Digital Transformation of Detailed Planning under the Territorial Spatial Planning System: The Nanhu Unit in Fuzhou

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Abstract: Territorial spatial planning reform requires detailed planning to develop an integrated digital application system for preparation, approval, implementation, and supervision. Using the Nanhu unit in Fuzhou, this paper proposes four linked strategies. Preparation aggregates data across all space and all elements and introduces intelligent methods. Approval integrates systems to enable parallel interdepartmental review and comprehensive control. Implementation manages land attributes and development activities across the land life cycle. Supervision establishes full-space and full-cycle digital monitoring. The framework improves scientific rigor, precision, and implementation efficiency and provides a replicable approach to detailed-planning transformation and modern urban governance.

Keywords: detailed planning; digital transformation; territorial spatial planning; life-cycle management; Fuzhou

National policy sets a 2035 objective of modernizing territorial spatial governance. Detailed planning is the final implementation stage of the system, and its digital transformation is a key mechanism for precise, intelligent, and collaborative governance [1-2]. Fuzhou, a national smart-city pilot and a leader in Digital Fujian, has developed a multi-plan coordination platform, three-dimensional decision support, and intelligent review systems, providing a practical case.

1 Digital Transformation of Detailed Planning

1.1 Concept and Extended Meaning

Digitization initially meant converting physical information into storable and processable data. Digital transformation now concerns organizational processes, decision rules, service delivery, and governance. For detailed planning, it connects data standards, models, rules, workflows, public participation, and monitoring. It changes planning from a document-centered product to a continuously updated governance system [3-6].

1.2 Current Explorations

Chinese cities have explored one-map platforms, three-dimensional models, planning archives, rule engines, online approval, and implementation monitoring. Existing systems often remain fragmented by department or stage. Data standards differ, preparation and approval are weakly linked, implementation records are incomplete, and monitoring is frequently retrospective [3-8].

1.3 Transformation Directions

1.3.1 From Document Compilation to Full-process Governance

Detailed planning should link preparation, approval, implementation, and supervision through common identifiers and rules. Every land parcel and planning unit should have a traceable digital record from plan formulation to construction and evaluation.

1.3.2 Data Sharing and Intelligent Decision Support

A unified data base should integrate planning, land ownership, projects, population, transport, public services, ecology, and municipal infrastructure. Rule-based checks and analytical models can support plan alternatives, detect conflicts, and improve coordination [9-12].

1.3.3 Integration of Emerging Technologies

Geographic information systems, digital twins, artificial intelligence, building information models, sensing, and spatiotemporal big data can support simulation, real-time updating, and scenario evaluation. Technology should remain aligned with statutory planning rules, public interests, and accountable decision making.

2 Fuzhou's Digital Transformation: The Nanhu Unit

Nanhu covers approximately 2.81 km² and is used to test a technical system spanning all four planning stages. The case creates a common spatial data base and a coordinated workflow that connects unit-level and parcel-level control.

