ATARC

WHITEPAPER

Quantum Technologies for Building the Quantum-Ready Workforce

Disclaimer: This white paper was prepared by the ATARC Quantum Working Group members in their personal capacity. The opinions expressed do not reflect any specific individual nor any organization or agency they are affiliated. This white paper is intended to be a helpful guidance relating to current quantum technological capabilities.

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Executive Summary

Quantum technologies have been deemed a critical technology for the U.S. and the world at large. Talent is the core pillar of bleeding-edge fields, such as quantum. In fact, in the U.S., a major component of the National Quantum Initiative (NQI) Act passed in December 2018 focused on, "enabling people by building the necessary talent pathways and ensuring that quantum information science creates new opportunities for all Americans."[1] During the first years of the NQI, government agencies were tasked with investing in activities to build a robust technology workforce pipeline. The strategy for creating a quantum-smart workforce is detailed in the Quantum Information Science and Technology (QIST) Workforce Development National Strategic Plan[2], which includes four focus areas:

1. Understand the short-term and long-term needs of the workforce.
2. Educate broader audiences on quantum through public outreach and educational materials.
3. Identify and address workforce gaps in professional education and training opportunities.
4. Make careers in QIST and related fields more accessible.

While some of these efforts have begun, there are still gaps in meeting the needs of the quantum workforce, both those who will work in the industry and those who will be end users of the technology. Different skills need to be mapped against available training programs as part of the steps in understanding critical learning and application gaps. Actions on workforce development have also been slow and focused on long-term needs. Therefore, there is still a need for a concentrated effort to accelerate upskilling and re-skilling programs where appropriate to address near-term requirements. Lastly, the skills needed may differ when looking at different types of quantum technologies (computing, sensing, communication, and networking. In this regard, a true objective assessment has not occurred.

This white paper aims to (a) identify global efforts for talent development, (b) identify high-level gaps in U.S. programs, and (c) provide recommendations to develop a quantum-ready workforce.

The Quantum Workforce and Future Needs

As highlighted in Demystifying the Capabilities of Quantum Technologies Available Today and in the Future: A Compilation of White Papers[3], quantum technologies are not a single, monolithic technology. In fact, each section of the industry has different types of technologies that are advancing at different rates. For compute, there are annealing and gate-model quantum computing systems with differing qubit architectures. Due to hardware advancements and cloud access, innovation in the software layer of quantum computing has been expedited, and new and novel algorithms are being developed. In quantum sensing, a variety of technologies are available, ranging from atomic clocks and inertial sensors (such as magnetometers and gyroscopes) to gravimeters and more. Within communications and networking, technologies can include advanced secure communication such as quantum key distribution (QKD), quantum random number generators, repeaters, and ultimately a quantum internet. The full list of different technologies within the fields of quantum can be found in the ATARC compilation of white papers.

Qureca, a global organization focused on educating and developing the necessary skills needed for quantum technologies, estimates that the exponential growth in quantum technologies will create nearly 600,000 new jobs per year by 2040.[4] For the US, while there is no official estimate of the size of the domestic quantum workforce, two regional tech hubs have published tallies. Colorado-based Elevate Quantum reports that approximately 3,000 workers in Colorado alone are currently employed in quantum technologies, and the number is expected to grow to around 30,000 by 2035. The Chicago-area Bloch Quantum estimates that more than 400 workers in the Chicago area are in quantum-related jobs, and the group projects a total of up to 191,000 jobs in the Illinois-Wisconsin-Indiana region in the next decade.[5] It is already challenging to fill existing roles, and the expected growth in the job market highlights the skills shortage, underscoring the need for implementing programs to address the near-term needs of the industry.

According to the GAO, Quantum Information Science Technology (QIST), "… is an umbrella [term] for the theory, science, engineering, technology, infrastructure, and applications related to exploiting quantum effects in the areas of computing, communication, and measurement and sensing."[6] Quantum systems will need different supply chains, including skills in optical engineering, which is needed for better interactions at the quantum level for lasers, quantum teleportation and secure communications and enhanced sensors. The skills needed for QIST may focus on quantum mechanics and physics, along with algorithm development, but some adjacent careers could benefit from adding quantum skill-building. For example, the need for cryogenics and engineering specialties for some quantum technologies could lead to engaging apprenticeship programs with electrical engineering programs. Another field is in algorithm development; business optimization programs and curriculum focused on artificial intelligence (AI) and machine learning (ML) can add quantum coding as part of their curriculum to quickly develop a basic level of understanding of the software layer of quantum computing and how it could help solve problems. Quantum technology has the potential to create new occupational specialties in both the private sector and government. These specialties may drive formal education, training, and course curriculum for classes that lead to degrees and/or certification.

