Technology Embedding, institutional coupling and social Adaptation: The Mechanism, Tension and Optimization Path of Responsibility Planners' Involvement in Grassroots Community Spatial governance

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Abstract. Against the backdrop of urban stock renewal, the responsibility planner system effectively makes up for the shortcoming of insufficient professionalization in traditional grassroots spatial governance. However, in the process of professional forces sinking to the grassroots level, there is a conflict between technical rationality and the operational logic of the local grassroots society, which can easily lead to imbalance or even alienation in grassroots governance. The existing research still lacks in-depth analysis of the adaptation mechanism and internal tension between the two. This paper takes the theory of the interaction between technology and society and the theory of refined governance as its theoretical foundation, builds a three-dimensional analysis framework of "technology embedding - system coupling - social adaptation", and combines the governance practice of the responsibility planner system in Beijing. Relying on first-hand interview materials and field research, it systematically analyzes the operational logic, value tension and governance alienation issues of professional forces sinking to the grassroots level. Meanwhile, this article proposes long-term optimization paths from four major aspects: concept correction, technical optimization, institutional reconstruction, and social empowerment, further improving the practical model of responsibility planners' participation in grassroots co-governance, and providing theoretical and practical references for the refined governance of grassroots levels in China.

Keywords: Grassroots Spatial governance; Responsibility Planner Technical governance; Diversified collaboration.

1. Introduction

Grassroots governance is the cornerstone of modernizing national governance. Various regions have carried out diversified governance practices in areas such as Party building leadership, digital empowerment, and residents' self-governance, forming a series of Chinese experiences. To address the professional shortcomings in grassroots spatial governance, the Responsibility Planner (hereinafter referred to as "responsibility planner") model empowers grassroots spatial governance with professional manpower, relying on regular professional empowerment to promote the transformation of grassroots spatial governance from extensive to refined and localized.

Although relatively mature professional forces have been formed both at home and abroad to practice at the grassroots level, the contradiction between professional embedding and the logic of local life at the grassroots still exists. The current research focus is no longer on demonstrating the necessity of embedding professional forces at the grassroots level, but on opening the practical black box of professional intervention at the grassroots level and analyzing the internal tension in its operation process. Based on this, this paper constructs a three-dimensional analysis framework and conducts empirical discussions in combination with the practical cases of responsibility planners in Beijing to clarify the mechanism of embedding professional forces into grassroots spatial governance and provide references for similar practices.

2. Literature Review

2.1. A review of domestic and foreign literature

The traditional research on the embedding of grassroots professional forces in governance mainly falls into two major directions: governance outsourcing [1] and social work embedding [2]. Governance outsourcing focuses on the market-oriented undertaking model of community public affairs and its burden reduction effect. The integration of social work focuses on exploring its role in transactional and service-oriented grassroots governance. In addition, the focus of the third type of model shifts from the downward allocation of service-oriented human resources to technical professionals. Existing research mainly focuses on the operational characteristics of projects [3] and the management models of planners [4]; Or pay attention to the collaborative paths, such as proposing the "responsibility multi-teacher" collaborative system, the Haidian "1+1+N" team [5], and the multi-disciplinary on-site collaborative path, etc. The research on responsibility teachers has evolved from the initial exploration of systems to a deeper stage of model segmentation and multi-party collaboration, promoting the iteration of grassroots spatial governance.

In conclusion, the research on the downward allocation of grassroots human resources has completed its shift from service supplementation to technological empowerment. Governance outsourcing and the embedding of social workers lay the foundation for the research on multi-service governance. The related achievements have expanded the research on grassroots spatial governance, providing theoretical and practical references for the empirical analysis of this study.

2.2. Research summary

Although the existing research has completed the shift from service governance to technology governance, there are still several obvious shortcomings: First, there is a lack of an overall analytical framework, the practical black box of embedding has not been opened, and the exploration of the embedding process and its sustainability is insufficient; Secondly, the relevant evaluations lack a dynamic analysis of the entire governance process, and there are still limitations in exploring the structural contradictions between technical governance and grassroots self-governance as well as the long-term adaptation path. Thirdly, the quantitative support at the empirical level is relatively weak, and this system is a new thing. There are objective difficulties in the research on its long-term sustainable effects. Based on this, this paper constructs a three-dimensional analysis framework, combines the practice of responsibility planners in Beijing, focuses on the game contradictions and alienation mechanisms in the embedding process, and explores the path of adaptation and optimization.

