

OQI Use Case Development

Alex Bernasconi, Philipp Kammerlander



An initiative hosted by CERN, born at GESDA, supported by UBS

Agenda – Session 2

In the next weeks, OQI will be at the center of attention in this course.

- story
- goals
- activities
- deep dives

25th February

Introduction to GESDA and OQI

Philipp Kammerlander

4th March

SDG-focused quantum
computing use case development
at OQI

Alex Bernasconi
Philipp Kammerlander

18th March

Quantum Diplomacy Game

Audrey Himmer
Philippe Caroff
and more

Strategic Pillars of the Open Quantum Institute



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



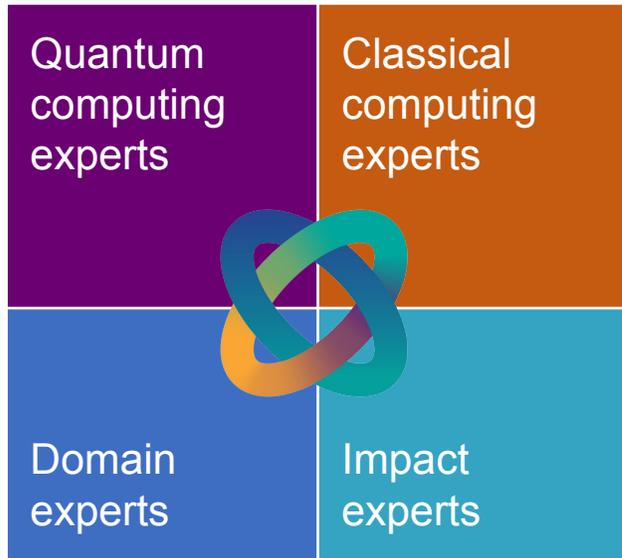


OQI
Open Quantum
Institute

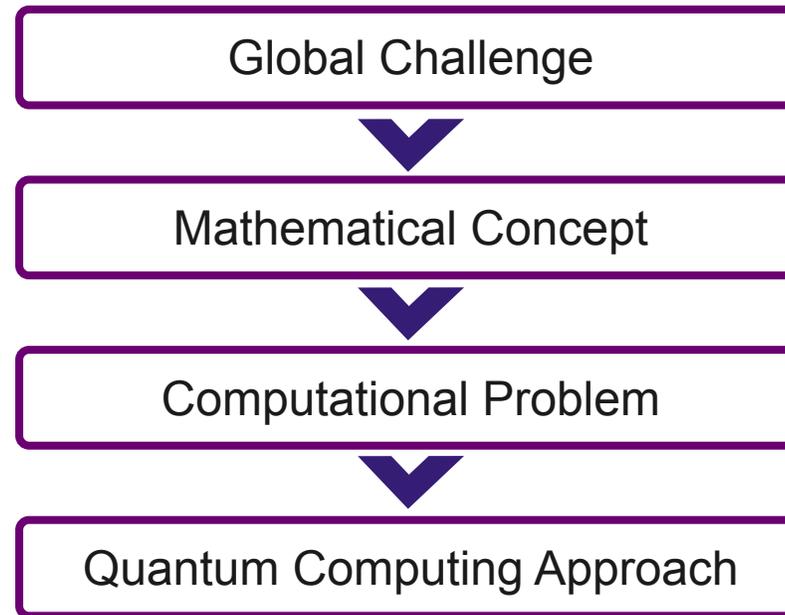
A1: Use Cases



From ideation to proof of concept

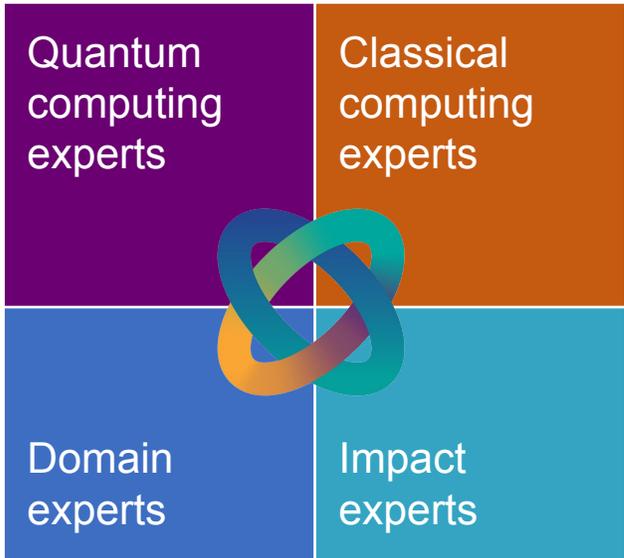


Multidisciplinary

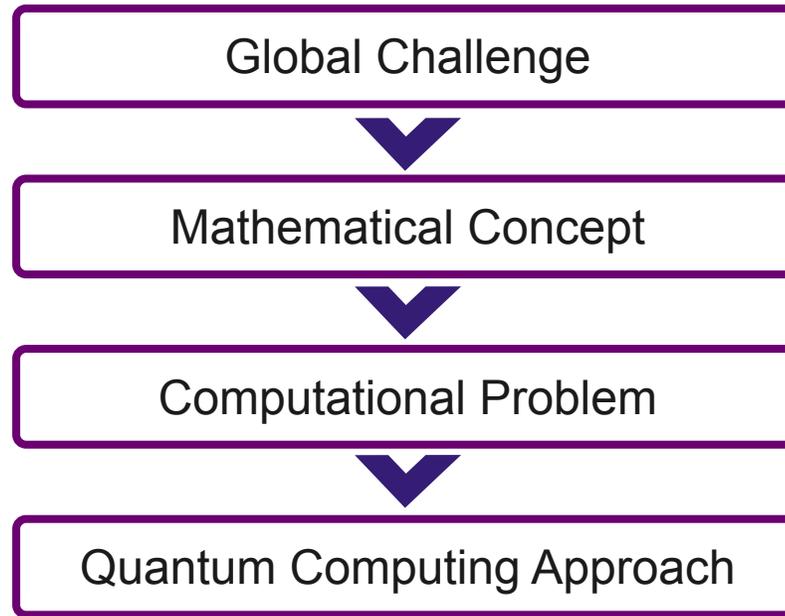


Pathway to Impact
- people
- planet
- prosperity

From ideation to proof of concept

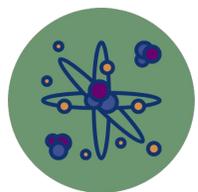


Multidisciplinarity

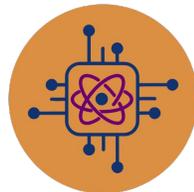


Pathway to Impact

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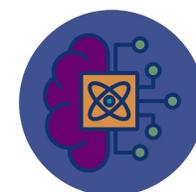