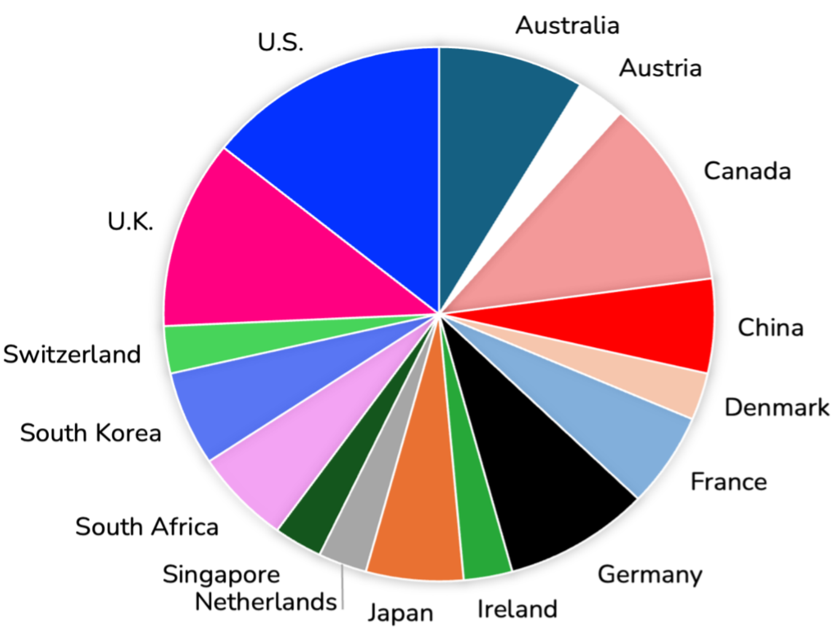
Quantum technologies may also be hybrid, meaning that classical technology is included or interacts with quantum systems. Therefore, understanding how these technologies work with classical technologies and other emerging technologies, such as artificial intelligence (AI) and machine learning (ML), must be incorporated into any workforce development plan. Quantum technologies will require a workforce that not only develops and advances the technology, but also one that understands how to effectively deploy it. Key programs are needed to ensure there are sustainable and applicable workforce development programs that build a quantum-ready workforce.

For the purpose of this white paper, we will focus on three key areas for workforce development: hardware, software, and end-user education and skill building. We will also provide policy recommendations needed to support these efforts. However, before focusing on skills, let's first identify global efforts for quantum skills development.

Global Workforce Development Efforts

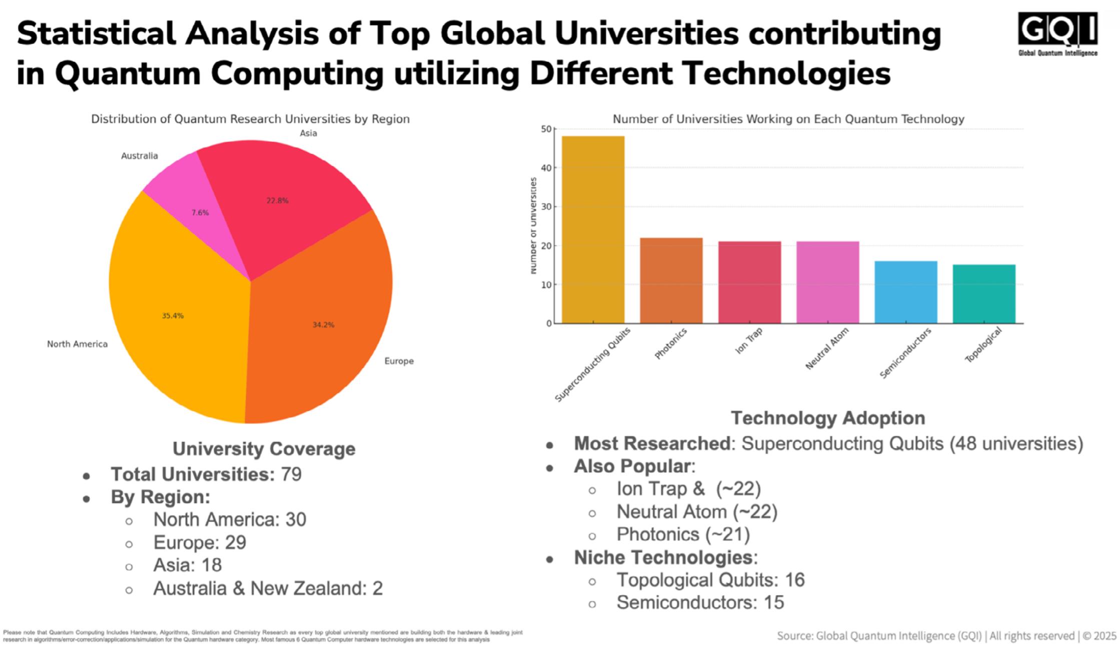
The supply chain for quantum technologies is not regional, and neither is the need for talent. Global government spending on quantum includes basic research as well as funding curriculum development, the creation of testbeds, and other initiatives that can include hands-on training and theoretical talent development. According to the Quantum Zeitgeist, the thirty-six top quantum computing and quantum technology research institutes around the globe are concentrated in North America, Europe, and Asia (See Figure 1)[7].

