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Contingent Reshaping and Agile Governance of Public Organizations amid Rapid Digital Technological Shifts: A Case Study of Hangzhou's "City Brain"

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ABSTRACT

The rapid development of digital technologies has profoundly transformed the external environment of public organizations, while traditional bureaucratic structures have encountered increasing challenges in adapting to dynamic and complex governance contexts. Existing studies have mainly focused on the application of digital technologies in improving governance efficiency, with insufficient attention paid to how digital environments drive organizational restructuring and governance transformation. Based on contingency theory, this study develops an Environment–Structure–Performance (E-S-P) analytical framework and examines the adaptive transformation of public organizations through a case study of Hangzhou's City Brain. The study explores how high-frequency digital environments generate structural mismatches and how public organizations achieve agile governance through contingency-based restructuring. The findings indicate that digital technologies reshape public organizations through three dimensions: data-driven integration, accelerated temporal coordination, and intelligent decision-making. To adapt to these changes, public organizations promote organizational restructuring through cross-departmental collaboration, process optimization, and the integration of technological capabilities with administrative decision-making. This study contributes to understanding the organizational mechanisms underlying digital governance transformation and provides insights into how public organizations can achieve agile governance in the digital era.

KEYWORDS

Digital Governance; Public Organizations; Contingency Theory; Agile Governance; Smart City; Hangzhou City Brain.

1. INTRODUCTION

The swift and ongoing evolution of technologies such as ubiquitous sensing networks and deep learning has dramatically redrawn the technical frontier of public administration. In the earlier phases of e-government, technology was typically framed as a static administrative aid, its main function confined to accelerating the circulation of official documents. The government data stockpiled during that period was, as a result, mostly fragmented, low-frequency, and lagged in availability. Governance environments have since moved into a phase of relentless fluidity, where cascading streams of real-time data and technologies that erode longstanding spatial and temporal barriers have embedded public organizations in a deeply demanding digital ecosystem. Rather than a single leap, digital transformation tends to unfold through a series of interlocking phases—from the initial birth and maturation of digital technologies, through their organizational and societal repercussions, to their eventual reconfiguration of governmental structures and governance routines. Digital transformation

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is not merely a process of technological upgrading; rather, it involves profound changes in organizational capabilities, institutional arrangements, and governance mechanisms[1][2]. Digital transformation has now entered a stage shaped by the advancement of digital government and smart cities, where the emphasis shifts toward systemic, holistic, and wide-ranging restructuring of governance architectures. Digital government efforts increasingly revolve around deploying digital infrastructures, platforms, and smart technologies to tighten cross-agency coordination, raise the caliber of public service provision, and spark the emergence of novel governance patterns[3][4]. Leading instances of smart city development reveal that digital technologies do more than fine-tune existing administrative procedures; they actively reconfigure governance architectures and decision-making frameworks. By weaving together artificial intelligence, big data analytics, and real-time sensing infrastructures, smart city platforms continuously collect, synthesize, and analyze streams of urban operational data, thereby underpinning strategic decision-making, risk forecasting, and emergency response. Such data-enabled governance capacities have steered a departure from reactive modes of governance and toward approaches that are inherently predictive and proactive[5][6]. Through the integration of sophisticated sensor networks and data-driven analytical tools, municipal governance structures have enhanced their capacity to anticipate emerging threats and intervene in intricate urban problems before they escalate.

However, the underlying logic of modern public organizations remains deeply rooted in Max Weber's classical model of rational bureaucracy. When confronted with a high-frequency technological environment measured in milliseconds, this relatively stable bureaucratic structure reveals significant limitations. Rigid organizational arrangements and lengthy administrative procedures have generated a substantial mismatch between public organizations and rapidly evolving digital environments. From Weber's perspective[7], bureaucracy represents an administrative system in which specialized professionals operate according to clearly defined divisions of labor and established abstract rules. Its original design was intended to ensure efficiency and stability within relatively stable and predictable low-frequency environments through horizontal specialization, hierarchical authority structures, formalized rules, and impersonal rationality[8]. In contrast, contemporary digital environments operate through high-frequency, multi-source data flows and intelligent agent-based automated task allocation, making traditional vertically structured organizational arrangements increasingly incompatible with this emerging ecosystem. Under the pressure of digital transformation, the structural frictions and operational deficiencies embedded within bureaucratic systems have become increasingly evident. First, the persistent challenge of "information silos" remains a fundamental obstacle to digital governance. Fragmented information systems, limited interoperability among governmental departments, and insufficient cross-organizational data-sharing mechanisms constrain the integration of heterogeneous data resources required for advanced analytics and artificial intelligence-assisted decision-making[9]. Second, temporal misalignment has emerged as an even more critical source of organizational friction. The value of contemporary predictive models increasingly depends on real-time data processing, rapid risk identification, and immediate response capabilities, whereas traditional bureaucratic organizations continue to rely heavily on hierarchical procedures and sequential administrative coordination. The divergence between algorithmic responsiveness and bureaucratic processing speed presents substantial challenges for digital governance. For instance, when algorithms have already detected emerging risks such as traffic congestion or public safety threats, administrative directives may still be undergoing formal approval and communication procedures. Consequently, the gap between technological velocity and bureaucratic velocity constrains the ability of digital systems to fully support agile governance[10].

In summary, the fundamental challenge confronting contemporary public governance lies in the intense friction between rapidly evolving technological environments and deeply institutionalized bureaucratic structures. Addressing such friction cannot be reduced to the superficial application of instrumental rationality, as technology itself does not automatically transform governments [11]. If public organizations merely prioritize hardware acquisition and platform development while maintaining conventional institutional arrangements and governance mechanisms, digital reforms

will not achieve agile governance. Instead, they may generate substantial internal friction costs, ultimately leading to ineffective digital governance practices and the proliferation of digital formalism [2]. A growing body of scholarship argues that digital governance is essentially a process of mutual embedding between technological innovation and institutional transformation[11]. Therefore, how to conduct profound structural reconstruction and mechanism innovation within public organizations in accordance with the evolutionary patterns of external technological environments, thereby developing "digital agility"[12], has become a critical question requiring urgent attention from both academia and practice.

