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A Holistic Capability Framework for Digital Transformation in Intelligent Societies: Integrating Technological, Organizational, and Societal Dimensions

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ABSTRACT
Digital transformation has become an indispensable driver of intelligent societal development, yet its implementation faces fragmented approaches across sectors. This study develops a holistic capability framework integrating technological infrastructure, organizational agility, and societal inclusivity through a systematic literature review (n=187) and cross-sector case analysis (public, private, and non-profit). The findings identify three core capability clusters—techno-ethical governance, adaptive leadership, and inclusive digital ecosystems—as critical enablers. The framework addresses gaps in existing research by bridging micro-level organizational practices with macro-level societal impacts. Practical implications for policymakers, organizational leaders, and technology developers emphasize human-centric transformation strategies that balance innovation with equity. This research contributes to the Intelligent Society discourse by providing a unified framework for sustainable digital transformation.

Keywords: Digital Transformation; Intelligent Society; Capability Framework; Inclusive Innovation; Adaptive Leadership; Techno-Ethics

1. Introduction

The emergence of intelligent societies, characterized by the seamless integration of digital technologies into social structures, economic systems, and daily life, has positioned digital transformation as a defining global trend [1]. Unlike incremental technological upgrades, digital transformation entails fundamental reconfigurations of organizational processes, cultural norms, and power dynamics [4]. Governments, businesses, and civil society organizations increasingly recognize its potential to address pressing challenges—from public service inefficiencies to social inequality—yet implementation remains uneven across regions and sectors [3].

A critical gap in current scholarship lies in the fragmented understanding of digital transformation capabilities. Existing research often focuses on single dimensions: technological infrastructure [2], organizational change management [6], or user adoption [8], failing to capture the interdependencies between individual, organizational, and societal levels [4]. This fragmentation has led to mismatched expectations, where technological investments do not translate into meaningful societal outcomes, exacerbating digital divides and ethical concerns [5].

Against this backdrop, this study aims to develop a holistic capability framework for digital transformation in intelligent societies. Three research questions guide the investigation: (1) What core capabilities are required to enable effective digital transformation across sectors? (2) How do these capabilities interact across micro, meso, and macro levels? (3) What strategies promote inclusive and sustainable transformation in diverse societal contexts?

The significance of this research extends beyond academic contribution. For policymakers, it offers a tool to design evidence-based digital strategies that balance innovation with social equity. For organizational leaders, it provides a roadmap to identify capability gaps and prioritize resources. For technology developers, it emphasizes ethical considerations that align technological advancement with societal needs. By addressing these stakeholders, this study contributes to the broader goal of building intelligent societies that harness digital transformation for collective benefit.

1.1 Theoretical Context

Digital transformation research draws on multiple theoretical traditions, including Technology Acceptance Model (TAM) [8], Strategic Management Theory [4], and Ecosystem Theory [12]. TAM highlights the role of perceived usefulness and ease of use in technology adoption, yet it overlooks structural barriers to transformation [8]. Strategic Management Theory emphasizes organizational alignment with digital goals, but often neglects societal impacts [4]. Ecosystem Theory, by contrast, considers interdependencies between actors, technologies, and institutions, providing a foundation for holistic analysis [12].

Recent scholarship has shifted toward human-centric approaches, recognizing that technological determinism fails to account for social dynamics [3]. Studies on meaningful work in digital transformation [3] and inclusive innovation [15] highlight the need to integrate human needs, cultural contexts, and ethical considerations into transformation strategies. This study builds on these developments by synthesizing cross-disciplinary insights into a unified capability framework.

1.2 Scope and Delimitations

This research focuses on digital transformation in three key sectors—public governance, financial services, and non-profit organizations—selected for their diverse societal impacts and varying transformation challenges [1,3,7]. The geographic scope includes case studies from Europe, Asia, and North America to capture contextual diversity [2,5,10]. While the framework is designed to be adaptable across regions, specific contextual factors (e.g., regulatory environments, digital literacy levels) may require localized adjustments.

Limitations include the reliance on secondary data for case analysis, as primary empirical research would extend beyond the study's scope. Additionally, the framework prioritizes generalizability over sector-specific detail, requiring future research to explore industry-specific adaptations. Despite these limitations, the holistic approach offers a valuable foundation for understanding cross-cutting capabilities in digital transformation.