3. Analysis frame, research methods and ideas

3.1. Three-dimensional analysis framework construction analysis

3.1.1 Definition of core concepts

To better facilitate readers' understanding, this article clarifies three important concepts.

Grassroots spatial technology governance is a kind of refined grassroots governance that takes urban and rural planning professional techniques as tools, and takes into account both the transformation of physical space and the reshaping of rights, responsibilities and interest relationships behind it. The responsibility planner system is a human resource allocation system that enables planners to stay on-site for a long time and coordinate the entire cycle of grassroots governance. Grassroots spatial autonomy is the public space governance order formed by local grassroots subjects from the bottom up, including the original demands and life logic of the grassroots, and there is a game between professional embedding and governance.

3.1.2 theoretical basis

This article takes the theory of technology-society interstructure and the theory of refined governance as its basis. Firstly, the theory of technology-society interstructure emphasizes that governance change is the result of dynamic adjustment between technology and society. The application of technology shapes the field structure and governance relationship, while social systems and residents' demands in turn restrict the form of technology implementation. It is the mother theory, providing the underlying logic for analysis. Second, select the theory of refined governance [6] to further adapt to the urban governance scenarios in China, and distill the technical, institutional, and social dimensions to form a theoretical dialogue. Among them, the technical dimension relies on professional tools to achieve precise governance. The institutional dimension ensures long-term governance through a collaborative mechanism. The social dimension is based on the demands of residents and cultivates self-governing forces to achieve people-oriented governance. It is a sub-theory that follows the two-way interaction logic of technology and society, and concretely deduces a three-dimensional analysis framework of "technology embedding - institutional coupling - social adaptation". The following will systematically explain the mechanism and predicament of the responsibility teacher's downward shift.

3.1.3 Construction of a three-dimensional analysis framework

This study, based on the professional actor of responsibility, establishes a humanistic analysis perspective, constructs a three-dimensional analysis framework of "technology embedding - institutional coupling - social adaptation", and takes into account the critical examination of governance tension and alienation phenomena to analyze the adjustment mechanism between professional embedding governance and the logic of grassroots life after professional forces intervene in grassroots governance. The existing research on grassroots spatial governance in the central urban area of Beijing is divided into three independent threads: technological empowerment, institutional construction, and governance effectiveness. A single perspective is difficult to fully reveal the mutual construction process of continuous interaction and adjustment among technology, system and local society during the process of professional penetration. This framework consists of three layers. The core is the dimension of technology embedding. Responsible teachers, as the technical carriers, go down to the grassroots level and input professional knowledge to make up for the professional deficiencies at the grassroots level, which is the inner starting point of governance. The middle circle represents the dimension of institutional coupling. By leveraging institutionalized tools such as negotiation platforms, it enables multi-subject collaboration, provides rigid operational rules, ensures the implementation of technology, and facilitates the transmission of demands. The outer layer represents the dimension of social adaptation. Through local integration mechanisms, it connects with the endogenous order at the grassroots level, reconciles interest games, responds to the genuine demands of residents, and at the same time, local practice feedback forces technological optimization and dynamic institutional correction [7]. Technology embedding, institutional coupling, and social adaptation form a circle governance system that is supported layer by layer from the inside out, feedback in reverse from the outside in, and mutually construct and coexist [8] (see Figure 1).

