

DIGITAL INCLUSION COORDINATION FAILURES: A QUANTUM-CLASSICAL GAP ANALYSIS OF MULTI-STAKEHOLDER TECHNOLOGY ACCESS MECHANISMS

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Abstract

This article examines the coordination failures among multiple stakeholders in digital inclusion initiatives, with particular attention to the emerging gap between classical computing infrastructure and quantum technologies. We analyze how the temporal mismatch between immediate digital access needs and long-term quantum technology investments creates collective action problems that undermine effective technology deployment. Drawing on coordination theory and multi-level governance frameworks, we identify three primary failure mechanisms: temporal misalignment between stakeholder investment horizons, asymmetric information distribution regarding technology capabilities, and incompatible incentive structures across public and private actors. Our analysis reveals that premature quantum technology narratives can divert resources from essential classical digital infrastructure, exacerbating existing digital divides. We propose a phased coordination framework that addresses current inclusion needs while preparing for future technological transitions. The findings suggest that successful digital inclusion requires coordinated governance mechanisms that align stakeholder incentives, manage technology transition timelines, and ensure equitable access to both current and emerging computational resources.

Keywords: Digital inclusion; Coordination failures; Quantum computing; Multi-stakeholder governance; Technology access.

JEL Classification: O33, O38, H41, D83

1 Introduction

The global digital transformation has intensified the urgency of addressing digital exclusion, yet efforts to provide universal technology access face persistent coordination challenges. While international organizations, national governments, private corporations, and civil society organizations all recognize the importance of digital inclusion, their collective efforts often fail to achieve desired outcomes. This persistent failure demands theoretical examination beyond simple resource constraints or technological limitations (de Jong, 2022; Wolbring, 2022). The challenges are compounded by widening inequalities in digital access, particularly affecting marginalized populations who face multiple barriers to technology adoption (Kuban State Agrarian University et al., 2025; Yolusever, 2025).

Recent developments in quantum computing have introduced a new dimension to this challenge. Although quantum technologies remain largely experimental with limited practical applications, their anticipated capabilities have begun influencing technology policy discourse and investment decisions (Wheatley Research Consultancy, 2024; Saltan and Hyrynsalmi, 2022; Gupta and Sharma, 2023). This creates a temporal paradox: stakeholders must simultaneously address current digital access gaps using classical infrastructure while preparing for potential quantum technology transitions (Priyanka et al., 2024). The resulting coordination problem is not merely technical but fundamentally economic, involving resource allocation decisions across multiple time horizons and stakeholder groups.

Existing literature on digital inclusion primarily focuses on infrastructure deployment, affordability, and digital literacy (?). However, it insufficiently addresses the coordination dynamics among heterogeneous stakeholders operating under different incentive structures and planning horizons. The digital divide has been exacerbated by automation and artificial intelligence, creating new forms of inequality that coordination mechanisms must address (Schindler et al., 2021; Ernst et al., 2019; Primakov National Research Institute, 2021). Similarly, emerging research on quantum technology impacts tends toward either technical descriptions or speculative future scenarios (Kumar et al., 2022; Abbas et al., 2024; Ho et al., 2024; Sood and Chauhan, 2023), neglecting the immediate coordination challenges that quantum narratives create for current digital inclusion efforts.

This article addresses this gap by analyzing digital inclusion through the lens of multistakeholder coordination theory. We examine how the quantum-classical technology gap generates coordination failures that impede effective digital access provisioning. Our analysis focuses on three interrelated questions: First, what coordination mechanisms currently govern multi-stakeholder digital inclusion initiatives? Second, how does the emergence of quantum technology discourse affect stakeholder behavior

and resource allocation in digital access programs? Third, what governance frameworks can reconcile immediate inclusion needs with long-term technology transitions?

We employ a theoretical analytical approach grounded in collective action theory (Holahan and Lubell, 2016; Ostrom and Cox, 2010) and multi-level governance frameworks (Bodin, 2017). Our contribution lies in identifying specific mechanisms through which quantum technology narratives create coordination failures in digital inclusion initiatives, and proposing policy frameworks that can address these failures while maintaining realistic expectations about technology timelines and capabilities. Understanding these coordination challenges requires integrating insights from behavioral economics and social science theory (Carlsson and Johansson-Stenman, 2012; Stern, 2018; Turaga et al., 2010).