Building upon this perspective, this study adopts a contingency perspective within organizational theory and examines the digital government reform of Hangzhou's "City Brain" as a case study. Specifically, it focuses on three central research questions:

(1) In what dimensions does a high-frequency, multi-source, and real-time digital technological environment generate irreversible pressures of misalignment on traditional bureaucratic structures and administrative workflows?

(2) Under the external pressures induced by technological transformation, how can public organizations achieve adaptive transformation toward greater agility?

(3) What practical challenges may emerge during the pursuit of agile governance transformation, and how can these challenges be effectively addressed?

2. THEORETICAL FOUNDATION AND ANALYTICAL FRAMEWORK CONSTRUCTION

2.1. Contingency Theory and Its Digital Evolution

Contingency theory emerged in the United States during the 1960s and 1970s as a theoretical response to the practical needs of management. Represented by scholars such as Lawrence and Lorsch[8], the contingency school argues that effective management requires organizations to adapt flexibly according to their internal conditions and external environments, and that there is no universally applicable "one best way" of management theory or practice. The central theoretical contribution of contingency theory lies in its challenge to the "one best method" principle[13] advocated by classical management theorists, including Taylor and Fayol. Rooted in systems theory, contingency theory emphasizes that organizations are constrained by environmental changes and conceptualizes contingency relationships as "if–then" functional relationships, where environmental conditions serve as independent variables, while managerial concepts and practices constitute dependent variables[14]The fundamental proposition of contingency theory is that organizational internal elements and external environmental conditions vary across contexts; therefore, no managerial principles or methods can be universally applied to all situations. Instead, effective management requires continuous adjustment according to changes in environmental conditions and internal organizational characteristics. In other words, the high performance of public organizations depends on the degree of alignment between their internal structures and external environments.

To rigorously conceptualize this dynamic mechanism, the survival and development process of organizations can be abstracted as an adaptive function system, which must satisfy specific alignment conditions:

$$\boldsymbol{P = f(S, E)\ and\ P \propto f(S, E)}$$

Within this mapping relationship, the variable **P** represents the ultimate realization of public value, while the effectiveness threshold is determined by the degree of alignment between the internal bureaucratic structure (**S**) and the external environment (**E**). The model suggests that the optimization of public organizational performance can only be achieved when the institutional power structure and

operational architecture are capable of sensitively perceiving environmental changes and subsequently undergoing self-deconstruction and reconstruction. Conversely, when external environments evolve at a pace that exceeds the adaptive capacity of institutional structures, deep structural friction caused by "structural misalignment" will emerge, ultimately undermining overall governance capacity. To further examine the micro-level mechanisms of organizational adaptation, Lawrence and Lorsch's two-dimensional analytical framework of differentiation and integration provides particularly important theoretical insights. According to their theory, when organizations encounter increasing environmental complexity, they respond by promoting internal functional differentiation, namely, establishing multiple highly specialized and vertically oriented departments to address diverse environmental demands. However, this process generates a fundamental paradox within bureaucratic operations: excessive differentiation is often accompanied by excessive fragmentation. To preserve the integrity of public governance, organizations must simultaneously activate integration mechanisms. When environmental uncertainty reaches its peak, organizations need to establish coordination and integration infrastructures across fragmented functional units in order to maintain collective action and ensure organizational coherence.

From a contemporary perspective, the fundamental limitation of Weberian bureaucracy lies in the fact that excessive functional specialization has gradually evolved into rigid departmental isolation, causing integration efforts to become trapped in internal coordination costs. More importantly, the environmental variables upon which classical contingency theory was originally based have undergone an ontological transformation. Traditional organizational environments, previously measured through annual or monthly cycles, have been replaced by a highly dynamic digital ecosystem characterized by continuous access to multi-source heterogeneous data, real-time computational processing enabled by underlying neural networks, and ultra-high-frequency concurrent demands from frontline operations. Together, these elements constitute an exceptionally fast-evolving technological environment. This new environment has intensified the inherent tension between differentiation and integration within organizational structures. At the foundational computational level of digital governance, massive volumes of data require highly granular feature extraction and decomposition. However, at the operational level, administrative execution chains demand a high degree of continuity and coherence, leaving little tolerance for physical disruptions caused by departmental boundaries. Consequently, public institutions are increasingly compelled to develop instantaneous cross-system coordination capabilities. Against this backdrop, classical contingency models require theoretical refinement and further evolution. Within the framework of agile governance, dynamic adaptation can no longer be achieved through occasional organizational restructuring conducted every several years. Public organizations must instead reconstruct their underlying architectures and develop agile infrastructures capable of supporting high-concurrency data processing and achieving closed-loop operations through system interfaces. Only by aligning the operational rhythm of institutions with the tempo of digital systems can deep friction arising from severe organizational misalignment be effectively mitigated.

2.2. Dimensional Deconstruction of the Technological Environment Facing Public Organizations

Technology has conventionally been situated at the margins of public administration scholarship, where it is framed as a backdrop that evolves only incrementally and remains relatively static. This assumption, however, has been seriously contested by the way ubiquitous sensing networks have become deeply woven into the backbone infrastructure of contemporary smart cities. The technological conditions faced by public agencies today have shifted from gradual, cumulative expansion to a profound qualitative shift. Rather than confining technology to the role of a passive administrative device, this study foregrounds its evolution into an encompassing external ecosystem, which exerts structural constraints on organizations and continuously reshapes their institutional forms. Drawing on the dimensions of data flows, spatiotemporal dynamics, and reasoning-based

decision-making, this study investigates how the technological environment is undergoing rapid transformation.