Quantum simulation



Optimisation



Systems of Eqns. and PDEs



Machine Learning

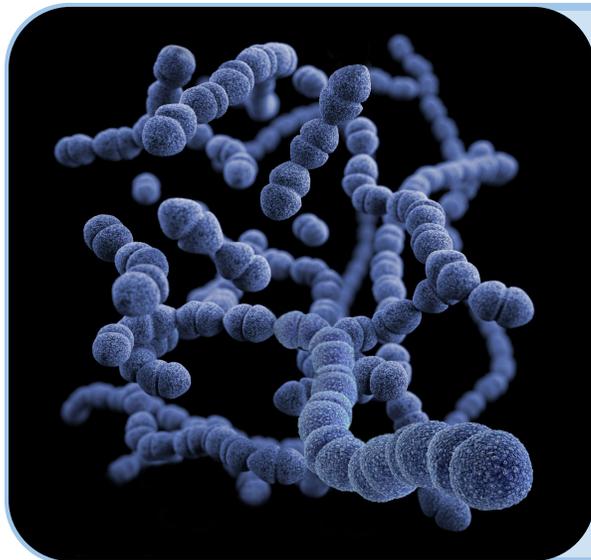
How can you ensure the impact of a Use Case?

Theory of Change: A strategic tool that maps how a solution leads to long-term impact through causal linkages.

- How and why a desired change is expected to happen in a particular context?
- We know the long-term impact we want to achieve and the activities we do today, but how do we bridge the missing middle?



Accelerating Novel Antimicrobial Discovery



Use Case Team:



McMaster
University  qBraid

 GARDP

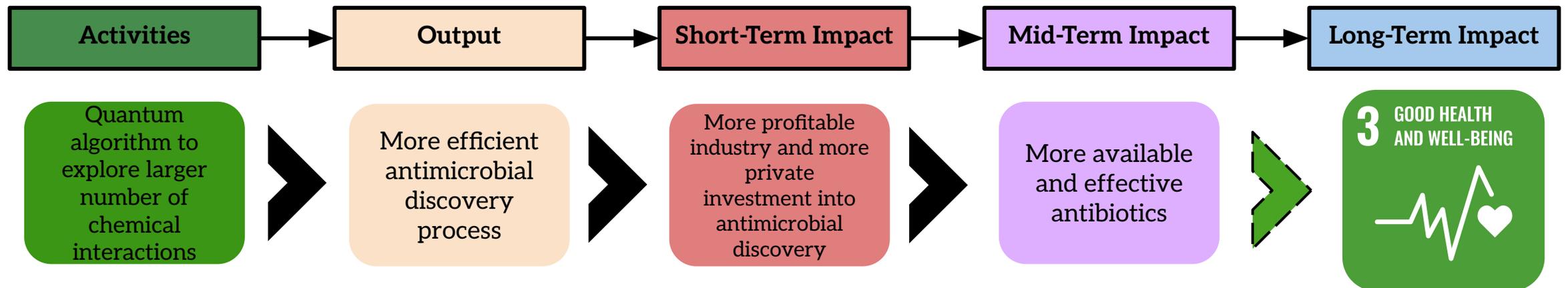
Global Antibiotic Research & Development Partnership

Team Origins:



Quantum Approach: Machine Learning (QRC)

- Antimicrobial resistance is considered to be one of the largest threats to global public health by the WHO.
- Due to a lack of profitability, promising antibiotics failing to reach market due to lack of investment from pharmaceutical companies.
- Quantum computing to explore a larger number of chemical interactions more effectively, improving ability to produce affordable antibiotics.