Figure 1: 36 Quantum Computing and Quantum Technology Research Institutes Around the Globe



Given that quantum technologies are not monolithic, we must also examine the breakdown of academic focus types across different quantum domains. For quantum computing, for example, Global Quantum Intelligence highlights not only the distribution of universities but also the mapping of the different qubit architectures for quantum computing (See Figure 2)[8].

Figure 2: Global Universities Contributing to Quantum Computing

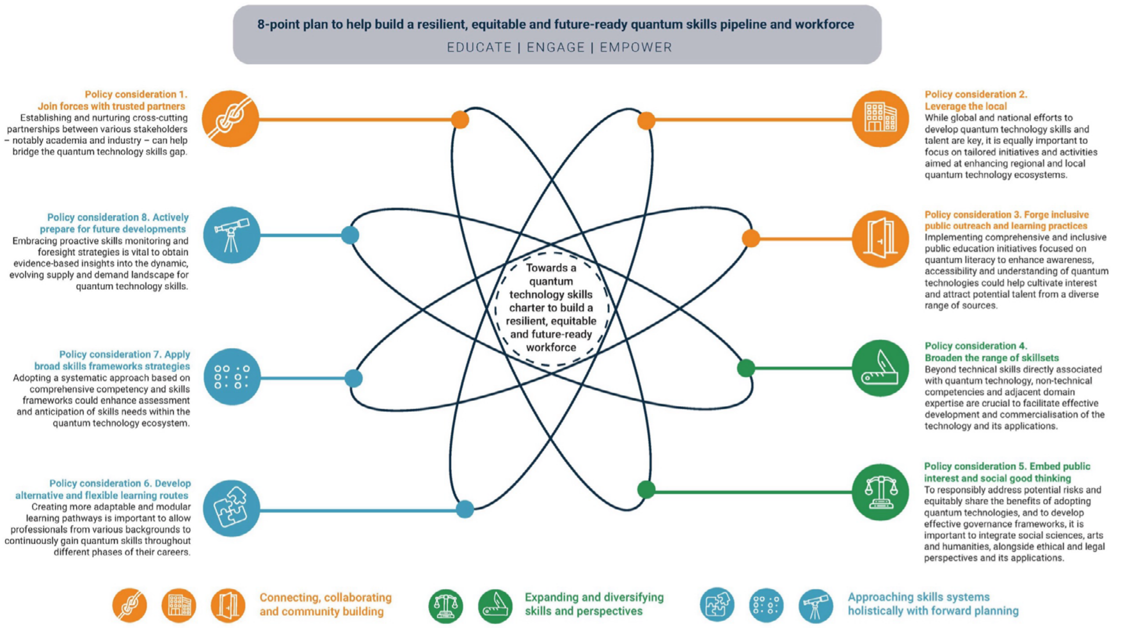


The global nature of quantum makes international engagement imperative. Working with like-minded nations to build the different segments of the workforce will be essential; however, each section of the workforce (hardware, software, and end-user) should have some domestic component to address national security interests.

The need to grow quantum talent has been a key pillar for nearly every national quantum strategy around the globe. In the U.K., the National Quantum Computing Centre (NQCC) has deployed the SparQ programme[9] that enables application discovery and supports skills development to build a U.K. quantum computing user community. The program offers upskilling and reskilling opportunities for current and future professionals in industry, business, and academia. Through funded programs, the U.K. program provides access to commercial quantum computers, training for application development, and mentorships through technical application support and networking. The program has conducted hackathons[10] to address real-world problems, including exploring solutions across quantum machine learning, optimization, and simulation. The program has also funded calls for application development relevant to the public, private, and charitable sectors, such as renewable energy generation and methods to improve cancer diagnosis.[11] Even with these programs, the U.K. Department of Transport highlighted commercial barriers to the adoption of quantum technology, including a talent gap, the need for a well-defined education strategy that addresses a mismatch between formal training and industry needs, and the need to tackle widespread quantum literacy.[12]

The E.U. is also investing heavily in building a workforce for quantum technologies, including initiatives like the Quantum Technologies Flagship[13] and the European Quantum Communication Infrastructure (EuroQCI).[14] These programs aim to build a strong European quantum ecosystem that includes talent development. In 2022, twenty universities from ten European countries announced a focus on education and training in quantum technologies, introducing sixteen new specialized Master's degree programs.[15] This initiative was supported by a € 17.6 million grant over four years from the European Commission's Digital Europe Programme. This program set up an open ecosystem of specialist quantum technology courses, which includes twenty-six partners. From 2021 to 2027, the goal of the Digital Europe Programme is to enhance businesses, citizens, and public services with new and emerging digital technologies, including high-performance computing, AI, cybersecurity, robotics, and quantum technologies. Even with this investment, the RAND Corporation Europe[16] highlighted that a focus on PhD-level physicists could harm commercialization. Therefore, the study called for expanded talent pathways, including technical and non-technical roles, flexible training models, and local ecosystem development (See Figure 3).

