Digital Public Management in the VUCA Era: A Systematic Review of Trends and Challenges

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Abstract

The VUCA era (Volatility, Uncertainty, Complexity, Ambiguity) demands the public sector to transform rapidly, adaptively, and innovatively. Digital transformation in public management not only involves the adoption of technology but also a paradigm shift in governance, leadership, and public service delivery. This study aims to systematically analyze the trends, challenges, and impacts of digital transformation on public governance in the VUCA era. The research employs a Systematic Literature Review (SLR) approach by examining 45 scientific articles indexed in Scopus, DOAJ, and Google Scholar published between 2018 and 2024. The findings reveal three main focuses in studies of digital transformation in the public sector: (1) digital governance innovation and transparency, (2) adaptive leadership and strengthening of digital human resource capacity, and (3) risk management in complex and uncertain government environments. The major challenges lie in cross-agency system integration, bureaucratic cultural resistance, and ethical as well as data security issues. This study recommends the "Adaptive Digital Public Management" model, which emphasizes collaboration, organizational resilience, and data-driven innovation as the foundation for robust public governance in the VUCA era.

1. Introduction

The 21st century is characterized by the VUCA environment, Volatility, Uncertainty, Complexity, and Ambiguity, which has profoundly reshaped how governments design and implement public policies. Rapid technological advancement, global crises, and dynamic social expectations force public institutions to evolve beyond traditional bureaucratic structures that are often rigid, hierarchical, and slow to respond (Bennett & Lemoine, 2019). In this environment, the conventional models of public administration no longer suffice; instead, governments must develop *adaptive digital governance* systems capable of maintaining agility and trust amid uncertainty (Ansell & Trondal, 2021).

From a more specific perspective, digital transformation in public management is not limited to adopting information technologies but also entails a paradigm shift in governance logic, leadership, and citizen engagement (Mergel et al., 2019). Digital governance emphasizes transparency, efficiency, and inclusivity supported by big data, artificial intelligence, and integrated information systems (Janssen & van der Voort, 2020). The increasing reliance

on digital infrastructure also creates new challenges related to cybersecurity, data privacy, and the ethical use of algorithms in decision-making (Zuiderwijk & Welch, 2021). Consequently, public organizations must not only innovate technologically but also cultivate adaptive leadership and digital competency among civil servants (Kettunen & Kallio, 2023).

Despite extensive discussions on e-government and digital governance, existing research remains fragmented. Most prior studies focus on single-country cases, sectoral innovations, or isolated technological tools, leaving a research gap in understanding how governments as systems adapt holistically within a VUCA context (OECD, 2021). This gap underscores the need for a systematic review that synthesizes emerging trends, identifies common challenges, and proposes integrative frameworks for adaptive governance in the digital era.

The novelty of this study lies in proposing the *Adaptive Digital Public Management (ADPM)* model, derived from cross-study synthesis, that conceptualizes how collaboration, organizational resilience, and data-driven innovation intersect to strengthen governance performance. The grand theory underpinning this study is Adaptive Systems Theory, which views public institutions as open systems continuously interacting and adapting to volatile environments (Uhl-Bien & Arena, 2018). By applying this theoretical lens, digital transformation is understood as a dynamic capability rather than a static technological adoption.

In this regard, the present research positions itself at the intersection of digital governance and adaptive management studies, aiming to systematically review how digital transformation contributes to public sector adaptability, transparency, and resilience in the VUCA era. This theoretical and practical positioning enables the study to offer a comprehensive framework for policymakers, scholars, and practitioners seeking to build robust digital public management systems responsive to uncertainty and complexity.

2. Research Methods

This study adopts a Systematic Literature Review (SLR) approach, following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher et al., 2019). The SLR method was chosen to ensure transparency, replicability, and comprehensiveness in identifying and analyzing the body of knowledge related to digital transformation in public management. Unlike narrative reviews, the SLR method allows the synthesis of diverse empirical and conceptual studies through structured screening, eligibility assessment, and coding procedures (Snyder, 2019). This approach is appropriate for mapping the evolution of digital governance research and identifying theoretical and methodological patterns across studies conducted in various contexts of the VUCA environment.

The data sources for this review include Scopus, DOAJ, and Google Scholar, chosen for their extensive coverage of peer-reviewed journals in public administration, management, and information systems. The publication range spans from 2018 to 2024, reflecting the latest developments in digital transformation and governance adaptation. The inclusion criteria consist of empirical or conceptual studies that explicitly discuss themes of *digital transformation*, *governance innovation*, *leadership adaptation*, or *risk management* in public institutions. Exclusion criteria include non-peer-reviewed papers, conference abstracts without full text, and articles unrelated to public sector management. Using these criteria, an initial pool of 75 articles was identified, and through multi-stage filtering and relevance assessment, 45 articles were selected for final analysis.

