



Taking a leap into the **future**

The Netherlands is ready for the quantum decade

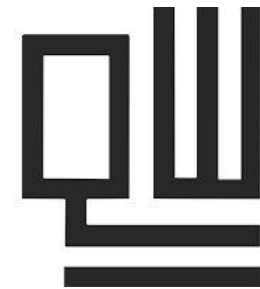
Relevance of standardization for the Dutch ecosystem

April 2022

Standaard voor
vooruitgang **nēn**

Relevance for the Dutch ecosystem

Participating organizations



Relevance for the Dutch ecosystem

What products are they creating?



Full I/O chain in a cryogenic fridge for quantum computers

Photonic software and hardware techniques for optical quantum computers

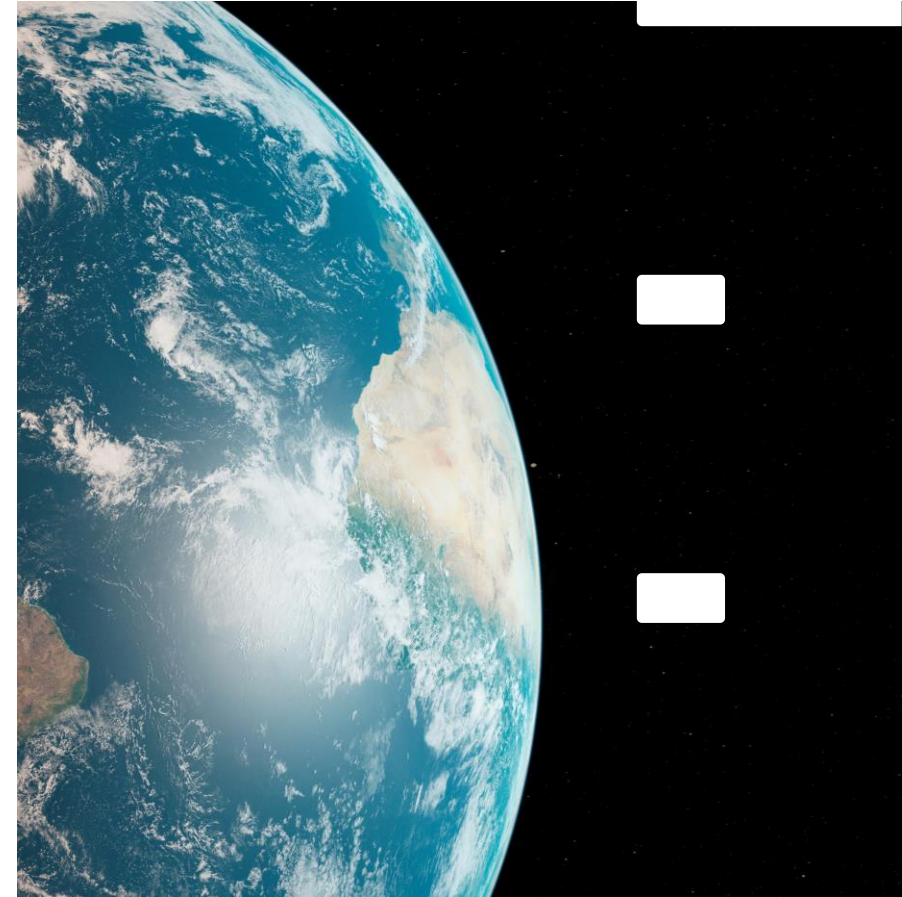
Characterization and **calibration** software and full-stack hardware systems for quantum device characterization

Relevance for the Dutch ecosystem

Why are they participating?