2. Literature Review

2.1 Conceptualizing Digital Transformation in Intelligent Societies

Digital transformation is defined as the integration of digital technologies into all aspects of an organization or society, resulting in fundamental changes to how value is created, delivered, and captured

[4]. In intelligent societies, this transformation is characterized by three key features: data-driven decision-making, interconnected systems, and human-technology collaboration [5]. Unlike digitalization (the conversion of analog to digital processes), digital transformation involves systemic change that transcends technological implementation [1].

Recent definitions emphasize duality: digital transformation as both an enabler of efficiency and a catalyst for societal change [3]. For example, in public governance, it can streamline service delivery while enhancing citizen participation [1]. In financial services, it enables financial inclusion but raises concerns about data privacy [3]. This duality underscores the need for a framework that balances functional and normative goals.

2.2 Existing Capability Frameworks

Current capability frameworks for digital transformation can be categorized into three streams: technological, organizational, and societal. Technological capability frameworks focus on infrastructure, data management, and digital skills [2,8]. For instance, the TOE (Technology-Organization-Environment) framework identifies technological readiness, organizational structure, and external pressures as key determinants of adoption [6]. However, these frameworks often reduce transformation to technology implementation, neglecting cultural and ethical dimensions [4].

Organizational capability frameworks emphasize leadership, change management, and agile processes [3,9]. Studies on leadership in digital transformation highlight the importance of adaptive leadership, which balances stability with innovation [3]. Emotional intelligence, regulatory compliance, and co-creation strategies emerge as critical practices for fostering meaningful work during transformation [3]. While these frameworks address internal organizational dynamics, they rarely connect to broader societal impacts.

Societal capability frameworks focus on digital inclusion, equity, and governance [5,15]. Research on digital divides identifies access, skills, and usage as three dimensions of exclusion [10]. Inclusive innovation frameworks emphasize the need to involve marginalized groups in technology design and implementation [15]. However, these frameworks often lack actionable guidance for organizations navigating transformation.

The fragmentation across these streams highlights the need for an integrated framework that bridges technological, organizational, and societal capabilities. This study addresses this gap by synthesizing cross-disciplinary research into a holistic model.

2.3 Key Enablers and Barriers

Literature identifies several critical enablers of digital transformation. Leadership commitment emerges consistently as a top enabler, with studies emphasizing the role of executives in driving cultural change and resource allocation [3,6]. Effective change management, including communication, training, and stakeholder engagement, facilitates smooth implementation [1,9]. Public-private collaboration enhances resource sharing and innovation, particularly in public sector transformation [1].

Technological enablers include robust digital infrastructure, interoperable systems, and data governance frameworks [2,12]. AI and machine learning technologies offer new possibilities for personalization and efficiency, but require ethical guardrails [5]. User-centric design, which involves end-users in technology development, increases adoption rates and relevance [8,15].

Barriers to transformation are equally multifaceted. Inadequate digital infrastructure and funding constraints hinder implementation, particularly in resource-constrained regions [2,10]. Resistance to change, rooted in organizational culture or fear of job displacement, poses significant challenges [3,6]. Regulatory

barriers, including outdated policies and data privacy concerns, create uncertainty for organizations [1,7]. Digital literacy gaps among employees and users limit the impact of technological investments [3,10].

Ethical concerns, such as algorithmic bias and data exploitation, represent emerging barriers [5]. As intelligent technologies become more pervasive, ensuring transparency and accountability has become a critical capability [5]. These enablers and barriers inform the development of the holistic framework presented in this study.

3. Research Methodology

3.1 Systematic Literature Review (SLR)

To identify core capabilities and their interdependencies, a systematic literature review was conducted following PRISMA guidelines [16]. The search strategy targeted three academic databases: Web of Science, Scopus, and JSTOR, using combinations of keywords: "digital transformation," "intelligent society," "capability framework," "inclusive innovation," "adaptive leadership," and "techno-ethics." Publication dates were restricted to 2022–2025 to ensure relevance to current research and practice.

Initial searches yielded 1,243 articles. After removing duplicates (n=318), titles and abstracts were screened for alignment with the research questions (n=627 excluded). Full-text analysis of the remaining 308 articles resulted in 187 eligible studies, based on inclusion criteria: (1) focus on digital transformation capabilities, (2) empirical or theoretical contribution to intelligent society discourse, (3) publication in peer-reviewed journals or reputable conference proceedings.

Thematic analysis of the eligible studies identified recurring capability dimensions, enablers, and barriers. These themes were organized into initial clusters, which were refined through iterative comparison and consultation with field experts. The SLR findings provided the theoretical foundation for the capability framework.

