Nordic-Estonian Quantum Computing e-Infrastructure Quest

Industrial Perspectives on Quantum Computing: Insights from a Survey

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NordIQuEst is a project of the Nordic e-Infrastructure Collaboration (NeIC).
NeIC is an organisational unit under NordForsk.

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Abstract

This report presents the results of the NordIQuEst WP1 Questionnaire, which surveyed industry professionals on their involvement in quantum computing, the tools and resources they use, and their perspectives on business applications. The findings indicate that most participants work in software development, followed by hardware and strategic roles. The majority rely on Qiskit, with other tools like Pennylane, QIBO, and AWS Braket also in use. Computing resources range from personal computers (90%) to cloud computing (63%). Most respondents (80%) employ computational modeling, particularly in logistics, fluid dynamics, and quantum system simulations. Additionally, 84% highlight the need for easy setup and access to quantum computing for business evaluation. While 16 out of 19 participants have used real quantum computers, concerns remain about their current practical applications. Notably, over half of the participants were unaware of the NordIQuEst project before the survey. The findings emphasize the need for improved access, clearer guidance, and increased awareness of quantum computing initiatives.

Introduction

Quantum computing is an emerging technology with the potential to revolutionize various industries by enabling complex computations beyond the capabilities of classical computers. The NordIQuEst project, part of the Nordic e-Infrastructure Collaboration (NeIC), aims to support the development and adoption of quantum computing within Northern Europe and beyond.

As part of Work Package 1 (WP1), a questionnaire was conducted to assess the current landscape of quantum computing involvement among industry professionals, including their use of quantum tools, computing resources, and perspectives on business applications. The survey also explored the challenges faced in evaluating the business value of quantum computing and the level of awareness about the NordIQuEst initiative.

This report presents the key findings from the questionnaire, highlighting the role of quantum computing in various business sectors, the tools and resources used, and the perceived importance of quantum simulators and hardware. The results provide valuable insights into existing barriers and potential opportunities for fostering further adoption of quantum computing technologies.

Results

Figure 1

In our survey, 18 out of 19 participants reported that their businesses in the industry are involved in quantum computing.

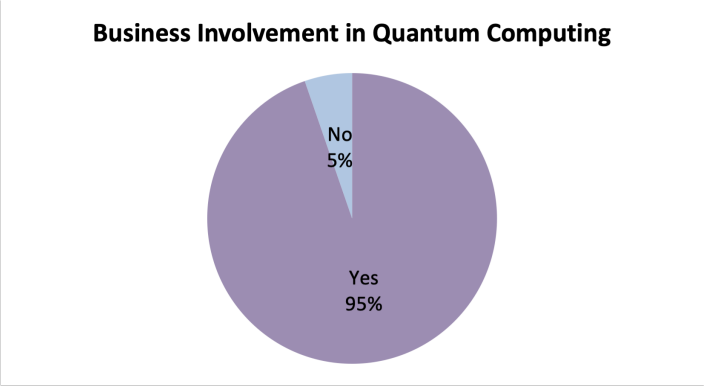

Figure 1: "Is your business involved in quantum computing in any way?"

Figure 2 and Figure 3

Among participants involved in quantum computing, some of them work in multiple domains. The majority focus on developing software related to quantum computing, followed by working in hardware and strategic/business. Some also focus on evaluating business use cases. Among all respondents, two work in policy advisory and research topics, respectively.

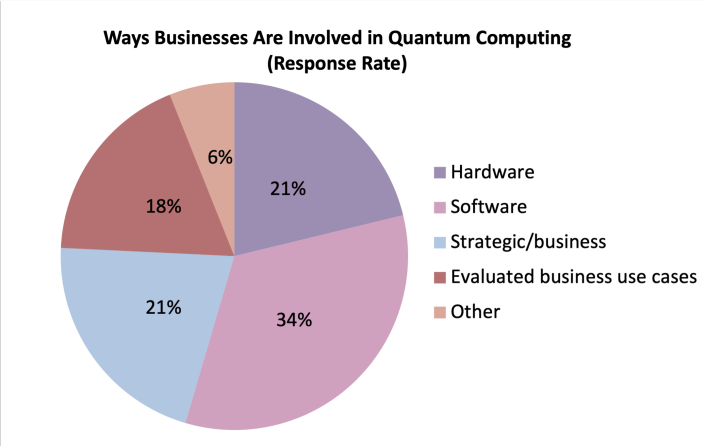

Figure 2: Response Rate for "In which ways are your businesses involved in quantum computing?"

