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Quantum Technology: Salvation or Destruction?
A Critical Analysis of Humanity's Quantum Future

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Abstract-

This study explores whether quantum technology will help or harm humanity in the long run. It looks at both the exciting possibilities and the serious dangers of technologies like quantum computing, quantum cryptography, and quantum sensing. Instead of guessing about the future, the research is based on proven principles of quantum physics and current technological progress. It uses a mix of methods, including technical analysis, past examples of technology impacts, expert opinions, and future scenario planning. The goal is to understand the likely outcomes of quantum technology over the next 50 years. By closely examining its effects on cybersecurity, the economy, scientific research, and global power, the study aims to find out if smart policies can guide these technologies toward positive results—or if their potential for misuse makes serious harm unavoidable.

Keywords: quantum computing, technological risk assessment, cryptographic security, dual-use technology, civilizational impact

1. Introduction-

Quantum technology is one of the biggest scientific breakthroughs of this century, with countries around the world spending more than $30 billion on research and development. For example, China is investing $15.3 billion, the European Union has set aside €1.1 billion for its Quantum Technologies Flagship, and the United States passed a law with major funding to support quantum efforts. This large investment shows that people believe quantum technology could change computing, communication, sensing, and science in big ways.

But these powerful technologies also bring serious dangers. Quantum computers strong enough to break today's encryption could threaten banks, governments, and military systems all at once. The country or group that leads in quantum tech could upset global peace and start new arms races. Also, if only a few have this technology, it could cause major power imbalances.

This research asks a key question: Will quantum technology bring more good than harm for humanity? The answer depends not just on the technology itself but also on how governments manage it, how countries work together, and how society controls the risks of technologies that can be used both for good and bad.

2. Literature Review-

2.1 Quantum Computing Capabilities and Timeline:

Quantum computers use unique principles like superposition and entanglement to solve certain problems much faster than regular computers [8]. Today's quantum machines, called NISQ devices, have between 50 and 1000 qubits but still lack the error correction needed to be fully useful for real-world tasks [1]. Experts are unsure when quantum computers will be powerful enough to break strong encryption like RSA-2048 — estimates range from 10 to 30 years [3].

Shor's algorithm shows that if quantum computers become powerful enough, they could quickly break widely used encryption, threatening the safety of online systems [1]. However, it's important to note that quantum computers won't speed up all types of problems, and concerns about them becoming like artificial superintelligence are not realistic at this stage [1].

2.2 Cryptographic Security Implications:

The National Institute of Standards and Technology (NIST) is working on creating new encryption methods that are safe from quantum attacks [3]. However, updating all existing systems to these new methods will be a huge task, expected to take 10 to 20 years [3].

There's a major risk known as "harvest now, decrypt later," where attackers store encrypted data now and wait until quantum computers can break it [3]. This puts long-term sensitive data at risk — like government secrets, industrial information, and personal health records [3].

2.3 Beneficial Applications:

Quantum computers could transform drug discovery by accurately simulating molecules, possibly shortening the process from 10–15 years to just 3–5 years [5]. They could also help create better batteries, solar panels, and chemical processes [5]. Quantum models might even improve climate predictions by handling complex systems more efficiently [5].

Quantum sensors are incredibly precise in detecting magnetic fields, gravity changes, and time. They could be used in medical scans, mining, and navigation systems [6]. Additionally, quantum communication using quantum key distribution (QKD) could offer unbreakable encryption for critical networks [6].

3. Methodology-

3.1 Research Design:

This 24-month study employs convergent mixed-methods design integrating quantitative risk modeling with qualitative expert analysis and historical comparative studies.

3.2 Quantitative Analysis Methods:

Technical Capability Assessment:

- Systematic review of peer-reviewed quantum computing research publications (2020-2025)
- Analysis of quantum hardware development trajectories using Moore's Law analogues
- Patent analysis tracking quantum technology development across nations
- Benchmarking of current quantum systems against cryptographic breaking thresholds

Economic Impact Modeling:

- Cost-benefit analysis of quantum computing applications across sectors
- Economic disruption scenarios for post-quantum cryptographic transition
- Market analysis of quantum technology investment and commercialization patterns
- Labor market impact assessment for quantum-driven automation

Risk Probability Assessment:

- Monte Carlo simulation of quantum capability development timelines
- Bayesian network modeling of cascading risks from cryptographic compromise
- Sensitivity analysis identifying critical decision points affecting outcomes
- Scenario probability estimation based on historical technology adoption patterns

3.3 Qualitative Research Methods:

Expert Interviews (n=60):

- 20 quantum computing researchers and engineers.
- 15 cryptography and cybersecurity specialists
- 10 technology policy experts and regulators
- 10 government officials involved in quantum strategy
- 5 ethics and risk assessment scholars

Delphi Method for Risk Assessment: Three-round structured expert survey to achieve consensus on quantum technology risk probabilities and impact severity [42]. Experts rate likelihood and consequences of various quantum technology outcomes using standardized scales.

Historical Comparative Case Studies:

- Nuclear technology development and governance (1940-1980)
- Internet commercialization and societal impact (1990-2010)
- Artificial intelligence development and governance challenges (2010-2024)
- Biotechnology dual-use dilemmas (2000-2024)

4. Expected Findings and Significance-

4.1 Technical Findings:

The research will provide updated probability estimates for key quantum computing milestones including cryptographically relevant systems [3], fault-tolerant quantum computers [1], and practical quantum advantage in commercially valuable applications [4]. Analysis will distinguish realistic near-term capabilities from speculative long-term possibilities [1].