Figure 3: RAND Europe Report Building a Pipeline for Quantum Skills



Source: RAND Europe analysis

Other examples of countries investing in skill development include the Netherlands, which has a program focused on skills within its national strategy and Australia which has several programs, including its Australian Research Council Training Centre for Current and Emergent Quantum Technologies[17] Lastly, the National Quantum Strategy in Canada, launched in January 2023, included a pillar on talent development that encompasses programs such as the Quantum Research and Development Initiative (QRDI) and MITACS[18] innovation internships. The MITACS program is a public-private partnership initiative, through which Canada has been able to fund $173M CAD and provide over 1,400 internships.

China is also investing in talent development for quantum with its "Thousand Talents Plan"[19] which focuses on education and research in quantum science and technology. Launched in 2008, the Chinese plan has focused on recruiting researchers from countries including the U.S., U.K., Germany, Singapore, Canada, Japan, France, and Australia to come to China. The FBI[20] has declared the Chinese program a threat to U.S. interests and warned companies and academia about engaging with researchers who are involved with the program.

The U.S. programs invested in quantum education include increased global cooperation and a focus on K-12 education. In Figure 4,[21] the U.S. National Workforce plan included education efforts such as World Quantum Day, along with education programs and internships.

Figure 4: U.S. Quantum Workforce Plan

Inspire	Educate	Experiences	Careers
Motivate students and broaden public understanding via foundational education and outreach. Examples include: • Q-12 Partnership • World Quantum Day	Develop and deploy formal and informal approaches. Examples include: • Quantum 101 • QIST Minors • QIST Masters	Grow confidence through unique opportunities. Examples include: • Internships • Externships • Hands-On Research • After School Programs	Make people aware of the impactful and diverse options in QIST and encourage them to pursue careers in: • Industry • Academia • Government

The U.S. Subcommittee on Economic and Security Implications of Quantum Science, part of the Committee on Homeland and National Security, along with the National Security Council and the National Science and Technology Council (NSTC), released a report[22] in October 2021 highlighting the need for global cooperation as it relates to quantum workforce development. While the report does contain important recommendations, much work still needs to be implemented:

1. Develop and support policies that welcome global talented individuals from around the world, while implementing appropriately balanced protections that mitigate potential research security concerns.

2. Federal organizations should engage in close collaboration with allies and partners to ensure a vibrant and secure international QIST ecosystem that is underpinned by shared values and principles, including freedom of inquiry, merit-based competition, openness and transparency, accountability, and reciprocity.

3. The NSTC Subcommittee on Quantum Information Science (SCQIS) should develop a five-year strategic plan for QIST workforce development, to assess evolving workforce needs, grow the domestic pool of talent, and foster ways to attract and retain top QIST talent from around the world.

4. Federal organizations that fund research, development, and acquisition of QIST should develop coordinated, comprehensive technology protection plans to safeguard intellectual capital and property, while accounting for specific mission needs. These measures should address current and evolving methods used to target U.S. technology, while promoting U.S. ideals of open and transparent research and development.

The U.S. National Q-12 Education Partnership[23] collaborates with educators to ensure a strong quantum learning environment for K-12 classrooms. The partnership includes classroom tools for hands-on experiences and the developing educational materials, all in support of building quantum careers for the future. In an August 2024 report,[24] the U.S. acknowledged that domestic quantum programs are not meeting domestic demands; hence, leveraging existing pathways for international talent is needed. Some other existing skill training programs that can and should be considered include the NSF Quantum Leap Challenge Institutes,[25] supporting interdisciplinary quantum science and engineering programs through the National Quantum Initiative and the Quantum Education Workforce Development (QEW),[26] and the National Quantum Literacy Network,[27] focusing on developing tools and resources to build a quantum and AI-literate workforce including training and curricula.

The Quantum Science Center, located at Oak Ridge National Laboratory, hosts a quantum summer school program[28] designed to cultivate the next generation of scientists and engineers. The summer program offers professional development opportunities for students and postdoctoral associates through lectures, interactive panel discussions, and hands-on training sessions, open to undergraduate and graduate students, as well as post-doctoral researchers, in conjunction with some of their private-sector quantum partners.

An example of a global public-private partnership addressing talent development is Womanium, a program that focuses on exposing, encouraging, and supporting increased engagement with STEM and entrepreneurship fields. They have a quantum AI initiative,[29] which includes training in quantum and AI skills, as well as providing industry challenges for the students to tackle. As of May 2025, the Quantum Solutions Launchpad (QSL),[30] an initiative of The Washington Institute for STEM, Entrepreneurship and Research, and the Womanium Foundation, has engaged over 40 students from more than 120 countries in over 17 industry projects.

Maintaining leadership of critical emerging technology includes growing a diverse and expert domestic workforce for all aspects of quantum technology. The global race to address workforce shortages is intensifying, and we must work together to upskill the existing workforce while also building new careers for critical emerging technologies. This can include programs at state and local levels, increased coordination with like-minded governments for enhanced international collaboration, and a focused effort on up-skilling and re-skilling the existing workforce.

There are also private sector programs, including IBM Quantum Developer Certification, Google's quantum bootcamps, Rigetti's developer training programs, and the D-Wave Learn™ program. Furthermore, private sector programs, such as the Nvidia Teaching Kit program and Black Opal by Q-CTRL, offer educators LMS integration and support for simplified integration of quantum literacy and skills into courses and labs. These efforts can be initiated through public-private engagement or directly with the companies to develop needed quantum coding skills.