The remainder of this article proceeds as follows. Section 2 develops our theoretical framework for understanding coordination failures in technology access. Section 3 characterizes the quantum-classical technology gap and its implications for digital inclusion. Section 4 analyzes specific coordination failure mechanisms among stakeholders. Section 5 examines policy implications and proposes governance frameworks. Section 6 discusses broader implications and limitations, followed by concluding remarks in Section 7.

2 Theoretical Framework: Coordination in Multi-Stakeholder

Technology Access

Digital inclusion represents a classic collective action problem where socially desirable outcomes require coordinated efforts from multiple actors with divergent interests. Drawing on collective action theory, we understand digital access as a quasi-public good exhibiting both non-rivalry in consumption and partial excludability (Holahan and Lubell, 2016; Ostrom and Cox, 2010). While one individual's internet usage does not reduce availability for others, access can be restricted through pricing, infrastructure availability, or technical requirements. The challenge of coordinating collective action for digital inclusion parallels similar challenges in environmental governance and resource management (Bodin, 2017; Zilberman et al., 2018).

2.1 The Multi-Stakeholder Coordination Challenge

The provision of digital access involves at minimum four stakeholder categories with distinct objective functions and constraints. Public sector actors prioritize universal access and social equity but face budget

constraints and political cycles. Private telecommunications firms maximize profit through infrastructure investment where returns are highest, creating geographic and demographic access disparities. Technology companies developing hardware and software seek market expansion while protecting proprietary advantages. Civil society organizations advocate for marginalized populations but lack financial resources for large-scale infrastructure deployment.

This heterogeneity creates coordination challenges that simple market mechanisms cannot resolve. Each stakeholder possesses information advantages in their domain: governments understand regulatory environments and public needs, private firms possess technical expertise and capital, technology developers control innovation trajectories, and civil society organizations maintain community relationships. However, these information asymmetries prevent efficient coordination, as stakeholders cannot accurately assess others' capabilities, intentions, or constraints (Dubbink, 2003). Network structures and hierarchical relationships among stakeholders further complicate coordination dynamics (Gilles, 2010; Slikker and Van Den Nouweland, 2001).

We model the coordination problem through stakeholder utility functions. For any stakeholder i in set N , utility U_i depends on their own investment I_i and coordinated investments by other stakeholders I_{-i} :

$$U_i(I_i, I_{-i}) = B_i(I_i + \gamma_i \sum_{j \neq i} I_j) - C_i(I_j) \quad (1)$$

Where B_i represents benefits, C_i represents costs, and γ_i captures complementarity between stakeholder investments. Coordination failures occur when γ_i is positive but stakeholders cannot commit to simultaneous investments, leading to suboptimal equilibria where total digital inclusion remains below socially efficient levels.

2.2 Temporal Misalignment and Technology Transitions

A critical but underexamined source of coordination failure involves temporal misalignment across stakeholder planning horizons. Public sector actors typically operate on electoral cycles of four to five years. Private infrastructure providers evaluate investments over ten to fifteen year depreciation periods. Technology developers work on innovation cycles ranging from two to five years for incremental improvements to fifteen to twenty years for fundamental breakthroughs. These misaligned time horizons create coordination failures even when stakeholders agree on ultimate objectives.

The emergence of quantum computing intensifies this temporal coordination problem. Quantum

technologies remain in early research and development stages, with realistic commercial applications likely decades away (Abbas et al., 2024). However, quantum narratives influence current investment decisions, creating a temporal allocation dilemma: resources directed toward quantum readiness today reduce resources available for classical infrastructure that could immediately serve excluded populations.

We conceptualize this as a temporal coordination game where stakeholder i chooses between immediate classical infrastructure investment I_i^C and future quantum preparation investment I_i^Q , subject to budget constraint $I_i^C + I_i^Q \leq B_i$. The coordination challenge emerges because optimal timing for quantum preparation depends on others' investment timing, yet this information remains private and uncertain.

2.3 Network Effects and Path Dependencies

Digital technologies exhibit strong network effects where a technology's value increases with the number of users (Gilles, 2010). This creates coordination benefits from standardization but also generates path dependencies that lock in existing technological paradigms. Classical computing infrastructure benefits from decades of standardization, skilled workforce development, and complementary service ecosystems. Quantum computing would require rebuilding much of this ecosystem, creating transition costs that current coordination mechanisms inadequately address.

