Modular Transmission System for Territorial Spatial Planning: A Case Study of Shenzhen

WANG Jia, WANG Lian, LI Chen

Abstract. Territorial spatial planning provides the fundamental spatial guarantee for advancing Chinese modernization, and specialized plans have become an essential implementation-support component within this system. This paper examines the renewed objective orientation and conceptual links of territorial spatial planning under Chinese modernization, focusing on the evolving transmission content between city- and county-level master plans and specialized plans. Drawing on modularity theory, it analyzes the theory's connotations, structural features, and applicability, and proposes a modular transmission system for the master-specialized territorial spatial planning framework. At the practical level, the paper reviews cases and technical standards for specialized-plan transmission, argues for constructing system submodules through catalogue-based list management, and strengthens horizontal coordination and vertical transmission through an efficient organizational model for planning transmission, thereby meeting the requirements of strategic-goal implementation. Based on Shenzhen's modular planning-transmission practice, the study further analyzes the operating mechanism and transmission model of ecological-space planning, with the aim of informing modular transmission pathways and implementation mechanisms for master-specialized territorial spatial planning.

Keywords: Chinese modernization; master-specialized plan transmission; modularity theory; Shenzhen.

Chinese Library Classification: TU984. Document Code: A. DOI: 10.16361/j.upf.202503011. Article No.: 1000-3363 (2025) 03-0087-07.

The Decision of the CPC Central Committee on Further Comprehensively Deepening Reform and Advancing Chinese Modernization, adopted at the Third Plenary Session of the 20th CPC Central Committee, calls for improving the national economic and social development planning system and strengthening mechanisms for planning coordination and implementation. This indicates that the systematic construction of territorial spatial planning has become a major issue in building a modern country and requires further improvement of the spatial planning system through institutional innovation and stronger coordination mechanisms [1]. Within this system, specialized plans are important instruments for implementing multi-plan coordination and optimizing the allocation of resources and factors. Territorial spatial master plans guide and constrain specialized plans, while specialized plans also transmit the master plan to detailed plans. In China, however, clear rules or guidance have not yet been established for such questions as how specialized plans should be classified and how they should be horizontally coordinated [2]. Internationally, hierarchical transmission in spatial planning does not have a single precise concept, but a broad consensus has formed. It operates along both horizontal and vertical dimensions, transmitting mandatory and flexible content among plans corresponding to different governmental powers. In international research, specialized plans play important roles in hierarchical transmission in various forms, including comprehensive coordination mechanisms, planning-coordination agencies, and feedback or negotiation with higher-level plans, thus enabling two-way transmission [3-5].

On the new journey, territorial spatial planning must reexamine its strategic role and further improve the coordination and transmission mechanism between master plans and specialized plans, thereby

strengthening the implementation support that specialized plans provide for Chinese modernization. Planning implementation and management must correspond to governmental authority. City and county levels occupy a key intermediate position in China's administrative system: in concrete planning work, they support steady development in the economy, people's livelihoods, and society, while also forming a crucial foundation for long-term national stability and modernization [6]. During China's period of rapid urban expansion, Shenzhen's cluster-based urban structure preserved spatial flexibility, enabling it to respond to extraordinary urban growth. Shenzhen also pioneered the first basic ecological control line in China and has conducted extensive research on pathways toward harmonious coexistence between people and nature in a high-density megacity [7]. For these reasons, this paper focuses on the theoretical construction, case abstraction, and implementation pathway of transmission between city- and county-level territorial spatial master plans and specialized plans. Taking Shenzhen as a typical case, it seeks to establish a planning-transmission paradigm with clear rules and a complete structure, thereby implementing planning objectives more effectively and reducing coordination costs.

1 Analysis of transmission content in city- and county-level master-specialized territorial spatial planning

1.1 Achieving strategic objectives: a new territorial-spatial orientation for Chinese modernization

The Several Opinions of the CPC Central Committee and the State Council on Establishing and Supervising the Implementation of the Territorial Spatial Planning System proposed the formation of a territorial development and protection system based on territorial spatial planning and implemented through unified use control, with the aim of comprehensively modernizing the territorial spatial governance system and governance capacity [8]. The construction of the territorial spatial planning system has thus become an imperative of the modernization of national governance [9]. Prioritizing ecological civilization and sustainable development is a basic value orientation of territorial spatial planning, which has long been one of China's key achievements in reforming the ecological-civilization system. This value shift has transformed the formerly anthropocentric planning mindset and technical system, fostering values centered on symbiosis between people and nature and the healthy, sustainable continuity of all life [10]. The Recommendations of the CPC Central Committee for Formulating the 14th Five-Year Plan for National Economic and Social Development and the Long-Range Objectives for 2035 explicitly call for a territorial spatial layout and support system for high-quality development, a new pattern of territorial development and protection with clear major functions, complementary advantages, and high-quality development, and stronger territorial spatial planning and use control [11]. As territorial space has become a major spatial carrier for economic and social development, new urbanization, and ecological-civilization construction [12], the report to the 20th CPC National Congress proposed advancing Chinese modernization. Based on a demand-function matching logic, it sets new strategic objectives for optimizing territorial spatial patterns: human-land coordination, integrated and equitable development, civilized order, beautiful harmony, and safe co-governance [13]. These core meanings of Chinese modernization call for stronger systemic, balanced, symbiotic, democratic, and security-oriented thinking, providing key directions for territorial spatial planning in the new era.