3.2 Cross-Sector Case Analysis

To validate and refine the framework, cross-sector case analysis was conducted across three sectors: public governance, financial services, and non-profit organizations. Case selection followed purposive sampling criteria: (1) organizations at advanced stages of digital transformation (minimum 3 years of implementation), (2) diverse geographic contexts (Europe, Asia, North America), (3) availability of public documentation or peer-reviewed case studies.

Ten cases were selected: four public sector organizations (e.g., Singapore's Smart Nation Initiative [10], Denmark's Digital Public Services [2]), three financial institutions (e.g., Indonesia's Bank Mandiri [3], China's Alipay [7]), and three non-profits (e.g., Oxfam's Digital Humanitarian Program [15], Wikimedia Foundation's Knowledge Equity Project [12]). Data collection involved document analysis of annual reports, transformation roadmaps, and evaluation studies, supplemented by secondary data from academic case studies.

Case analysis followed the Gioia methodology [3], progressing from first-order concepts (e.g., "data governance," "stakeholder engagement") to theoretical themes (e.g., "techno-ethical governance") and aggregate dimensions (e.g., "systemic capabilities"). Cross-case synthesis identified common capability patterns and contextual variations, enabling the framework to be both generalizable and adaptable.

3.3 Framework Development

The capability framework was developed through an iterative process integrating SLR findings and

case analysis results. Initial dimensions were derived from thematic analysis of the literature, focusing on technological, organizational, and societal capabilities. Case analysis validated these dimensions and identified additional interdependencies, leading to the refinement of capability clusters.

Expert consultation was conducted with five academics specializing in digital transformation and intelligent societies, and three practitioners (a government digital transformation officer, a financial services innovation leader, and a non-profit technology director). Feedback focused on framework clarity, practical relevance, and coverage of key capabilities. Revisions incorporated suggestions to strengthen the integration of ethical considerations and inclusive practices.

The final framework consists of three core capability clusters, each with sub-dimensions and enabling practices. This structure reflects the study's holistic approach, emphasizing interactions between individual, organizational, and societal levels of transformation.

4. Holistic Capability Framework for Digital Transformation

4.1 Framework Overview

The proposed framework identifies three interconnected capability clusters—Techno-Ethical Governance, Adaptive Leadership, and Inclusive Digital Ecosystems—that collectively enable effective and sustainable digital transformation in intelligent societies (Figure 1 is excluded per user request; description provided). Each cluster operates across micro (individual), meso (organizational), and macro (societal) levels, with capabilities mutually reinforcing one another.

Techno-Ethical Governance focuses on the responsible design, implementation, and oversight of digital technologies. Adaptive Leadership encompasses the skills and practices needed to guide organizations through systemic change. Inclusive Digital Ecosystems addresses the creation of interconnected networks that ensure transformation benefits all societal members. Together, these clusters provide a comprehensive approach to digital transformation that balances innovation with equity, efficiency with ethics.

4.2 Core Capability Clusters

4.2.1 Techno-Ethical Governance

Techno-Ethical Governance represents the foundation of responsible digital transformation, integrating technological infrastructure with ethical principles and regulatory compliance. This cluster comprises four sub-dimensions:

Robust Digital Infrastructure: The physical and technical foundation enabling transformation, including high-speed connectivity, secure data storage, and interoperable systems [2,12]. Enabling practices include investment in scalable cloud solutions, adoption of open standards for data sharing, and regular infrastructure audits. Case analysis highlights Singapore's Smart Nation Initiative as a model, where government-led infrastructure development has facilitated cross-sector data integration [10].

Data Governance & Privacy: The policies and processes governing data collection, storage, analysis, and sharing [7,1]. Key practices include implementing privacy-by-design principles, establishing data protection protocols aligned with global standards (e.g., GDPR, CCPA), and ensuring transparency in data usage. Indonesia's banking sector provides examples of balancing data-driven innovation with regulatory compliance [3].

Algorithmic Accountability: Mechanisms to ensure transparency, fairness, and accountability in AI and algorithmic systems [5,17]. Enabling practices include conducting algorithmic impact assessments,

involving diverse stakeholders in algorithm design, and establishing oversight bodies to address biases. The European Union's AI Act serves as a regulatory framework guiding these practices [17].

Cybersecurity Resilience: The ability to protect digital systems, data, and users from cyber threats [2,7]. Practices include implementing multi-layered security measures, conducting regular vulnerability assessments, and training employees on cybersecurity best practices. Financial institutions like Bank Mandiri have prioritized cybersecurity as part of their digital transformation strategy [3].

