University of Colorado
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Creating a Colorado Quantum Ready Workforce in Service of the Nation

Introduction

The last several years have brought QIST workforce development

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outlines clear steps needed to develop a deeper understanding of QIST workforce needs, address QIST-specific gaps in education and training opportunities, increase the awareness and accessibility of careers in QIST and related fields, and introduce broader audiences to QIST through public outreach. In 2022, to support this national framing, the Quantum Economic Development Consortium (QED-C), the largest quantum industry consortium in the world, surveyed its members to better understand both the demand and the required skills on the QIST horizon, paying particular attention to the role of the professional technician in the QIST ecosystem. ***With these efforts as the backdrop, how can the State of Colorado, a national leader in QIST industry, research, and education, translate its expertise, assets, and infrastructure into a cohesive workforce pipeline for both the Mountain West and the nation? How can we design that pipeline that reaches students and workers where they are, professionally and geographically, to create a diverse and inclusive quantum ready workforce?***

To start this conversation, the University of Colorado Boulder and Colorado's Office of Economic Development and International Trade (OEDIT) convened a workshop of higher education, industry, national laboratory, and government stakeholders in October 2023. The goal was to develop a statement of workers, including professional technicians, and focused on the connections between K-12, community colleges, smaller four-year universities, and research-intensive universities.

QIST is a rapidly evolving field requiring a wide range of technical architectures. Intentional and

functional connections between these institutions across Colorado, along with adequate financial resources from

https://www.quantum.gov/wp-content/uploads/2020/10/QuantumFrontiers.pdf

[3] https://www.quantum.gov/wp-content/uploads/2022/02/QIST-Natl-Workforce-Plan.pdf

Colorado's QIST leadership in research and development can be translated into a robust workforce that supports not only Colorado industries, but the

- A focal point of exchange, ensuring that Colorado's quantum efforts extend beyond the borders to adjacent states and the Mountain West and allows straightforward migration of other states' successful models into Colorado.
- Quantum Community Coalition of educators and other stakeholders across the state with cohorts 'owning' specific pieces of the ecosystem, as well as creating collaboration opportunities for their constituents. The Coalition worked to create a shared set of goals and language around QIST workforce development.
- Intentional pathways of development for QIST that starts with community colleges and leads to Colorado School of Mines, CSU and CU Boulder.
- Common curricula aligned with identified, industry-driven KSAs (both technical and durable skills) (see Theme 2). Key courses have shared syllabus, learning goals, labs, etc., sharing the workload across the stakeholders and creating a degree of uniformity (e.g., hands-on cryogenics training at one college has the same basic structure and learning goals as that taught at another.) Includes a Quantum Concepts course at all community colleges in Colorado. These efforts could be exported to other parts of the country.
- Coordinated system for sharing industry engagement across K-12, 2- and 4-yr, and research-intensive universities.
- Identify how the KSAs for quantum could be used in adjacent industries (e.g., semiconductors), broadening the opportunities for students and workers participating.

The Portfolio of Quantum Education and Training Ideas

Beyond traditional Bachelors, Masters and PhD in quantum-related/adjacent fields, workforce development encompasses a broad range of alternative credentialing that should be considered as part of Colorado's approach, including:

• Quantum minors, based on the needs of QIST jobs
• Critical and Emerging Technology minor
• Badging, certificates, micro- and stackable credentials, digital wallet of verifiable credentials
• Industry-focused/designed capstones for all levels of student
• Quantum certificates and micro-Masters for business majors, law students, program management
• End-to-end quantum business pipeline education, from idea to market
• Bring quantum into University 101 courses
• Concurrent enrollment options for high school students that can be stacked from certificate to AAs to BAs, with ultimate flexibility for both on-ramps and off-ramps

Theme 2: Industry driven learning objectives that lead to credentialing equivalents across institutions

Throughout the discussion, the idea of industry-driven, skills-based education that connects training (upskilling and reskilling) to

Systemic Solutions

To build an effective, state-level, coordinated quantum education pipeline means novel approaches for overcoming the historical competition both within and between higher education institutions. The Quantum Community Coalition has to have the ability, messages and resources to incentivize participation and buy in of higher education administration. The case for quantum is compelling for students and for the state, but it will require intentional engagement by QIST researchers, higher education, industry, and state officials of the stakeholders across the ecosystem to motivate participation and flexibility to create a functional quantum workforce network.

Beyond well documented concerns about student financial stability, wrap around services, and the challenges of a traditional academic calendar and work week can pose for some students, quantum workforce ecosystem in the state would benefit from:

- Consider adding skills-based transcripts that connects assessment to specific skills into the

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