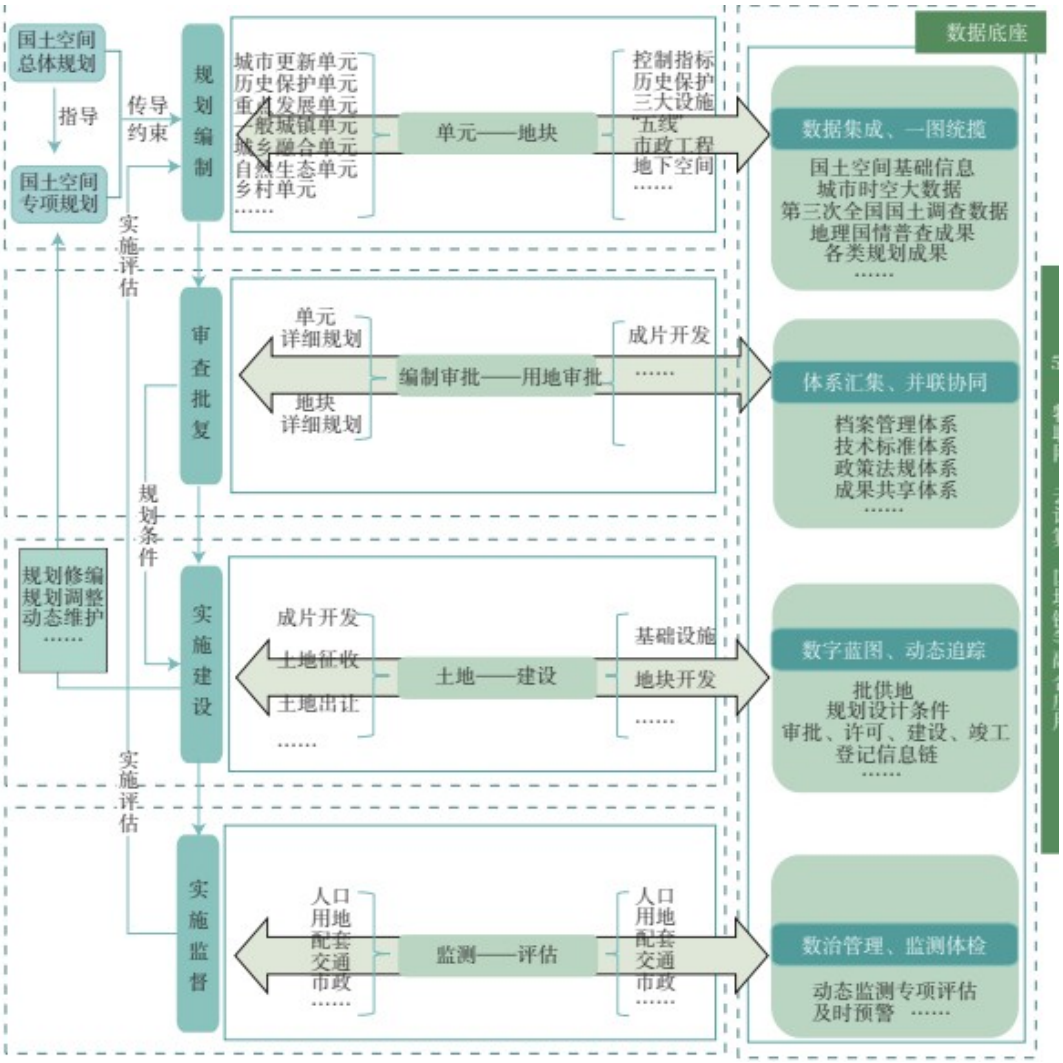

Fig. 1 Technical framework for the digital transformation of detailed planning in Fuzhou

2.1 Preparation: From Static Compilation to Intelligent Data-driven Planning

2.1.1 Constructing a Spatial "Digital Base"

The digital base covers all space and all elements. At unit level it integrates population, public facilities, transport, infrastructure, ecological control lines, cultural heritage, landscape, underground space, and development intensity. At parcel level it includes land use, ownership, construction indicators, interfaces, facilities, design guidance, and approved-project boundaries. Common coding connects every object to documents and rules.

Fig. 2 Composition of the all-space, all-element digital base

2.1.2 Innovating Detailed-planning Techniques

Preparation uses automated data aggregation, conflict detection, accessibility analysis, service-radius evaluation, three-dimensional simulation, and scenario comparison. Models examine population carrying capacity, facility demand, transport, and environmental constraints. The results support plan formulation while retaining professional judgment and statutory review.

2.2 Approval: From Serial Procedures to Parallel Collaboration

2.2.1 Upgrading the Planning-archive System

Digital archives manage current and historical plans, approvals, changes, conditions, and project records through unified parcel and unit identifiers. Version control makes modifications traceable and allows departments to work from the same legal information.

2.2.2 Intelligent Parallel Review

Approval rules are translated into machine-readable checks. Multiple departments can review land use, control lines, facilities, transport, municipal engineering, and urban design in parallel. The system highlights conflicts, records opinions, and shortens repeated communication while leaving final authority with responsible agencies.

2.3 Implementation: From Land Supply to Full Life-cycle Management

2.3.1 Constructing a Land Life-cycle Chain

The platform links planning conditions, land preparation, investment promotion, supply, design, permits, construction, completion, operation, renewal, and withdrawal. Each change in land attributes or development activity becomes part of a continuous record, reducing gaps between planning and implementation.

生命周期	动态追踪内容	合规性警示	报告
土地报批阶段	选址红线、收储红线、用地红线(用地范围、用地面积、用地性质、容积率、绿地率、建筑密度等规划指标)	申报指标是否突破详细规划规定的规划设计条件	自动生成监管报告和统计报表
土地出让阶段	出让计划、出让信息、出让合同(出让条件)	是否违规出让	
土地建设阶段	规划设计方案	总平方案、单体方案合规性(工程规划许可智慧审图)	
土地竣工验收阶段	竣工验收测量成果	建设是否合规性	
土地使用阶段	土地产权信息	是否违规使用土地	
土地监管阶段	通过卫星遥感、无人机等技术实时监控土地状态	对土地数据进行分析，提供决策支持	

Table 1 Land life-cycle chain

2.3.2 Upgrading the Land-investment Cloud Service

A cloud service matches enterprise requirements with available parcels, planning conditions, infrastructure, and policy. It supports transparent promotion, project comparison, and preliminary compliance checks, and provides feedback on market demand to future planning adjustment.

2.4 Supervision: From Ex-post Accountability to Full-cycle Monitoring

2.4.1 Public Participation and Social Governance

The platform publishes planning information, receives comments, records participation, and tracks responses. Public access is differentiated to protect security and privacy while improving transparency and community involvement.