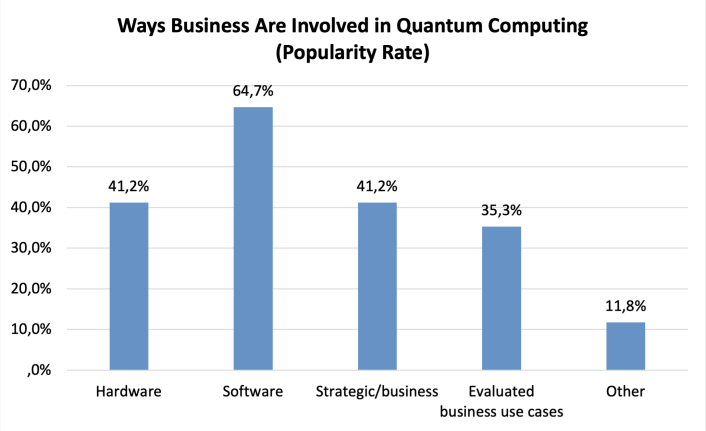

Figure 3: Popularity Rate for "In which ways are your businesses involved in quantum computing?"

Figure 4 and Figure 5

Among participants working in quantum computing, some have used multiple types of tools. The majority have experience with Qiskit, while others have used Pennylane. Additionally, participants mentioned various other tools for quantum computing, including QIBO, Qadptiva, D-Wave, Classiq Platform, CUDA-Q, TKET, AWS Braket, Qulacs, and Q#.

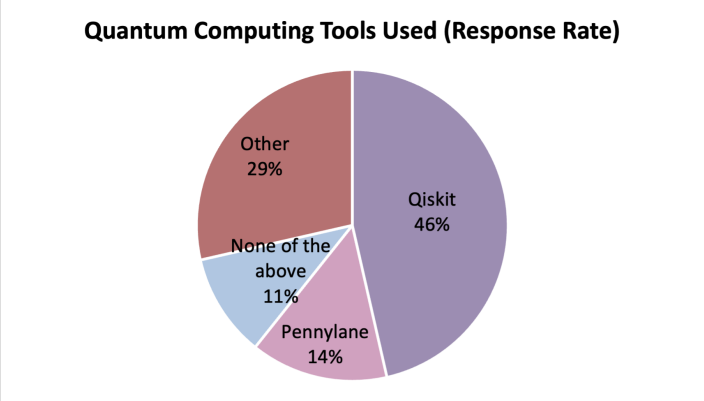

Figure 4: Response rate for "Which tools have you used before?"

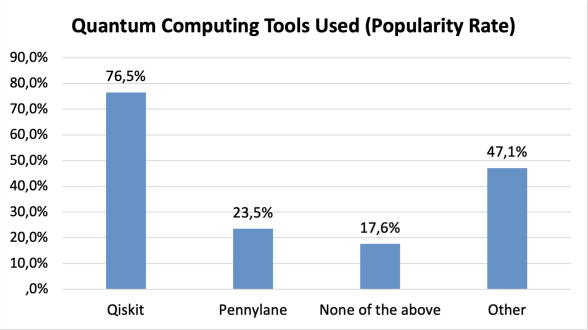

Figure 5: Popularity rate for "Which tools have you used before"

Figure 6 and Figure 7

This question gathers information about the types of computing resources used for work. It is evident that the majority of the participants (approximately 90%) rely on individual computers for their work. However, there is also significant demand for local computer clusters, cloud computing resources, and supercomputers, especially for cloud computing resources, which are used by 63% of participants.