The transition from classical to quantum computing, if and when it occurs, will not follow a simple substitution pattern but rather a complex coevolution requiring sustained coordination across stakeholder groups. Historical technology transitions, such as the shift from analog to digital telecommunications, demonstrate that successful transitions require explicit coordination mechanisms, substantial public investment, and decade-long timelines (?). Yet current digital inclusion initiatives often lack formal coordination mechanisms capable of managing such transitions.

3 The Quantum-Classical Technology Gap: Characteristics and Implications

3.1 Defining the Technology Gap

The quantum-classical technology gap refers to the disparity between existing classical computing infrastructure and anticipated quantum computing capabilities. However, this gap operates differently than previous technology transitions in several critical ways. Unlike the transition from mechanical to electronic computing, where newer technologies offered clear performance advantages for existing applications,

quantum computing excels at fundamentally different problem classes ([Abbas et al., 2024](#); [Paudel et al., 2022](#)).

Classical computers process information through deterministic binary operations, optimized over decades for general-purpose computing tasks. Quantum computers leverage quantum mechanical phenomena to perform certain calculations exponentially faster than classical machines, but only for specific problem types: factorization, optimization in high-dimensional spaces, quantum system simulation, and certain machine learning tasks ([Jain et al., 2025](#); [Taiwo et al., 2025](#)). For the vast majority of computing tasks relevant to digital inclusion, basic internet access, word processing, video streaming, online education, classical infrastructure remains not merely adequate but actually superior when considering cost, reliability, and ease of use. While quantum technologies show promise for specialized applications in business intelligence and decision-making ([Mugel et al., 2020](#); [Gupta and Sharma, 2023](#)), these applications remain far from the core needs of digital inclusion initiatives.

This creates a coordination challenge unique to quantum technologies: the gap is not between inferior and superior versions of the same capability, but between mature, cost-effective infrastructure for common tasks and expensive, experimental hardware for specialized applications. Digital inclusion initiatives primarily require universal access to classical computing capabilities; quantum technologies address different needs entirely.

3.2 Realistic Assessment of Quantum Technology Timelines

A sober evaluation of quantum computing progress reveals substantial gaps between current capabilities and practical applications. Contemporary quantum computers operate with dozens to hundreds of qubits, require near-absolute-zero temperatures, maintain quantum states for microseconds, and exhibit high error rates ([Abbas et al., 2024](#)). Error correction requires thousands of physical qubits to create single logical qubits capable of reliable computation. Building quantum computers suitable for practical applications beyond current classical capabilities requires solving formidable engineering challenges that may take decades.

The quantum computing field faces what [Saltan and Hyrynsalmi \(2022\)](#) term the "quantum winter" risk, where inflated expectations followed by disappointing near-term results lead to reduced investment and slower progress. This pattern has historical precedents in artificial intelligence and other emerging technologies. For digital inclusion policy, premature commitment to quantum readiness diverts resources from proven classical solutions that can immediately address access gaps. Furthermore, the workforce

requirements for quantum computing development remain highly specialized and limited (Peterssen, 2020), creating additional barriers to widespread deployment. Concerns about quantum technology’s societal implications, including impacts on security, privacy, and human rights (Krishnamurthy, 2022), add further complexity to coordination challenges.

Moreover, when quantum computers do achieve practical advantages for specific applications, they will not replace classical infrastructure but rather complement it. Most digital inclusion needs, email, web browsing, video conferencing, document editing, will continue using classical infrastructure indefinitely. Quantum technologies will serve specialized roles in cryptography, drug discovery, materials science, and complex optimization, applications largely irrelevant to basic digital access.

3.3 The Resource Diversion Effect

Perhaps the most consequential implication of the quantum-classical gap for digital inclusion involves resource diversion. Government funding agencies, private investors, and research institutions face zero-sum allocation decisions between classical infrastructure expansion and quantum technology development. When quantum computing receives disproportionate attention relative to its near-term practical value, resources flow away from mundane but essential infrastructure projects.

We can express this resource allocation challenge through a simple investment efficiency measure. Let E represent the inclusion efficiency of an investment:

$$E = \frac{N_{\text{newly connected}}}{C_{\text{investment}}} \times \frac{1}{T_{\text{deployment}}} \quad (2)$$

Where N is the number of individuals gaining digital access, C is the investment cost, and T is the deployment timeline. Classical infrastructure expansion, deploying fiber optics to underserved regions, typically achieves high E values: relatively low cost per connection, rapid deployment, immediate access. Quantum computing investments, by contrast, achieve near-zero E values for digital inclusion because they connect zero additional individuals to basic digital services in any reasonable time frame.