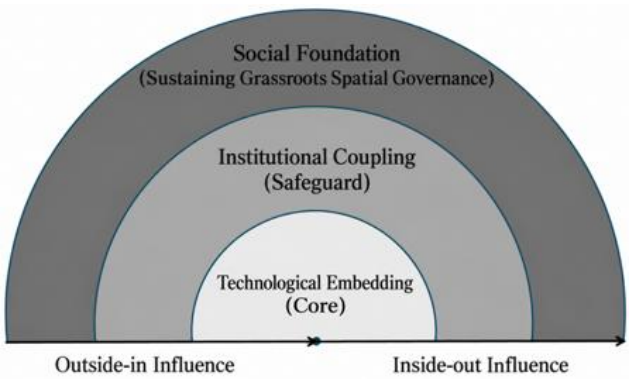


Figure 1. Three-dimensional relationship diagram.

3.2. Research ideas, methods and case selection

3.2.1. Research methods and approaches

This paper follows the research approach of "analysis framework construction - contradiction analysis - case verification - path optimization", builds a three-dimensional analysis framework of "technology embedding - system coupling - social adaptation", and combines multi-source data such as policy documents to conduct stratified analysis from the three dimensions of technology, system and society to ensure the authenticity and reliability of the research conclusion. The calculated Kappa value is 0.87.

3.2.2. case selection

This article selects the practice of responsible planners in Beijing as a research case, and the reasons mainly lie in two aspects. First, in most regions of the country, the practice of professional decentralization is fragmented and scattered. However, in Beijing, a three-dimensional mechanism has been implemented in a coordinated manner within the same grassroots field, forming a complete and integrated governance practice, which is in line with the three-dimensional analysis framework of this article. Secondly, most similar practices in China have the problem of being difficult to sustain. Since the pilot program in 2017, Beijing has completed the institutionalization and standardization, forming a sustainable and regular governance model. The maturity and representativeness of the practice are stronger, which is in line with the analysis requirements of this study.

Table 1. Interviewee Coding Table (Partial).

Interviewee group	Interviewee	Interview code
Grassroots worker in Subdistrict B	MX	M20240625
Residents' committee staff member in Community H	LFJ	L20240617
Resident A in Community H	DJG	D20240702
Resident B in CommunityH Resident C in Community H	ZN KDX	Z20240702 K20240702
...	...	...

4. The structural shortcomings of traditional grassroots spatial governance and the functional supplementation of responsibility planners

4.1. The dual inherent shortcomings of grassroots spatial governance

Under the traditional governance model, outsourcing, social workers and other grassroots forces have shortcomings such as insufficient professional capabilities and the absence of long-term services, which have given rise to three structural contradictions: the lack of professional carriers, confusion of main functions, and mismatch between supply and demand for updates. The fundamental contradiction lies in the cognitive conflicts, power and responsibility frictions, and interest games that arise between the "embedded governance" of professional elites and the local grassroots fields. Traditional sinking is a shallow embedding. It lacks both long-term on-site action subjects and institutional designs for professional output and demand translation, making it difficult to resolve the aforementioned contradictions. For this reason, the on-site embedding of responsible teachers serves as an intermediary carrier. Compared with the superficial intervention of outsourcing and social workers, this system relies on a more complete practical mechanism and can alleviate various structural contradictions in grassroots spatial governance under certain conditions.

4.2. Abstract complementary logic of the three-dimensional theory of responsibility planners

To understand the supplementary role of the responsible teacher, we should return to the carrier of "people". Unlike the superficial intervention of outsourcing and social workers, responsibility experts, relying on their professional expertise, deeply integrate into the grassroots level, acting as an

intermediary between the planning system, administrative system and residents' lives. They respond to conflicts of cognition, rights and responsibilities, and interests from the technical, institutional and social levels, making up for the structural governance shortcomings brought about by traditional shallow integration.

At the level of technology embedding, responsible teachers, as long-term professional carriers, delve into planning knowledge, break through the predicament of professional disintegration at the grassroots level, and fill the gap in community technology supply. At the level of institutional coupling, the responsible person, as an integration node in the governance network, breaks down the communication barriers among administration, design, community and residents, facilitates the flow of information among multiple parties [9], and builds a multi-party collaborative organizational carrier [10]. At the social adaptation level, responsible engineers complete the translation from instrumental rationality to life value rationality, carry out local adaptation of standardized plans, absorb the real spatial demands of residents, and promote the convergence of grassroots spatial governance towards the logic of people's livelihood [11].