Key Challenges in QIST Workforce Development

The rapid advancements in QIST hold transformative potential for national security, economic growth, and innovation; however, building a workforce capable of fully realizing these opportunities presents significant challenges that require urgent attention across education, industry, and government.

Talent Shortage Across Levels: Demand for QIST professionals far exceeds the supply, spanning roles that require foundational knowledge to highly specialized expertise in quantum software, hardware, and multidisciplinary fields. This shortage restricts innovation and delays progress.

Limited Educational Pathways: Quantum education is rarely included at K-12 or undergraduate levels, with the focus typically placed on advanced coursework or research. This limits early exposure and development of talent in QIST fields. It also limits the near-term talent pool.

Infrastructure and Resource Constraints: Institutions lack the expensive infrastructure and advanced lab equipment necessary to deliver hands-on training in QIST hardware. Access to quantum computing simulation platforms is also limited, restricting skill development.

Fragmentation and Lack of Standards: Training programs, tools, and curricula are inconsistently distributed across institutions, resulting in a lack of uniformity. The absence of cohesive national standards for quantum education hinders workforce readiness and the acquisition of practical skills, particularly in programming and algorithm development.

Retention Challenges in Federal Agencies: Federal entities struggle to attract and retain QIST professionals due to competitive industry pay, lengthy hiring processes, and stringent security clearance requirements. This impacts the government's ability to meet the growing demands of QIST. Moreover, the limited federal focus on basic research to advance hardware has left a gap in understanding the capabilities of current systems, hybrid technologies, and ability to upskill the current workforce to understand how the technology can be deployed to solve public-sector problems today.

Slow Integration of Quantum Simulators: Delayed integration of simulation platforms in education programs hinders the acquisition of practical skills for quantum computing applications, thereby widening the talent gap. There are some open-source tools, such as Qiskit[31], KetQuantum[32], Cirq[33], Ocean[34], and Pennylane[35], that could serve as critical tools for hands-on learning of quantum programming

Global Competition: Other nations have begun embedding QIST education early in their STEM pipelines, giving them a competitive edge over the U.S. in talent cultivation. Domestic efforts must scale rapidly to remain competitive, which would require a dedicated program to recruit and retain the top quantum talent.

Limited Awareness of Quantum Capabilities: QIST remains largely unknown to students, educators, and end-users, which restricts early engagement and interest in the field. Public outreach must demystify quantum technologies and emphasize career opportunities.

Addressing these challenges requires coordination across government, academia, industry, and non-profits. Investments in public outreach, infrastructure development, cohesive standards, and hands-on training opportunities are essential to sustain U.S. leadership in QIST. Only through strategic, inclusive, and scalable actions can the nation ensure a workforce capable of advancing quantum technologies and their applications.

Recommendations

Mitigating challenges will be important to addressing the workforce needs now and in the future. Skills for hardware, software, and end-users are quite different. Below we provide separate recommendations for both the workforce and policy.

Talent needs in quantum overlap significantly with those in quantum computing, quantum sensing and quantum communications and networking. The Quantum Economic Development Consortium (QED-C®) released a quantum workforce report indicating the current hiring needs of the quantum industry (See Figure 5)[36]. The report highlights the needs of the entire quantum computing stack from hardware to software. But not all quantum jobs need quantum skills, a fact highlighted by QED-C (see Figure 6)[37]. Positions such as data scientists, database engineers, and cryogenics experts do not require quantum skills when entering the industry. In light of these varied needs, and based on the QED-C pilot program report, "Connecting the Dots: Quantum Learning Through Experiential Activities and Practice"[38] we make the following recommendations.

