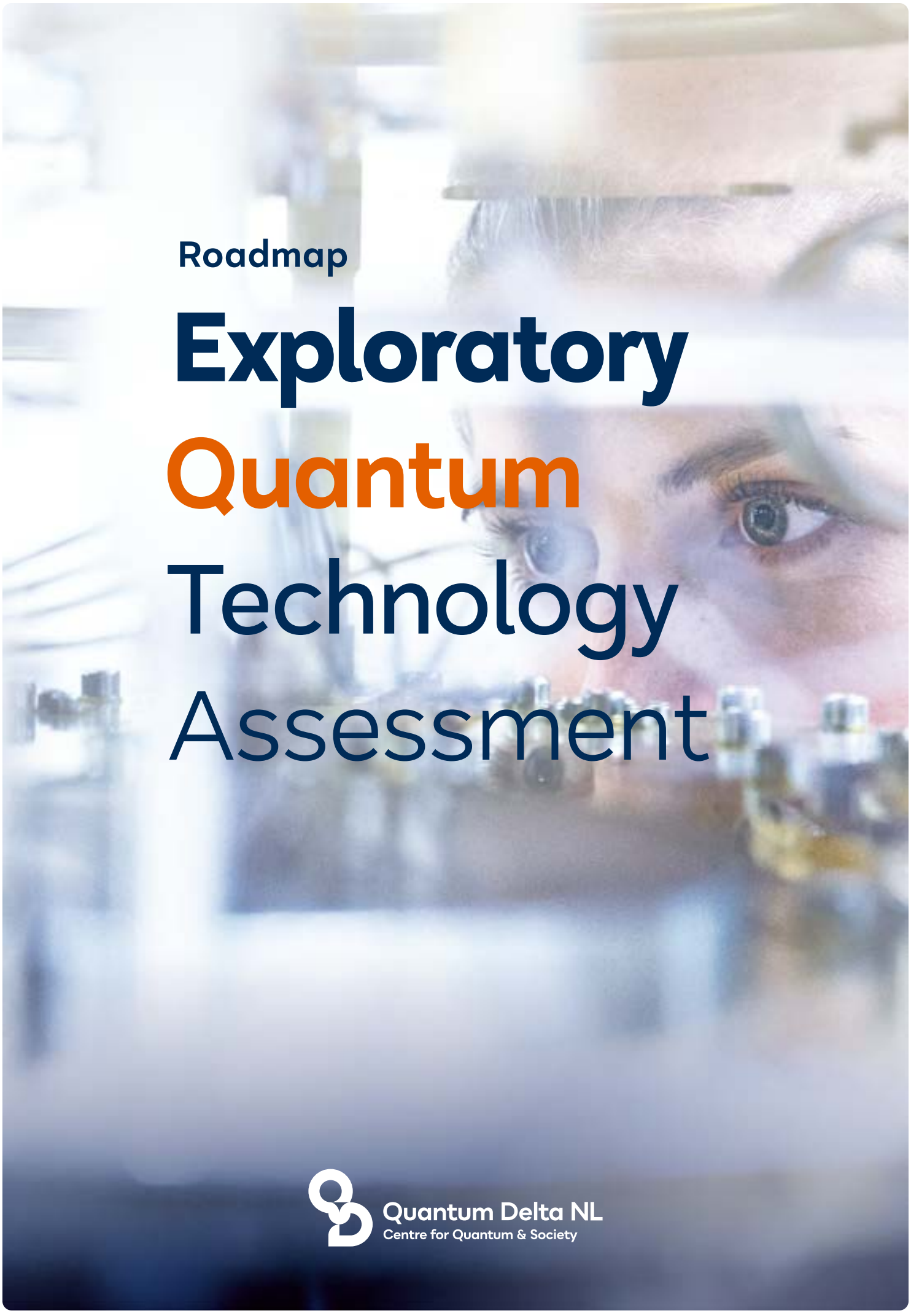


Roadmap

Exploratory Quantum Technology Assessment

Quantum Delta NL
Centre for Quantum & Society

Template
EQTA Roadmap

Going through this EQTA Roadmap is more than just collecting information to make a decision about the responsible application of quantum technology. It helps organizations think about where quantum technology can take them, whether that is desirable, how to gradually gain certainty about these ideas, and what needs to be done to realize that future.

