Implications and Social Impact of Quantum Computers:

Analysis and Reflection Activity

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I SEE

It's your time to imagine the futures

The Quantum Manifesto

- 2016 document presented to the European Commission by a team of European scientists and entrepreneurs.

- How competitive is the EU in the context of research in quantum technologies?

The Quantum Manifesto

"Europe needs strategic investment now in order to lead the second quantum revolution."
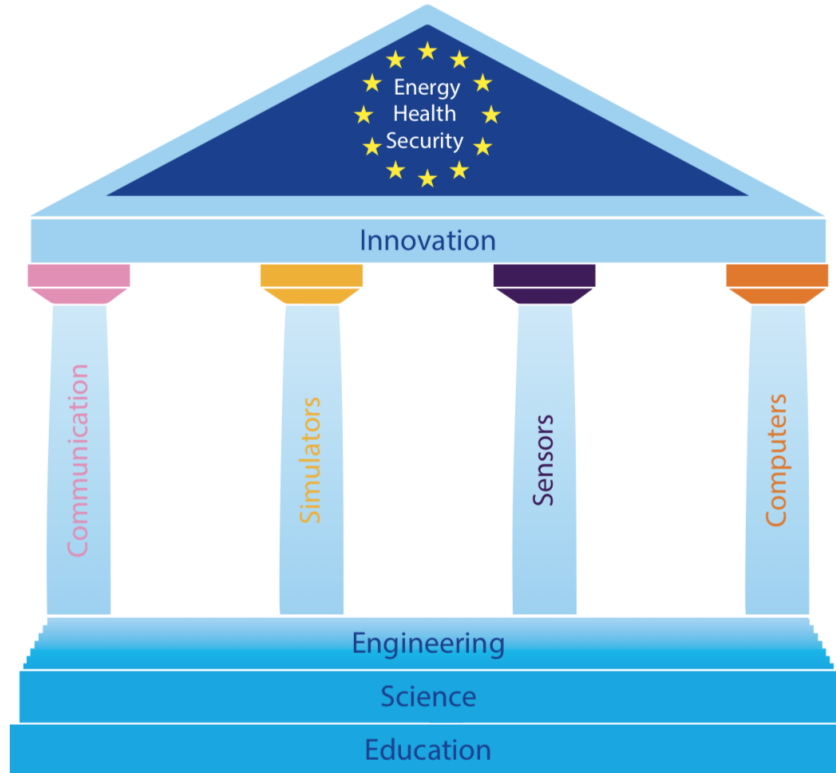
Two fundamental consequences:

- Lots of expectations for what quantum technologies will be able to produce;

- Lots of implications for the society.

Wide-ranging objectives

Quantum Manifesto

Communication

Simulators

Quantum
Computers

Sensors

The worksheets

- Based on the analysis of documentation such as institutional reports and scientific literature.

| Scientific & Technological Research | Communication | Society | Politics |

QC & Society

Some definitions:

- **Quantum optimisation:** a branch of quantum technologies that tries to improve already existing machine-learning algorithms for obtaining new solutions, not only thanks to the fastest computational speed of QCs but also thanks to the qubit-like, substantially different from the classical bit-like one. The techniques for optimising machine-learning algorithms are called "quantum annealing techniques".

Optimisation has various applications in different fields, not only in the scientific and engineering ones. It is predicted that the massive use of such algorithms, robotics and machine learning will radically modify the way the intend jobs and industry today.

The mechanical, manual and computing professions could be given to machines, leaving creative and coordinating jobs to humans. It is the so-called "Industry 4.0": will the quantum computer accelerate its arrival?

Some examples:

- **Traffic optimisation:** Volkswagen, in collaboration with D-Wave Systems— a company specialised in quantum technology— is studying a way to predict the places of a city where traffic congestions are more probable, in order to direct cars to other free streets. This requires the analysis of a dataset that is so huge no supercomputer can actually handle it.
- **Optimisation for medicine:** a clinic in the US made a collaboration with D-Wave for developing algorithm that can optimise the current techniques that determine the optimal dosage of radiations for a patient in radiotherapy. This depends on the kind of cancer, its stadium, and the clinical characteristics of the patient.

- **Optimisation of online advertisements:** Recruit Communications, a human resources company, has developed an optimisation algorithm that matches consumers with proper advertisements and allows companies using online ads to increase their CTR (Click-through-rate), which is the ratio between the number of times a consumer clicks on the ad and the number of times the ad appears on a website. This is one of the rates that most influences how much the provider of a website is paid by the company that wants its advertisements to be published online.

Links	Descriptions
https://ai.google/research/teams/applied-science/quantum-ai/	Google AI website with research areas in Quantum AI and short-term applications
https://qz.com/1323987/quantum-computing-could-put-a-stop-to-traffic-jams/	Article explaining the principle behind the traffic optimisation
https://media.vw.com/en-us/releases/1098	Press release by Volkswagen
https://www.dwavesys.com/sites/default/files/VW.pdf	Slides explaining in detail the algorithm for traffic optimisation
https://www.dwavesys.com/sites/default/files/Radiotheraphy-Optimization-Roswell-Park_0.pdf	Slides on the optimisation in the field of radiotherapy
https://www.dwavesys.com/press-releases/recruit-communications-and-d-wave-collaborate-apply-quantum-computing-marketing	Press release by D-Wave on the Recruit Communications algorithm for optimisation of online ads
https://www.dwavesys.com/sites/default/files/RCO_0_0.pdf	Slides on the algorithm for advertising
https://qt.eu/app/uploads/2018/04/93056_Quantum-Manifesto_WEB.pdf	Quantum Manifesto

Teams

Scientific & Technological Research	Communication	Society	Politics

Activity

1. Read the map and explore together the worksheets and the links within them.

2. Select from the worksheets and the links the information that refers to possible implications of quantum technologies.

3. Represent the found connections between quantum computers and the aspects by drawing arrows and, if necessary, by adding new aspects in the blank spaces.

4. Confront each other and discuss on the map, trying to imagine and to build new possible futures;

5. Choose the way you prefer for speaking about the results of your own analyses and prepare for expressing your ideas and opinions in front of the whole class during the third day.

It's your time to imagine the futures

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