Territorial spatial planning has become a spatial-governance paradigm for supporting Chinese modernization in a country with a very large population. Its primary objective is to build a spatial logic of coordinated development across all elements through human-land coupling. Under this logic, territorial spatial planning aims to optimize the allocation of territorial resources, improve land-use efficiency, encourage population concentration in economically advantaged areas such as metropolitan areas, urban

agglomerations, and regional central cities, allocate population and environmental resources more rationally, and promote coordinated regional development [14]. In the sociocultural inheritance of urban-rural material environments, one inherent defect of modernism has been the rupture between tradition and modernity [15]. Facing such contradictions and challenges, territorial spatial planning should follow the symbiotic thinking of Chinese modernization, aim to integrate diverse cultures, improve the transmission mechanism for urban-rural historical and cultural values and their carriers, and balance protection with utilization and inheritance with development [16]. At the same time, territorial spatial planning in the new era continues to explore ways to enhance the value of ecosystem services. In the integrated governance of special regions, specialized plans for the Yangtze River Economic Belt, coastal zones, integrated mountain-water-forest-farmland-lake-grassland restoration, and natural protected areas are being formed or will emerge in large numbers [17]. Practice shows that territorial spatial planning is providing spatial safeguards for ecological values in Chinese modernization, including the construction of a Beautiful China and harmonious coexistence between people and nature. As a spatial carrier of national strategic security, territorial spatial planning incorporates natural disasters, safety hazards, and other elements that are likely or potentially likely to threaten urban safety into evaluations of resource and environmental carrying capacity and territorial development suitability, constructing new multi-scenario resilient-city visions [18]. This both expands the resilience of territorial spatial planning and spatially expresses safe co-governance in Chinese modernization.

1.2 Responding to spatial needs: new multidimensional pathways between master plans and specialized plans

In responding to the spatial-demand logic of innovation-driven development, specialized plans achieve orderly coordination through a dual transmission mechanism of rigid control and flexible adaptation. Specifically, specialized plans implement mandatory content in master plans - including binding indicators, control boundaries, regulatory zones, and major infrastructure layouts - through rigid transmission, while facility scale and use, allocation standards, and related content are optimized and deepened through flexible transmission according to practical needs [19]. Nanjing's practice shows that constructing a horizontal transmission framework of master plan-specialized plan both ensures the transmission of baseline controls and strategic intentions from the master plan and reserves appropriate flexibility to meet municipal needs for deepening and adjustment in specialized plans [20]. In essence, this transmission model is a spatial-governance tool for resolving conflicts among multiple plans [21], coordinating and balancing the spatial needs of specialized sectors.

The key task in the new round of specialized-plan preparation is to reconstruct the synergistic relationship with the master plan, establishing the master plan as a platform for spatial coordination and further clarifying the strategic orientation, system layout, and implementation mechanisms of specialized systems [22]. To adapt planning transformation to new urban-governance needs, Shanghai has proactively explored the Specialized Planning Outline① as a transmission carrier. In practice, the city's master plan serves as a top-level design framework for coordinating various specialized plans, precisely embedding the construction requirements of specialized systems under municipal authority and planning content involving cross-departmental authority into the Specialized Planning Outline for transmission and implementation. In this way, specialized plans that meet urban-governance needs undertake the systematic tasks of implementing megacity transformation and development [23]. In terms of content framework, the classified sections of the Specialized Planning Outline respond to urban development needs such as population growth, land-resource use, ecological and environmental protection, safety assurance, cultural soft power, organic renewal, and regional coordination. At the level of spatialized management in vertical transmission,

Changsha has formulated the Work Plan for Coordinating and Reviewing the Preparation of Changsha Territorial Spatial Specialized Plans. It provides a checklist of elements for specialized plans, including implementation requirements for indicators, provisions, layouts, and databases, and is supplemented by layout-guidance maps for specialized facilities and explicit multi-scenario checking methods to resolve conflicts between the master plan and specialized plans [24]. Overall, as plans for specific spaces or elements, specialized plans should strengthen the internal transmission among identification, objectives, schemes, and controls, thereby achieving organic integrity in planning [25].

The preparation and review of specialized plans must strengthen their linkage with related territorial spatial plans and strictly conduct data verification through the one-map system [26]. In the approval stage, a quality-inspection system covering all elements should be established before data submission, with emphasis on data completeness, format standardization, spatial-topological consistency, and other core elements. Based on the Territorial Spatial Master Planning Database Specification (Trial), classified transmission rules can improve data-adaptation efficiency. Construction-oriented plans should strengthen spatial siting control, protection-oriented plans should clarify control boundaries and use access, and project spatial layouts and land-use demands should be mapped on the Third National Land Survey base map. For elements that are difficult to locate spatially, list-based control mechanisms should be established. It is therefore important to rely on the one-map platform to normalize plan coordination and integrate implementation in accordance with technical rules.

2 Review of modularity-related theory and practice

2.1 Connotations and features of modularity theory

Modularity theory originated in German industrial production in the 1930s and was later applied to product design, computing, architecture, spatial design, and other fields. Its theoretical meaning has evolved multidimensionally. A module is usually defined as a typical, general-purpose independent unit that can be combined into a system and has a clearly defined function and interface structure [27]. In building a modular system, modules exhibit diversity, independence, generality, and interchangeability. Through a set of system submodules with either the same functions or different structural performance and uses [28], modules can be adapted according to certain rules to form more complex systems.

Modularization can be understood as a systems-theory approach that decomposes a highly complex system into several system submodules, then replans and reorganizes them, and finally combines them into a complete system through standardized module interfaces [27]. In product design, modular design enables the flexible combination and matching of functional modules, generating diversified products with distinctive functions, hierarchies, and structures and helping respond to changes in market and technological demand [29]. As a strategic method for solving complex problems, modularity theory was then gradually applied to the design and production of unitized buildings, including housing, office buildings, and container buildings with clear standardization and repetition, and it generated modular design methods such as integrated design, serial design, and typical design. Modularity theory has since moved beyond traditional engineering and has become a methodological foundation for complex-system governance [30]. In territorial spatial planning, it can be organically embedded in the institutional reform framework of multi-plan integration and used as a governance tool that combines institutional flexibility with dynamic adaptability, helping address multi-level complexity in the transmission mechanism and implementation pathways between master plans and specialized plans.

