

Research on the Logic of Digital Governance of Territorial Space from the Perspective of Digital Transformation

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Abstract: Under the dual background of digital China construction and the modernization of territorial space governance, the digital transformation of territorial space governance has become an inevitable trend. Based on this, this paper conducts an in-depth study on the logic of digital governance of territorial space from the perspective of digital transformation, hoping to provide some references and insights for promoting the modernization of the territorial space governance system and governance capacity.

Keywords: territorial space governance; digital transformation; digital twin; multi-domain collaboration; smart governance

Online publication: October 26, 2025

1. Introduction

Under the dual objectives of advancing the “Digital China” strategy and building an ecological civilization, the modernization of territorial space governance has become a core component of the modernization of the national governance system and governance capacity. In recent years, top-level arrangements such as the “Overall Layout Plan for Digital China Construction” and the reconstruction of the territorial space planning system have explicitly proposed leveraging digitalization to transform the governance methods of territorial space. However, current transformation practices still largely manifest as fragmented use of technical means and independent platform development. In the deepening process of transitioning from “digitalization” to “smart governance” and from “sectoral management” to “systemic governance,” challenges such as unclear governance approaches, imperfect cross-regional collaboration mechanisms, and a disconnect between technical support and operational needs remain. Therefore, systematically clarifying the intrinsic mechanisms of digital transformation in territorial space governance, breaking the mindset of “emphasizing technology while neglecting governance,” and finding ways to integrate technology with institutional restructuring have become the theoretical foundation and practical demand for implementing top-level arrangements and leveraging the role of digital governance.

2. The basic connotation and the requirements of the times of the digital transformation of the governance of the territorial space

2.1. The connotation of digital transformation

The digital transformation of territorial governance is not merely about adopting technology, but rather a comprehensive process where multiple stakeholders leverage next-generation information technologies—including big data, artificial intelligence, blockchain, and real-scene 3D modeling—to systematically establish digital twin territorial spaces. This foundation enables strategic spatial planning, optimized resource allocation, and ultimately drives profound changes toward high-quality territorial development. The core concept can be broken down into three dimensions: (1) In terms of governance targets, it marks a transition from traditional physical space management to interactive, computable, and controllable digital twin spaces, laying the groundwork for comprehensive digital representation of all elements. (2) Regarding governance actors, it breaks through the government-centric approach by utilizing digital platforms and tools to foster efficient cross-sector collaboration among governments, markets, and society. (3) In terms of governance objectives, it focuses on systemic restructuring to optimize spatial resource organization, enhance spatial resilience and risk response capabilities, and strengthen people-oriented precision governance. This concept differs from corporate digital transformation centered on internal process reengineering and transcends the early-stage government informatization aimed solely at improving office efficiency. It highlights the distinctive characteristics of spatial-based governance with system-oriented management and value realization as its core direction^[1].

2.2. Motivation of digital transformation of territorial space governance

The digital transformation of territorial space governance is an inevitable outcome driven by multiple forces of the times. In the field of policy and strategic impetus, the top-level planning of “Digital China” and “Beautiful China” construction at the national level provides clear guidance. The Ministry of Natural Resources undertakes the responsibilities of “two unifications” and the specific arrangements for building a “single map” implementation and supervision system, bringing urgent institutional needs and action paths for the transformation. In terms of technological empowerment, digital technologies such as geographic information technology, the Internet of Things, and cloud computing are becoming increasingly mature and rapidly converging. This not only makes dynamic perception and detailed depiction of territorial space with full coverage, all elements, and three-dimensional stereoscopic characteristics feasible but also provides powerful means for intelligent processing, simulation, and collaborative judgment of massive spatial data, driving governance from experience-based judgments to data-driven approaches. Facing practical challenges such as increasing ecosystem complexity, highly intertwined spatial functional demands, and arduous cross-regional and cross-departmental coordination tasks, the traditional governance approach, which relies on fragmented and qualitative experience, has become unsustainable. There is an urgent need to leverage digital transformation to integrate scattered information and operations, reconstruct governance processes and rules, thereby enhancing the integrity, systematicness, and intelligence of territorial space governance to better meet the demands of high-quality development and ecological civilization construction^[2].

