

1. Research Title: Quantum-Enhanced Digital Materiel Management: Integrating Quantum Information Science into AFRL/RA's Digital Environment

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3. Academic Area/Field and Education Level: Systems Engineering, Computer Science, Electrical Engineering, and Quantum Information Science / Quantum-Enhanced Digital Materiel Management (MS or PhD level)

4. Objectives: The primary objective of this research is to investigate how emerging Quantum Information Science (QIS) can supercharge AFRL/RA's Digital Materiel Management (DMM) Strategy to accelerate research, improve decisions, and streamline capability transitions. Specific objectives may include:

- **IT Infrastructure:** Exploring quantum-safe networking (Post-Quantum Cryptography) and hybrid quantum-classical cloud interfaces to support a secure, scalable digital environment.
- **Data:** Developing quantum-assisted algorithms to enhance data indexing, governance, and rapid searchability across the AFRL/RA Catalogued Data Lake.
- **Digital Engineering:** Integrating quantum modeling and simulation into model-centric systems engineering workflows and Digital Engineering Environments to enable higher-fidelity digital twins.
- **AI:** Leveraging Quantum Machine Learning (QML) to advance responsible AI-enabled analytics for automated workflows and warfighter-driven decision quality.

5. Description: AFRL/RA's Digital Materiel Management (DMM) Strategy aims to transform research, engineering, and acquisition into a connected, data-driven enterprise. As computational demands scale, classical systems face speed and capacity bottlenecks in executing complex digital workflows and managing massive enterprise data. Integrating quantum computing, algorithms, and secure communication offers a path toward quantum-enabled advantage in digital materiel workflows.

This project directly aligns with AFRL/RA's core functional areas and digital deliverables:

- **IT Infrastructure:** Assesses the digital foundation needed to connect quantum nodes into the DMM digital environment, ensuring data resilience and ultra-secure collaboration.

- **Data:** Applies quantum search and optimization algorithms to transform structured and unstructured data into trusted, governance-ready assets within the enterprise data lake.
- **Digital Engineering:** Leverages quantum within open-standard digital engineering environments, achieving "Integrated by Design Engineering."
- **AI:** Uses quantum-enhanced AI algorithms to achieve "AI-Enabled Speed of Relevance," dramatically accelerating pattern recognition, decision-making, and workflow automation.

6. Research Classification/Restrictions: Unclassified / Distribution A: Approved for Public Release; distribution is unlimited.

7. Eligible Research Institutions: State of Ohio Higher Education Institutions participating in the Dayton Area Graduate Studies Institute (DAGSI) Cooperative Agreement.