2.2 Applicability of modularity theory to master-specialized territorial spatial planning transmission

Territorial spatial master plans and specialized plans differ substantially in preparation bodies, content, and technical standards. These differences obstruct transmission pathways between master plans and specialized plans, leading to transmission failure in the form of low transmission efficiency, inconsistent plan outputs, and difficulties in multi-departmental collaboration [31]. As a result, specialized plans struggle to play their intended intermediate role in deepening spatial layouts and effectively supporting master plans [32].

The core advantage of modularity theory is that it can provide a flexible and efficient co-governance framework and standardized operating procedure for resolving transmission failure, reducing transmission resistance through maximum system integration and organized operation. First, it improves planning-transmission efficiency. By organizing planning content and hierarchy modularly, it simplifies transmission processes through layered transmission and can set priorities for relatively independent types of specialized plans or general content, thereby saving time and improving efficiency. Second, it strengthens standardization capacity. It is well suited to the requirements of implementing unified base maps, unified standards, unified planning, and a unified platform: by regulating baseline maps and data, setting standardized module interfaces, and clarifying plan positioning and output content, it ensures effective linkage and coordinated division of labor among system submodules and improves the consistency and accuracy of transmission. Third, it enhances planning flexibility. Because planning often lags behind environmental change, a more variable, expandable, and independent integrated planning system can facilitate the addition of new functions or submodules; even if some submodules encounter problems, their impact remains limited, preserving greater flexibility in planning transmission. Fourth, it promotes multi-party collaboration. It provides a coordinating framework for the common spatial program involved in specialized plans across multiple departments and fields, helping actors quickly build consensus amid differences and strengthening the division of labor, collaboration, and implementation capacity among multiple actors, disciplines, and teams through shared planning objectives, transmission requirements, and work platforms.

3 Modular transmission system for master-specialized territorial spatial planning based on modularity theory

3.1 Organizational model: providing more flexible and diversified transmission methods

Constructing an integrated transmission system for master-specialized territorial spatial planning based on modularity theory can open up the bottlenecks and difficult points of planning transmission and establish an efficient, precise, flexible, and practical lifecycle transmission system. The sound operation of a modular system depends on explicit, strictly defined rules and implicit design rules [33]. Designing the organizational model of system modules is an important step: it specifies how modules interact, exchange information, and provide feedback, thereby maximizing system operating efficiency. At the organizational-structure level, the organizational model of the master-specialized territorial spatial planning transmission system consists of two major components: module interfaces and transmission carriers. Module interfaces are transmission rules; transmission carriers are transmission methods. Local experience shows that Guangzhou has strengthened transmission interaction between master plans and specialized plans in horizontal coordination and clarified transmission rules for indicators, catalogues, locations, and structures [34]. Zhanjiang has established a city-county linked vertical transmission mechanism combining rigidity and flexibility, using a multidimensional set of carriers - objectives or indicators, structure, catalogue, location, zoning, boundary, and rules - together with compound transmission methods such as implementation,

deepening, optimization, and supplementation to form a vertical transmission system [35]. At the sectoral standard level, the Guidelines for Preparing Municipal Territorial Spatial Ecological Restoration Plans specify key ecological-restoration tasks through zoning transmission, indicator decomposition, project-list guidance, and policy requirements.

Accordingly, in light of differences in specialized-plan types and preparation requirements, and to improve the universality and implementability of the master-specialized territorial spatial planning transmission system, this paper defines module interfaces as transmission rules including control indicators (numbers), spatial structures (maps), spatial boundaries (lines), policy requirements (texts), project lists (catalogues), and database specifications (databases). Transmission carriers are defined as methods such as implementation, deepening, optimization, and supplementation. The one-map platform for territorial spatial planning is used to coordinate and manage transmission interfaces, further clarifying standardized transmission rules and jointly forming a diversified, flexible, efficient, and interconnected organizational model.

3.2 Module decomposition: a catalogue list of specialized plans serving management needs

Module decomposition refers to breaking a complex subsystem into several system submodules [36]. In terms of transmission logic, territorial spatial master plans and specialized plans form a one-to-N mapping relationship, and the focus of transmission should be on overall coordination and classified transmission content. The decomposition of system submodules therefore follows not only explicit features revealed by visible external differences but also deeper implicit features. It should identify the interrelationships, potential influences, and other attributes among specialized plans so that the functional organization of system modules avoids conflict, overlap, and redundancy.

Catalogue-based list management of specialized plans is an innovative institution in territorial spatial planning reform. It provides an important tool for clarifying specialized-plan needs across sectors and strengthening the master plan's coordinating transmission to specialized plans. In response to local planning-management needs, many places have issued institutional documents for specialized-plan management [37]. To strengthen the linkage between specialized plans and territorial spatial master and detailed plans and to improve the standardization of specialized-plan outputs, Anhui Province has proposed six categories of specialized plans - municipal facilities, public facilities, urban-rural industries, resource protection, transportation, and public safety - and encourages the combined preparation of specialized plans with similar spatial-use attributes and strong interconnections②. Zhejiang Province has proposed that specialized plans should take into account the implementation of major strategies and the priority of key projects, allocate spatial elements rationally, and organize an 8+X category system of specialized plans. The 8 refers to eight types of specialized plans closely related to the master plan, including industry, environmental protection, urban construction, transportation, and water conservancy; X refers to other specialized plans with a general degree of linkage③. Changsha has defined a catalogue list of 47 specialized plans in six categories: resource protection; industry and urban-rural development; public services; transportation; municipal facilities; and public safety④. Although catalogue-list management remains exploratory, a common understanding has emerged: dividing specialized plans into system submodules based on catalogue management not only satisfies practical development needs but also supports the realization of major national and provincial strategic goals under territorial spatial planning management norms, thereby ensuring the goal orientation and operability of plan implementation.