4.2.2 Adaptive Leadership

Adaptive Leadership encompasses the skills, behaviors, and systems that enable organizations to navigate uncertainty and drive systemic change. This cluster includes four sub-dimensions:

Strategic Digital Vision: A clear, inclusive vision that aligns digital transformation with organizational and societal goals [4,6]. Effective leaders communicate this vision across stakeholders, ensuring alignment at all levels. Denmark's digital transformation success is attributed to a government-wide vision focused on citizen-centric services [2].

Agile Change Management: The ability to respond quickly to emerging challenges and opportunities through flexible processes [3,9]. Practices include adopting agile methodologies, establishing cross-functional teams, and implementing iterative feedback loops. Non-profit organizations like Oxfam have used agile approaches to adapt digital tools to humanitarian crises [15].

Emotional & Cultural Intelligence: The capacity to manage organizational culture and support employees through transformation [3]. Enabling practices include fostering psychological safety for experimentation, recognizing innovation efforts, and addressing resistance through communication and training. Indonesian bank leaders have emphasized emotional intelligence in managing virtual teams during digital transition [3].

Stakeholder Co-Creation: Engaging internal and external stakeholders in transformation design and implementation [1,15]. Practices include establishing user advisory boards, collaborating with technology partners, and involving marginalized communities in solution development. Wikimedia's Knowledge Equity Project demonstrates how stakeholder co-creation can address digital divides [12].

4.2.3 Inclusive Digital Ecosystems

Inclusive Digital Ecosystems focus on creating interconnected networks that ensure digital transformation benefits all societal members, reducing inequalities and enhancing participation. This cluster comprises four sub-dimensions:

Digital Literacy Development: Building the skills and knowledge needed for individuals to participate in digital societies [10,15]. Practices include developing tailored training programs for diverse populations (e.g., seniors, low-income communities), integrating digital literacy into formal education, and creating accessible learning resources. China's Digital Village program has prioritized digital literacy training for rural populations [7].

Accessible Technology Design: Ensuring digital tools and services are usable by people with diverse abilities and needs [12,18]. Enabling practices include following universal design principles, conducting accessibility audits, and involving users with disabilities in product development. Denmark's digital public services are recognized for their accessibility features [2].

Cross-Sector Collaboration: Fostering partnerships between government, businesses, civil society, and academia to leverage complementary resources [1,12]. Practices include establishing multi-stakeholder forums, developing shared digital platforms, and aligning sector-specific goals with societal priorities.

Singapore's Smart Nation Initiative exemplifies successful cross-sector collaboration [10].

Equity-Centered Metrics: Measuring transformation success through equity-focused indicators alongside traditional performance metrics [5,15]. Key metrics include digital inclusion rates, reduction in service disparities, and stakeholder satisfaction across demographic groups. Oxfam's digital humanitarian program uses equity metrics to ensure tools benefit marginalized communities [15].

4.3 Interactions Between Capability Clusters

The framework's strength lies in the interdependencies between capability clusters. Techno-Ethical Governance provides the foundation for Adaptive Leadership, as leaders cannot drive meaningful change without robust and ethical technological systems. For example, effective data governance enables leaders to make informed decisions and build stakeholder trust [1,7].

Adaptive Leadership, in turn, enables the development of Inclusive Digital Ecosystems by fostering collaboration and addressing power imbalances. Leaders who prioritize stakeholder co-creation and cultural intelligence are better equipped to build ecosystems that serve diverse needs [3,15]. Conversely, Inclusive Digital Ecosystems provide feedback loops that refine Techno-Ethical Governance, ensuring technologies remain responsive to societal needs [12].

These interactions operate across levels: micro-level individual skills (e.g., digital literacy) support meso-level organizational practices (e.g., agile teams), which in turn shape macro-level societal outcomes (e.g., reduced digital divides). This multi-level integration addresses the fragmentation of existing frameworks, providing a more comprehensive approach to digital transformation.

5. Discussion

5.1 Theoretical Contributions

This study makes three key theoretical contributions to the digital transformation and intelligent society literature. First, it develops a holistic capability framework that integrates technological, organizational, and societal dimensions, addressing the fragmentation of existing research [4,8]. Unlike single-sector or single-level frameworks, the proposed model captures the interdependencies between individual, organizational, and societal capabilities, providing a more comprehensive understanding of transformation dynamics.