Figure 5: Industry Quantum Jobs

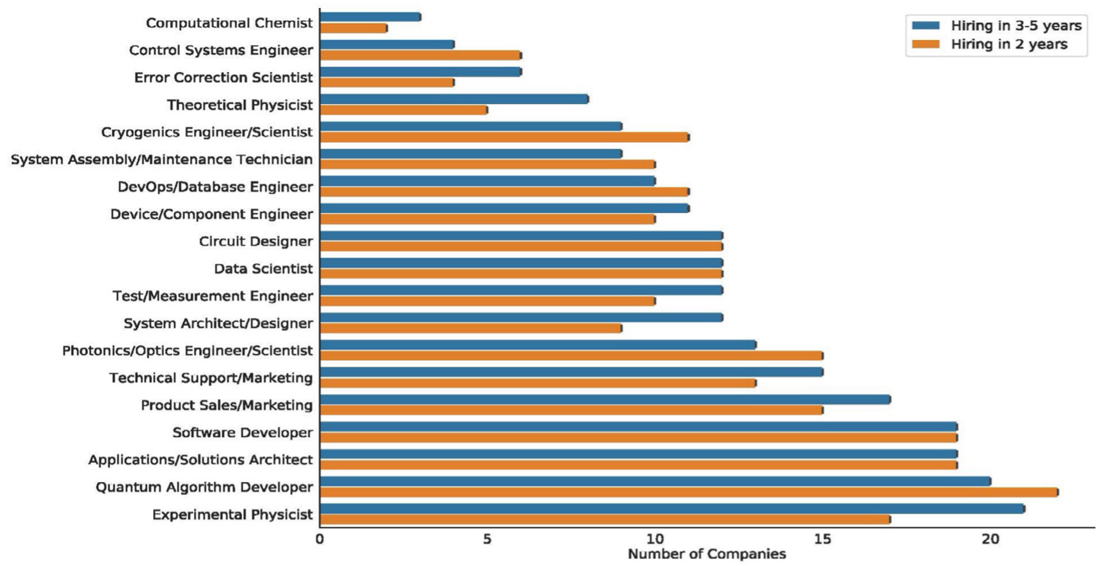
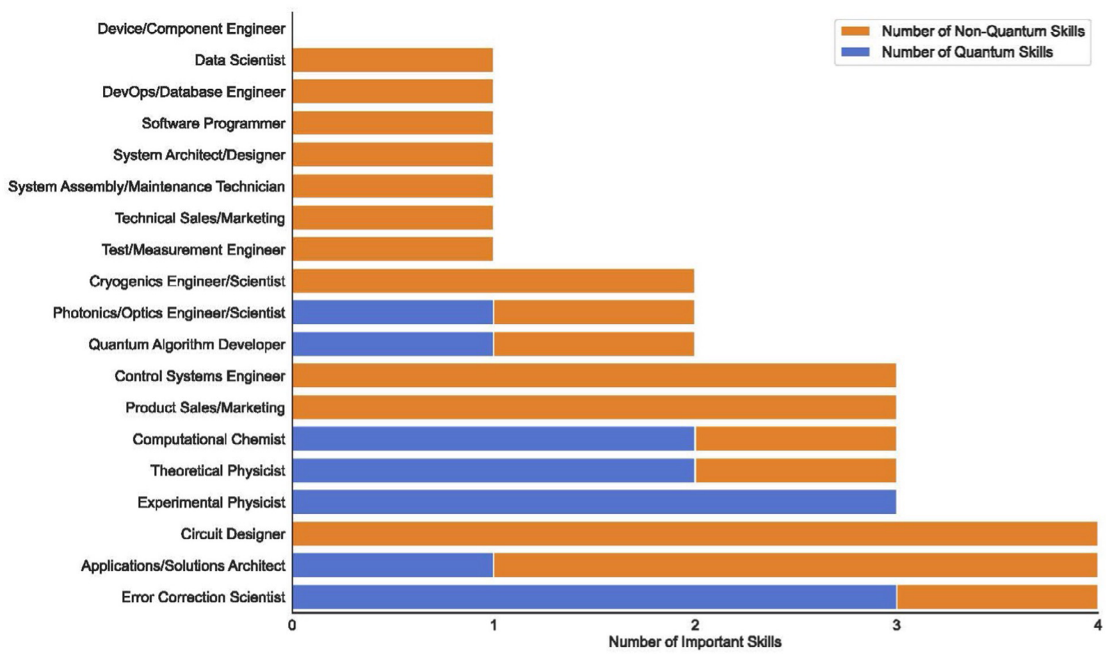


Figure 6: Types of quantum industry jobs

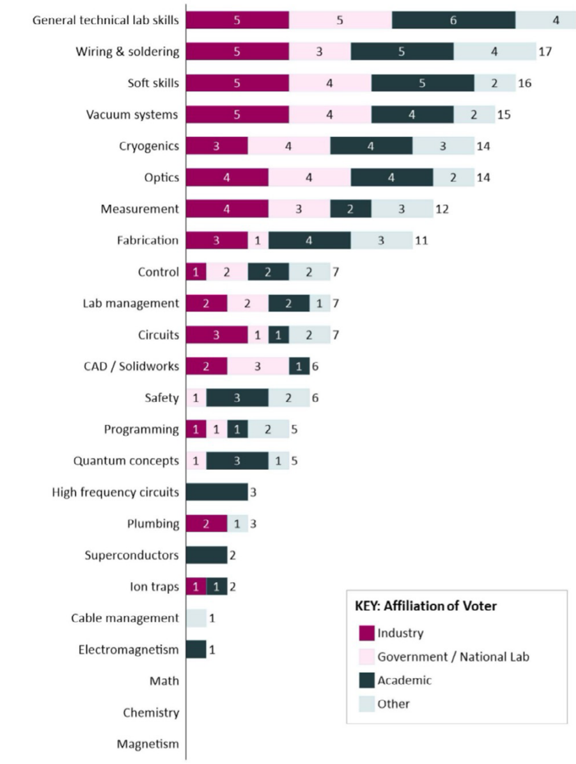


Workforce Development: Hardware Recommendations

As previously mentioned, quantum technologies are not monolithic; different skills are needed for quantum technologies. QED-C has detailed specific job specifications for hardware, which include cryogenics, electrical controls, lab management, optics, and more. (See Figure 7)[39]. These roles will be critical for building more advanced quantum technology hardware.