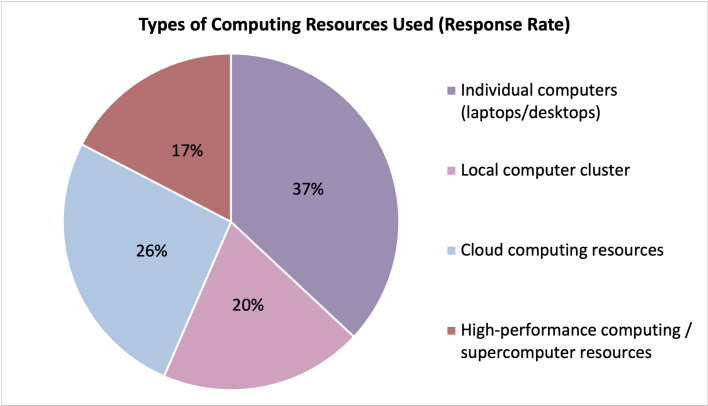

Figure 6: Response rate for "What kind of computing resources do you presently use?"

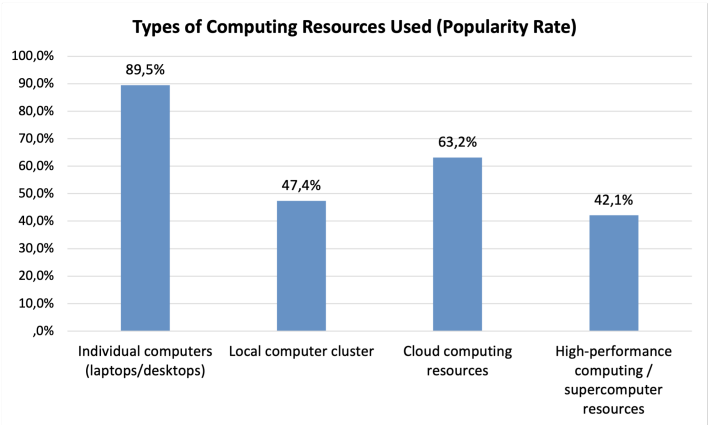

Figure 7: Popularity rate for "What kind of computing resources do you presently use?"

Figure 8

In this question, approximately 80% of the participants indicated that they currently use computational modeling in their company. Specifically, three participants reported performing logistics modeling, five performed computational fluid dynamics, four conducted materials modeling, and three worked on quantum system simulations. Additionally, some participants mentioned other types of modeling, including multiphysics modeling, price risk modeling, particle flow modeling, smart grid modeling, electromagnetic simulation, and modeling for the optimization of semiconductor process technologies and devices.

The majority of the modeling types mentioned are related to quantum computers. Additionally, participants mentioned other simulations that are also considered relevant to quantum computing, such as quantum chemistry simulations, biological system simulations, aerodynamics, combinatorial optimization, lattice models like Lattice-Boltzmann methods and Lattice-Gas Cellular Automaton, testing use cases for finance, and optimization problems (including combinatorial optimization).

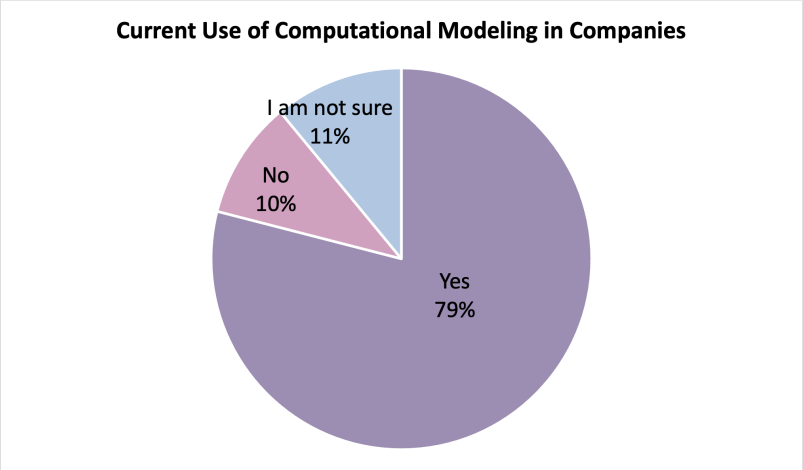

Figure 8: "Do you presently use computational modeling in your company?"