2.2.1. Data Flow Dimension

Traditional administrative systems have long been accustomed to processing periodically aggregated statistical reports and static textual archives, with their underlying characteristics constrained by low-frequency and discontinuous information flows. However, once governmental operations become integrated with digital infrastructures such as the "City Brain," the nature of environmental inputs undergoes a fundamental transformation. Data generated by sensors, communication infrastructures, and backend operational logs collectively inject massive volumes of concurrent real-time information into administrative systems. The enormous scale and multi-source heterogeneity of these data flows have already exceeded the processing capacity of individual departments. The physical expansion of the data environment itself has directly disrupted information barriers constructed around departmental interests, forcing public organizations to move beyond isolated departmental operations and establish collaborative data mechanisms capable of supporting cross-domain data integration, real-time processing, and centralized coordination.

2.2.2. Spatiotemporal Dimension

Beyond the expansion of data flows, technological transformation has substantially compressed the spatial and temporal boundaries of public governance. Traditional bureaucratic systems often operate with delayed response cycles: from problem identification and grassroots reporting to hierarchical transmission and administrative coordination, the entire feedback loop typically unfolds over days or even weeks. Today, enabled by cloud–edge–terminal architectures, subtle changes in the physical world can be comprehensively projected into digital systems within extremely short periods, allowing governance centers to achieve near-instantaneous perception of urban emergencies. On one side lies the external demand for real-time responsiveness characterized by second-level updates; on the other side remains a sequential administrative process based on interconnected chains of document circulation and approval. This profound temporal divergence has pushed traditional organizations toward comprehensive acceleration and operational restructuring.

2.2.3. Reasoning and Decision-Making Dimension

A deeper transformation concerns the core of organizational authority: the restructuring of administrative decision-making logic. Within traditional Weberian bureaucratic systems, decision-makers are constrained by Simon's theory of bounded rationality[15]. Due to limitations in information availability and cognitive capacity, administrative actors can only pursue locally optimal solutions that satisfy decision criteria under bounded rationality constraints. Consequently, decision-makers' subjective experiences, personal preferences, and historical administrative routines have long played a central role in shaping public decision-making processes. The fundamental limitation of this decision-making model lies in its declining ability to approximate actual governance demands when confronted with increasingly complex governance environments. However, contemporary technological environments are driving a fundamental transformation of this decision logic. Through powerful computational capabilities enabled by architectures such as deep learning, governance problems can be transformed into machine-processable feature representations, allowing governance actions to shift from passive post-event responses toward proactive pre-event prediction. The deeper significance of this transformation lies in the gradual relocation of the core basis of decision-making from human subjective experience toward data-driven objective inference. Machines are no longer merely auxiliary systems supporting administrative decisions; rather, they are increasingly becoming embedded within the front end of decision-making processes and directly generating action-oriented analytical judgments.

2.3. Construction of the "Environment–Structure–Performance" Contingency Analytical Framework (E-S-P Framework)

Based on the aforementioned dimensional analysis of the high-frequency digital technological environment and Lawrence and Lorsch's classical contingency theory, this study develops a dynamic contingency analytical framework of "Environment–Structure–Performance" (E-S-P). The core proposition of contingency theory is that the maximization of organizational effectiveness depends on the degree of alignment between internal organizational structures and external environments. This logical relationship can be expressed as follows:

$$P=f(S, E, Fit)$$

where the dependent variable P represents the agile governance performance that the organization seeks to achieve, while its level is determined by the dynamic degree of alignment (Fit) between institutional structure S and the high-frequency digital environment E. As illustrated in Fig 1, this relationship reveals a fundamental condition: the peak of organizational effectiveness can only be achieved when S and E achieve sufficient synchronization and resonance. When the external digital ecosystem E undergoes a generational transformation while institutional structure S remains constrained by rigid bureaucratic arrangements, a severe structural misalignment emerges between the two. Within the governance context, this misalignment is directly manifested in persistent information silos, delayed administrative decision-making, inefficient cross-departmental coordination, and other governance challenges.

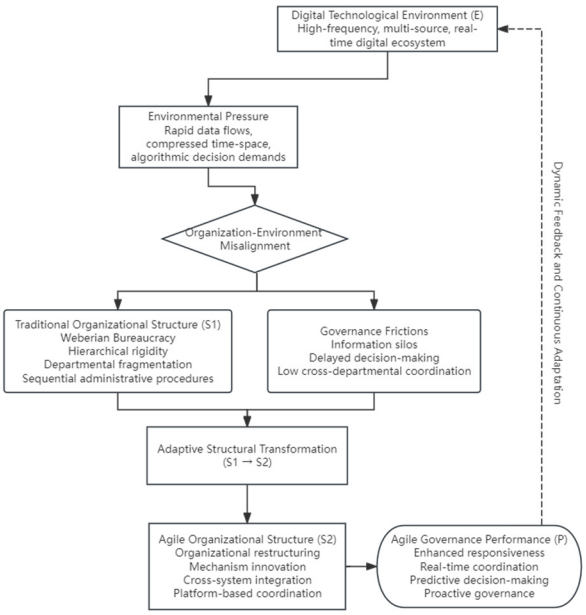


Fig 1. The E-S-P Framework for Public Organizational Transformation under High-Frequency Digital Environments

Public organizations often face a persistent challenge: structures become misaligned with functions, and the usual response involves tinkering at the edges, yet this rarely restores equilibrium. What is needed, I argue, is a more deliberate, contingency-based restructuring. Three interrelated interventions stand out. The first involves the physical organization itself. Instead of maintaining vertical silos, agencies should create a dedicated horizontal coordination unit, a hub that cuts across departments. But the real test lies deeper. At both the foundational infrastructure level and the logic of operations, this structure must ensure that data from across the entire organization are not just collected separately, but brought together as an integrated whole. Without that, the hub risks becoming another empty layer. A second intervention concerns how workflows are actually redesigned. Many organizations still operate through lengthy sequential approval routines, where proposals move up

layer by layer and tasks are then assigned back down. Replacing that pattern decisively is not just a matter of trimming steps. Rather, organizations should let system interfaces handle much of the routine distribution automatically, cutting out unnecessary hierarchical layers and allowing a kind of parallel, cross-departmental response mechanism to take shape. The third shift, however, touches on something more delicate, namely how authority itself is reorganized. In an environment that demands fast, high-frequency adaptation, it is no longer viable to keep technical expertise and managerial power running on separate tracks. What is needed, I would suggest, is a deeper interweaving of technological capability and decision-making authority, so that those who understand the technical terrain also carry the right weight in organizational choices. Without that fusion, even well-designed structures and workflows will quickly become brittle.Taken together, these three moves are not just a collection of isolated fixes. When they actually start to work in concert, public organizations gain a certain kind of structural steadiness, even as the technological environment keeps shifting around them. The more immediate effect is an internal reordering of how operations are carried out, which is tangible enough. But perhaps the more important, if quieter, outcome is that agile governance ceases to be a slogan and gradually becomes the default way of working. In that sense, effectiveness is not a separate goal added at the end; it emerges from the very way the organization learns to hold itself together under pressure.

