaewan Kim
Korea Institute for Advanced Study

Urbasi Sinha
Raman Research Institute

Veronica Fernandez-Marmol
Spanish National Research Council

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Breakout session - Sensing potential: An overlooked revolution in measurement?

- **Potential**: This technology offers unprecedented sensitivity and resolution, promising to revolutionize fields like brain imaging and disease detection.
- **Challenges**: Transitioning from lab to real-world applications requires overcoming hurdles in achieving target sensitivities, miniaturizing devices, and cost reductions.
- **Ethics and governance**: As quantum sensing has dual-use potential, careful consideration is needed regarding ethical implications, governance, and potential misuse.
- **Collaboration**: Multidisciplinary and international collaboration is key to development, but sovereignty concerns and IP protection may pose barriers.
- **Outlook**: The technology's transformative potential requires early adopters, test cases and increased public literacy in quantum impact.

Jan Westenkær Thomsen
Niels Bohr Institute

Kai Bongs
German Aerospace Centre

Volkmar Denner
Bosch; QuantumBW

Tracey Forrest
University of Waterloo

Liron Stern
Hebrew University

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Panel discussion - Towards a quantum-safe future: Joining forces to advance scientific progress and responsible technology development

- **Encryption disruption timeline:** Quantum-safe technologies are urgently needed to protect global digital infrastructures. A five to ten-year timeline is predicted for quantum computers to disrupt current encryption methods.
- **Dual approaches to secure communication:** Two approaches to achieve quantum resilience were discussed: Post-Quantum Cryptography (PQC) and Quantum Key Distribution (QKD). A hybrid approach is likely required.
- **A complex transition:** The transition to quantum-safe systems will be challenging, requiring investment in R&D, transparency, workforce training and coordination between stakeholders.
- **Mitigation strategy and collaboration:** A thoughtful mitigation strategy is feasible within the available timeline, but calls for worldwide engagement, policy development, and balancing national security with international cooperation.

Thierry Botter
European Quantum Industry Consortium

Vikram Sharma
QuintessenceLabs

Corey Stambaugh
National Institute of Standards and Technology, U.S

Jesse Robbers
Quantum Delta NL

Kate Weber
Google

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Breakout session - Shaping technological leadership: Charting national plans for emerging technologies

- **Challenges:** The session identified shared challenges in quantum technology development, incl. scientific and technological uncertainties, the need for long-term and capital-intensive investment, partnerships, and talent incentivisation.
- **National efforts:** Countries like Canada, the UK, France, India, and Japan have distinct, but often overlapping, strategies. Common themes include a focus on research, commercialization, talent development, and regulation.
- **Shared emphasis:** Identifying strengths and weaknesses in the ecosystem and fostering international collaboration.
- **Funding and regulation:** The challenge of securing funding for quantum technology and the critical role of regulatory frameworks were highlighted. Governments viewed not just as funders, but also as procurers and users of quantum technology.

Neil Abroug
French National Quantum Strategy

Reena Dayal
Quantum Ecosystem and Technology Council of India

Masahiro Horibe
National Institute of Advanced Industrial Science and Technology, Japan

Phil Kaye
National Research Council of Canada

Roger McKinlay
UK Research and Innovation

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Additional keynote addresses & flash talks

- **Aviv Zeevi Balasiano** highlighted that Israel is advancing rapidly in quantum technologies, with a strategic focus on sensing, and is building a multidisciplinary quantum tech ecosystem.
- **Justine Lacey** underscored Australia's commitment to responsible innovation in quantum technology, with a national strategy focusing on R&D, access to infrastructure, workforce development, and ethical standards.
- **Pieter Vermaas** emphasized the need for constructive ethics in quantum technology, focusing on the functionalities and their applications to avoid undesired impacts and create beneficial ones.
- **Eugene Kandel** discussed Israel’s innovation policy and the unique challenges it faces. He stressed the importance of strategic proactive governments, effective global competition, and smart public-private partnerships based on trust.

Aviv Zeevi
Israel Innovation Authority

Justine Lacey
Commonwealth Scientific & Industrial Research Organisation

Pieter Vermaas
Delft University of Technology

Eugene Kandel
Start-Up Nation Policy Institute

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