Figure 7: QED-C Highest Priority Technical Knowledge, Skills, and Ability Categories

Number of Votes Allocated by Workshop Participant (n=23)



Recommendation 1: Skills Analysis

NSF, in coordination with other agencies, industry and academia should conduct an in-depth assessment for each of the critical quantum technologies hardware, and identify the critical skills needed for hardware advancements. This capability modeling should map existing training programs and align with the industry's need for knowledge, skills, and ability. Identifying any overlaps across the different quantum technologies can provide a holistic view of skills needed. Moreover, this should include mapping the supply chain for quantum hardware as well, to ensure a domestic workforce is available to address the supply chain. For hardware needs, many skills could be found through partnerships with trade schools such as welding and electrical engineering. Skills analysis can and should be completed within 3 months or less and then reviews of the analysis should be conducted again every few years to realign needs.

Recommendation 2: Curriculum Development

Once the capability mapping is completed, programs to develop curriculum with academia and apprenticeship programs should be established to address the near-term talent needs. These can be cloud-based programs that work with the industry to ensure the curriculum aligns with the needs of the R&D for hardware. Curriculum development can include opportunities to engage with testbeds to get hands-on experience as well as cloud-based programs, where appropriate, to break down regional barriers. Curricula can also include collaboration with national labs and military labs to ensure the government has a quantum knowledgeable talent pool. Mapping curricula to the different parts of the quantum workforce will also be important to ensure there is appropriate coverage across all quantum technology hardware needs now and in the future. This can be accomplished through continued funding of the NSF Quantum Leap Challenge program and curriculum development for any gaps identified in the capabilities mapping.

Recommendation 3: Greater partnerships with the private sector

The private sector has invested in R&D of hardware and is engaging with industry through expanded co-op and internship programs. This can expedite on-the-job training and skill development, ensuring greater employment of students upon graduation. A place to start could be with the twenty-five military academies to establish quantum courses to prepare future service members for these emerging capabilities and jobs. These programs should begin at the undergraduate and graduate levels of academia to address the near-term needs. Moreover, the private sector can partner with national labs for summer schools, community colleges, and HBCUs[40] for skill development programs. Further consideration should be given to the development and capacity building of QIST programs at the twenty-five military academies, as the adoption and widespread use of these technologies will be necessary in this domain initially. Scaling and maintaining these programs can be an effective way to attract the talent needed in the near term and contribute to ongoing recruitment efforts for mid- and long-term planning strategies.

Recommendation 4: Regional Testbeds & Incubators:

Much of hardware R&D requires hands-on training, and having regional testbeds that cover the full range of quantum hardware can provide locations for collaboration between industry, government, and academia, along with providing a pathway for rapid prototyping for next-generation technology advancements. Testbeds can have a focus on different quantum technologies and should be reviewed and modified regularly to reduce any duplicative efforts, ensure all quantum technologies are included, and incorporate any new advancements in the technology, allowing skills development to progress in step with innovations. Testbeds can host incubator programs to support quantum hardware startups and should be regionally distributed for broad access to innovative quantum technologies.

Workforce Development: Software Recommendations

Recommendation 1: Skills Analysis

Similar to hardware, skill analysis and capability mapping are needed. This should include quantum-classical hybrid technologies in the software stack, such as the intersection of hybrid solvers that use both quantum processing units and high-performance computing (HPC). Quantum technologies will not operate in a silo; therefore, identifying which of these technologies will likely have near-term synergistic applications will be critical for building curricula to address gaps.

Recommendation 2: Supporting Quantum Simulators and Quantum-Hybrid Technologies

In the near term, technologies that will help prepare the workforce will be quantum simulators and quantum-hybrid technologies. Emphasizing the use of quantum simulators can play a critical role in workforce preparation, enabling hands-on experience with software development, quantum programming languages, and algorithm design. Moreover, many quantum technologies will utilize hybrid solvers, and leveraging these hybrid applications will provide a better understanding of the depth and breadth of technology capabilities. Hybrid technologies are already showing promise, providing return on investment today, and the workforce needed to fully commercialize the technology requires skills to understand how quantum will work with other emerging technologies, including machine learning, high-performance computing, artificial intelligence, and generative AI. All government programs, including those funded by the NSF, NQI, DoD, and DARPA, should incorporate quantum and quantum-hybrid technologies.

Recommendation 3: Government-Supported Hackathons:

Collaborating with academia and the government contracting workforce to conduct government-supported hackathons can be a tool for accelerating coding skills for real-world problems. Government can provide public-sector challenges or engage with local communities to identify appropriate problem sets, and then a hackathon can focus on skill training that also provides a better understanding of how quantum technology and quantum-hybrid technologies can address real-world problems. Hackathon participants can include academia, government contractors, and government personnel to develop their skills. We recommend hackathons a few times per year to focus on software skill development and ensuring all quantum technologies applicable are included in these programs to ensure skills are built for all quantum hardware and software.

