Construction of the "Multi-actor Collaborative Operation" Model for Community Practice Bases from the Perspective of Applied Sociology

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Abstract: *The heterogeneous characteristics of multi-actors in community action bases often lead to coordination costs and conflicts, while existing studies mostly remain within a single theoretical perspective. This paper integrates field theory, social network theory, and the reciprocal norm framework to examine the structural generation, interaction mechanisms, and evolutionary logic of collaborative operation. Position differentiation and capital allocation constitute the structural precondition for collaboration, relationship strength determines the efficiency of resource mobilization, and reciprocal norms shape the order of collective action. The heterogeneity of actors is transformed into collaborative advantage through hierarchical nesting with functional complementarity. Reputation constraints and supervision games in trust transmission maintain collaboration stability, while equilibrium adjustment under asymmetric dependence alleviates distribution conflicts. Rule redundancy generates a negative entropy effect, and the hierarchical coupling of resource sharing platforms promotes boundary blurring. The self-organized critical threshold provides an evolutionary indicator for mode replacement. This paper aims to construct a systematic analytical framework for multi-actor collaborative operation.*

Keywords: *Applied Sociology; Collaborative Operation; Field Theory; Social Network; Reciprocal Norm; Institutional Elasticity*

Introduction

In collaborative fields represented by community action bases, multi-actors face coordination costs and conflict risks in resource exchange and task collaboration due to differences in capital endowments, decision-making logics, and action rhythms. Existing studies either focus on field position analysis, or emphasize the emotional dimension of network relationships, or remain at the abstract discussion of exchange norms, and they have not yet formed a systematic framework that integrates the above theoretical resources to explain the construction of collaborative operation models. This gap limits the academic community's depth of understanding regarding the generation mechanism of inter-actor collaborative order and weakens the explanatory power of relevant analytical frameworks for real collaborative situations. From the perspective of applied sociology, this paper integrates field theory, social network theory, and reciprocal norms to construct a comprehensive analytical approach covering structural generation, interaction mechanisms, and institutional elasticity. This paper aims to clarify how multi-actors can achieve sustainable collaborative operation through endogenous rules, trust transmission, and resource allocation under the condition of no external coercion. This research not only provides an integrative supplement to the collaborative theory system but also contributes transferable analytical tools for the operation design of similar collaborative fields.

1. Theoretical Foundation of Applied Sociology and the Analytical Approach to Collaborative Operation

1.1 Position Differentiation and Actor Capital Allocation in Field Theory

Within the analytical framework of applied sociology, the community action base can be viewed as a dynamic relational space constituted by multiple actors occupying different positions. Each actor, based on the amount of economic capital, cultural capital, and social capital at its disposal, forms a positional pattern featuring both vertical differentiation and horizontal division of labor within the base.

Actors with abundant economic capital often control the pace of material resource investment, those with prominent cultural capital dominate the setting of knowledge transmission and interpretative frameworks, and those with extensive social capital assume boundary-spanning bridging functions. This position differentiation is not statically fixed but is continuously restructured through capital exchange and rank competition in the ongoing interaction of collaborative operation[1].

The capital allocation behaviors among actors follow the internal logic and access rules of a specific field. The effectiveness of capital is not absolute but depends on the relative weight assigned to different types of capital by the field. In the operational context of a community action base, resource allocation is not only reflected in the distribution of tangible assets but also manifested as mutual recognition and accumulation of symbolic capital among different actors. Different subjects strive for more favorable structural positions by displaying their unique capital combinations, while also dynamically adjusting their own capital investments through exchanges and games with other subjects. This process creates an unbalanced yet predictable pattern of capital flow, which establishes a structural precondition for the subsequent generation of collaborative mechanisms.

1.2 The Connectivity Logic of Relationship Strength from the Perspective of Social Network Theory

From the perspective of social network theory, the interactions among multiple actors in a community action base are not isolated events but are embedded in a network structure interwoven with strong and weak ties. Strong ties manifest as a connection form characterized by high frequency, high emotional investment, and interwoven multiple obligations. These ties mainly form among actors with similar capital reserves and functional positions, and they assume the functions of trust transmission and tacit knowledge sharing. Weak ties are characterized by low-frequency contact and single-obligation associations. They cross different positional levels and functional boundaries, providing channels for the flow of heterogeneous information and scarce resources. The complementary use of these two types of relationship strength enables the overall network to achieve a balance between cohesion and openness.