Sustainable Food Production



Use Case Team: **EPFL**  Stellenbosch
UNIVERSITY
IYUNIVESITHI
UNIVERSITEIT

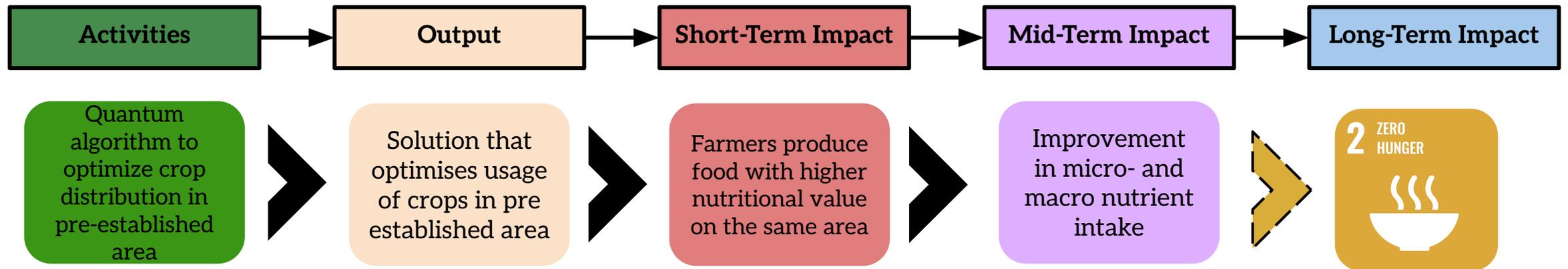
NITheCS  **gain**
National Institute for
Theoretical and Computational Sciences Global Alliance for
Improved Nutrition

Origin of contributors:



Quantum Approach: Optimisation

- Climate change adversely affects yields and nutritional quality of major staple crops, raising the risk of food insecurity and malnutrition.
- Quantum computing solution that optimises the usage of different crops in a pre-established area to maximise nutritional value & density, affordability, sustainability and minimize environmental impact



Use case development and support from OQI

Ongoing support from OQI to interdisciplinary collaboration teams, through pairings with quantum, domain and SDG experts

Ideation

Proof of Concept



Phase 0

Submit ideas for use cases with an SDG focus



Phase 1

Outline of project (3-5 page abstract)



Phase 2

Describe the model for a proof of concept



Phase 3

Proof of concept implemented on quantum simulator



Phase 4

Proof of concept implemented on quantum processor

Review by OQI team

Review by OQI team and ad-hoc experts

Impact and scientific reviews by expert panel

Impact and scientific reviews by expert panel

Your Turn – Develop Your Own Idea

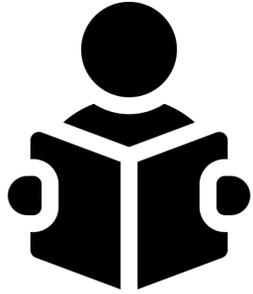
Form teams of 2-4 people.

For the next 30 minutes, please:

- Think about:
 - A **global challenge**
 - An associated **mathematical concept and computational problem**
 - How a **quantum computing approach** that may help to achieve a more accurate, faster, better solution (determine the relevant metrics)
 - How your solution would **lead to meaningful impact** on the global challenge
- Prepare a 5 minutes pitch for your idea (with or without slides or other supporting material)

Please take breaks individually.





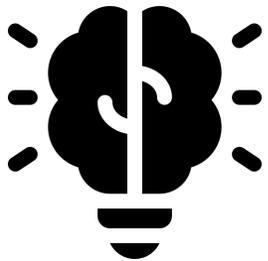
It's not easy!

Developing quantum computing applications that could be beneficial to SDGs is a challenge to many researchers and developers.



Collaboration is key

It requires interdisciplinary teams to work together, from quantum engineers to domain and SDG experts, in order to make sure the proposed solution serves its purpose.

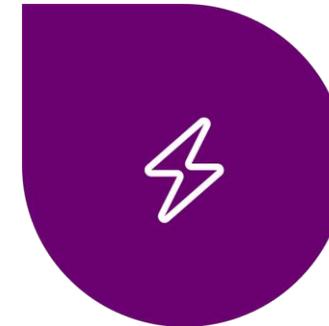


Keep the impact in mind!

It is part of the responsibility of a quantum engineer to be aware of the impact their solution can have and design it in a way that is most beneficial to humanity.



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