Data were analyzed using thematic coding to identify recurring themes, theoretical frameworks, and methodological approaches. The coding process was conducted in three stages: open coding to capture initial patterns, axial coding to connect related concepts, and selective coding to formulate overarching themes (Braun & Clarke, 2021). The analysis revealed three dominant thematic clusters: (1) *digital governance innovation and transparency*, (2) *adaptive leadership and human resource capacity*, and (3) *risk management in complex governmental environments*. The integration of these themes provides the analytical foundation for proposing the Adaptive Digital Public Management (ADPM) model as a conceptual framework to navigate the challenges of governance in the VUCA era.

3. Result and Discussion

Digital Governance Innovation and Transparency

The findings reveal that digital transformation in the public sector has become a fundamental strategy for achieving transparency, accountability, and citizen-centric governance. Governments increasingly utilize digital platforms to facilitate access to public information, encourage participation, and streamline administrative processes (Janssen & van der Voort, 2020). Tools such as open data portals, smart city dashboards, and AI-assisted service systems enable real-time decision-making and foster public trust by enhancing institutional visibility (Gil-Garcia, Dawes, & Pardo, 2018). In several advanced economies, open government initiatives have been institutionalized through legislative frameworks mandating data openness and digital reporting mechanisms (OECD, 2021).

However, in many developing nations, digital governance innovation remains hindered by structural inequalities, including limited infrastructure, low digital literacy, and fragmented information systems (Heeks, 2022). Technological innovations often fail to achieve sustainability when not aligned with socio-political contexts and citizen needs (Mergel et al., 2019). Moreover, the overreliance on technology without institutional reform can reproduce bureaucratic inefficiencies in digital form a phenomenon known as "digital bureaucracy" (Cordella & Tempini, 2021). Thus, while digital platforms expand transparency and accessibility, their success depends on integrative policies, cross-sectoral coordination, and continuous capacity development.

The discussion also indicates that transparency is no longer limited to data disclosure; it now encompasses *algorithmic transparency* and *digital accountability*. Governments must ensure that data-driven decisions such as those produced by AI or automated systems are traceable, explainable, and aligned with ethical standards (Zuiderwijk & Welch, 2021). This broader conception of transparency requires an interplay between technical, legal, and ethical frameworks to maintain citizen trust in algorithmic governance.

Adaptive Leadership and Human Resource Capacity

Leadership has emerged as a decisive factor in the success or failure of digital transformation initiatives. The reviewed studies consistently emphasize that technological innovation must be accompanied by adaptive leadership, characterized by agility, systems thinking, and a willingness to experiment under uncertainty (Uhl-Bien & Arena, 2018). Digital leaders are expected not only to introduce technological tools but also to shape a new organizational culture that values data-driven decision-making, collaboration, and resilience (Kettunen & Kallio, 2023).

Developing digital human capital is central to this transformation. Public servants must acquire digital literacy, analytical competencies, and ethical awareness to navigate technology-mediated work environments (Tangi, Janssen, & Benedetti, 2021). However, many bureaucracies still suffer from skill gaps and generational divides, where senior officials are less adaptable to technological change compared to younger employees (Dwivedi et al., 2022). The challenge, therefore, is to integrate continuous learning mechanisms and hybrid training models that balance technical and managerial competencies.

Furthermore, adaptive leadership promotes a learning-oriented organizational culture that treats digital failure as a learning opportunity rather than a bureaucratic risk (Ansell & Trondal, 2021). In the VUCA era, leaders must facilitate rapid experimentation, encourage cross-departmental collaboration, and use data analytics to inform strategic decisions. Leadership agility, underpinned by emotional intelligence and foresight, enables public institutions to remain responsive amid crises such as pandemics, cyberattacks, or economic disruptions (Mazzucato & Kattel, 2020). This shift in leadership orientation represents a move from command and control hierarchies toward networked and adaptive governance systems capable of learning in real time.

Risk Management in Complex and Uncertain Environments

The VUCA environment amplifies the complexity of risk management in digital public management. The reviewed literature identifies multiple dimensions of digital risk: cybersecurity threats, data breaches, misinformation, and algorithmic bias (Hansson, Belkacem, & Ekenberg, 2020). Cybersecurity incidents targeting public institutions ranging from ransomware attacks to data manipulation highlight the need for stronger institutional resilience and cross-agency coordination (Norris & Reddick, 2022). In addition, data privacy and ethical governance have become pressing concerns as governments deploy AI and big data analytics for surveillance, policy evaluation, and service delivery. Without robust legal safeguards and transparent data governance frameworks, digital transformation risks undermining public trust.