3. Evolution and current status of digital transformation in territorial space governance

3.1. Review of development stages

The digital transformation of China’s territorial governance has evolved through distinct phases in tandem with national development strategies and technological progress. Its origins trace back to the early exploratory stage characterized by comprehensive natural resource surveys, where governance primarily relied on field inspections and empirical reasoning. Computer technology played limited roles in specific areas like cadastral management, with digitization remaining nascent. The introduction of the Digital Earth concept and the establishment of the Ministry of Natural Resources ushered in a

new phase of infrastructure development marked by digitalization. Technologies such as remote sensing and geographic information systems (GIS) were widely adopted for land surveys and planning, while initial government management information systems and public service platforms emerged. However, fragmented data systems remained prevalent. During the Smart Earth era, driven by ecological civilization initiatives and new urbanization strategies, governance shifted toward balancing development and conservation. Cloud computing and big data technologies propelled a data-driven transformation, with efforts to integrate multiple planning frameworks and develop spatiotemporal big data analytics. Since the establishment of the Ministry of Natural Resources in 2018, the transition entered a comprehensive “data-driven governance” phase. This stage emphasized creating a unified “one-map” system for natural resources and a systematic territorial spatial information platform, deepening digital transformation from technical implementation to institutional restructuring and governance model innovation.

3.2. Current status of transformation

The digital transformation of territorial governance has now entered a phase characterized by platformization, scenario-based applications, and collaborative integration. At the national and provincial levels, the foundational digital infrastructure centered around territorial spatial information platforms has been largely established. The “One Map” system for natural resources, serving as the cornerstone of data resource management, is actively advancing toward unified base maps, standardized protocols, coordinated planning, and integrated platforms. This initiative provides technical solutions to longstanding issues like conflicting land classifications and planning conflicts. In practical applications, digitalization has expanded from strategic planning to operational implementation, giving rise to representative scenarios such as real-time monitoring of “One Map” planning, collaborative approval processes for land, forest, and grassland use, smart farmland protection systems, and 3D urban construction with real-time data. These developments have significantly enhanced the scientific rigor of planning processes, accelerated administrative approvals, and improved regulatory precision. Regarding collaborative mechanisms, cross-departmental and multi-level government networks have been strengthened through unified platforms. Pilot initiatives like “land code” linkage and project list management have begun engaging market forces, forming preliminary models of multi-stakeholder governance. Overall, the transition is evolving from fragmented technical experiments to integrated, intelligent system integration. However, achieving comprehensive effectiveness still requires deeper convergence between data systems, operational workflows, and governance frameworks.

4. The logic of digital governance of territorial space from the perspective of digital transformation

4.1. Digitization of governance targets

The foundation of digital transformation lies in the profound restructuring of governance subjects themselves. At its core, it transforms territorial space from static, fragmented physical entities into dynamic, interconnected digital twins. These digital twin territorial spaces are not merely electronic maps or 3D models, but rather virtual representations that integrate multi-source sensing data from space, air, land, sea, and networks, based on unified spatiotemporal benchmarks. They provide holographic, precise, and chronologically ordered representations of natural elements (mountains, rivers, forests, farmlands, lakes, grasslands, deserts) and urban-rural artificial elements. This digital representation forms the “digital chassis” for governance, whose value lies in digitally representing spatial elements, relationships, processes, and rules with computational feasibility. By building this chassis, governance activities can transcend traditional administrative boundaries and departmental limitations. Virtual simulations, conflict detection, and impact assessments can be conducted in virtual spaces—for instance, simulating multiple land-use layouts before planning or implementing intelligent risk warnings before disasters occur. This digitization of governance subjects becomes the foundation for transforming governance logic, converting territorial space into a complex system capable of perception, analysis, and regulation. It provides a unified “operational interface” and “virtual sandbox” for collaborative governance and intelligent decision-

making, driving governance from qualitative judgments relying on vague experience to quantitative insights based on clear data^[3].