3.3 Module aggregation: modular specialized-plan sets supporting strategic objectives

Module aggregation refers to organically combining modules according to certain rules into a complex system with specific objectives and functions [36]. The aggregation of system submodules should address the differences among specialized-plan submodules and integrate a set of specialized-plan system submodules with clear transmission objectives, decomposable and combinable structures, and independent operation, thereby forming a more concise and efficient planning-transmission system that maximizes comprehensive benefits. To support the strategic objectives of Chinese modernization and draw on the institutional advantages of innovative linkage between master plans and specialized plans, this paper uses the catalogue list of specialized plans as a carrier for constructing system submodules. By summarizing the type characteristics of specialized plans in different localities, it proposes a 2+X submodule integration system. The 2 refers to specific-region or basin categories and specific-field categories; X includes functional submodules such as resource protection and utilization, urban-rural development, public safety, public services, infrastructure, transportation, and urban characteristics.

At the same time, the system should accommodate differences in local conditions. Provided that the strategic objectives of Chinese modernization - human-land coordination, integrated and equitable development, civilized order, beautiful harmony, and safe co-governance - are met, the modular transmission system should reserve flexible, supplementable, and operable submodules. This allows localities to formulate specialized-plan catalogue lists according to local conditions, ultimately forming a modular transmission system for master-specialized planning that has clear authorities, openness and flexibility, and complete functions, as shown in Figure 1. In addition, a dynamic feedback and correction mechanism for master-specialized planning should be explored, along with linkage rules that connect upper and lower levels and coordinate horizontally, in order to build a modular planning-transmission system with unified transmission objectives, clear transmission paths, and an explicit technical paradigm.

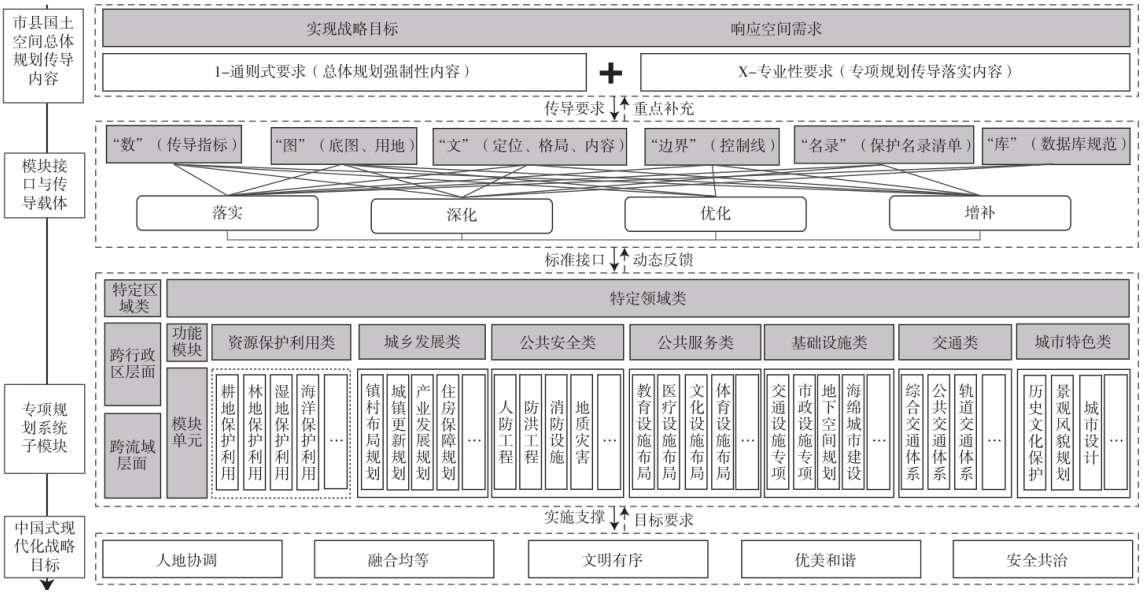

Figure 1. Technical-theoretical framework for modular transmission of master-specialized territorial spatial plans

4 Shenzhen as a modular case: operating mechanism and organizational model of the ecological-resource transmission system

4.1 Ecological units as spatial carriers for transmitting ecological-space protection indicators

Nature provides the basic conditions for human survival and development, and development should be planned from the height of harmonious coexistence between humanity and nature⑤. Chinese modernization is modernization in which people and nature coexist harmoniously. As a typical high-density megacity, Shenzhen's dense population and socioeconomic activity have placed considerable disturbance and pressure on the ecological environment, and the risk of ecosystem degradation has long persisted. Under this spatial challenge, the Shenzhen Territorial Spatial Master Plan (2021-2035) divides land and marine natural resources into control zones and further refines them, according to resource characteristics and functional positioning, into three types of detailed units - urban, ecological, and agricultural - as well as marine bay-area units, thereby forming a planning-transmission and control system covering all land-sea areas and all elements. Specifically, land-based detailed units focus on effectively decomposing and transmitting the objectives and indicators of higher-level plans to ensure orderly development and construction within the established framework, while marine units focus on coordinated governance and sustainable development through integrated control elements [38]. At the district planning stage, factors such as ecological conservation redlines, suitability evaluation for urban construction land, and marine functional zoning are considered comprehensively to create a detailed unit system covering the whole territory. This system includes 21 ecological units, 4 agricultural units, 43 urban units, and 9 bay-area units. In addition, tailored and operable spatial guidelines are formulated by category in response to each unit's needs in environmental governance, ecological restoration, industrial development, spatial quality, and facility construction [39], providing strong support for high-quality territorial spatial development. The control model of ecological units has shifted from simple top-down rigid control to a governance model centered on refined functional guidance and the shared benefits of rights and interests [40]. On the basis of coordinating the interests of multiple parties, ecological units serve as basic units for multilevel decomposition, transmission, supervision, and assessment from the municipal to district and subdistrict levels, realizing the transmission and implementation of key objectives and indicators for ecological-space protection across the city [41].

