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Quantum Computing in Canada: An Update

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Problem

A research study completed in 2020 found that over a third of companies abandoned projects since 2017 given their complexity despite 97% believing that complex problem-solving is either very important or critical

451 Research - Insight in the age of digital disruption

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Quantum Computing - Significance

Harnesses microscopic properties to consider many solutions to a problem simultaneously

Can solve problems that are beyond the capabilities of classical computers

A quantum computer was shown to complete a computation in 200 seconds that would've taken 2.5 billion years using a supercomputer

(Dec 2020, The Chinese Academy of Sciences Center for Excellence in Quantum Information and Quantum Physics)

Sectors such as Material Science, Cryptology, Pharmaceutical Development, Sensing, and Artificial Intelligence will be transformed

(2020). DOI: 10.1126/science.abe8770
https://medium.com/the-21st-century/chinese-lead-in-quantum-computation-claiming-quantum-supremacy-9a3b33437403

Quantum Computing – Global Efforts

Global effort 2021 is estimated to be $24.1b

Canadian Institute for Advanced Research
https://www.qureca.com/overview-on-quantum-initiatives-worldwide-update-mid-2021/

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Current State (1)

- **Current QC are Noisy Intermediate-Scale Quantum (“NISQ”) computers with less than 200 qubits**
- **Algorithms with provable performance advantages require fault-tolerant QC which requires millions of physical qubits**
- **Recent heuristic-based quantum algorithms that have the potential to run on NISQ computers have been developed but the performance advantage is unknown. Potential use cases include:**
  - **Optimization problems,**
  - **Simulation of physical systems**
  - **Drug design,**
  - **Advanced material design, …**

Current State (2)

- **Commercial QC systems available through cloud services**
- **Great interest in industry for identifying the potential of NISQ computers**
- **Exploring new algorithms/applications is crucial to harnessing the technology's potential as HW scales towards fault-tolerance**

Areas of Research

1. **Algorithms/Applications -** optimization, machine learning, differential equations, graph theory, …

2. **Simulations -** drug design, carbon capture, advanced materials, clean fuels, **...**

3. **Architecture -** mathematical modeling (problem formulation), error correction, compiling, ...

The Canadian Quantum Computing Ecosystem

Canada is home to some of the most promising QC providers

Canada has one of the largest number of quantum applications startups

Not For Profit Organizations driving the QC ecosystem

- **BC: The Quantum Algorithms Institute, Quantum BC, PIMS, Innovate BC, Digital Supercluster, DigiBC, SFU Innovates, ..**
- **Quebec: Quebec Quantique, PINQ2, Calcul Quebec**
- **Alberta: Quantum City, AMII**
- **Ontario: Institute for Quantum Computing, Perimeter Institute, FIELDS Institute, VECTOR,..**
- **Quantum Industry Canada, NRC, Mitacs, CMC Microsystems, SOSCIP, ..**

Academic institutes

- **UBC, SFU, UVic, Sherbrook, Waterloo, UCalgary, UoT, ..**

QAI - Overview

- **Focused on Quantum Applications Development**
- **Links Industry End-users, Providers, Academia, Government, and other organizations through *a de-risked and clearly defined process***
- **QAI offers :**
  - **Academic and Industry Affiliates**
  - **Subsidized HW support through industry members and not for profit partners (e.g., CMC)**
  - **Expertise in quantum computing**
  - **Independent benchmarking – Not for Profit**
  - **Flexible Funding Models**

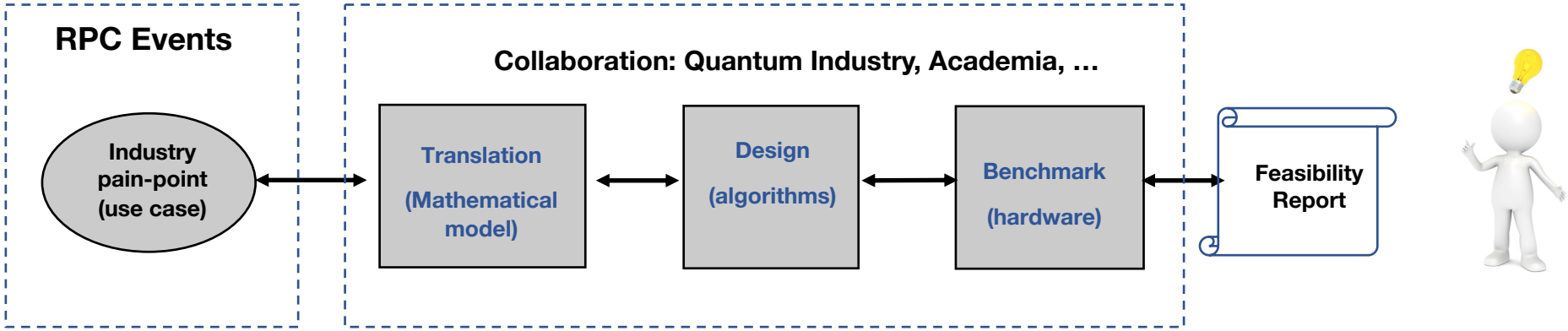
QAI - Goals

Developing talent/workforce

Developing the ecosystem: Commercialization that guides R&D efforts

QAI - De-risking Quantum Computing Exploration

De-risking = Funding , Subsidized Access to HW, Access to Expertise , Connecting to Partners , Feasibility Study



6–8 month proof of concept study

- If the result of the report are promising : Signing a contract with client
- Valuable inputs will be shared with quantum providers (software and hardware to improve), and end-users
- Either way ideal team has been trained (both from academic to industry) and from classical to quantum – increasing hiring pool

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QAI - Revers Pitch Challenge Events

- **Potential end-users pitch their pain points**
- **Industry providers and academia propose solutions and collaborations**
- **Experts panel to choose projects that will go forward**
- **Resulting projects are supported through several initiatives that include funding and subsidized hardware access**

QAI - RPC Format

Periodic occurrences

First event - Sept 12, 2022

Virtual and in person participation

Open to all industries to pitch (later RPC will be focused on specific sectors)

QAI facilitates match making and team creation

Final Thoughts

We would love to see you at the RPC!

We look forward to collaborating with and supporting Triumf