This analysis does not argue against quantum computing research, which may yield important scientific and technological advances. Rather, it highlights a coordination failure where quantum technology hype influences digital inclusion resource allocation despite quantum computing’s irrelevance to core inclusion

objectives. Stakeholders responding rationally to quantum narratives by shifting investments create collectively suboptimal outcomes for digital access.

3.4 Information Asymmetries in Technology Capabilities

The quantum-classical gap is exacerbated by severe information asymmetries regarding technology capabilities. Quantum computing research primarily occurs in specialized academic laboratories and private research facilities, limiting public understanding of realistic capabilities and timelines. Media coverage often emphasizes breakthroughs and potential applications while understating limitations and challenges ([Wheatley Research Consultancy, 2024](#)).

Public sector decision-makers, civil society organizations, and general citizens typically lack the technical expertise to distinguish realistic assessments from speculative projections. This information asymmetry creates vulnerability to technology narratives that overstate near-term quantum capabilities. Private sector actors with detailed technical knowledge may strategically emphasize quantum potential to attract investment, even when internal assessments reveal longer timelines and greater challenges.

These information asymmetries undermine effective coordination because stakeholders make decisions based on inconsistent or inaccurate beliefs about technology trajectories. Some may overinvest in quantum readiness relative to classical infrastructure needs, while others may entirely ignore quantum developments and miss opportunities for strategic preparation. Neither extreme serves digital inclusion objectives effectively.

4 Multi-Stakeholder Coordination Failures in Digital Access

4.1 Public-Private Coordination Failures

The coordination challenge between public and private sectors in digital infrastructure deployment exhibits characteristics of a common pool resource problem combined with positive externalities. Private telecommunications firms invest in infrastructure where expected returns exceed costs, typically urban areas with high population density and purchasing power. Rural and economically disadvantaged areas, where connection costs are high and expected revenues low, remain unserved without public intervention ([Kuban State Agrarian University et al., 2025](#); [Yolusever, 2025](#)). The resulting digital divide creates and perpetuates social inequalities that extend beyond mere technology access ([Jia, 2024](#); [Kazan National Research Technical University et al., 2024](#); [Cazzaniga, 2024](#)).

Traditional solutions involve public subsidies for infrastructure deployment in unprofitable areas, or direct public provision of infrastructure. However, these approaches face coordination failures when stakeholders cannot commit credibly to their respective roles. Private firms may strategically delay investment, anticipating public subsidies. Public agencies may underinvest, expecting private sector expansion. Neither stakeholder can observe the other's true cost structure or investment intentions, creating inefficient equilibria.

The quantum technology dimension adds complexity to this coordination problem. Private firms emphasize quantum computing potential in lobbying for research and development subsidies, even though quantum technologies contribute nothing to immediate digital access gaps. Public agencies face pressure to demonstrate technological leadership through quantum initiatives, diverting resources from prosaic but effective classical infrastructure subsidies. This coordination failure is not merely distributional, determining who bears costs, but allocational, determining what technologies receive investment priority.

4.2 Technology Developer and Infrastructure Provider Misalignment

Hardware and software technology developers face different incentive structures than infrastructure providers, creating additional coordination challenges. Developers maximize returns through product differentiation, proprietary standards, and rapid innovation cycles.

Infrastructure providers benefit from standardization, long-term stability, and interoperability. These conflicting objectives create tension in digital inclusion initiatives.

Quantum computing intensifies this tension because quantum technologies require entirely new hardware, software, and network architectures incompatible with existing classical infrastructure. Technology developers positioning for future quantum markets advocate for early quantum network deployment and quantum-ready software development. Infrastructure providers, bearing actual deployment costs, resist premature investments in unproven technologies. This misalignment delays coordinated strategies for managed technology transitions.

The coordination failure manifests in fragmented approaches to technology standards. Without coordinated standard-setting, quantum technology development proceeds along multiple incompatible paths. When practical quantum applications eventually emerge, the lack of early coordination may require costly standardization processes or lock-in to suboptimal technologies. Yet premature standardization before technological maturity risks cementing inferior approaches.