4.2. Coordination of governance entities

Digital transformation has created pivotal opportunities to dismantle long-standing compartmentalization and departmental silos in territorial governance, fostering innovative collaborative frameworks. The traditional top-down governance model, dominated by single government entities, struggles to address the challenges of highly complex spatial functions and rapidly evolving governance needs. The digital governance approach emphasizes establishing a unified territorial spatial information platform and “One Map” system, creating an open collaborative network that connects government departments at all levels, market enterprises, and the public. This network streamlines vertical communication between ministries, provinces, cities, and counties while enabling seamless horizontal integration of data sharing across planning, natural resources, ecological conservation, and transportation sectors. Through this platform, market forces can more accurately participate in resource allocation and project investment, the public can utilize visualization tools to understand planning intentions and provide feedback, and expert think tanks can conduct in-depth research based on comprehensive data. This collaboration transcends mere information sharing; it represents a profound business integration grounded in shared digital infrastructure, standardized processes, and restructured rules. The ultimate goal is to establish a multi-stakeholder governance ecosystem characterized by “government leadership, corporate empowerment, public participation, and expert support,” enabling decision-making that harnesses collective wisdom, accommodates diverse values, and ultimately enhances the legitimacy, scientific rigor, and practicality of governance solutions.

4.3. Intelligent governance tools

Building upon the foundations of object digitization and entity collaboration, the intelligent transformation of governance tools forms the direct logic driving a leap in governance efficiency. This signifies a shift in core governance approaches from relying on personal experience, qualitative documents, and static indicators to leveraging data, models, and algorithms for dynamic perception, intelligent analysis, and autonomous decision support. The intelligence of these tools first manifests in their comprehensive situational awareness capabilities across all domains and timeframes of territorial space. By real-time aggregation of multi-source data streams—including IoT sensors, remote sensing imagery, and mobile signaling—they enable “smart health checks” for resource changes, spatial utilization, population activities, and environmental quality. Subsequently, through artificial intelligence, machine learning, and spatial analysis models, massive datasets are deeply mined to identify spatial evolution patterns, diagnose urban health issues, and predict future risks. For instance, algorithms can detect non-agricultural use of farmland patches or simulate urban heat island effects. Ultimately, these analytical results are packaged into intelligent tool modules—such as smart project siting, automated compliance reviews of planning proposals, and real-time resource carrying capacity assessments—embedded into specific operational processes like planning formulation, project approval, and monitoring supervision. These tools provide managers with precise and timely decision-making recommendations. Thus, the intelligent logic of governance tools fundamentally integrates data throughout the entire governance process, combining human wisdom with machine computational power to achieve profound transformations—from passive response to proactive foresight, and from extensive management to targeted governance^[4].

5. Digital governance path of territorial space from the perspective of digital transformation

5.1. Establishing a data governance system

The implementation of digital governance for territorial space fundamentally requires establishing a unified, reliable, and interoperable data governance framework. The immediate priority is to resolve inconsistencies in standards, formats, and spatiotemporal benchmarks across multi-source, multi-type data. By formulating and rigorously enforcing comprehensive

natural resource data standards that cover the entire lifecycle from surveying to management, we can integrate monitoring results from land, forestry, grassland, and marine sectors into a unified national dataset. The ultimate goal is to create a cohesive “single data source” free from conflicts nationwide. Key to this effort is establishing a mechanism where “each data point has a single origin and authoritative release,” clearly defining who produces, updates, and manages each type of data. This will be achieved through national and provincial distributed data hubs that enable orderly aggregation and efficient circulation. Additionally, robust quality management must be implemented throughout the data lifecycle—from creation to disposal—enhancing data integration accuracy through semantic conversion and intelligent cleaning technologies. Blockchain-based solutions should also be actively adopted to ensure data security and property rights integrity. Only by solidifying this foundational data infrastructure can we provide stable, clean “raw materials” for building digital twin territorial spaces and advancing intelligent applications, ultimately eliminating information silos at their source.