4.2 Establishing a transmission system for ecological protection and restoration planning and modular project control

Ecological restoration is shifting from a focus on key-area treatment toward integrated ecosystem protection and comprehensive governance. This shift reflects a deeper understanding of ecosystem integrity and interconnection. Shenzhen aims to enhance ecosystem diversity, stability, and sustainability as a whole, comprehensively coordinating ecological protection and restoration and implementing the ecological-protection pattern and natural-resource protection objectives of its territorial spatial master plan. The Shenzhen Territorial Spatial Ecological Protection and Restoration Plan (2021-2035), issued by the city, innovatively modularizes the specialized plan for ecological protection and restoration. In transmitting planning content, it identifies the module interface as the core, establishes a planning-indicator system consisting of 19 indicators in two categories, implements the overall ecological spatial pattern of four belts, eight patches, and multiple corridors, delineates 6 ecological protection and restoration zones and 48 key areas, and deploys transmission rules for 44 major municipal projects in six categories. At the ecological-pattern level, the transmission path is to implement the four belts, eight patches, and multiple corridors protection pattern and the ecosystem-protection planning map of territorial spatial district planning, and then supplement or refine key patches and corridors according to local conditions, as shown in Figure 2.

Shenzhen has also established transmission carriers in the modular system - implementation, deepening, optimization, and supplementation - to refine the ecological protection and restoration zones identified in the restoration specialized plan and link them with secondary planning zones in territorial spatial district planning, such as water-source security units, important-corridor management units, and ecological-recreation units. For key areas, the system implements the boundaries and restoration modes specified in the restoration specialized plan, including natural conservation, assisted restoration, and ecological reconstruction; implements the layout of major ecological-restoration projects defined in territorial spatial district planning by incorporating project implementation areas into key ecological-restoration areas; and, on the basis of the two levels of implementation, appropriately supplements key areas according to demands for enhancing regional ecological functions. In addition, it is recommended that key areas be named scientifically by combining natural geographic units, dominant ecological functions or principal ecological problems, and protection-restoration directions. In this way, Shenzhen has built a planning-transmission system and project-control model centered on ecological protection and restoration, clarifying preparation requirements for ecological restoration across plan levels and types and strengthening the transmission effect of municipal ecological-restoration specialized planning. At the project level, in view of the diverse types of ecological-restoration projects and the participation of multiple actors, the city follows the management principles of multi-departmental coordination and whole-process guidance and control, strengthening the translation of planning into project implementation.

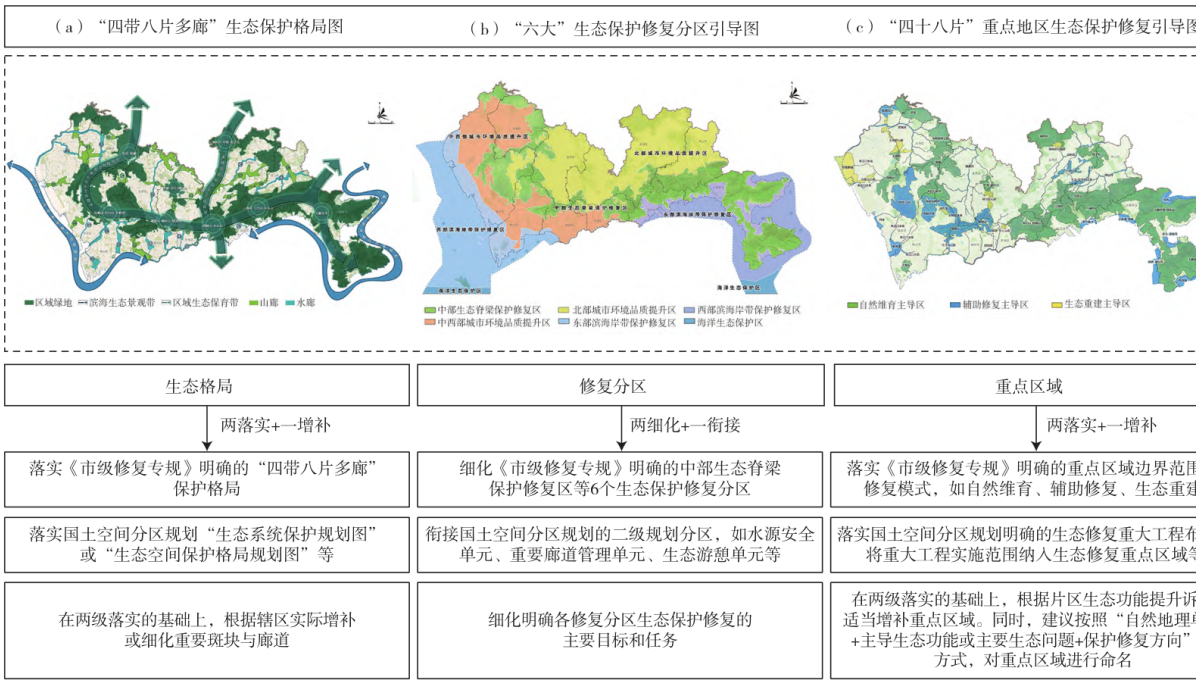

Figure 2. Transmission system of the Shenzhen Territorial Spatial Ecological Protection and Restoration Plan

Source: prepared based on the Shenzhen Territorial Spatial Master Plan (2021-2035) and the Shenzhen Territorial Spatial Ecological Protection and Restoration Plan (2021-2035).