Goal: to create a global market

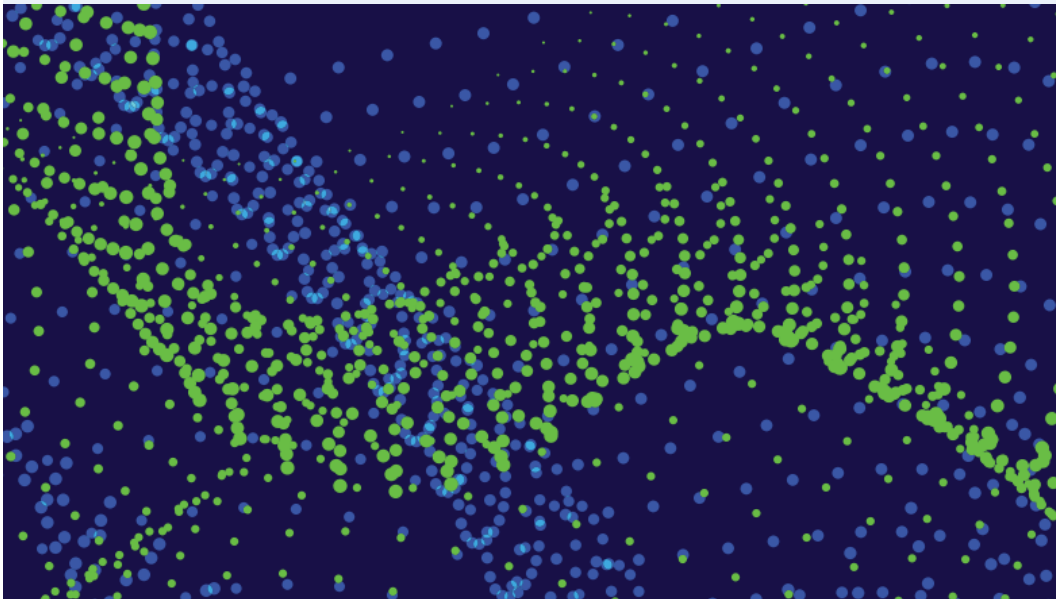
1. Identifying the functional requirements from customers
2. Products that have agreed interfaces
3. Products that can interwork with each other
4. Products that meet market demands
5. Having realistic requirements
6. Learning from other experts
7. Networking with other organizations



Relevance for the Dutch ecosystem

Leading position in standardization (1/2)

CEN-CENELEC Focus Group on Quantum Technology (FGQT)



Shaping European standardization plans such that standards meet our requirements

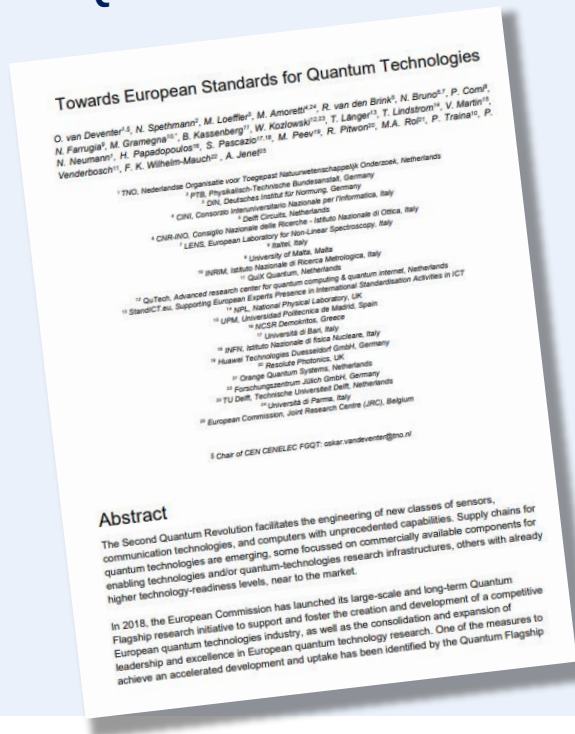
The consensus modularity maps on Dutch products

- > 65 Experts
- > 180 contributions
- Coordination with Quantum Flagship, ITU, ISO, ETSI, QuIC
- Key positions for the Netherlands
- Quantum standardization event in May 2022

Relevance for the Dutch ecosystem

Leading position in standardization (2/2)

Paper in EPJ Quantum on standardization



Towards European Standards for Quantum Technologies

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² PTB, Physikalisch-Technische Bundesanstalt, Germany

³ DIN, Deutsches Institut für Normung, Germany

⁴ CINI, Consorzio Interuniversitario Nazionale per l'Informatica, Italy

⁵ Delft Circuits, Netherlands

⁶ CNR-INO, Consiglio Nazionale delle Ricerche - Istituto Nazionale di Ottica, Italy