3. THE “MISFIT” DILEMMA OF TRADITIONAL BUREAUCRATIC STRUCTURES IN HIGH-FREQUENCY TECHNOLOGICAL ENVIRONMENTS

Traditional pyramid-shaped and functionally fragmented public organizations tend to experience severe structural incompatibility and functional dysfunction when confronted with high-frequency technological environments. This misfit is primarily manifested across three dimensions (see Table 1).

Table 1. Manifestations of Misfit in Traditional Bureaucratic Organizations under High-Frequency Technological Environments

External Technological Environment (E)	Traditional Bureaucratic Organizational Structure (S1)	Manifestations of Misfit
Multi-source, heterogeneous data flows characterized by organization-wide circulation and integration	Functional specialization across departments and vertically centralized hierarchical control	**Data fragmentation and "data silos":** incompatible system interfaces across departments prevent the lateral monetization of data resources, while organizational structures impede the integrity of the data environment.
Real-time sensing capabilities and second-level responsiveness requirements	Sequential administrative procedures and lengthy hierarchical chains of command	**Speed misalignment and “governance latency”**: external real-world problems have already evolved, yet internal administrative document flows have not broken out of their routine cycles; the tempo of hierarchical bureaucracy cannot keep pace with the high-frequency rhythm of the technological environment.
Intelligent governance requirements based on algorithmic prediction and data-driven decision-making	Experience-based decision-making and department-centered authority structures	**Decision-making blind spots and “technological exclusion”**: the absence of organizational tentacles capable of absorbing algorithmic predictions leads frontline personnel to selectively disregard the forecast results generated by the system.

3.1. Structural Constraints in Organizational Arrangements: Departmental Barriers and Information Silos

Within Weberian bureaucratic organizations, the principles of clear division of labor and hierarchical differentiation have traditionally been regarded as fundamental organizational norms. However, when these principles encounter high-frequency digital environments, previously well-defined functional boundaries may be transformed into structural barriers that obstruct data circulation and cross-departmental coordination. In practical administrative contexts, different departments and functional divisions often perceive governmental data as critical organizational resources, or even as instruments of institutional power, thereby demonstrating limited willingness to share data across organizational boundaries. This generates a pronounced structural misfit: while underlying deep-learning algorithms require comprehensive, multi-source, and integrated datasets to conduct accurate feature extraction and predictive analysis, in reality they can only access fragmented and physically isolated information resources distributed across specialized administrative departments, such as public security agencies, traffic management authorities, and urban management departments. Information silos generated by entrenched departmental interests and institutional boundaries fundamentally constrain the capacity of digital technologies to enhance governance. Consequently, substantial investments in digital infrastructures may be reduced to inefficient information storage systems rather than functioning as effective foundations for data-driven governance and organizational transformation.

3.2. Discontinuity in Administrative Processes: The Misalignment between Sequential Approval Procedures and Second-Level Early Warning Systems

Spatial fragmentation among organizational units inevitably leads to temporal discontinuities in administrative processes, thereby generating a structural dilemma of governance latency. An examination of administrative document circulation under traditional bureaucratic systems reveals that its operation follows a sequential pattern of hierarchical reporting from the bottom upward and directive transmission from the top downward. Specifically, when frontline grid-based governance units identify emerging problems, relevant information must undergo multiple rounds of form completion, reporting, and administrative review before corresponding tasks can be reassigned downward through hierarchical channels after assessment by central functional departments. This sequential approval chain demonstrates a severely limited capacity for response when confronted with second-level alerts generated by modern predictive models. In practical governance scenarios, a common situation is that real-time congestion indicators displayed on command center dashboards have already revealed significant warning signals, and algorithmic models have generated corresponding alternative diversion strategies; however, the administrative intervention directives required for action remain trapped within the internal circulation procedures of a particular functional department. This creates a clear rupture between the efficiency of algorithmic computation and the sluggishness of administrative approval processes. The divergence between machine speed and bureaucratic speed substantially diminishes the agility benefits enabled by digital technologies, thereby constraining the transformation of technological capabilities into timely and effective governance responses.

3.3. The Detachment of Power Mechanisms: Algorithmic Black Boxes and Decision-Making Blind Spots among Street-Level Bureaucrats

While information silos and governance latency remain primarily manifested at the structural and procedural levels, misalignment within decision-making mechanisms directly affects the core of public administration. Under the inertia of traditional administrative practices, the enforcement and operational decisions of street-level bureaucrats remain highly dependent on subjective experience and are typically shaped by bounded rationality decision-making patterns. Although contemporary deep neural network models are increasingly capable of translating complex social realities into

machine-readable feature representations and generating forward-looking predictive outputs, these algorithmic results often remain detached from actual administrative practices and exist merely at the level of technological demonstration. For frontline public officials, automatically generated warning signals and task-assignment directives frequently lack sufficient interpretability. The underlying computational processes and decision rationales resemble a "black box," leaving officials unable to fully comprehend the model's reasoning mechanisms. Meanwhile, they are often reluctant to replace established administrative procedures entirely with machine-generated judgments due to the potential risks associated with delegating discretionary authority to algorithms. As a result, the outputs of predictive models cannot be effectively integrated into frontline administrative discretion, and the final stage of integrating computational capabilities with public authority remains incomplete.