Figure 9

In this question, we ask about the experience of using a real quantum computer. It is clear that most of our participants have used real quantum computers before (16 of 19 participants). In detail, the participants mainly use the cloud service to access real quantum computers through the platforms of IBM quantum, D-Wave, Azure quantum from Microsoft, Amazon Braket, and Helmi. Additionally, four of the participants mentioned that they have on-site access to quantum computers at work. However, some of the participants never have a chance to access the real quantum computer.

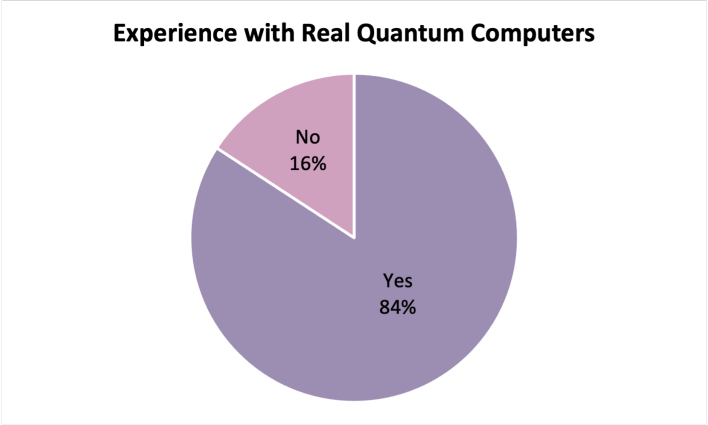

Figure 9: "Have you used a real quantum computer before?"

Figure 10 and Figure 11

The participants highlighted the importance of access to quantum simulators and quantum computers. Over half of them regarded quantum simulators as essential to their work, and the same was true for quantum hardware. A few participants, whose work is not directly related to either quantum simulators or hardware, expressed interest in exploring them for fun. Notably, none of the participants viewed quantum simulators or hardware as entirely useless. Here the participants reported the importance of access to quantum simulators and quantum computers. More than half of them considered quantum simulators vital for their work, and the same for quantum hardware. A few participants, whose work is not directly related to either quantum simulators or hardware, expressed interest in exploring them for fun. Notably, none of the participants think quantum simulators or hardware are useless at all.

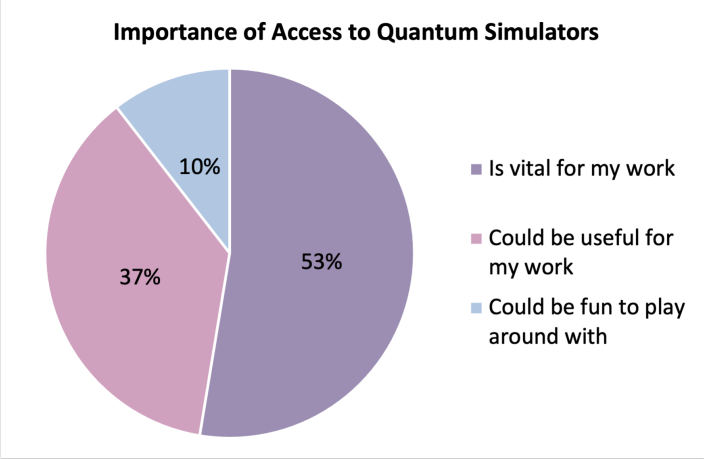

Figure 10: "How crucial is the access to quantum simulators for you?"

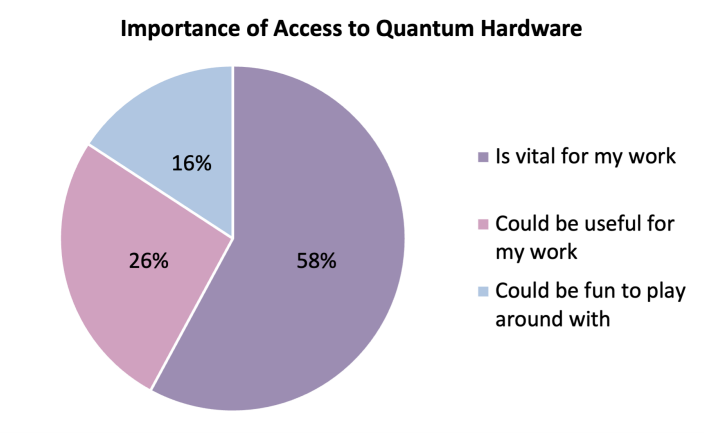

Figure 11: "How crucial is the access to quantum computers for you?"