(a) Ecological protection pattern of four belts, eight patches, and multiple corridors. (b) Guidance map for the six major ecological protection and restoration zones. (c) Guidance map for ecological protection and restoration in the forty-eight key areas.

4.3 Exploring modular ecological-space structures to guide continuing innovation in ecological-space governance

Compared with traditional urban planning, whole-territory spatial governance extends control objects from urban space to ecological spaces such as mountains and forests, farmland, rivers and lakes, and the sea. Reviewing the evolution of Shenzhen's master plans, the city has adopted a cluster-based spatial organization that uses the ecological background to preserve ecological green gaps, providing, to a certain degree, room for cluster expansion. In 2005, Shenzhen considered the harmony between people and nature from a whole-territory perspective, designated nearly 50% of the city's total land area within the basic ecological control line, and promulgated the Shenzhen Basic Ecological Control Line Management Regulations. It became one of the first Chinese cities to demarcate a basic ecological control line to anchor urban ecological space, an innovative and appropriately scaled exploration for ensuring urban ecological security and preventing disorderly construction sprawl. The modular ecological-space structure can respond to urban development needs in a timely manner and can be understood as an extension and development of modular thinking.

Against the background of ecological-civilization construction, Shenzhen has preserved cluster structure through ecological land, forming a favorable ecological environment. Its evolution shows that modular systems can be highly resilient: since implementation of the basic ecological control line, more than 95% of ecological patches such as mountains, forests, and country parks have been completely protected. This modular strategy appears not only at the city scale but also at meso- and micro-scales, giving rise to the Shenzhen Greenway Network Specialized Plan. That plan created a three-level regional-urban-community greenway network and shaped a spatial structure with 300 km of regional greenways as its backbone. At this stage, the modular cluster structure also possessed functional integrity and structural growth capacity. As problems of coarse delimitation emerged, the management of Shenzhen's basic ecological control line gradually moved toward refinement. While ensuring that the total land area within the line would not decrease, Shenzhen comprehensively optimized and adjusted the ecological line in 2013 and introduced the concept of protective development, formulating supporting policies for community coordination, land consolidation, and industrial development, and exploring a win-win model that coordinates community transformation within the line with ecological-land protection. The flexibly expandable strategy of structural modularization continues to demonstrate its ability to transform functions. Shenzhen has now launched the Mountain-Sea City Connection Plan, systematically upgrading the whole-territory habitat-making system of this high-density city. On the basis of consolidating the scale-oriented thinking of ecological control lines, it is comprehensively enhancing the value of ecological services. Shenzhen is coordinating multidimensional governance across spatial, ecological, and social domains, promoting the synchronous evolution of the urban organism in physical form, smart development, humanistic care, and social-emotional life.

5 Conclusion

Territorial spatial planning is the solid spatial base and resource platform for Chinese modernization. Clarifying the new development goals of Chinese modernization provides important strategic guidance for the coordination, preparation, implementation, and management of territorial spatial planning. Shenzhen's series of ecological-space plans, oriented toward refined spatial governance and planning transmission, has built a multilevel, multi-type, and multi-strategy modular transmission system for territorial spatial planning. At the master-plan level, ecological units serve as transmission carriers to build a planning-transmission and control system covering the whole territory and all elements, effectively ensuring refined ecological-space

control and the transmission and implementation of key objectives and indicators. At the specialized-plan level, the municipal ecological protection and restoration plan attempts to establish standardized module interfaces and transmission carriers, using a flexible and efficient transmission system and modular project-control model to promote planning transmission and project implementation. Shenzhen has gradually explored a modular ecological-space organization model of multiple scales and flexible clusters, laying a foundational framework for ecological-space protection, utilization, and positive growth, and providing an important reference for achieving harmonious coexistence between people and nature and modernizing ecological-space governance.

The study suggests that the modular transmission pathway for master-specialized territorial spatial planning depends on three key points. First, it should adhere to systems thinking: the territorial spatial planning system should be regarded as a complex system whose configuration ensures efficient and flexible operation; the correspondence between master plans and specialized plans should be clarified; and standardized module interfaces and transmission carriers should be established. Second, it should adhere to relational thinking: according to differences in planning objects and key content, the functional system and organizational model of specialized-plan submodules should be improved, feedback mechanisms among modules strengthened, specialized-plan transmission efficiency enhanced, and horizontal linkage mechanisms improved. Third, it should adhere to goal orientation: planning transmission and coordination must respond in a timely manner to changing realities, with flexible addition, optimization, and upgrading of system submodules to meet the objectives of territorial spatial governance in the new era.

Looking ahead, given the special attributes of specialized-plan types, their classification and the definition of rights and responsibilities remain unclear. In practice, preparation bodies and implementation bodies are not fully aligned, which can negatively affect transmission feedback between master plans and specialized plans. The feedback mechanism for Shenzhen's specialized plans in specific fields also requires further improvement. Future work should move beyond the traditional theoretical understanding of urban-rural planning transmission mechanisms, respond to the governance needs and objectives of Chinese modernization, build a whole-process, standardized control and feedback mechanism within the territorial spatial planning system, and form technical consensus on the transmission and coordination pathways of specialized plans, thereby better ensuring the implementation effects of relevant specialized plans involving territorial-space use.