Ultimately, the constraints imposed by information silos, the dilemma of governance latency, and the persistence of decision-making blind spots collectively illustrate the broader pattern of misfit between traditional bureaucratic systems and digital environments. This multidimensional misalignment also constitutes a critical reason why some local governments have fallen into the trap of "digital formalism" in recent years. These challenges provide a counter-evidence-based validation of the theoretical proposition advanced in this study: overcoming such dilemmas requires public organizations to move beyond merely expanding technological infrastructure. Instead, they must undertake a deeper process of contingency-based organizational restructuring that encompasses transformations in organizational arrangements, administrative processes, and power mechanisms.

4. THE CONTINGENCY-BASED RESTRUCTURING PRACTICE OF HANGZHOU'S "CITY BRAIN"

4.1. A "Multi-Source and High-Frequency" Data Environment and a "Centralized Coordination" Organizational Structure

4.1.1. Evolution of the Technological Environment: The Emergence of Multi-Source Heterogeneous Data Flows at the City-Wide High Frequency

An examination of the evolution of the data environment requires moving beyond the outdated assumption that digitalization is merely equivalent to electronic transformation. Previous information systems primarily accumulated low-frequency and unidirectional static data, which provided limited support for dynamic governance. However, this pattern has undergone fundamental changes after Hangzhou's "City Brain" adopted a city-wide digital architecture for urban governance. Under this new governance infrastructure, diverse data streams—including traffic surveillance video feeds, geomagnetic sensor pulse sequences, and GPS trajectory data—are continuously integrated and interactively aggregated, forming a high-frequency and concurrent data environment. To accommodate this multi-source heterogeneous digital flow, the underlying technological architecture relies heavily on high-throughput computing and concurrent processing capabilities. Through API-based connectivity and real-time data channels, the system enables continuous and uninterrupted data ingestion, thereby providing deep neural network models with sustained access to rich and dynamic information resources. Consequently, data elements have shifted from passive archival records to continuously circulating and highly dynamic governance resources, becoming an active foundation for intelligent decision-making and adaptive urban governance.

4.1.2. Manifestation of Organizational Structural Misfit

Confronted with an environment characterized by the rapid emergence of high-frequency data flows, traditional organizational structures that adhere to Weberian principles of functional differentiation have revealed profound internal fragmentation. For a long period, public administration systems have tended to divide urban governance according to functional jurisdictions, separating areas such as public security, urban management, and transportation into relatively independent administrative

domains with limited interaction. This institutional logic has also extended into the process of digitalization, resulting in the development of numerous closed databases with heterogeneous underlying architectures and incompatible system interfaces. Meanwhile, external deep-learning models require the integrated extraction of multidimensional features across departmental boundaries, including meteorological conditions, road network capacity, and activity schedules. However, rigid departmental structures have physically constrained the mobility and integration of data resources. Organizational boundaries have effectively created barriers that obstruct data flows, limiting algorithmic performance due to insufficient access to high-quality, multi-source information inputs. Therefore, during the process of digital transformation, traditional organizational structures themselves have become a significant source of institutional friction, substantially constraining the effective utilization of technological capabilities in public governance.

4.1.3. Contingency-Based Organizational Restructuring

To mitigate the aforementioned structural misfit, Hangzhou initiated a profound organizational restructuring experiment in April 2016, taking the transportation sector as an initial breakthrough point to explore how big data could be leveraged to improve urban mobility governance. The fundamental logic of this restructuring was to respond to a multi-source and high-frequency technological environment through organizational centralization and coordinated governance. The reform directly targeted the core of organizational authority arrangements within the public sector. By establishing a dedicated Data Resource Management Bureau, Hangzhou centralized and reclaimed data governance authority that had previously been dispersed across various functional departments. The incorporation of this horizontally oriented specialized agency provided institutional support for the mandatory aggregation, integration, and cleansing of city-wide data at the administrative level, thereby weakening the institutional foundations of data monopolization. Alongside institutional restructuring, the concept of a data middle platform was substantively embedded into the organizational system. Under the coordination of the Data Resource Management Bureau, the City Brain established a cross-departmental foundational architecture that integrated data loading from previously isolated systems, algorithmic model configuration, computational simulation, and situational awareness capabilities. Different administrative departments interacted through standardized API interfaces, gradually dismantling the previously fragmented “data silos”[16] that had existed across organizational boundaries. Through this process, public organizations achieved effective integration with the digital environment. Data flows that previously struggled to cross bureaucratic boundaries were transformed into interconnected governance resources, providing a foundational driving force for public sector digital transformation.

4.2. Real-Time Predictive Governance Environments and the Flattening and Agilization of Administrative Processes

4.2.1. Evolution of the Technological Environment: Spatiotemporal Awareness Enabled by Short-Term Traffic Flow Prediction

A closer examination of the operational mechanism of Hangzhou’s City Brain reveals that the most significant transformation in the external technological environment lies in the advancement of systemic sensing capabilities from post-event detection toward proactive prediction. Traditional traffic monitoring systems could primarily capture congestion conditions that were occurring or had already emerged. However, with the integration of deep-learning-based short-term prediction models, the temporal logic of urban governance has undergone a fundamental transformation. The system continuously processes dynamic data generated from tens of thousands of road network nodes across the city and rapidly extracts the nonlinear and spillover characteristics of traffic flows across spatial and temporal dimensions. Supported by the computational capabilities of its underlying architecture, the system is able to identify potential congestion peaks 15 to 30 minutes before actual congestion occurs. Through the seamless integration of data ingestion, model invocation, predictive inference,

and visualization, this tightly coupled forecasting mechanism creates a highly demanding governance environment beyond the organizational boundary. It effectively generates continuous pressure on traditional public organizations, compelling them to achieve unprecedented levels of administrative responsiveness and operational agility.