Figure 12 and Figure 13

In this question, we ask about the purpose of using quantum hardware or software. Among the 19 participants, 16 indicated research as their main purpose. Additionally, 9 participants reported using quantum computing for workforce education. Other purposes mentioned by participants include:

- Testing and evaluating quantum algorithms on both quantum simulators and hardware
- Investigating real-world or industrial use cases implemented with quantum computers
- Providing quantum computing service
- Developing software or products related to quantum computing

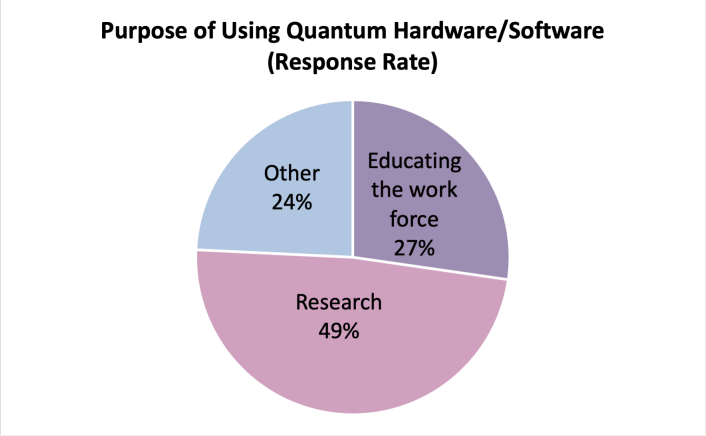

Figure 12: Response rate for "What is/would be the main purpose of using quantum hardware/software for you?"

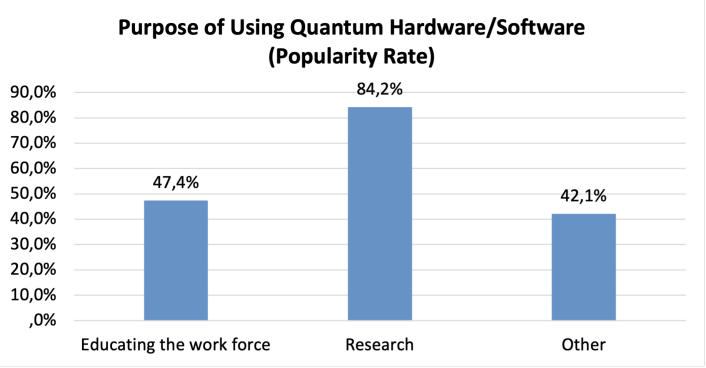

Figure 13: Popularity rate for "What is/would be the main purpose of using quantum hardware/software for you?"

Figure 14 and Figure 15

In this question, most participants (84%) emphasized the importance of easy setup and access to hardware or simulators for evaluating the business value of quantum computing. Additionally, 74% considered the collaborating with domain experts were beneficial, while 58% expressed the need for proper tutorials and clear guidance. In this survey, about half of the participants have heard about NordIQuEst project before.

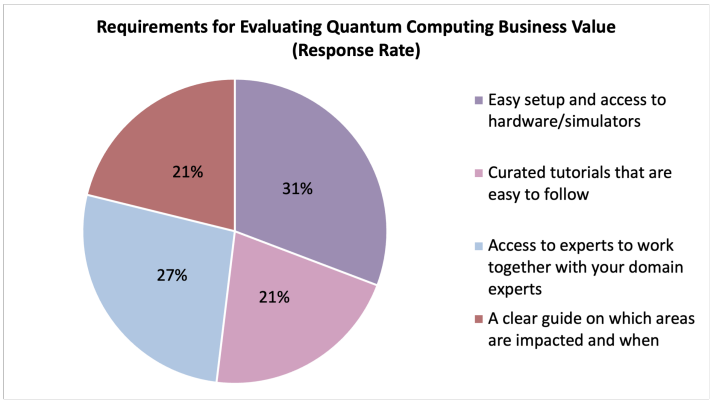

Figure 14: Response rate for "In order to get started with evaluating business value of quantum computing, what do you need?"