To clearly demonstrate the role mechanism of the responsible teacher as the governance subject, responding to the traditional governance predicament and resolving the fundamental contradiction, Figure 2 is drawn.

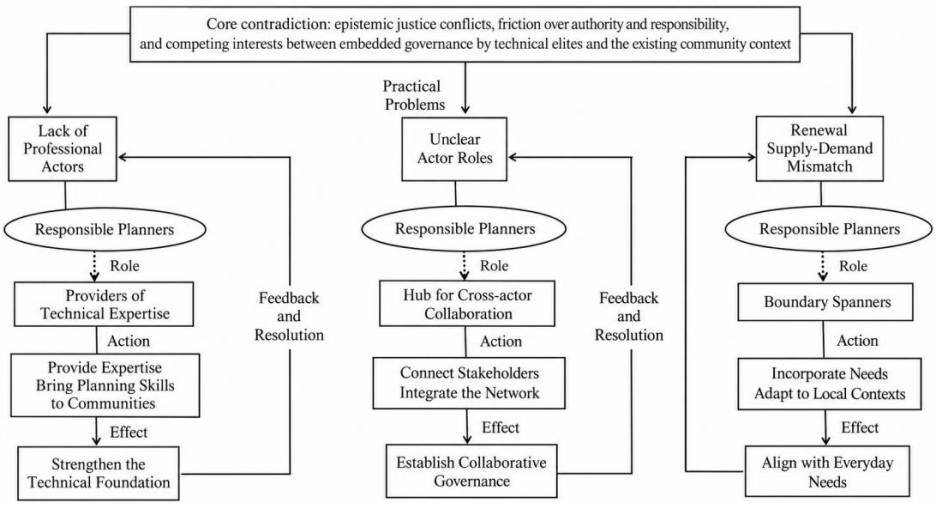


Figure 2. Responsibility planner working mechanism diagram.

5. Empirical Analysis of the Governance Operation Mechanism of Responsibility Planners under the Three-Dimensional Framework

5.1. The disassembly and analysis of the operation mechanism of the responsibility planner system under the framework of "technology embedding - system coupling - social adaptation"

5.1.1 Technology Embedding - Cracking the disembedding of grassroots specialties

There is a widespread problem of professional disintegration in grassroots spatial governance. In the past, governance basically followed the lead of leading cadres. Due to the lack of professional planning, some public facilities could not be implemented. (Interview record: M20240625) The regular absence of professional forces and standardized design weakened the internal driving force of grassroots governance, giving rise to contradictions such as inefficient space utilization and the mismatch between macro top-level planning and residents' living demands. [10] To fill the gap in the supply of professional talents and technologies at the grassroots level, Beijing has established a full-time on-site dispatch mechanism, attracting full-time planners from the Municipal Planning Institute and urban and rural planning teaching and research personnel from universities to take root at the grassroots level. By 2024, Beijing has completed all the recruitment work, with 76 units, 328 teams

and thousands of practitioners going down to the grassroots level. Take the Beijing Urban Planning and Design Institute as an example. In the five years since 2019, it has provided 267 services to 52 sub-districts and towns in 14 districts. Street responsibility officers participate in the entire stage of grassroots spatial governance by relying on on-site mapping and other tools, providing them with continuous professional support. Meanwhile, different regions in Beijing have explored differentiated paths for technology penetration based on their own realities: Xicheng District has appointed a chief engineer to conduct technical analysis for major projects, and Shahe Town in Changping District has added 2,890 non-motorized vehicle parking Spaces around the subway with the professional strength of the chief engineer. The sinking of professional and technical expertise is not a temporary measure but is institutionalized and embedded through policies at both the municipal and district levels. In 2024, the municipal government issued the "Implementation Measures for the Beijing Responsibility Planner System" [12], clearly defining the rights and responsibilities of the responsibility planner positions and the norms for on-site management. Each district has issued supporting documents such as the "Detailed Rules for the Implementation of the Responsibility Three Divisions Work in Mentougou District", defining the frequency of downward deployment, the mechanism for discussion and participation, and the renovation process. A complete chain of grassroots spatial governance has been established from top to bottom, covering "demand investigation - scheme planning - joint discussion - construction implementation - long-term supervision" [10,11].