4.2.2. Manifestation of Structural Misfit: The Speed Crisis of Traditional Vertical Administrative Processes

Confronted with the pressure generated by high-frequency and agile technological environments, the operational processes of traditional public organizations have revealed a profound mismatch in response speed. Under the established paradigm of transportation governance, intervention mechanisms are inherently characterized by delayed activation. Whether relying on public reports or manual video surveillance, existing approaches essentially represent reactive responses that trace and address congestion events only after they have already occurred. A more fundamental challenge lies in the underlying structure of administrative information flows. From the initial stage of receiving public reports, through central departmental assessment, to the gradual transmission of intervention directives toward frontline enforcement personnel, this conventional vertically structured command chain inevitably generates substantial temporal costs. When delayed administrative instructions finally reach street-level bureaucrats, the spatial spillover effects of traffic flows may have already transformed localized congestion into severe disruptions across surrounding road networks. Within this context, the significant superiority of machine-based predictive speed over administrative approval speed has become a fundamental driving force for the deep restructuring of internal administrative processes.

4.2.3. Contingency-Based Restructuring and Agile Governance Loops: Cross-Departmental Coordination and Interface-Driven Automated Dispatch

To adapt to the temporal and spatial pressures generated by predictive governance environments, Hangzhou undertook a profound flattening reform of existing cross-departmental administrative processes. By enabling the horizontal and instantaneous circulation of data-driven directives, this transformation replaced the inefficient vertical transmission of administrative documents that had traditionally characterized bureaucratic operations. On the one hand, the reform achieved the first large-scale realization of machine-to-machine (M2M) coordination within the administrative system. Once deep-learning models generate predictive results regarding short-term congestion risks at specific intersections, the City Brain can eliminate redundant human intervention procedures and automatically activate traffic signal control through underlying API interfaces, enabling the adaptive reconfiguration of signal phases in real time. On the other hand, an integrated cross-departmental human–machine coordination loop has been established. Once predictive warnings are generated, the system immediately assumes the function of task allocation. By transcending traditional departmental boundaries among traffic police, urban management agencies, and other administrative units, intervention directives bypass intermediate managerial nodes and are directly delivered to the mobile terminals of frontline enforcement personnel. Through this process restructuring, Hangzhou's City Brain has successfully established a tightly connected operational chain of "feature extraction → anticipatory simulation → interface-based coordination → agile frontline execution." This mechanism effectively reduces organizational response time from several tens of minutes to the second level, thereby creating institutional space for improving organizational performance amid persistent bureaucratic friction.

4.3. Mechanism-Level Adaptation: From Experience Dependence to Quantitative Decision-Making through Technological–Managerial Integration

The deeper pressure exerted by the external digital environment on public organizations ultimately reaches the core decision-making mechanisms of bureaucratic systems. Traditional administrative decision-making has often been constrained by the subjective judgments and experiential knowledge

of senior officials. Due to the delayed nature of information acquisition, managers have typically relied on coarse-grained periodic reports to conduct retrospective adjustments and remedial actions. With the comprehensive deployment of the digital infrastructure underlying Hangzhou's City Brain, the decision-making environment has been elevated toward a new dimension characterized by quantitative precision. Dynamically updated predictive models and second-level refreshed situational dashboards have replaced static paper-based information carriers, thereby constructing a highly transparent digital simulation environment in which governance scenarios can be continuously analyzed, evaluated, and anticipated.

To reconstruct certainty under changing environmental conditions, Hangzhou undertook a profound transformation of its internal logic of power operation. First, central decision-making authority has increasingly extended toward algorithmic governance. In addressing complex urban governance challenges, managerial reliance on experiential judgment has gradually been reduced in an orderly manner, while administrative directives have become unprecedentedly embedded within computational logic chains. For instance, when confronting sudden scenarios such as rapid increases in tourist flows within scenic areas, short-term passenger flow prediction curves generated by the system can directly bypass lengthy hierarchical deliberation procedures and serve as highly weighted decision-making references, which are immediately transformed into dynamic instructions for reallocating public transportation capacity. Second, the mode of frontline administrative discretion has undergone substantial transformation. As the terminal actors responsible for policy implementation, street-level bureaucrats have experienced a shift in their operational logic: traditional random street patrols have increasingly been replaced by targeted interventions based on model-generated predictions of high-risk areas. Guided by algorithmic outputs, frontline enforcement personnel increasingly assume the role of executors of algorithmically generated directives, conducting precise interventions according to high-risk coordinates identified by predictive models. Through this top-down adjustment of power mechanisms, public organizations have not only overcome the blind spots associated with bounded rationality in traditional decision-making but have also facilitated the deeper integration of computational capabilities and administrative authority within micro-level governance practices.

5. DEEPER REFLECTIONS ON CONTINGENCY-BASED ADAPTATION OF PUBLIC ORGANIZATIONS IN HIGH-FREQUENCY TECHNOLOGICAL ENVIRONMENTS

In practice, by restructuring administrative organizations and removing barriers among data interfaces, Hangzhou's City Brain reform has substantially alleviated the physical friction between organizational structures and high-frequency data environments, thereby achieving significant progress in the first stage of agile transformation. However, the complexity of digital governance has proven to be far greater than initially anticipated. The essence of public administration lies in balancing diverse interests rather than solving a mathematical optimization problem with a single optimal solution. The longstanding institutional inertia within traditional administrative systems, characterized by the tendency of "policy implementation gaps" between formal directives and practical responses, continues to persist even when bureaucratic structures are strongly driven by pervasive high-frequency computational capabilities. Deep within administrative systems, behavioral inertia and institutional path dependencies may continue to generate resistance in more subtle forms. The substantial improvement in administrative efficiency often comes at the cost of compromising certain traditional values of public administration. A closer examination of agile governance practices reveals that the deeper concerns generated by technology-driven transformation are gradually permeating administrative systems through two less visible pathways.