⁷ LENS, European Laboratory for Non-Linear Spectroscopy, Italy

⁸ Italtel, Italy

⁹ University of Malta, Malta

¹⁰ INRIM, Istituto Nazionale di Ricerca Metrologica, Italy

¹¹ QuIX Quantum, Netherlands

¹² QuTech, Advanced research center for quantum computing & quantum internet, Netherlands

¹³ StandICT.eu, Supporting European Experts Presence in International Standardisation Activities in ICT

¹⁴ NPL, National Physical Laboratory, UK

¹⁵ UPM, Universidad Politécnica de Madrid, Spain

¹⁶ NCSR Demokritos, Greece

¹⁷ Università di Bari, Italy

¹⁸ INFN, Istituto Nazionale di fisica Nucleare, Italy

¹⁹ Huawei Technologies Duesseldorf GmbH, Germany

²⁰ Resolute Photonics, UK

²¹ Orange Quantum Systems, Netherlands

²² Forschungszentrum Jülich GmbH, Germany

²³ TU Delft, Technische Universiteit Delft, Netherlands

²⁴ Università di Parma, Italy

²⁵ European Commission, Joint Research Centre (JRC), Belgium

Relevance for the Dutch ecosystem

Leading position in standardization (2/2)

Paper in EPJ

4.7 INRIM: quantum metrology

INRIM [76] is a public realises, maintains, and the International System on both a national and

The INRIM Quantum application between quantum electronics enhanced imaging, initiatives at National, EMPIR normative project quantum fibre-optic based Quantum Communications Flagship.

INRIM is one of the (EMN-Q) [51], [53], founder member of coordinated.

supported by full scale of additional, quantum

4.5 Huawei Technologies Duesseldorf: advanced CV-QKD

prototypes

4.10 Italtel: QKD for secure communications

Italtel [85] is a

4.12 Universidad Politécnica de Madrid: quantum networking

Universidad Politécnica de Madrid (UPM, [87]) is the largest Spanish technological university. With two recognitions as Campus of International Excellence, it is outstanding in its research activity together with its training of highly-qualified professionals. It is among the Spanish universities with the greatest research activity and first in the capture of external resources in a competitive regime. UPM signs around 600 contracts with private businesses annually, due to its traditional and close relationship with the industrial and business sectors in all Engineering fields.

Due to its industrial and tech transfer activities, UPM has been involved in QKD standardisation since the very beginning. It was a founding member of the ETSI Industry Specification Group on QKD in 2008, where it chaired (rapporteur) four approved specifications, mostly about quantum network interfaces. It has also participated in the ITU-T activities, both in the Study Group 13 on future networks and in the Focus Group for Quantum Information Technologies for Networks (FGQIT4N). Currently it also participates in the CEN-CENELEC FGQT and is part of the Quantum activities at UNE (the official Spanish Standardisation body). UPM also coordinates the National program on Quantum Communications.

... both directional and wavelength switching on demand, as well as dual optical polarisation and rapid FPGA-powered pre-processing. The 5 senders and 5 receivers are situated in 7 locations across two operator networks in Madrid, establish up to 25 links over significant distances and interoperate with optical equipment, encryptors and QKD devices of other providers.

generation. For such networks, indeed, the last steps of QKD, namely measurement of the "transmitted" state and the subsequent post-processing, are not needed.

Quantum Technologies

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Relevance for the Dutch ecosystem

More ambitions from the Netherlands

Ambition groeifonds and Quantum Delta NL



Standardization is key to reach these goals

Economic growth

1. Establish strong business position on quantum
 - 5 to 7 billion euros domestic product (GDP)
 - 30.000 Dutch jobs on quantum
2. Leading European knowledge cluster in 7 years
3. Creating a global market for Dutch quantum products thanks to agreed interworking and interfacing

Relevance for the Dutch ecosystem

Conclusions

1. Standardization is key for the Dutch quantum industry
2. We have a leading position within European standardization
 - Vision on the future
 - Consensus on Dutch view within CEN-CENELEC
 - Paper on quantum standardization, co-signed by 30 authors
3. Started with quantum computing, to be extended to other quantum technologies
 - Quantum communication
 - Quantum metrology/ sensors

We created the momentum

Now is the moment to intensify the Dutch leading position



Standaard voor
vooruitgang