This institutionalized and full-cycle professional on-site model systematically resolves the predicament of professional disintegration at two levels. On the one hand, it is necessary to reverse the empirical transformation approach dominated by administration, establish a scientific decision-making system of "data identification - professional judgment - local adaptation", bridge the professional gap between macro planning and grassroots implementation [10], and promote the scientific and refined transformation of grassroots spatial governance. On the other hand, optimize the efficiency of grassroots people's livelihood supply. The deep integration of professional technology and the street and community governance system not only smooths the bottom-up expression channels for residents but also enhances the implementation efficiency of upper-level planning. Under the full participation of planners, scattered and idle plots of land have been revitalized, and convenient facilities such as shared activity Spaces have been refined and renovated. "After the resident planner is on site, there will be people following up on all the renovations, big or small, and all our demands can be properly addressed." " (Interview Record: K20240702) This regular integration of professional technology breaks away from the cycle of "short-term renewal and long-term neglect", fundamentally solving the problem of professional disintegration.

5.1.2 Institutional Coupling - Breaking the decoupling of Multiple Subjects

Due to the lack of an active professional subject, the rights and responsibilities of the administrative, design and social parties are ambiguous and their collaboration is fragmented. The traditional grassroots spatial governance generally suffers from the structural predicament of subject decoupling [13]. In response to the tension between technological rationality and life rationality, the responsibility teacher system builds a differentiated institutional coupling system based on the policy framework at both the municipal and district levels. The municipal government has issued the "Implementation Measures for the Responsibility Planner System in Beijing", and each district has also issued supporting documents, such as the "Trial Work Plan for the Implementation of the Responsibility Planner System in Chaoyang District", clearly defining the framework of multi-party governance and the requirements for performing duties at the grassroots level from the institutional perspective. The municipal government has established an online collaborative platform to provide digital communication channels, with approximately 1,300 active users. Each district formulates a characteristic system, and most areas provide an annual allocation of 100,000 to 300,000 yuan for the responsible teacher teams. By leveraging the regular on-site presence of professional talents, the responsibility team breaks free from the limitations of policy implementation tools. Adhering to the principle of putting people first [9], they intervene in administrative control, professional technology, and local grassroots fields, addressing the shortcomings in the compatibility between rigid systems

and standardized technologies, and fundamentally solving the problem of decoupling governance subjects.

Throughout the entire cycle of grassroots spatial governance, responsibility planners continuously reconcile the dual governance tension between technology and life. A series of localized collaborative systems have also been formed in various regions, such as the "Wonderful Painter" alliance co-governance in Yanqing District and the "Party Building + Responsibility Planner" integration mechanism in Shijingshan District. In the early stage of research, the responsible person relied on the on-site workstations and community discussion platforms to collaborate with social workers to identify the differentiated demands of residents. Through a four-party joint discussion mechanism, the metro parking management project in Shahe Town, Changping County, collected over 700 suggestions from residents. In the mid-term plan co-creation, the responsible engineer takes the lead in establishing a multi-faceted discussion platform, coordinating the demands of designers, streets, residents, and construction parties, and balancing the standardized renovation plan with the residents' daily life needs. The interviewee mentioned, "The small venues and drying and leisure Spaces we have been using for years are necessities of life. We hope to preserve the original living atmosphere and not simply copy the templates." (Interview Record: D20240702) This feedback directly reflects the governance value of professional talents who have been dispatched to the grassroots level. This is a local demand that is difficult to be covered by the institutional framework but is crucial for spatial adaptation. In the later stage of supervision and operation and maintenance, the responsible engineer, in collaboration with multiple parties, forms a supervision team to control the construction quality. Relying on online ledgers, they dynamically collect residents' feedback and iteratively optimize the spatial layout through regular meetings to make up for the shortcoming of traditional governance that "emphasizes construction but neglects management and maintenance".