5.1. The "Algorithmic Black Box," Accountability Paradox, and Crisis of Administrative Legitimacy

5.1.1. The Incompatibility between Deep Learning Opacity and Procedural Justice

The legitimacy of modern bureaucratic systems among citizens is derived not only from the delivery of effective governance outcomes but also from the public justification of administrative actions and adherence to procedural justice. However, in the process of comprehensively embracing high-frequency digital environments through contingency-based restructuring, public organizations have introduced a new governance instrument characterized by inherent limitations in interpretability. The current engines driving predictive governance are primarily constructed upon complex neural network architectures. These deep learning models rely on massive numbers of high-dimensional parameters for feature mapping, and their internal reasoning processes often exceed the boundaries of human intuitive understanding, exhibiting a significant "algorithmic black box"[17] characteristic. Once decision-making authorities become accustomed to treating such model outputs as primary guides for administrative action, the transparency of public decision-making may be substantially weakened. When questioned by citizens or relevant stakeholders, these systems are unable to reconstruct the causal chains underlying their decisions in the same manner as traditional administrative records and documented procedures. This trade-off—exchanging enhanced computational accuracy for diminished decision interpretability—fundamentally undermines the legitimacy foundations upon which modern rule-of-law-oriented governments rely.

5.1.2. The Paradox of Accountability Allocation in Contingency-Based Restructuring

Within the traditional bureaucratic system, power and accountability have historically maintained a highly structured relationship of correspondence. Any erroneous administrative directive could be traced through the vertical hierarchy to identify the responsible actor with relative precision. However, this well-established accountability loop faces potential disruption within agile governance architectures characterized by human–machine integration. Once administrative systems enter automated operational modes, defects embedded within algorithmic models may become a "Damocles' sword" threatening governance effectiveness. When distortions in underlying algorithms lead to serious administrative misjudgments, public organizations may encounter profound difficulties in determining responsibility attribution. The developers who write the code are not the legitimate holders of public authority; administrative departments that formally possess decision-making responsibility may become increasingly constrained by algorithmic systems; and frontline implementers may function merely as physical extensions of system-generated instructions. In other words, within complex governance systems constituted by the interaction of multi-source data and latent computational features, accountability subjects become systematically diluted. The ambiguity of responsibility boundaries is not merely a technical deficiency in management systems; rather, it represents a deeper challenge to the foundational legitimacy of public organizations.

5.2. Technological Displacement and Bureaucratic Resistance: Strategic Responses of Frontline Implementers

5.2.1. The Algorithmic Erosion of Discretionary Authority

Any technological transformation aimed at pursuing maximum operational efficiency will inevitably encounter countervailing forces at the organizational frontline. Within Lipsky's classical framework, street-level bureaucrats, as "frontline agents"[18] connecting the state and society, are able to sustain the everyday functioning of public administration precisely because they possess discretionary authority. Such discretion enables them to adjust administrative practices according to situational conditions and develop coping strategies in response to workload pressures and organizational constraints[19]. However, the algorithmic organizational and managerial model generated by high-frequency technological environments, as exemplified by Hangzhou's City Brain, has increasingly

begun to reshape the role of street-level bureaucrats by assuming functions of panoramic monitoring and (semi-)automated decision-making[20] Through real-time positioning and directive transmission enabled by mobile terminals, central algorithmic systems exert a high-dimensional form of digital control over the actions of frontline personnel. Ambiguous situations that previously required street-level bureaucrats to rely on personal experience and practical judgment are decomposed by algorithms into numerous standardized task packages containing explicit spatial and temporal coordinates. This transformation not only reshapes the nature of frontline administrative work but also redefines the boundaries of discretionary authority, as portions of such discretion are transferred to, or increasingly constrained by, artificial intelligence systems [21]. Such a forceful erosion of discretionary authority at the administrative frontline deprives street-level bureaucrats of the flexibility required to navigate complex real-world situations, reducing them to mechanical executors through which algorithmic logic is extended into the physical world.

5.2.2. Blame Avoidance Strategies and the Emergence of Digital Formalism

It is important to recognize that such erosion of discretion does not necessarily produce unilateral compliance. Driven by strong institutional inertia and self-preservation incentives, frontline implementers may gradually develop subtle strategic responses to cope with the pressures imposed by high-frequency algorithmic governance. When the frequency of algorithmically generated assignments exceeds the physical capacity of frontline personnel, their attention may gradually shift away from resolving substantive problems toward the more immediate objective of completing digitally monitored tasks as quickly as possible. To satisfy the stringent requirements for closed-loop data management displayed on central monitoring platforms, while simultaneously responding to trace-based management practices, dependence on digital records, and symbolic performance incentives associated with digital formalism, frontline officials and staff may adopt various forms of strategic compliance under conditions of downward accountability pressure. These practices may include manipulating location records, uploading inaccurate completion reports, and other forms of procedural performance designed to pass automated system verification. From a backend perspective, the various performance indicators appear to align perfectly with the assumptions of agile governance, thereby producing a deceptive appearance of effective governance. However, the substantive core of governance practices has gradually become transformed into a new form of digital formalism oriented toward satisfying algorithmic evaluation requirements. The original vision of public organizations—to reshape institutional processes through adaptation to technological environments—is ultimately weakened by the widespread and passive strategic responses of frontline actors.

6. CONCLUSION

Drawing upon theoretical reasoning and empirical analysis of Hangzhou's City Brain, this study attempts to delineate the underlying logic of public organizational evolution under the pressures of digital ecosystems. The empirical evidence demonstrates that when confronted with high-frequency, multi-source, and real-time data flows, traditional bureaucratic structures exhibit significant structural misfits across three dimensions: information architecture, response tempo, and decision-making foundations. The reform experiment of Hangzhou provides a potential pathway for organizational adaptation. By establishing cross-departmental data coordination institutions to dismantle organizational barriers, replacing hierarchical approval procedures with automated system-based task allocation, and embedding algorithmic outputs into operational coordination and frontline enforcement, the reform has enabled organizational processes to better align with the external computational environment and has generated substantial governance capacity in the short term. Nevertheless, the latter part of this study also reveals that such an agile transformation is not without costs. While algorithmic systems accelerate task assignment and predictive governance, they simultaneously blur traditional accountability chains. Moreover, frontline implementers whose discretionary space has been constrained do not necessarily comply fully with algorithmic

instructions; instead, they may develop strategic compliance practices, including manipulated location records and inaccurate completion reports, ultimately giving rise to a new form of digital formalism.