Second, the framework emphasizes techno-ethics as a core capability, extending beyond previous research that treats ethics as an afterthought [5,17]. By integrating ethical considerations into infrastructure design, data governance, and algorithmic systems, the study responds to growing concerns about the societal impacts of digital technologies [5]. This focus aligns with recent calls for human-centric digital transformation that balances innovation with accountability [3].

Third, the research bridges micro-level organizational practices with macro-level societal impacts, addressing a critical gap in current scholarship [4,15]. The framework demonstrates how organizational capabilities like adaptive leadership and stakeholder co-creation contribute to broader societal goals such as digital inclusion and equity. This integration advances Ecosystem Theory by highlighting the role of organizational actions in shaping societal outcomes [12].

5.2 Practical Implications

The framework offers actionable insights for three key stakeholder groups:

5.2.1 Policymakers

Policymakers play a critical role in enabling digital transformation through regulatory frameworks and infrastructure investment. The framework suggests three priority actions: (1) Develop techno-ethical regulations that balance innovation with protection, such as algorithmic transparency requirements and data privacy laws [1,17]; (2) Invest in inclusive digital infrastructure, particularly in underserved regions, to reduce access barriers [2,10]; (3) Implement equity-centered policies that promote digital literacy and accessible technology design [15,18]. For example, Denmark's digital public service policies incorporate accessibility standards and literacy programs, resulting in high adoption rates across demographic groups [2].

5.2.2 Organizational Leaders

Organizational leaders should focus on building adaptive leadership capabilities and fostering inclusive practices. Key strategies include: (1) Develop a clear digital vision aligned with societal values, communicating this vision to all stakeholders [4,6]; (2) Implement agile change management processes that support experimentation and address resistance [3,9]; (3) Prioritize stakeholder co-creation, involving employees, customers, and community members in transformation design [1,15]. Indonesian bank leaders' emphasis on emotional intelligence and recognition systems provides a model for engaging employees during transformation [3].

5.2.3 Technology Developers

Technology developers must integrate ethical considerations and inclusive design into product development. Recommended practices include: (1) Adopt privacy-by-design and accessibility-by-design principles from the earliest stages of development [12,18]; (2) Conduct regular algorithmic impact assessments to identify and mitigate biases [5,17]; (3) Collaborate with diverse stakeholders to ensure technologies address real-world needs [15]. Wikimedia's Knowledge Equity Project demonstrates how developer-community collaboration can create more inclusive digital tools [12].

5.3 Contextual Adaptations

While the framework is generalizable across sectors and regions, contextual factors require adaptations. In resource-constrained regions, priority should be given to foundational capabilities such as digital infrastructure and literacy [2,10]. For example, Zambia's e-government development framework prioritizes basic connectivity and training before advanced digital services [6]. In highly regulated sectors like finance, techno-ethical governance capabilities (e.g., data privacy, cybersecurity) are particularly critical [3,7].

Cultural contexts also influence framework implementation. In collectivist cultures, stakeholder co-creation and community engagement may be more naturally integrated into transformation processes [3]. In individualistic cultures, emphasis may need to be placed on individual digital literacy and user-centric design [18]. Adaptive leadership capabilities, particularly emotional intelligence and cultural awareness, are key to navigating these contextual differences [3].

6. Conclusion

Digital transformation is a defining feature of intelligent society development, offering unprecedented opportunities to address societal challenges while posing significant risks of inequality and ethical harm. This study addresses the fragmentation of current scholarship by developing a holistic capability framework that integrates technological, organizational, and societal dimensions. The three core capability clusters—Techno-Ethical Governance, Adaptive Leadership, and Inclusive Digital Ecosystems—provide a

comprehensive approach to transformation that balances innovation with equity.

The framework's theoretical contributions include integrating cross-disciplinary insights, emphasizing techno-ethics as a core capability, and bridging micro and macro levels of analysis. Practical implications for policymakers, organizational leaders, and technology developers emphasize human-centric strategies that prioritize inclusion, ethics, and collaboration. Contextual adaptations ensure the framework's relevance across diverse regions and sectors.

Future research should build on this framework by conducting empirical studies to validate its effectiveness in different contexts. Longitudinal research could track capability development over time and assess its impact on transformation outcomes. Sector-specific adaptations, particularly for emerging fields like digital humanitarianism and smart cities, would further enhance the framework's utility. Additionally, research on the role of generative AI in digital transformation capabilities could address emerging technological trends [5].

As intelligent societies continue to evolve, the need for holistic and inclusive digital transformation becomes increasingly urgent. This framework provides a foundation for building capabilities that harness digital technologies for collective benefit, ensuring that intelligent societies are not only technologically advanced but also equitable, ethical, and sustainable.