5.2. Enhancing platform support capabilities

A powerful platform serves as the core hub that supports governance logic and integrates multiple applications. The future focus should shift from fragmented system development to building centralized, intelligent unified platforms. A typical example is the territorial spatial infrastructure information platform that combines data and business mid-platform capabilities. This platform should not merely function as a data warehouse or approval system, but rather serve as a “capability foundation” providing shared technical components, universal analytical models, and collaborative business services. It requires cloud-native and microservices architectures to achieve elastic computing and storage support, particularly enhancing dedicated computing power for spatial big data analysis and AI training. The platform’s core functions include unified spatiotemporal data management, intelligent model analysis toolkits, standardized interface-based service sharing, and engines supporting online collaborative orchestration of cross-level and cross-departmental business processes. By building such an open, intelligent, and collaborative platform, underlying data resources can be efficiently transformed into upper-layer business capabilities, offering flexible and configurable digital support for diverse users and scenarios. This approach avoids redundant construction while improving the agility and intelligence of overall governance.

5.3. Innovative scenario-based application models

The value of digital governance ultimately manifests through efficiency improvements in specific business scenarios. Innovation in application models must adhere to the principle of “demand-driven and business collaboration,” focusing on core tasks such as territorial spatial planning, land use regulation, ecological restoration, farmland protection, and law enforcement supervision. This requires designing deeply integrated digital application scenarios that are not standalone functional units but are built on unified platforms and data foundations, achieving solutions for business process reengineering and collaboration. For instance, in the scenario of planning implementation monitoring, it is essential to integrate dynamic data from multiple sources, automatically compare planning blueprints with current changes, and enable intelligent urban health assessments. In land use approval scenarios, it is crucial to streamline processes across land, forest, and grassland utilization, promoting “one-stop” collaborative approvals to enhance service efficiency. For smart farmland protection scenarios, integrating remote sensing monitoring, video surveillance, and mobile inspections is necessary to achieve intelligent identification and early warning of illegal land occupation. Scenario development should adopt a “large-scale, small-scale” approach, prioritizing resolution of operational pain points while emphasizing data and process connections across different scenarios. Gradually, this will weave a comprehensive intelligent governance application network covering the entire territorial space, all elements, and the entire lifecycle^[5].

5.4. Supply system and mechanism and talent guarantee

For technology to be truly implemented, it requires continuous deepening of supporting institutional reforms and sustained supply of professional talent teams. At the institutional level, we must break through the constraints imposed by current administrative frameworks. By focusing on the concrete implementation of the “One Map” initiative and inter-departmental

collaboration, we should establish robust cross-departmental coordination mechanisms and regular working teams. Responsibilities and processes for data sharing and business integration must be clearly defined, while the actual effectiveness of digital transformation should be incorporated into relevant evaluation systems. It is also crucial to expedite the development of legal standards and policy frameworks tailored for digital governance, providing institutional foundations for emerging issues such as data ownership definition, legal validity of electronic documents, and intelligent algorithm applications. Regarding talent development, to address the shortage of interdisciplinary professionals, a dual approach of “simultaneous recruitment and cultivation” should be adopted. Universities need to accelerate interdisciplinary integration and teaching reforms in fields like territorial spatial planning, geographic information science, and public administration. They should introduce courses and practical components such as real-scene 3D modeling, spatial data analysis, and digital governance to cultivate new talents with both spatial thinking and digital literacy. Meanwhile, industries should strengthen regular digital skills training for existing managers and actively recruit professionals like data scientists and algorithm engineers, thereby building a well-structured and continuously evolving talent echelon for digital governance.

6. Conclusion

The digital transformation of territorial governance represents a fundamental paradigm shift, with its core focus on leveraging technological means to reshape governance frameworks and structures. The logical framework and implementation pathways presented in this paper demonstrate that the key to successful transformation lies in adopting a holistic approach, driving coordinated development across data infrastructure, platform ecosystems, operational processes, and institutional contexts. This process will continue to evolve, relying not only on technological advancements but also on interdisciplinary knowledge integration, enhanced cross-sector collaboration, and the cultivation of digital governance professionals. Only through such comprehensive efforts can we truly harness digital potential into tangible governance outcomes, establishing an intelligent, robust, and open new paradigm for territorial governance.

Disclosure statement

The author declares no conflict of interest.

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