The EQTA helps organizations understand which developments they need to follow in the field of quantum technology and whether and how they can initiate and steer these developments. Some organizations may decide that they need to gain experience with quantum technology. Others may decide that management, employees, and other stakeholders should learn and understand what quantum technology can mean for the organization and involve these groups actively in developing ideas. After completing the EQTA, organizations may start working together or make an effort to achieve standardization and develop ethical frameworks and regulations.

By going through the EQTA, organizations can better understand the impact of geopolitical developments for the application of quantum technology. They can ensure that education responds in a timely manner to the skills needed to use quantum technology or that service providers develop services that meet their requirements. The most important part of going through the EQTA may be the last step: the evaluation. This involves planning evaluation of the decision, when looking at the effect of the measures taken, and then planning further steps.

Quick scan and roadmap

QUICKSCAN

Quantum Technology exploration and timelines (page 89)

Explore Applications: examples of applications (page 75)

Describe impact on organization, opportunities, and potential threats (page 13)

Perform a **stakeholder analysis** (page 69)

Organize a dialogue to validate the description, develop, and decide if it is necessary to continue the EQTA (page 69)

Decide: is it necessary to continue to the full EQTA?

No / **Yes**

Document and justify the decision (page 71)

EXPLORATION

Step 1 **Explore the societal framework** (page 36)

- Communication, knowledge, imaging and myths
- Societal, organizational requirements to embed technology in society
- Stakeholders in and outside the organization
- Indepence of developments outside the organization

Step 2 **Explore technological frameworks** (page 48)

- Quality requirements for technology and cloud
- Technological requirements for safety, trust and data governance
- Requirements for futureproof investments and freedom of choice for innovation

Step 3 **Explore legal and ethical frameworks** (page 54)

- Applicable legal frameworks
- Ethical frameworks

IN PRACTICE

Step 4 **Stakeholder dialogue** (page 69)

Develop approaches for (social) innovation with stakeholders based on relevant values

Step 5 **Balancing** (page 71)

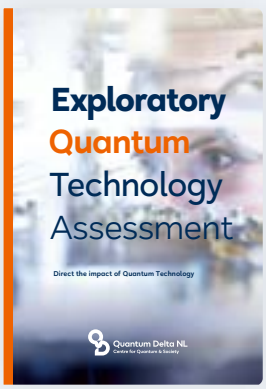
Compare approaches based on subsidiarity (are there alternatives?), proportionality (are the means and ends in proportion?) and necessity

Step 6 **Decision making and justification** (page 72)

Decide on the steps to be taken and justification

Step 7 **Feedback and evaluation** (page 72)

Set up processes to follow developments in a targeted manner and periodically evaluate the decision



Exploratory Quantum Technology Assessment

This Roadmap is part of the Exploratory Quantum Technology Assessment (EQTA), developed on behalf of Quantum Delta Netherlands, with the help of a working group of experts and stakeholders guided by ECP | Platform for the Information Society. The page numbers refer to the explanation in the full EQTA.

Download the full EQTA on quantumdelta.nl or scan the QR-Code.

Quick Scan

Quantum Technology exploration and timelines.

Explore how quantum technology will play a role in your organization's sector or domain. What changes for your organization when other organizations start using quantum technology? How long does it take for products to reach the market?

Explore Applications: examples of applications.

Which applications of quantum technology are important for your organization? Or are there threats that your organization needs to take into account?

Describe impact on organization, opportunities, and potential threats.

Who within and outside the organization will be affected by the application of quantum technology (employees on the shop floor, management, customers or partners, regulators)? What expertise is needed to assess and manage that impact?

Organize a dialog to validate and develop the insights.