2.4.2 Dynamic Monitoring and Evaluation

Real-time and periodic data monitor control lines, land use, construction intensity, facilities, transport, infrastructure, landscape, and implementation. Long-term urban-health tracking integrates population, housing, economy, transport, and services. An education-facility model, for example, simulates project-induced population change and calculates school-place deficits.

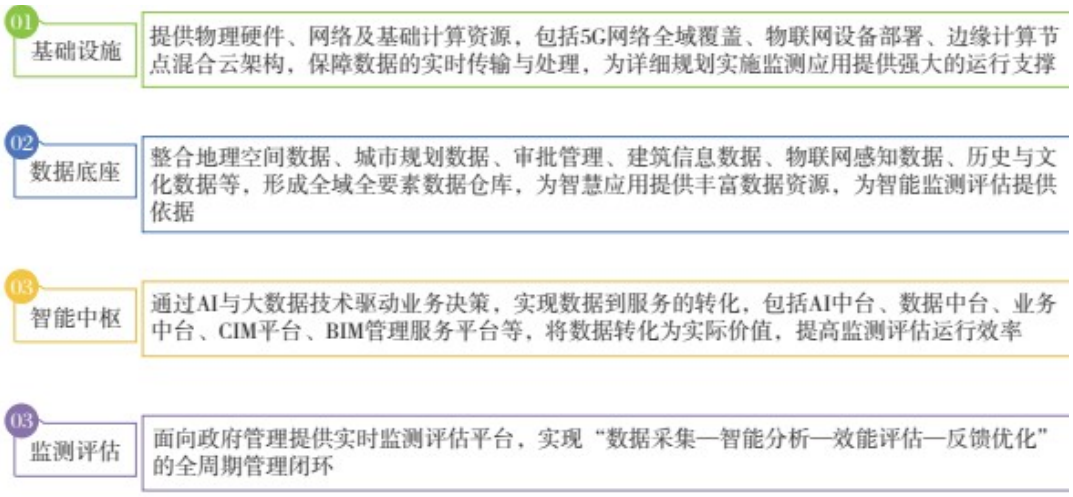

Fig. 3 Intelligent platform for real-time monitoring of detailed planning

评估层面	监测类别	监测内容	监测指标
市级层面	总体规划	“三区三线”	控制永久基本农田、生态保护红线、城镇开发边界等控制线的四至边界、管控要求
		结构性廊道	风廊、绿廊、视线廊道等
		重要保护线	绿线、蓝线、黄线、紫线等范围与规模
		重大设施	市级及以上公共服务设施、交通设施、公用设施等位置、用地规模、建设要求等
分区层面	专项规划	专项规划	福州市已批复或在编涵盖公共服务、交通市政等专项规划43项。涉及专项规划的用地规模、建设管控要求等
	特定区域	重点区域要求	两江四岸、重要水体、山体周边、历史文化街区等景观风貌要求
	建设总量	建设总量	开发总量与开发强度
单元层面	核心指标	主导功能	主导功能相关用地应占所在单元面积比例为最高
		“五线”	控制道路红线、城市绿线、蓝线、黄线、历史文化保护线的位置、范围、宽度、面积和管控要求
		“三大设施”	控制公共管理与公共服务设施、道路与交通设施、公用设施的等级、用地规模、建设规模、设施位置、管控要求等内容
		生活圈	5分钟、15分钟生活圈的体系构建与覆盖
		道路交通	快速路、主干路、次干路的功能、走向、红线宽度、控制点坐标、道路平曲线拐点坐标和半径、横断面等
	特殊管控	景观风貌	节点、廊道以及色彩、风格、高度等分区及其控制要求
		地下空间开发	地下空间开发位置、开发规模、建设要求以及与地面、周边地下空间衔接的要求等
地块层面	核心指标	土地用途	用地布局与用地性质构成，可混合用地的比例
		开发建设指标	用地面积、容积率、建筑密度（建筑系数）、绿地率、建筑高度、配套设施及规模、停车泊位、建筑退距等开发建设要求
	其他内容	重要控制线	落实单元层面的“五线”；已批项目权属边界、文物、名木古树等
		规划条件变更	变更申请、审查、公示与公众监督等
		市政配套	给排水、电力、通信等配套接口
		特殊规定	建筑体量、体型、色彩等景观风貌指引等

Table 2 Monitoring content for detailed planning

3 Conclusions and Outlook

Fuzhou integrates digital technology into preparation, approval, implementation, and supervision while maintaining a people-centered orientation. Shared and continuously updated data improve scientific rigor and foresight; digital workflows increase efficiency and reduce governance costs. Future work should deepen intelligent applications and ensure that digital benefits remain inclusive, transparent, and accessible.

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