Cross-agency collaboration remains another persistent challenge. Most public organizations operate with siloed information systems and incompatible digital architectures, impeding interoperability and integrated policymaking (Anthopoulos, 2022). The lack of standardized data protocols and communication channels between ministries or local governments exacerbates coordination failures, particularly during emergencies that require rapid, unified responses (Kettunen & Kallio, 2023). To address this, several scholars recommend adopting whole-of-government digital strategies that unify data governance and strengthen interdepartmental networks (World Bank, 2024).

Finally, effective risk management in the VUCA context demands resilient digital governance frameworks capable of anticipating, absorbing, and adapting to disruptions. This aligns with the principles of Adaptive Systems Theory, which view public institutions as dynamic entities continuously interacting with complex external environments (Uhl-Bien & Arena, 2018). The review underscores that governments must shift from reactive to proactive risk management approaches—integrating predictive analytics, scenario planning, and ethical auditing mechanisms. By doing so, public institutions can ensure not only technological robustness but also institutional legitimacy and social trust in an increasingly volatile digital era.

Challenges in Digital Public Transformation

The systematic review identified three major challenges that consistently hinder the effectiveness of digital transformation in the public sector: (1) cross-agency system integration, (2) bureaucratic cultural resistance, and (3) ethical and security concerns. These challenges highlight the paradox of digital governance, while technology promises efficiency and transparency, institutional and cultural constraints often delay or distort its implementation (Cordella & Tempini, 2021). Addressing these issues requires not only technological solutions but also adaptive organizational reforms that align digital innovation with governance values, institutional capacity, and citizen trust.

The first challenge, cross-agency system integration, reflects the structural fragmentation of government data architectures and the persistence of siloed administrative operations. Many public institutions deploy digital systems independently, resulting in redundant databases and incompatible software infrastructures that hinder interoperability (Janssen & van der Voort, 2020). This lack of integration prevents data sharing and coordinated decision-making across ministries or local governments, ultimately reducing efficiency and responsiveness (Anthopoulos, 2022). Effective digital transformation therefore demands a *whole-of-government* approach that promotes interoperability standards, shared digital infrastructure, and collaborative platforms. Countries such as Estonia and South Korea demonstrate that strong institutional coordination mechanisms and centralized digital frameworks can significantly enhance the scalability and resilience of e-government systems (OECD, 2021).

The second challenge involves bureaucratic cultural resistance, which remains one of the most persistent barriers to sustainable digital reform. Public bureaucracies are traditionally characterized by stability, hierarchy, and risk aversion features that often conflict with the experimental and agile nature of digital innovation (Uhl-Bien & Arena, 2018). Civil servants may perceive automation or data-driven decision systems as threats to professional autonomy or job security (Dwivedi et al., 2022). Additionally, many digital

initiatives fail because they prioritize technological implementation over cultural adaptation and human capacity building (Heeks, 2022). To overcome this, public institutions must foster a *digital mindset* that values learning, collaboration, and experimentation. Leadership development, incentives for innovation, and participatory change management strategies can gradually transform bureaucratic culture from compliance-oriented to innovation-oriented (Kettunen & Kallio, 2023).

The third major challenge concerns ethical and security issues, particularly in relation to data governance and algorithmic accountability. As governments increasingly rely on big data and artificial intelligence for decision-making, new ethical dilemmas emerge regarding privacy, bias, and transparency (Hansson, Belkacem, & Ekenberg, 2020). Weak regulatory frameworks and limited technical expertise exacerbate the risks of data misuse, surveillance, and discrimination in algorithmic systems (Zuiderwijk & Welch, 2021). Moreover, cyberattacks targeting government databases have grown more frequent and sophisticated, threatening national security and public trust (Norris & Reddick, 2022). Strengthening cybersecurity infrastructure, enforcing data protection laws, and institutionalizing algorithmic auditing are therefore critical to ensuring ethical digital transformation. Governments must embed digital ethics into policy design and promote public accountability through transparent data governance mechanisms.

Overall, these three interrelated challenges underscore that digital transformation is not merely a technological endeavor but a socio-institutional evolution. Successful reform requires aligning digital infrastructure with adaptive leadership, cross-sectoral collaboration, and robust ethical frameworks. Only through such integration can governments transform digital tools into sustainable instruments for democratic governance and resilience in the VUCA era.