Grassroots practice shows that the regular on-site governance by responsible teachers breaks the traditional top-down transformation model, builds a regular channel for matching demands, and forms a coupling system between top-down political governance and bottom-up grassroots self-governance [14]. It effectively balances professional construction standards with grassroots habits, making multi-party consultation governance take root and bear effect. In the past, the renovation was carried out from top to bottom, and the daily usage needs of residents were hard to be taken seriously, making the renovation impractical. After the responsible engineers were stationed at the site, there was a fixed channel to connect with the demands of all parties, taking into account both professional standards and the living habits of residents. "Negotiation is no longer just a formality; governance is truly implemented." (Interview Record: L20240617

The full-cycle governance model with flexible intervention of professional talents makes up for the rigid deficiencies of systems and technologies, resolves the contradiction between professional integration and local life, completely breaks the predicament of subject decoupling, and ultimately forms a long-term collaborative governance pattern that unifies institutional norms, professional support and human-oriented adaptation.

5.1.3 Social adaptation - Eliminating the disconnection between supply and demand in space renovation

The concept of "people's City" proposed by China provides fundamental guidance for the human-oriented and adaptive development of urban renewal in the new era in our country [7]. As an independent professional governance entity stationed on-site, Zheshi practices the concept of a people's city and flexibly reconciles the conflicts between technology-embedded governance and the logic of grassroots life. Relying on the stratified resident consultation mechanism and the local understanding formed by long-term on-site presence, the responsible officials accurately capture the detailed and localized demands of the people's livelihood, and smooth the bottom-up channels for the transmission of public opinion. For instance, in the Xicheng District's Sanjiaodi space renovation project, residents' opinions were collected through questionnaires and symposiums, and children were mobilized to participate in the co-creation of the plan. The residents' volunteer group was responsible for the later operation and maintenance of the site. Just as the interviewed residents said, "Finally,

someone can see our need to bask in the sun and chat." (Interview Record: Z20240702) The responsible engineer, based on the real grassroots life, abandoned the template-based design thinking, proactively optimized the planning scheme, resolved the governance contradiction between technical rationality and the rationality of grassroots life, and promoted the spatial governance to be in line with the real life needs of residents. Some streets simultaneously carried out planning science popularization activities, such as the "Little Community Planner" event in Yuetan Sub-district. Meanwhile, the responsible teachers integrate diverse demands through the deliberation platform, guide residents to participate in the discussion of plans, and build a full-cycle resident participation chain of "demand collection - plan adjustment - on-site implementation - joint management", enabling residents to stimulate their enthusiasm for governance [15], accumulate governance experience, strengthen their sense of subjectivity, and gradually cultivate the ability of grassroots self-governance and space co-management through practical participation. Activate the intrinsic driving force of grassroots governance.

Overall, this governance model is an innovative implementation of the people-centered development philosophy in grassroots governance. Its governance advantage lies in giving full play to the local dynamic value of professional talents who have been dispatched to the grassroots level, breaking through the limitations of procedural and technological governance, and forming a complete governance closed loop of "uncovering people's livelihood demands - adapting to local planning - cultivating self-governing forces". It not only corrects the mismatch between supply and demand caused by mechanical technology embedding [16], but also relies on regular human-oriented co-governance to strengthen the self-governance capacity at the grassroots level, ultimately achieving the goal of spatial governance serving people, adapting to life, and being long-lasting in governance [10].

5.2. The overall effectiveness of the three-dimensional mechanism collaboration

The above empirical analysis indicates that the responsibility teacher operation mechanism has significant collaborative governance effectiveness. Among them, professional technical supply provides the underlying support, diverse institutional arrangements regulate the collaborative order, and the grassroots social level anchors the demands of people's livelihood. However, this judgment is based on the "ideal type" abstraction of institutional operation - that is, assuming that all dimensions are in an equilibrium state. In the real context of grassroots governance, there will be disconnections and conflicts among these three. The effectiveness of a three-dimensional framework is highly dependent on a specific institutional environment and social foundation. Once the actual conditions deviate, the dynamic balance among the three dimensions may be disrupted, and the originally mutually supportive mechanisms may instead become mutually restrictive, giving rise to various governance tensions and alienation phenomena. Therefore, it is necessary to deeply analyze the imbalance mechanism of the three-dimensional analysis framework in practice and its derived predicaments from the theoretical perspective of the interaction between technology and society.