Notes

① The Shanghai Master Plan (2017-2035), released in January 2018, formed a complete 1+3 output system. The 1 refers to the Shanghai Master Plan (2017-2035) Report, and the 3 refer to district guidelines, the Specialized Planning Outline, and the Action Planning Outline. The Specialized Planning Outline corresponds to departmental authority and clarifies planning objectives, indicators, technical guidelines, development strategies, spatial layouts, and related content by section and system, guiding specialized systems to implement the city's overall development objectives and strategic orientation. According to the Specialized Planning Outline, specialized plans for social services, infrastructure, and other fields are prepared to clarify development objectives, planning layouts, construction standards, and implementation measures in each field and system.

② In July 2022, the Department of Natural Resources of Anhui Province issued the Technical Guidelines for the Linkage of Territorial Spatial Specialized Plans in Anhui Province (Trial), introducing innovative provisions

on the classification of specialized plans, strengthening linkage with master plans, and enhancing spatial attributes.

③ In April 2023, the General Office of the Zhejiang Provincial People's Government issued the Measures for the Management of Territorial Spatial Specialized Plans in Zhejiang Province, requiring all levels and types of specialized-plan preparation to establish evaluation mechanisms and implement catalogue-list management.

④ In September 2022, the Changsha Municipal Bureau of Natural Resources and Planning and the Changsha Development and Reform Commission issued the Catalogue List for the Preparation of Changsha Territorial Spatial Specialized Plans. It defines the scope of specialized-plan preparation, clarifies preparation and review responsibilities, decomposes 47 specialized plans to the competent municipal departments, and forms a joint planning model of sectoral departments plus natural-resources and planning departments, thereby promoting a unified work framework for collaborative governance.

⑤ On 16 October 2022, in his report to the 20th National Congress of the Communist Party of China, General Secretary Xi Jinping stated that nature provides the basic conditions for human survival and development; respecting, adapting to, and protecting nature are intrinsic requirements for comprehensively building a modern socialist country; and China must firmly establish and practice the principle that lucid waters and lush mountains are invaluable assets, planning development from the height of harmonious coexistence between humanity and nature.

References

[1] WU Zhiqiang, GUO Renzhong, ZHANG Bing, et al. Academic forum on the systematic construction of the national spatial planning system [J]. Urban Planning Forum, 2024(5): 1-11. [in Chinese]

[2] YANG Mei, LI Fuying, LUO Yan. Discussion on the preparation and implementation of territorial spatial specialized plans under an outcome-oriented approach [J]. Urban Planning Forum, 2022(S1): 214-218. [in Chinese]

[3] ZHOU Yixiao. Management and coordination of spatial elements in Germany's spatial-order planning, urban planning, and specialized planning [J]. Urban Planning International, 2021, 36(1): 99-108. [in Chinese]

[4] LI Yazhou, LIU Songling. Building a spatial planning system with clearly defined authorities: Japanese experience and implications [J]. Urban Planning International, 2020, 35(4): 81-88. [in Chinese]

[5] ZHAO Min. Australia's urban planning system [J]. City Planning Review, 2000(6): 51-54. [in Chinese]

[6] ZHAO Yi, ZHENG Jun, XU Chen, et al. Key issues in preparing county-level territorial spatial master plans [J]. Urban Planning Forum, 2022(2): 54-61. [in Chinese]

[7] ZOU Bing, HONG Wuyang. Exploration and reflection on ecological-space governance in highly urbanized areas: also on innovation in Shenzhen's urban ecological-space governance path [M]// SUN Shiwen. Governance Planning II. Beijing: China Architecture & Building Press, 2021. [in Chinese]

[8] CPC Central Committee, State Council. Several opinions on establishing and supervising the implementation of the territorial spatial planning system [R/OL]. (2019-05-23) [2023-11-15]. http://www.gov.cn/zhengce/2019-05/23/content_5394187.htm. [in Chinese]

[9] MENG Peng, WANG Qingri, LANG Haiou, et al. Challenges and reform orientations for China's territorial spatial planning under the modernization of spatial governance: reflections from a series of seminars on key issues in territorial spatial governance [J]. China Land Science, 2019, 33(11): 8-14. [in Chinese]

[10] LI Peng, CHEN Yi, CHEN Lian, et al. Territorial spatial planning for Chinese modernization: conceptual links, strategic directions, and core issues [J]. Academic Exploration, 2024(11): 16-25. [in Chinese]

[11] LIN Jian, ZHANG Yu. From the spatial planning system to the territorial spatial system: also on territorial spatial governance trends under the construction of the territorial spatial system [J]. China Land Science, 2024, 38(1): 1-8. [in Chinese]

[12] XUE Ling, YANG Kaizhong. Territorial spatial optimization and regulation under Chinese modernization: a paradigm shift toward resilience [J]. Economic Review Journal, 2023(6): 47-55. [in Chinese]

[13] YAN Jinming, HUANG Yujin, XIA Fangzhou. Optimization of territorial spatial patterns for Chinese modernization: basic principles, theoretical logic, and strategic tasks [J]. China Land Science, 2023, 37(11): 1-10. [in Chinese]

[14] ZHANG Jinjin, HAN Keyong, HUANG Zhengxue. Understanding the connotations and practical strategies of the territorial spatial system for Chinese modernization [J]. Jiangsu Social Sciences, 2024(3): 178-186. [in Chinese]

[15] ZHOU Jianyun, SU Zhangna. Reviewing the institutional construction and practice of territorial spatial planning from the perspective of Chinese modernization [J]. Journal of Urban Studies, 2023(5): 31-38. [in Chinese]

[16] DUAN Jin, ZHANG Tingwei, YIN Zhi, et al. Academic forum on Chinese-style urban-rural modernization: connotations, characteristics, and development pathways [J]. Urban Planning Forum, 2023(1): 1-10. [in Chinese]