In a dialogue with stakeholders (who experience the impact) and experts, test and enrich ideas about the application of quantum technology, the opportunities it offers, and its impact. Discuss what the organization needs to do to seize these opportunities and manage their consequences.

Decide: is it necessary to continue to the full EQTA?

Based on the results of the dialogue, determine if further analysis is required to realize the opportunities and to mitigate the risks.

- ☐ **Yes**, further analysis is required. Continue to Step 1.
- ☐ **No**, additional analysis is not required. Record and account for the decision. If the EQTA is not continued, establish which developments or at what point in time the decision and its underlying assumptions will be reassessed.

Exploration

Step 1. Explore the societal framework

Communication, knowledge, perceptions and myths.

What are the perceptions surrounding quantum technology?

Auxiliary questions: What ideas exist inside and outside the organization about quantum technology and how might that affect the intended application? Which groups or individuals should be able to participate in the application? What do they need to know?

Social and organizational conditions for succesful embedding of technology.

In a dialogue with stakeholders (affected by its impact) and experts, evaluate and expand upon ideas regarding the implementation of quantum technology, its potential benefits, and its impact. Discuss the actions the organization must take to capitalize on these opportunities and mitigate any consequence.

Stakeholders in and outside the organization.

Who are the stakeholders. Who are affected by the impact of the application?

Auxiliary questions: Who will be 'impacted' by the application and how? How can these groups be involved in development, implementation and evaluation?

Depence on developments outside the organization.

What is the international context?

Auxiliary questions: which international players are involved in the proposed implementation? What potential dependencies could arise (such as issues of sovereignty)? Do foreign entities have access to the implementation? What are the potential implications of this?

Step 2. Explore technological frameworks

Quality Requirements.

What standard quality criteria must the technology meet to attain the stated objectives and advantages? Consider factors such as functionality, sustainability (in terms of materials and energy consumption), reliability, maintainability, error resilience, flexibility, scalability, and transparency. Also take into account requirements for outsourcing the use of quantum technology through cloud and online services.

Technological requirements: safety, trust, data-governance.

What technical requirements should be imposed in relation to privacy, security, data, identity, authentication, and authorization?

Develop with stakeholders, experts and management possible approaches and timelines.

Which preconditions should be set on quantum technology to ensure future proof investments and freedom of choice for organizations in future?

Step 3. Explore legal and ethical frameworks

Legal Framework.

Which legal frameworks apply? Consider frameworks for human rights, privacy and data protection, good governance, intellectual property, quantum-specific legislation, and country-, sector-, and industry-specific frameworks.

Ethical frameworks.

What ethical frameworks are relevant? Take into account the 'quantum computing governance principles' established by the World Economic Forum, as well as ethical guidelines set forth by organizations such as the UN, IEEE (engineering), and OECD. What principles and values does your organization uphold?

Make these general principles and premises as specific as possible in light of the proposed application and its objectives.

In practice

Step 4. Stakeholder dialogue

Develop with stakeholders, experts and management possible approaches and timelines.

Incorporate the key considerations identified in the previous three steps (from various perspectives including societal, technical, organizational, legal, and ethical) by developing potential approaches through dialogue with the organization's management and leadership, future users, those impacted by the implementation, and experts (such as technicians, lawyers, ethicists, and social issue specialists). Discuss the effects of each approach, the underlying values at stake, and the implications for technology, the organizational environment, and people/users.

Step 5. Balancing

Compare approaches.

Compare the described approaches in terms of subsidiarity (what are the alternatives with the least impact), proportionality (are the means in proportion to the goal) and necessity. Document the analysis.

Step 6. Decision making and justification

Decision on steps to be taken and on accountability.

Document the choice, the steps to be taken and justify both.

Step 7. Feedback and evaluation

Establish processes to track developments in a focused way and evaluate the decision on a regular basis.

Implement procedures to consistently assess the decision, ensure the objectives of the steps are being met, verify the assumptions, and react appropriately to new developments.

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