The connectivity logic of relationship strength further determines the efficiency and stability of resource mobilization in collaborative operation. When the base faces routine collaborative tasks, the network of strong ties can achieve rapid action coordination through the immediate activation of reciprocal obligations. In the face of uncertain situations or unconventional tasks that require external input, weak ties become the critical pathway for introducing new information and alternative solutions. Actors strategically choose to activate or suspend different types of relational ties based on task nature and risk perception. This dynamic selection mechanism based on relationship strength prevents the network structure from falling into a closed homogeneity trap or losing the foundation of collaborative trust due to excessive openness.

1.3 The Shaping of Collective Action Order by Reciprocal Exchange Norms

As a regulatory principle endogenous to social interaction, the reciprocal exchange norm performs an order-generating function in the multi-actor collaboration process of the community action base. Unlike equivalent exchange in market transactions or command obedience in hierarchical systems, the reciprocal norm requires actors to exchange unequal immediate contributions for credible promises of future expected returns within a temporally extended sequence of exchanges. Through repeated, delayed give-and-take, this norm gradually dissolves the problem of asymmetric expectations arising from actor heterogeneity. Each exchange behavior simultaneously carries the dual functions of resource transfer and symbolic confirmation, addressing immediate needs while accumulating reputational capital for subsequent collaboration[2].

Long-term adherence to the reciprocal norm in interactions fosters a spontaneous collective action order, whose binding force does not depend on external coercion but originates from the actors' positive expectations of net gains from long-term cooperation. Under such an order, behaviors deviating from the reciprocal principle face dual sanctions of reputation damage and marginalization from the relational network, thereby raising the psychological cost of opportunistic behaviors. At the same time, the reciprocal norm provides a non-zero-sum resolution path for distribution conflicts: actors no longer pursue absolute fairness in a single exchange but focus on the overall balance of the exchange sequence. This normative mechanism, which substitutes temporal dimension for spatial dimension in equity, enables collaborative operation to maintain a low friction coefficient and a high self-repair capacity in an environment with highly heterogeneous resource distribution.

2. Structural Generation and Interaction Mechanism of Multi-Actor Collaborative Operation

2.1 Heterogeneous Characteristics of Actors and Functional Complementarity Through Hierarchical Nesting

The actors participating in collaborative operation exhibit systematic differences in resource endowments, decision-making logics, and action rhythms. Such heterogeneity is not an obstacle to collaboration but rather a structural precondition for functional complementarity. Actors with dominant economic capital tend to follow the rational logic of cost-benefit accounting, those with prominent cultural capital pay more attention to the integrity of the knowledge system and the legitimacy of symbolic evaluation, and those with dense social capital prefer relationship maintenance and cross-boundary mediation. The coexistence of these three types of action logics within the base forms a multi-axis decision-making center different from that within a single organization. The incommensurability of heterogeneous characteristics precisely provides a basis for functional division of labor: different actors occupy complementary roles according to their own advantages, thus avoiding the dissipation of collaborative resources caused by homogeneous competition.

Functional complementarity further evolves into an organizational form of hierarchical nesting, in which each level undertakes an irreplaceable integration function. The base level is responsible for information aggregation and routine decision-making in daily operations, the middle level handles coordination across actor boundaries and resource allocation, and the top level focuses on conflict resolution and rule redefinition. The relationship between levels is not a one-way chain of command transmission but achieves dynamic coupling through a feedback loop of two-way penetration. Uncertain signals emerging from lower-level operations are transmitted upward through information filtering, while the regulatory rules formulated at the upper level are implemented downward through resource allocation. This nested structure prevents the functional complementarity of heterogeneous actors from devolving into disorderly superposition, allowing it to obtain an orderly expression within a clearly stratified framework.