Workforce Development: End-User Education and Training Recommendations

Recommendation 1: Expanding Access to commercial quantum systems for skill development and training through the QUEST program

The government has provided skills training for AI, but not for algorithm development in quantum computing. The Quantum User Expansion for Science and Technology Program (QUEST), as outlined in the CHIPS Act, provided cloud access to commercial quantum computers to researchers. To date, this program has not been fully established by the Department of Energy's Office of Science. This program would provide access to commercial quantum computers via the cloud. The program should be fully funded and also expanded to include training for government employees and the government contracting community to better understand quantum algorithm development.

Recommendation 2: Government Up-Skilling Program

Establishing an up-skilling program where current government employees and the government contracting community can access training and certifications for learning to code on quantum computing technologies will help address near-term gaps in the existing public sector workforce. Private companies have training programs that the government can access to address near-term gaps. Government officials who are data scientists, data engineers, data analysts, computer scientists, mathematicians, and those working on artificial intelligence and machine learning could be top targets for up-skilling programs across the government and within the national and military labs. This program can include training courses, access to systems via the QUEST program, and participation in hackathons.

Recommendation 3: Implement Near-Term Application Development Programs – Quantum Sandbox

Derisking technology and educating on the art of the possible can be achieved through focused application development programs, such as a Quantum Sandbox for Near-Term quantum applications for civilian programs and the Defense Quantum Acceleration Act for military use cases. These programs will have a dual purpose. First, to educate on what quantum technologies can accomplish, and second, to derisk engagement with the technology. Sandbox programs should have a near-term focus for demos and proofs of concept development, providing a tangible return on investment. These programs can leverage existing activities, such as the Department of Commerce's Manufacturing Institutes,[41] to optimize domestic manufacturing, allowing it to align with the economic development needs of the government, or the Department of Defense manufacturing institutes to optimize the defense industrial base. These programs can utilize the testbeds, hackathons, and the QUEST program as recommended above.

National Quantum Initiative (NQI) Policy Recommendations

Recommendation 1: Reauthorize the NQI with Regular Skill Gap Analysis

The NQI is a comprehensive government strategy, and one of its components should be continued engagement in talent development, but with clear timelines and metrics in place. A skill gap analysis, as recommended above for both hardware and software, along with strict timelines for completion of analysis and a roadmap for implementation should be included. For example, a skill analysis report should be expected no later than 180 days after enactment, and a roadmap with implementation should be completed no later than 1 year after enactment to ensure these programs address the skill needs. Curriculum for high school and undergraduate degrees should be prioritized to address near-term workforce needs. Moreover, the skill gap analysis should be conducted regularly, we recommend at least every 2 years, to ensure current programs are keeping pace with technological innovations.

Recommendation 2: Talent Attraction, Recruitment and Retention

The skills required for quantum technologies are highly specialized, and there needs to be a focused effort to attract, recruit, and retain talent. This can be achieved through focused, high-skilled visa programs and international agreements with like-minded nations focused on the high-tech skills needed for critical technologies, including quantum.

Recommendation 3: Enhanced Public-Private Partnership with Domestic Industry

The private sector has developed skill training, and the government should engage with those who can expedite accreditation and skill training. This can be accomplished through NSF programs, skill training for other government employees, and funding for co-ops and internships. Working through a public-private partnership can help to expedite skill training and provide domestic industry expertise on the latest innovations.

Conclusion

This report aims to provide a guideline for strengthening the U.S. quantum workforce through enhanced investment in research labs, simulation platforms, and training programs. By addressing current gaps and leveraging the nation's existing leadership in quantum innovation, the U.S. can secure its position as a global leader in quantum technology.

Recommendations include expanding partnerships between labs and academia, increasing funding for simulators and standardized curricula, and fostering talent development. These can include continuing early education programs but adding a new focus on undergraduate and graduate programs across community colleges, HBCUs, and universities. The focus on addressing immediate upskilling and reskilling needs should involve public-private partnerships to enhance workforce development and training, particularly for employees in software and algorithm development.

Securing America's global leadership in quantum is a national imperative. This requires closing the critical gap in **talent development and capacity building** while leveraging our existing technological strengths

Acronyms

AI – Artificial Intelligence

CHIPS Act /CHIPS and Science Act – Creating Helpful Incentives to Produce Semiconductors and Science Act of 2022

DARPA – Defense Advanced Research Projects Agency

DoD – Department of Defense

EuroQCI – European Quantum Communication Infrastructure

HBCUs – Historically Black Colleges and Universities

MITACS – Mathematics of Information Technology and Complex Systems

NQCC – National Quantum Computing Centre

NQI – National Quantum Initiative

NSC – National Security Council

NSF – National Science Foundation

NSTC – National Science and Technology Council

QED-C – Quantum Economic Development Consortium

QIS – Quantum Information Science

QRDI – Quantum Research and Development Initiative

QSL – Quantum Solutions Launchpad

QUIST – Quantum Information Science & Technology

QUEST – Quantum User Expansion for Science and Technology

R&D – Research & Development

SCQIS – NSTC Subcommittee on Quantum Information Science

STEM – Science, Technology, Engineering, and Mathematics

End Notes

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