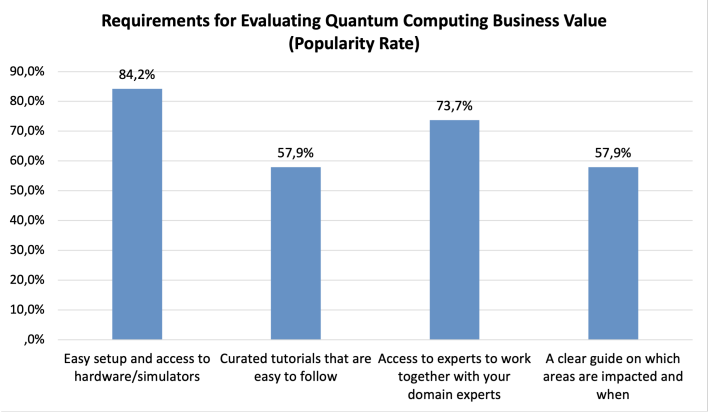

Figure 15: Popularity rate for"In order to get started with evaluating business value of quantum computing, what do you need?"

Figure 16

This question surveyed the participants' working locations in Northern Europe. Additionally, participants from other countries also took part in the survey, including Spain, Germany, the Netherlands, Slovenia, Israel, Switzerland, France, Ireland, the United States, and Canada.

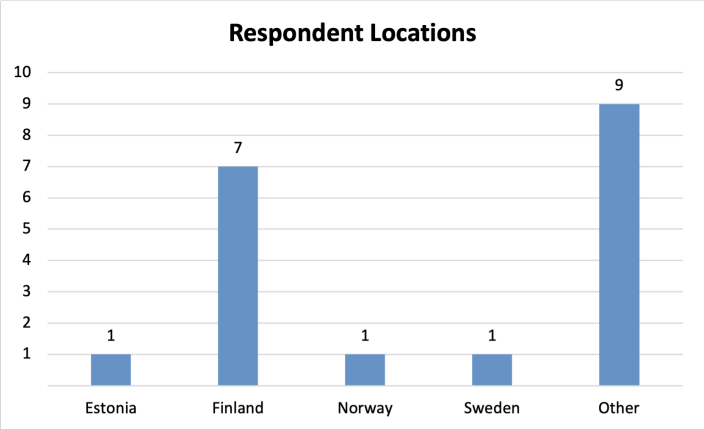

Figure 16: "In which country are you currently working?"

Figure 17

In this survey, more than half of the participants have never heard about the NordIQuEst project before.

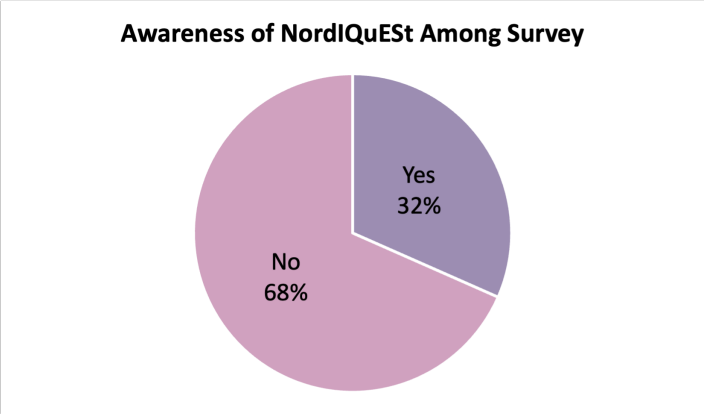

Figure 17: "Did you hear about NordIQuEst before you received this questionnaire?"

Conclusions and next steps

The results of the survey reveal a strong engagement with quantum computing among participants, with a focus on software development and research applications. However, several challenges remain, including accessibility, practical business evaluation, and the need for educational resources. The findings suggest that to accelerate industry adoption, future efforts should prioritize:

- Simplifying access to quantum hardware and simulators.
- Strengthening collaboration between businesses and domain experts.
- Developing comprehensive educational materials and tutorials.
- Increasing awareness of initiatives like NordIQuEst to enhance engagement.

Going forward, the project should focus on addressing these challenges to facilitate broader industry adoption and practical application of quantum computing technologies.