6. The internal tension of embedding technology into the grassroots self-governance field and the predicament of governance alienation

6.1. The conflict framework between technological rationality and community social logic under the theory of technology-society interconstruction

Based on the theory of technology-society interstructure, the core root cause of the imbalance in grassroots spatial governance lies in the two-way game imbalance between the professional technical logic and the local life logic at the grassroots level. In an ideal state, the three-dimensional system of "technology embedding - institutional coupling - social adaptation" can be dynamically coordinated. However, the standardized technical paradigm and hierarchical governance order brought about by the decentralization of responsibility teachers have a natural divergence from the value rationality at

the grassroots level centered on residents' living needs and spatial rights and interests. Professional elements are unidirectionally embedded in the grassroots field. Rigid systems and template-based designs are difficult to adapt to the differentiated people's livelihood demands, while the fragmented interest pattern and inherent living patterns at the grassroots level in turn restrict the implementation of professional solutions [17]. The ineffective adaptation of the old and new governance logics has led to the problems of spatial governance tension and alienation at the grassroots level.

6.2. The four core value tensions derived from technology embedding

The structural conflict between technological rationality and local social logic is manifested in the practice of grassroots governance as four types of core value tensions, which are the predisposing factors for the alienation of governance.

First, the tension between instrumental rationality and the rationality of people's livelihood values. Standardized planning and design focus on renovation efficiency [17], which is prone to deviate from the real life scenarios at the grassroots level, resulting in a mismatch between supply and demand where the scheme is drawn on paper and the actual utilization rate of space is relatively low.

Second, the implementation conditions and the actual supply tension. The implementation of the responsibility teacher system relies on supporting resources such as professional talents and fiscal funds. There are significant differences in regional resource reserves, and the shortcomings in some areas directly restrict the effectiveness of the system's implementation [11].

Third, the tension between technological efficiency and community equity. Excessive pursuit of progress and landscape effects in work, with resources concentrated on display projects and mainstream groups while neglecting the demands of disadvantaged groups, has led to unfair distribution of spatial resources at the grassroots level [16].

6.3. The alienation of multiple realities in governance caused by the imbalance of three-dimensional adaptation

If the above-mentioned value tensions cannot be effectively reconciled, it will lead to the failure of the three-dimensional analysis framework and give rise to multiple governance alienation problems from the dimensions of technology, system and society.

First, at the technical level, there is operational alienation: one is technical suspension, mechanically applying design templates to simplify and dissolve differentiated real demands [17]; Second, self-governance is squeezed out. Professional teams take over the entire governance process, squeezing the residents' dominance in governance, weakening the awareness of grassroots self-governance subjects [17], and fostering a reliance on technology at the grassroots level. The third is spatial reconstruction. Specialized spatial layout occupies the small and micro living Spaces of residents, disrupts the neighborhood interaction scenarios, and disturbs the original community interest pattern [16].

Second, at the institutional level, there is a distortion of rights and responsibilities as well as mechanisms: The current rights and responsibilities system only covers the regular division of labor for reform, lacking detailed rules for handling interest disputes and accountability [18]. At the same time, there exists a mechanism shortcoming of emphasizing construction over management and maintenance [10]. The renovation funds only cover the design and construction stages, and there is a lack of funds for later operation and maintenance [15], which makes it difficult for public Spaces to operate in the long term.

Third, at the resource level, there is a distortion in distribution: human and financial resources for governance are overly tilted towards areas with better conditions, while regions with weak foundations have insufficient resource supply, resulting in a Matthew effect in grassroots governance.

7. The long-term optimization path for grassroots governance of responsibility planners under the guidance of three-dimensional balance

The essence of the alienation of grassroots governance stems from the mismatch between the logic of professional embedding brought about by the sinking of professional technologies and the local grassroots field [17]. This chapter aims at three-dimensional dynamic balance and, through a hierarchical path of concept correction, technological optimization, institutional reconstruction, and social empowerment, achieves a benign mutual construction and long-term governance between professional embedding and grassroots governance.