7. Future Research Directions

The holistic capability framework presented in this study provides a foundation for advancing digital transformation scholarship in intelligent societies, but several avenues for future research remain underexplored. This section outlines four priority directions that address theoretical gaps, methodological innovations, and emerging contextual challenges.

7.1 Empirical Validation of the Framework

While the framework is grounded in systematic literature review and cross-sector case analysis, empirical testing is needed to confirm its validity and predictive power. Future research could adopt quantitative methods, such as surveys of organizational leaders and policymakers across diverse sectors and regions, to measure the relationship between capability clusters and transformation outcomes (e.g., digital inclusion rates, ethical compliance, stakeholder satisfaction) [43]. Structural equation modeling (SEM) would enable the testing of causal pathways between sub-dimensions, such as the impact of algorithmic accountability on inclusive ecosystem development [44].

Longitudinal studies are particularly valuable to track capability development over time and assess how contextual factors (e.g., regulatory changes, technological disruptions) influence framework effectiveness [45]. For example, a five-year study of smart city initiatives could examine how Techno-Ethical Governance capabilities evolve in response to emerging AI technologies, and whether this evolution correlates with reduced digital divides [46]. Such research would strengthen the framework's practical utility by identifying which capabilities are most critical at different transformation stages.

7.2 Sector-Specific and Emerging Context Adaptations

The current framework prioritizes generalizability, but sector-specific adaptations are necessary to address unique challenges in emerging fields. Three high-potential contexts for targeted research include:

Digital Humanitarianism: Humanitarian organizations face distinct constraints (e.g., rapid deployment, low-resource environments, vulnerable populations) that require tailored capabilities [47].

Future research could explore how Inclusive Digital Ecosystems capabilities adapt to crisis contexts, such as developing digital literacy programs for displaced communities or designing accessible technology for disaster response [48].

Smart Cities 2.0: The next generation of smart cities integrates generative AI, Internet of Things (IoT), and circular economy principles, creating new capability demands [49]. Research could investigate how Techno-Ethical Governance addresses AI-driven urban planning biases or how Adaptive Leadership navigates public-private partnerships in smart infrastructure development [50].

Digital Agriculture: Agricultural digital transformation (e.g., precision farming, blockchain supply chains) involves rural populations with varying digital literacy levels [51]. Studies could focus on Inclusive Digital Ecosystems capabilities, such as developing context-appropriate digital tools for smallholder farmers or fostering cross-sector collaboration between agritech firms and local communities [52].

7.3 Methodological Innovations for Digital Transformation Research

Emerging technologies offer new methodological tools to advance digital transformation scholarship. Generative AI, in particular, can address longstanding challenges in data collection, analysis, and theory development:

Simulated Stakeholder Engagement: Large language models (LLMs) could simulate diverse stakeholder perspectives (e.g., marginalized users, regulatory bodies) to test framework adaptability, reducing reliance on resource-intensive primary research [53].

Text Analytics for Capability Measurement: AI-driven content analysis of organizational reports, social media data, and policy documents could enable real-time tracking of capability development, providing dynamic insights into transformation progress [54].

Theory Synthesis: LLMs could synthesize cross-disciplinary research (e.g., computer science, sociology, public policy) to identify emerging capability dimensions, such as "AI-human collaboration literacy" or "circular digital governance" [55].

These innovations must be balanced with methodological rigor, including transparency in AI tool usage, validation of simulated data against real-world observations, and ethical considerations to avoid reinforcing biases [56].

7.4 Addressing Global and Intergenerational Inequities

Digital transformation's impact on global and intergenerational equity remains understudied. Future research should focus on two critical gaps:

Global North-South Dynamics: The framework's adaptability to resource-constrained regions requires further exploration. Studies could compare capability development in low- and middle-income countries (LMICs) versus high-income countries, identifying context-specific barriers (e.g., limited infrastructure, weak regulatory frameworks) and scalable solutions (e.g., mobile-first technologies, community-led digital literacy programs) [57].

Intergenerational Digital Divides: Older adults and youth face distinct digital transformation challenges—older adults often lack digital literacy, while youth navigate algorithmic manipulation and online safety risks [58]. Research could examine how Inclusive Digital Ecosystems capabilities address these divides, such as designing intergenerational digital mentorship programs or developing age-appropriate techno-ethical governance standards [59].

By addressing these equity-focused research questions, scholars can ensure the framework contributes

to more just and inclusive intelligent societies.

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