Proposed Model: Adaptive Digital Public Management (ADPM)

Building upon the synthesis of the 45 studies reviewed, this research proposes the Adaptive Digital Public Management (ADPM) model as a conceptual framework for understanding how public institutions can navigate the challenges of governance in the VUCA era. The model integrates three foundational pillars Collaborative Governance, Organizational Resilience, and Data-Driven Innovation as mutually reinforcing mechanisms that enhance adaptability, transparency, and effectiveness in digital public management. Unlike traditional e-government frameworks, which focus primarily on technological implementation, ADPM emphasizes the dynamic interaction between human, institutional, and technological dimensions as a pathway toward sustainable governance transformation (Uhl-Bien & Arena, 2018; Mergel et al., 2019).

The ADPM framework operates under the theoretical foundation of Adaptive Systems Theory and Complexity Leadership Theory. These perspectives conceptualize public institutions as open systems that continuously learn and evolve through interactions with volatile environments (Ansell & Trondal, 2021). Within this paradigm, digital transformation is not viewed as a one-time reform but as an ongoing adaptive process driven by collaboration, feedback loops, and evidence-based learning. The following subsections elaborate the three interrelated components of the ADPM model.

Collaborative Governance

The first component, Collaborative Governance, underscores the importance of multi-actor cooperation involving government agencies, private enterprises, civil society organizations, and citizens. In the digital era, governance processes are increasingly networked, requiring joint action to address complex public issues such as data management, cybersecurity, and service innovation (Ansell & Gash, 2018). Collaboration ensures that policy design and implementation are co-created rather than imposed, improving legitimacy, accountability, and public value creation.

Empirical evidence demonstrates that successful digital governance depends on the ability of institutions to share data, align standards, and co-produce solutions across sectors (OECD, 2021). For instance, open innovation platforms and digital citizen engagement tools enable governments to crowdsource ideas and

feedback, expanding participatory decision-making (Gil-Garcia et al., 2018). Collaborative networks also enhance crisis responsiveness, as seen during the COVID-19 pandemic, when governments, private tech firms, and communities jointly developed digital tracing and health information systems (Mazzucato & Kattel, 2020).

However, collaboration requires deliberate governance mechanisms, including clear role distribution, trust-building processes, and interoperable systems. Without these, inter-organizational cooperation risks being symbolic rather than substantive (Janssen & van der Voort, 2020). Within the ADPM model, collaborative governance serves as the connective tissue linking digital initiatives across boundaries, ensuring that innovation remains inclusive and anchored in shared accountability.

Organizational Resilience

The second component of the ADPM model is Organizational Resilience, defined as the capacity of public institutions to anticipate, absorb, and adapt to technological and environmental disruptions. Resilience in digital public management involves developing flexible structures, agile workflows, and learning-oriented cultures that can adjust rapidly to emerging challenges (Kettunen & Kallio, 2023). Unlike traditional bureaucratic rigidity, resilient organizations embrace experimentation, modular structures, and decentralized decision-making to maintain functionality under uncertainty (Uhl-Bien & Arena, 2018).

Resilient digital governance is underpinned by three adaptive capacities:

1. Cognitive capacity, the ability to sense environmental change through data and analytics;
2. Behavioral capacity, the organizational flexibility to reconfigure resources and processes; and
3. Institutional capacity, the existence of supportive leadership, trust, and cross-sectoral learning networks (Ansell & Trondal, 2021).

For example, during global crises such as pandemics or cyberattacks, resilient institutions leveraged digital technologies to maintain service continuity through remote governance, online service portals, and cloud-based coordination tools (Norris & Reddick, 2022). However, resilience is not built overnight it requires sustained investment in infrastructure, human capital, and adaptive leadership development. Within the ADPM framework, organizational resilience ensures the sustainability and scalability of digital transformation by fostering institutions that are capable of learning from disruption rather than being destabilized by it.

Data-Driven Innovation

The third pillar, Data-Driven Innovation, emphasizes the use of big data analytics, artificial intelligence, and digital intelligence systems to support evidence-based policymaking. In an era where information is abundant, the capacity to transform raw data into actionable insights becomes a decisive factor in governance quality (Tangi et al., 2021). Governments can employ predictive analytics to anticipate citizen needs, monitor service performance, and allocate resources more efficiently (Mergel et al., 2019).