Overall, the Hangzhou case does not demonstrate a linear convergence of public organizations from misfit toward fit. Rather, it reveals a redistribution of organizational tensions. The contingency-based adaptations initiated to resolve technology–structure conflicts merely shift friction from one domain to another, generating new forms of institutional counteraction at the implementation frontline. Agile governance therefore remains situated in a continuous tension between the release of technological efficiency and its erosion during practical implementation, far from reaching a stable equilibrium.

This study also has several limitations. First, due to the single-case research design, the generalizability of the findings is constrained by Hangzhou's specific institutional context and technological conditions. Whether the identified mechanisms can be extended to other cities with substantially different governance environments remains an empirical question. Second, constrained by the cross-sectional nature of the research materials, this study does not fully capture the temporal dynamics through which street-level bureaucrats develop strategic coping behaviors under algorithmic governance, nor does it identify the conditions under which such behaviors may weaken or disappear over time. Future research may extend this study in two directions. First, comparative multi-case research could be employed to examine the explanatory power and contextual boundaries of the mechanism linking algorithmic constraints on discretion with strategic responses among frontline implementers across different institutional settings. Second, at the micro level, experimental or quasi-experimental approaches could be introduced to systematically investigate how the placement and intensity of human-in-the-loop review mechanisms causally influence frontline personnel's perceptions of procedural fairness and their propensity for blame avoidance. Such research would provide more actionable empirical evidence for the institutional design of algorithmic governance systems.

REFERENCES

[1] Dunleavy, P., Margetts, H., Bastow, S., & Tinkler, J. (2006). New public management is dead—long live digital-era governance. Journal of Public Administration Research and Theory, 16(3), 467-494. https://doi.org/ 10. 1093/ jopart/ mui 057.

[2] Mergel, I., Edelmann, N., & Haug, N. (2019). Defining digital transformation: Results from expert interviews. Government Information Quarterly, 36(4), 101385. https://doi.org/10.1016/j.giq.2019.101385.

[3] Janssen, M., & Estevez, E. (2013). Lean government and platform-based governance—Doing more with less. Government Information Quarterly, 30, S1-S8. https://doi.org/10.1016/j.giq.2012.11.003.

[4] Meijer, A., & Bolívar, M. P. R. (2016). Governing the smart city: a review of the literature on smart urban governance. International Review of Administrative Sciences, 82(2), 392-408. https://doi.org/ 10.1177/ 002 085 2314564308.

[5] Kitchin, R. (2014). The real-time city? Big data and smart urbanism. GeoJournal, 79(1), 1-14. https://doi. org/ 10. 1007/ s10708-013-9516-8.

[6] Batty, M. (2013). Big data, smart cities and city planning. Dialogues in Human Geography, 3(3), 274-279. https:// doi. org/10.1177/2043820613513390.

[7] Weber, M. (2019). Economy and society: A new translation. Harvard University Press.

[8] Lawrence, P. R., & Lorsch, J. W. (1967). Organization and environment: Managing differentiation and integration. Division of Research, Graduate School of Business Administration, Harvard University.

[9] Dawes, S. S. (1996). Interagency Information Sharing: Expected Benefits, Manageable Risks. Journal of Policy Analysis and Management, 15(3), 377-394. https://doi.org/ 10.1002/ (SICI) 1520-6688 (199622) 15:3< 377:: AID-PAM3>3.0.CO;2-G.

[10] Kitchin, R. (2017). Thinking critically about and researching algorithms. Information, Communication & Society, 20(1), 14-29. https://doi.org/10.1080/1369118X.2016.1154087.

[11] Feldman, M. (2003). Building the virtual state: Information technology and institutional change. Brookings Institution Press.

[12] Salmela, H., Baiyere, A., & Tapanainen, T. (2022). Digital agility: conceptualizing agility for the digital era. Journal of the Association for Information Systems, 23(5), 1080-1101. https://doi.org/10.17705/1jais.00744.

[13] Donaldson, L. (2001). The contingency theory of organizations. SAGE Publications, Inc.

[14] Burns, T., & Stalker, G. M. (1994). The management of innovation. Oxford University Press.

[15] Simon, H. A. (1985). Human nature in politics: the dialogue of psychology with political science. American Political Science Review, 79(2), 293-304. https://doi.org/10.2307/1956660.

[16] Zhou, L., Chen, L., & Han, Y. (2021). “Data stickiness” in interagency government data sharing: a case study. Journal of Documentation, 77(6), 1286-1303. https://doi.org/10.1108/JD-11-2020-0191.

[17] Wirtz, B. W., Weyerer, J. C., & Geyer, C. (2019). Artificial intelligence and the public sector—applications and challenges. International Journal of Public Administration, 42(7), 596-615. https://doi.org/ 10. 1080/ 01900 692. 2018. 1554298.

[18] Lipsky, M. (1980). Dilemmas of the individual in public services. Russell Sage Foundation.

[19] Young, M. M., Bullock, J. B., & Lecy, J. D. (2019). Artificial discretion as a tool of governance: a framework for understanding the impact of artificial intelligence on public administration. Perspectives on Public Management and Governance, 2(4), 301-313. https://doi.org/10.1093/ppmgov/gvz017.

[20] Meijer, A. J., Lorenz, L., & Wessels, M. (2021). Algorithmization of bureaucratic organizations: Using a practice lens to study how context shapes predictive policing systems. Public Administration Review, 81(6), 1029-1039. https://doi.org/10.1111/puar.13382.

[21] Busch, P. A., & Henriksen, H. Z. (2024). AI technologies and the reconfiguration of discretion in street-level bureaucracy. In Handbook on Public Policy and Artificial Intelligence (pp. 80-92). Edward Elgar Publishing. https: // doi.org/10.4337/9781803923938.00013.