4.3 Civil Society and Technical Stakeholder Disconnection

Civil society organizations working directly with excluded populations possess detailed knowledge of community needs, cultural contexts, and implementation challenges. However, they typically lack technical expertise in computing infrastructure and emerging technologies. Technology developers and infrastructure providers possess technical knowledge but limited understanding of end-user contexts. This reciprocal ignorance creates coordination failures where technical solutions inadequately address actual community needs (Wolbring, 2022; de Jong, 2022). Successful coordination requires integrating diverse knowledge systems and ensuring inclusive participation in decision-making processes (Bodin, 2017; Turaga et al., 2010).

Quantum computing narratives exacerbate this disconnection. Civil society organizations, already struggling to obtain resources for basic digital literacy programs and affordable internet access, must now navigate discussions of quantum computing potential. Technical stakeholders emphasize quantum capabilities without translating this into concrete implications for community-level digital inclusion. The resulting communication failures prevent effective coordination of efforts.

Moreover, civil society organizations often lack representation in quantum technology policy discussions, which occur primarily in technical and industry forums. This exclusion perpetuates coordination failures by developing quantum strategies without input from organizations that understand digital inclusion implementation challenges. When quantum technologies eventually reach practical deployment stages, this early exclusion may create adoptability problems and misalignment between technical capabilities and community needs.

4.4 Measuring Coordination Failure Severity

We can characterize the severity of coordination failures through a simple coordination efficiency index. Let I^* represent the socially optimal total investment in digital inclusion infrastructure, allocated efficiently between classical and quantum technologies. Let I^A represent actual aggregate investment by all stakeholders. The investment gap is:

$$G_I = I^* - I^A \quad (3)$$

Additionally, we measure allocation efficiency A as the proportion of investment directed toward technologies that can provide near-term digital access:

$$A = \frac{I^C}{I^C + I^Q} \quad (4)$$

Where I^C is classical infrastructure investment and I^Q is quantum technology investment. Severe coordination failures exhibit both high investment gaps ($G_I > 0$) and allocation inefficiency (A significantly below or above the socially optimal proportion).

Current evidence suggests significant coordination failures on both dimensions. Total global investment in digital inclusion infrastructure remains far below levels needed for universal access (?), indicating positive G_I . Simultaneously, the ratio of quantum computing research and development funding to classical infrastructure deployment funding in digital inclusion initiatives exceeds any reasonable estimate of quantum technology's near-term contribution to access goals, indicating suboptimal A .

5 Policy Implications and Governance Frameworks

5.1 Phased Coordination Mechanisms

Addressing the coordination failures identified requires implementing phased governance mechanisms that separate near-term infrastructure deployment from long-term technology transition preparation. In Phase One, covering the next five to ten years, policy should prioritize universal classical infrastructure deployment. Governments should coordinate with private providers through subsidies, regulatory requirements, and direct public provision where necessary to achieve basic digital access for all populations. This approach aligns with evidence from sustainable development initiatives demonstrating the effectiveness of phased coordination mechanisms ([Zilberman et al., 2018](#); [Stern, 2018](#)).

During Phase One, quantum technology policy should focus on fundamental research rather than premature commercialization or integration with digital inclusion initiatives. Research coordination mechanisms should facilitate knowledge sharing while avoiding duplicative efforts, but without diverting resources from essential classical infrastructure deployment ([Priyanka et al., 2024](#); [Ho et al., 2024](#); [Sood and Chauhan, 2023](#)). This phased approach acknowledges the temporal mismatch between immediate inclusion needs and uncertain quantum technology timelines.

Phase Two, potentially beginning in ten to fifteen years depending on quantum technology progress, would involve coordinated transition planning as quantum capabilities mature. This requires establishing monitoring mechanisms to assess quantum technology readiness and formal processes for adjusting infrastructure investment priorities as technologies prove viable. Early transition planning prevents lock-in

to purely classical infrastructure that might impede future adoption of genuinely useful quantum applications.

5.2 Information Coordination and Technology Assessment

Coordination failures arising from information asymmetries require policy interventions that improve stakeholder access to realistic technology assessments. Governments should establish independent technology assessment offices that evaluate emerging technologies, including quantum computing, and provide accessible reports to policymakers, civil society organizations, and the public. These assessments must clearly distinguish proven capabilities from speculative projections and identify relevant timelines for practical applications.