[17] LIN Jian, ZHAO Ye. National governance, territorial spatial planning, and central-local coordination: also on the development and trend of central-local relations in the evolution of the territorial spatial planning system [J]. City Planning Review, 2019, 43(9): 20-23. [in Chinese]

[18] TAO Sirui, WANG Min. Research on resilient-city construction from the perspective of Chinese modernization [J]. Urban Development Studies, 2023, 30(9): 5-8. [in Chinese]

[19] CHEN Zhiqian. Preparation methods for specialized civil air-defense engineering plans based on transmission thinking [J]. Chinese Journal of Underground Space and Engineering, 2024, 20(2): 369-377. [in Chinese]

[20] GUAN Weihua, YE Bin, HE Liu. Evolution of Nanjing's urban-rural planning development over forty years of reform and opening-up: also on integrated innovation in territorial spatial planning in the new era [J]. Urban Planning Forum, 2019(5): 32-41. [in Chinese]

[21] CHENG Peng, TU Qiyu. Territorial spatial planning strategies responding to the logic of innovation-driven development [J]. Urban Planning Forum, 2022(6): 72-79. [in Chinese]

[22] JIN Zhongmin. Exploration of preparation methods for Shanghai's specialized plans based on spatial coordination [J]. Shanghai Urban Planning Review, 2017(4): 26-32. [in Chinese]

[23] ZHANG Shangwu, JIN Zhongmin, WANG Xinzhe, et al. Strategic guidance and rigid control: innovation in the output system of city master planning in the new era - basic ideas for constructing the Shanghai 2040 master plan output system [J]. Urban Planning Forum, 2017(S1): 52-60. [in Chinese]

[24] ZHENG Hua, DONG Xiaoshan, TANG Zhifa, et al. Linkage pathways between Changsha's territorial spatial specialized plans and master plan [J]. Planners, 2024, 40(4): 81-87. [in Chinese]

[25] LEI Hongben, CHEN Hongying, SUN Hongyang, et al. Research on preparation methods for sponge city construction planning based on transmission thinking [J]. Environmental Engineering, 2020, 38(4): 101-107. [in Chinese]

[26] DONG Yu, CHEN Zhong, YU Biao, et al. Framework and implementation pathway for integrated preparation and management of municipal territorial spatial specialized plans [J]. Planners, 2024, 40(11): 1-8. [in Chinese]

[27] LI Jiutai. Application of modular strategies in architectural design from a sustainability perspective [J]. Architecture Technique, 2016(2): 116-118. [in Chinese]

[28] AIKI M, ANDO H. Modularity: the nature of new industrial architecture [J]. RIETI Economic Policy Review, 2002(4): 1-20.

[29] HOU Liang, TANG Renzhong, XU Yanshen. Research progress on theories, technologies, and applications of product modular design [J]. Journal of Mechanical Engineering, 2004(1): 56-61. [in Chinese]

[30] XU Shuangqing, CHEN Xueguang, LI Jing. Review of modularity theory at home and abroad [J]. Science and Technology Management Research, 2008(9): 179-182. [in Chinese]

[31] CHEN Chuan, LI Haiyan. Discussion on the technical system and guarantee mechanism for the linkage and transmission of territorial spatial specialized plans [J]. China Land, 2024(2): 9-13. [in Chinese]

[32] WANG Chaoyu, MA Xing, XUAN Yuan, et al. Discussion on pathways for constructing a specialized planning system under the territorial spatial planning system [J]. Planners, 2021, 37(15): 87-94. [in Chinese]

[33] LEI Ruqiao, CHEN Jixiang, LIU Qin. Comparative study of modular organizational models and their efficiency [J]. China Industrial Economics, 2004(10): 83-90. [in Chinese]

[34] HUANG Huiming, HAN Wenchao, ZHU Hong. Research on Guangzhou's territorial spatial planning transmission system for whole-territory and all-element governance [J]. Tropical Geography, 2022, 42(4): 554-566. [in Chinese]

[35] FAN Xiaodong, CHONG Wei, YE Fangfang. Construction of territorial spatial planning transmission mechanisms and Zhanjiang practice [J]. Planners, 2024, 40(3): 86-94. [in Chinese]

[36] AOKI Masahiko, ANDO Haruhiko. The modular age: the nature of new industrial architecture [M]. Translated by ZHOU Guorong. Shanghai: Shanghai Far East Publishers, 2003. [in Chinese]

[37] XU Xiaoli, GU Yuqing, LIU Jianbo. Exploratory research on catalogue-list management of territorial spatial specialized plans [J]. China Land, 2024(2): 14-17. [in Chinese]

[38] CHEN Dunpeng. Exploration and reflection on the standard-unit system of Shenzhen territorial spatial planning [J]. City Planning Review, 2022, 46(9): 13-19. [in Chinese]

[39] WANG Dongxue, FANG Yu, HU Yanghaobo, et al. Exploration of territorial spatial planning in coastal ecological areas under land-sea whole-territory coordination: the case of Dapeng New District, Shenzhen [J]. Urban Planning Forum, 2022(S1): 232-239. [in Chinese]

[40] DAI Qing, TANG Hao. Practice and exploration of ecological-space management in highly urbanized areas: the case of Shenzhen [J]. Shanghai Urban Planning Review, 2018(3): 13-16. [in Chinese]

[41] ZOU Bing, CHEN Liuxin. Delineation methods and refined control approaches for land-based ecological units in highly urbanized areas: the case of Shenzhen [J]. Urban Planning Forum, 2023(3): 38-46. [in Chinese]

Revised: May 2025.

AI-assisted translation