7.1. Conceptual correction: Reshaping the value orientation of "autonomous technical services"

The root cause of governance conflicts first stems from cognitive misalignment [16]. It is necessary to establish the value orientation of technical service autonomy, position the responsible teachers as technical support providers, respect the original life order and residents' experience at the grassroots level, and promote the alignment of professional logic with the local people's livelihood logic [11]. In the governance practice of Jianguomen Sub-district in Dongcheng District, the responsible master incorporated the actual demands of residents into the entire process of plan formulation by coordinating with the sub-district, thus avoiding the one-way output of professional skills.

7.2. Technical dimension optimization: Build a hierarchical and elastic technical system to dissolve the alienation between technology and spatial governance

Under the guidance of the correct governance concept, rely on flexible technological means to address alienation issues such as technological suspension. Establish a hierarchical and flexible technical system, implement low-intervention micro-governance in old communities, and preserve the original living scenes. The Xincheng community takes into account both standardization improvement and human-oriented adaptation. Weaken the efficiency-first orientation, pay attention to the demands of disadvantaged groups, and rely on on-site research to dynamically iterate the plan. For instance, the responsibility planners for the back streets and alleys in Dongcheng District insist on conducting on-site investigations and communicating with residents through multiple rounds to carry out targeted and refined designs.

7.3. Institutional dimension optimization: Reconstructing the multi-coupling mechanism to resolve the alienation of power and responsibility and the tension of implementation conditions

The practical operation of technology requires relevant rigid systems such as dispute resolution and closed-loop feedback as support. It is necessary to improve the relevant mechanisms to resolve conflicts such as ambiguous rights and responsibilities and insufficient supporting conditions. The "1+11" development model of Changping Shisanling Town, at the town level, is responsible for coordinating technical work, while at the district level, it is responsible for development planning, project planning and planning tracking. It builds a regular communication channel among the government, enterprises and villagers, clarifies the division of labor between the town and the district levels, and alleviates the problem of insufficient talent and institutional supply in the far suburbs.

7.4. Social dimension optimization: Build a local self-governance empowerment system to prevent self-governance squeeze and alienation in resource allocation

On the basis of ideological guidance and institutional guarantee, improve social adaptation and reconcile the imbalance of spatial interests. Implement the full-cycle participation mechanism for residents. Stimulate residents' enthusiasm for participating in governance through a favorable institutional environment and technological embedding [15]. The grassroots level should return the authority to collect demands, fine-tune plans and conduct post-operation and maintenance to the

residents, cultivate local management and maintenance forces, and activate the internal self-governance capacity of the grassroots level. The responsible teacher team of Qingyundian Town, Daxing, relied on research and discussion to investigate the real demands of the villages, incorporated local needs into the planning, and achieved long-term adaptation of governance.

8. Conclusions and Research Prospects

This study builds a three-dimensional analysis framework of "technology embedding - institutional coupling - social adaptation" based on the theory of technology-society interstructure, and conducts analysis with the Beijing teacher responsibility system as the empirical object. Research has found that responsible experts can improve the governance of grassroots Spaces from the aspects of technical complementarity, system establishment, and social communication, and promote refined governance. However, during the process of professional elements sinking to the grassroots field, there still exist governance alienation phenomena such as technical suspension, ambiguous rights and responsibilities, and unbalanced interests. To achieve a positive mutual construction between professional embedding and grassroots self-governance, it is necessary to carry out concept correction, technology adaptation, system reconstruction and social empowerment to maintain the dynamic balance of the three-dimensional system.

This study has certain limitations. The empirical cases are mainly concentrated in the Beijing area, lacking cross-regional references. At the same time, it mainly focuses on qualitative analysis, with insufficient quantitative indicators. Moreover, the research scenarios are limited to urban communities and have not extended to rural and county-level governance fields. Subsequently, cases from multiple regions can be introduced to conduct model comparisons, expand the analysis of governance scenarios such as rural planners, and attempt to construct an evaluation index system to promote quantitative empirical tests.

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