International coordination of technology assessment processes can reduce redundancy and improve assessment quality. Organizations such as the United Nations and regional bodies can facilitate collaborative assessment efforts that pool expertise while maintaining assessment independence from commercial interests. Such assessments should explicitly address implications for digital inclusion, clarifying which emerging technologies contribute to access goals and which serve other purposes.

Technology assessment must also extend to evaluation of existing coordination mechanisms themselves. Regular audits of digital inclusion initiatives should examine whether stakeholder coordination achieves intended outcomes and identify obstacles to effective collaboration. These audits can reveal whether quantum technology narratives inappropriately influence resource allocation decisions and suggest corrective measures.

5.3 Multi-Level Governance Structures

Effective coordination of digital inclusion requires governance structures that operate at multiple levels: international, national, regional, and local. International coordination establishes global standards, facilitates technology transfer, and coordinates research efforts. National coordination develops country-specific strategies, regulatory frameworks, and investment programs. Regional and local coordination adapts national strategies to local contexts and manages implementation ([Bodin, 2017](#)). Multi-level governance approaches have proven effective in addressing complex socio-ecological challenges and can be adapted to digital inclusion coordination ([Ostrom and Cox, 2010](#); [Carlsson and Johansson-Stenman, 2012](#)).

Multi-level governance structures must include representation from all stakeholder categories at appropriate levels. International forums require participation from governments, private sector representatives, technology developers, and civil society organizations with global scope. Local implementation requires engagement with community organizations, local government, regional infrastructure providers, and local technology businesses. Coordination mechanisms must translate priorities and information vertically across governance levels while enabling horizontal coordination within each level.

Quantum technology governance should integrate into these multi-level structures rather than creating separate quantum-specific coordination mechanisms. This integration ensures quantum technology policy decisions consider implications for broader digital inclusion objectives and prevents quantum narratives from dominating agenda-setting at the expense of immediate access needs.

5.4 Incentive Alignment Mechanisms

Coordination failures persist when stakeholders face incompatible incentive structures. Policy interventions can realign incentives through several mechanisms. Performancebased subsidies reward infrastructure providers for connecting underserved populations rather than simply deploying infrastructure. Public procurement policies can incentivize technology developers to prioritize interoperability and affordability over proprietary differentiation. Civil society organizations can receive capacity-building support to participate effectively in technical policy discussions. These incentive alignment mechanisms draw on insights from behavioral economics and collective action theory ([Carlsson and Johansson-Stenman, 2012](#); [Turaga et al., 2010](#); [Holahan and Lubell, 2016](#)). Evidence from technology transitions and sustainable development initiatives demonstrates the effectiveness of properly designed incentive structures ([Zilberman et al., 2018](#); ?).

For quantum technology development, incentive mechanisms should reward realistic progress assessment and community-relevant application development rather than hype and speculation. Research funding should require clear articulation of practical applications and realistic timelines. Commercial investment tax incentives should apply only to quantum projects that demonstrate clear pathways to useful applications within defined timeframes.

Additionally, stakeholder coordination can be strengthened through formal partnership mechanisms that align individual incentives with collective objectives. Public-private partnerships for infrastructure deployment should include performance requirements, costsharing arrangements, and benefit-sharing

provisions that encourage cooperation. Multistakeholder governance boards for digital inclusion programs should include representatives from all stakeholder categories with decision-making authority proportional to their contributions and expertise.

6 Discussion

Our analysis reveals that digital inclusion coordination failures arise not merely from insufficient resources or technological constraints, but from fundamental misalignments in stakeholder incentives, information distribution, and temporal planning horizons. The emergence of quantum computing narratives exacerbates these failures by creating resource allocation pressures that divert attention and investment from immediate inclusion needs toward speculative future technologies. These dynamics parallel coordination challenges observed in other domains of technological change and social policy ([Schindler et al., 2021](#); [Klinova and Korinek, 2021](#); [Ernst et al., 2019](#)).

This finding challenges prevailing assumptions in both digital inclusion policy and quantum technology development. Digital inclusion literature often treats coordination failures as implementation problems soluble through better communication or stronger partnerships. Our analysis demonstrates that structural features of multi-stakeholder governance, information asymmetries, temporal misalignments, create coordination failures that resist simple organizational solutions ([Ostrom and Cox, 2010](#); [Bodin, 2017](#)). Similarly, quantum computing literature typically treats social implications as downstream effects of technological development. We show that quantum technology narratives actively shape current resource allocation decisions in ways that may impede digital inclusion progress ([Wolbring, 2022](#); [Krishnamurthy, 2022](#)).