However, data-driven innovation requires robust governance mechanisms to prevent bias, ensure data security, and uphold ethical standards (Zuiderwijk & Welch, 2021). Data is not neutral, it reflects political, social, and institutional assumptions that must be critically examined (Hansson et al., 2020). Thus, ADPM integrates algorithmic transparency and data ethics as central elements of responsible innovation. Governments are encouraged to establish data stewardship frameworks that combine technical standards with ethical oversight, enabling citizens to trust data-driven public services.

In addition, cross-sectoral data collaboration can generate *collective intelligence*, where insights from multiple stakeholders contribute to continuous innovation. For instance, open government data initiatives have enabled startups, researchers, and civic organizations to co-develop applications that enhance public value

(OECD, 2021). Therefore, data-driven innovation is both a technical and social process that empowers adaptive learning and co-creation across governance networks.

Integrative Perspective of the ADPM Model

The Adaptive Digital Public Management (ADPM) model conceptualizes digital transformation as an iterative cycle of *collaboration → resilience → innovation*. Collaborative governance establishes the social foundation for digital integration; organizational resilience provides the institutional capacity to adapt; and data-driven innovation delivers the analytical intelligence for continuous improvement. These three dimensions interact dynamically within an ecosystem shaped by uncertainty and technological change (Dwivedi et al., 2022).

The key insight from the ADPM model is that digital transformation success depends on balancing technological advancement, human adaptability, and institutional integrity. Overemphasis on technology without social or ethical grounding risks creating digital divides and bureaucratic alienation. Conversely, neglecting innovation in favor of stability leads to stagnation. Thus, the ADPM model advocates a *balanced, adaptive equilibrium* that aligns digital infrastructure with governance ethics, collaborative culture, and data-informed decision-making.

In practical terms, the ADPM framework provides policymakers and scholars with a conceptual roadmap for designing resilient digital governance systems. It encourages governments to move beyond project-based digitalization toward an integrated ecosystem approach grounded in collaboration, adaptability, and continuous learning. Future research should empirically test the ADPM model across different governance contexts, comparing national, regional, and sectoral cases to evaluate its applicability and refine its theoretical propositions.
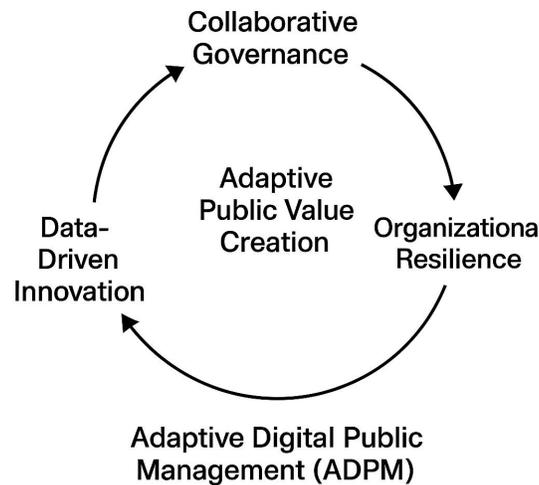

Figure 1. Adaptive Public Value Creation Model

4. Conclusions

Digital transformation in the VUCA era is both a strategic imperative and a profound governance challenge. The rapid pace of technological change, coupled with volatility and uncertainty, requires public institutions to evolve from rigid bureaucratic systems into adaptive, learning-oriented organizations. The findings of this study emphasize that the success of digital governance depends not solely on the adoption of advanced technologies but on the integration of human adaptability, institutional reform, and ethical governance practices. In this sense, digital transformation must be viewed as a continuous socio-technical evolution, one that balances innovation with accountability and inclusiveness.

The proposed Adaptive Digital Public Management (ADPM) framework provides a conceptual lens through which governments can strengthen their resilience and agility in facing complex and unpredictable environments. By linking Collaborative Governance, Organizational Resilience, and Data-Driven Innovation, the ADPM model redefines digital transformation as an adaptive process rooted in partnership, learning, and evidence-based decision-making. This integrative approach ensures that digitalization contributes not only to administrative efficiency but also to democratic legitimacy, public trust, and long-term sustainability. As governments become increasingly data-driven, ethical considerations, particularly transparency, privacy, and algorithmic accountability, must remain central to public value creation.

Future research should empirically test the ADPM model across different governance levels and national contexts to assess its applicability and refine its theoretical propositions. Comparative case studies between developed and developing nations would offer valuable insights into how institutional maturity, political culture, and technological infrastructure shape adaptive capacity. Additionally, longitudinal studies could explore how public institutions internalize digital transformation principles over time. Ultimately, by validating and contextualizing the ADPM framework, scholars and practitioners can contribute to building more resilient, inclusive, and trustworthy public governance systems capable of thriving in the digital and VUCA-driven century.

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