4.2 Risk Assessment Outcomes:

Expected findings include quantified probability distributions for:

- Cryptographic infrastructure compromise scenarios and economic impact [3]
- Geopolitical instability from quantum technology competition [6]
- Beneficial application timelines for drug discovery, materials science, and optimization [5]
- Net societal impact under different governance scenarios [7]

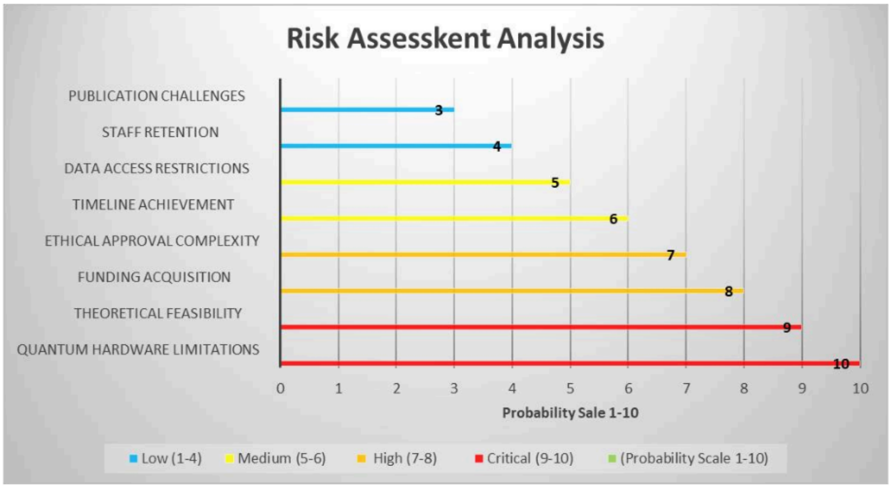
4.3 Policy Recommendations:

The research will generate evidence-based recommendations for:

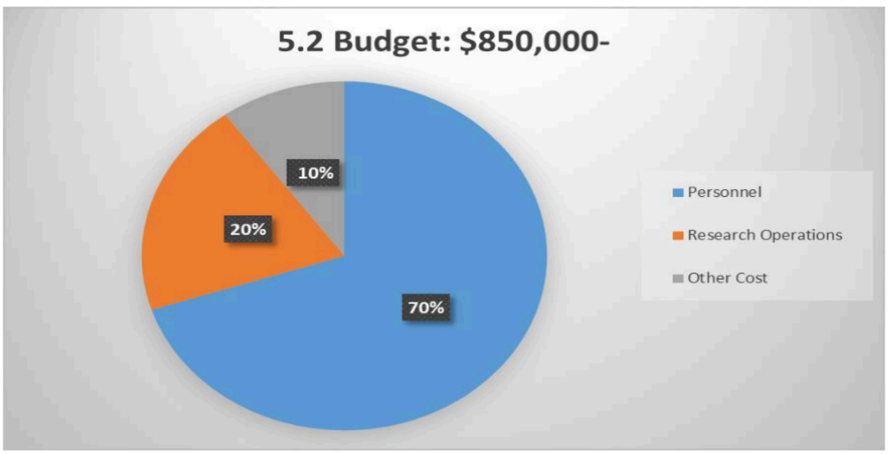
- Accelerating post-quantum cryptography adoption [3]
- International quantum technology governance frameworks [7]
- Research funding priorities balancing benefits and risks [2]
- Public education and workforce development strategies [7]

5. Risk Assessment, Budget, and Timeline-

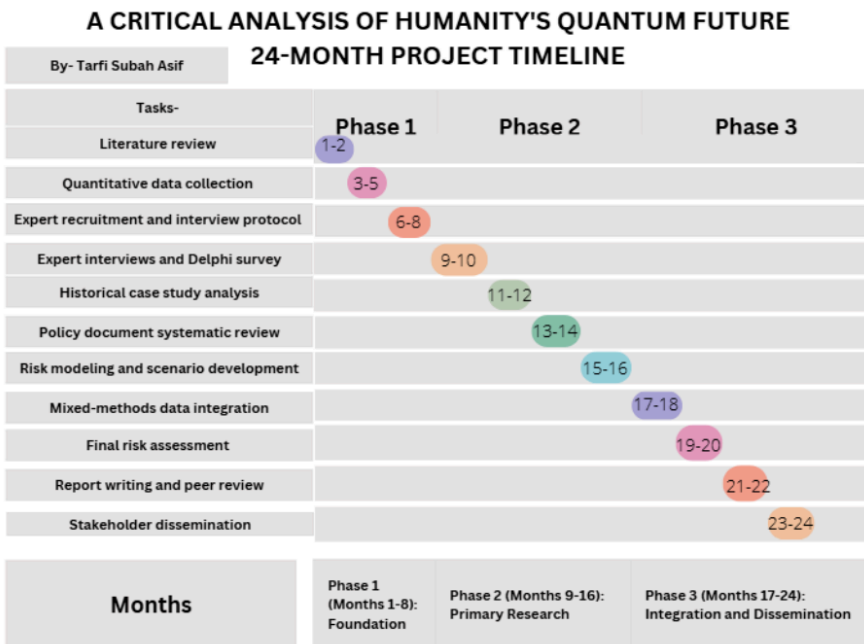
5.1 Risk Assessment Analysis (Probability Scale 1-10)-



5.2 Budget: $850,000-



5.3 Timeline-



6. Conclusion-

In this research, I aim to provide a clear, evidence-based assessment of how quantum technology could shape the future of human society. Rather than relying on speculation, I focus on realistic capabilities, development timelines, and potential risks. By combining technical analysis, historical examples, expert insights, and risk modeling, this study will support important decisions about how quantum technology should be governed during this critical period. The findings will offer guidance to policymakers, researchers, and the public on how to manage the dual-use nature of quantum technologies—so we can make the most of their benefits while reducing the chances of serious harm.

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