Several limitations constrain our analysis. First, we employ theoretical modeling rather than empirical measurement of coordination failures. While this approach clarifies mechanisms and relationships, it cannot quantify the magnitude of coordination failures in specific contexts. Future research should develop metrics and gather data to measure coordination efficiency in actual digital inclusion initiatives. Second, our focus on quantum-classical technology gaps may overlook other emerging technology transitions that create similar coordination challenges. Artificial intelligence, blockchain, and other technologies may generate analogous temporal allocation dilemmas. Third, we primarily examine coordination among formal stakeholder organizations. Informal networks, grassroots initiatives, and individual actors also influence digital inclusion outcomes but receive less attention in our framework.

The policy implications extend beyond digital inclusion to broader questions of technology governance and innovation policy. The quantum computing case illustrates how emerging technology narratives can create coordination challenges even before technologies reach practical maturity. This suggests that technology assessment and governance mechanisms should activate earlier in innovation cycles, shaping narratives and expectations to prevent premature resource diversion and coordination failures.

Furthermore, the analysis highlights the importance of maintaining realistic expectations about technology timelines and capabilities in policy discourse. While optimism about technological potential can mobilize resources and enthusiasm, unrealistic expectations create misallocation and coordination failures. Finding the appropriate balance between aspirational technology narratives and sober capability assessments remains a persistent challenge in innovation policy.

7 Conclusion

Digital inclusion represents a pressing global challenge requiring coordinated action from multiple stakeholders with divergent interests and capabilities. This article has examined how the quantum-classical technology gap creates and exacerbates coordination failures that impede effective digital access provisioning. We identified three primary coordination failure mechanisms: temporal misalignment between stakeholder investment horizons, information asymmetries regarding technology capabilities, and incompatible incentive structures across stakeholder groups. These coordination challenges reflect broader patterns observed in technological transitions and sustainable development initiatives ([Zilberman et al., 2018](#); [Stern, 2018](#)).

The analysis demonstrates that quantum computing narratives, despite the technology's limited near-term relevance to digital inclusion, influence current resource allocation in ways that may delay universal digital access. This occurs through resource diversion toward quantum technology development, premature emphasis on quantum readiness over classical infrastructure deployment, and coordination complexity arising from additional technology transition uncertainties. Understanding these dynamics requires integrating insights from collective action theory, behavioral economics, and multi-level governance frameworks ([Holahan and Lubell, 2016](#); [Ostrom and Cox, 2010](#); [Carlsson and Johansson-Stenman, 2012](#); [Bodin, 2017](#)).

Addressing these coordination failures requires phased governance frameworks that prioritize immediate classical infrastructure deployment while maintaining strategic flexibility for eventual quantum technology transitions. Policy interventions should focus on improving information coordination through

independent technology assessment, aligning stakeholder incentives through performance-based mechanisms, and establishing multilevel governance structures that enable effective collaboration across organizational and geographic scales.

The broader lesson extends beyond digital inclusion to technology governance generally. Emerging technologies create coordination challenges that require early, active governance intervention rather than passive accommodation of technology-driven change. Successful technology transitions demand explicit attention to stakeholder coordination, realistic assessment of capabilities and timelines, and policy frameworks that balance innovation encouragement with pragmatic implementation focus. These lessons apply not only to quantum computing but to artificial intelligence, automation, and other emerging technologies that reshape labor markets and social structures (Schindler et al., 2021; Klinova and Korinek, 2021; Ernst et al., 2019; Jia, 2024).

Universal digital access remains achievable through coordinated deployment of proven classical infrastructure. Quantum computing may eventually contribute to digital technologies in specific ways (Priyanka et al., 2024; Ho et al., 2024; Sood and Chauhan, 2023), but this potential should not distract from immediate inclusion imperatives. By recognizing and addressing the coordination failures identified in this analysis, policymakers, infrastructure providers, technology developers, and civil society organizations can work together more effectively to achieve meaningful digital inclusion for all populations. This requires sustained commitment to collaborative governance, equitable resource allocation, and realistic technology assessment (Bodin, 2017; Ostrom and Cox, 2010; de Jong, 2022; Krishnamurthy, 2022).

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