2.2 Reputation Constraints and Supervision Games in Trust Transmission Pathways

Trust does not exist a priori in multi-actor collaborative operation; instead, it gradually accumulates through transmission pathways in the process of repeated interaction. In the initial stage, actors form indirect trust judgments based on the other party's performance in past third-party relationships, meaning that trust spreads from known credible actors to unknown new actors along the edges of the social network. The effectiveness of transmission depends on network connectivity: when a sufficient number of common contacts exist between two actors, the attenuation coefficient of trust transmission decreases significantly. Once trust is established within a local scope, its spillover effect extends outward along relational chains, ultimately forming a multi-actor trust network.

The reputation constraint mechanism and the supervision game together constitute the dual guarantee for maintaining the continuity of trust. Reputation can be viewed as the institutionalized sedimentation of trust, in which actors' trustworthy or untrustworthy behaviors in past collaborations are encoded as traceable symbolic records. Individuals who deviate from the reciprocal norm suffer reputation depreciation, and the probability of their being selected as cooperation partners by other actors in future exchanges decreases accordingly. This expectation itself forms a powerful deterrent. At the same time, the supervision game does not unfold through monitoring devices or formal audits but is embedded in mutual observation behaviors in daily interaction. Each actor plays the dual role of both the supervised and the supervisor, and the benefits of any party's deviation are diminished due to being detected by others. This pattern of multilateral mutual supervision reduces the burden on a single supervisor to bear all monitoring costs and makes it difficult for opportunistic behaviors to find systemic loopholes[3].

2.3 Asymmetric Dependence in Benefit Distribution and Equilibrium Adjustment Strategies

The degree of dependence on each other's resources among multiple actors in collaborative operation presents an asymmetric characteristic, which constitutes the structural root of conflicts in benefit distribution. One actor may be highly dependent on a scarce resource provided by another party, while the latter's reverse dependence on the former is relatively weak, creating a significant gap in the dependence gradient. Actors in a high-dependence position are relatively disadvantaged in distribution negotiations and are more likely to accept unfavorable distribution plans in exchange for continued

resource inflow. In contrast, low-dependence actors have greater room for exit threats and can secure favorable terms in the negotiation of distribution rules. If this pattern of asymmetric dependence becomes rigidified over time, it will erode the intrinsic motivation of the weaker parties to participate in collaboration, ultimately leading to network fragmentation.

The equilibrium adjustment strategies for coping with asymmetric dependence mainly unfold along two pathways. The first pathway involves the weaker party actively seeking alternative resource channels to reduce the intensity of unilateral dependence on a specific actor. When alternative contacts available for switching increase, the original dependence gap tends to flatten, and the bargaining power in distribution rises correspondingly. The second pathway involves the stronger party proactively introducing delayed compensation or intertemporal adjustment clauses in the distribution plan, sacrificing short-term gains in exchange for the stability of long-term collaborative relationships. This strategy ostensibly compromises some of the distribution advantages but actually preserves greater overall benefits by retaining future exchange opportunities. The alternating use of these two adjustment strategies allows the distribution equilibrium point to continuously move with the dynamic changes in the dependence structure, rather than rigidifying at a fixed ratio. In this process of rolling equilibrium, collaborative operation maintains a low exit rate and a moderate level of distribution satisfaction.

3. Institutional Elasticity and Evolutionary Tendency of the Collaborative Operation Model

3.1 The Negative Entropy Effect of Rule Redundancy Design on Conflict Mitigation

In the institutional arrangement of collaborative operation, rule redundancy refers to the presetting of multiple alternative processing paths or verification nodes for the same type of task, rather than pursuing a single optimal solution. This seemingly inefficient design actually performs a conflict-buffering function. When multiple actors disagree on a certain decision due to differences in their positions, rule redundancy provides switchable action channels, preventing the dispute from reaching a deadlock at a single node. The coexistence of multiple paths means that the blockage of any single path will not lead to the stagnation of overall operation, and the conflict energy is gradually dissipated through diversion channels rather than erupting centrally. The redundant design also increases the difficulty for any party to unilaterally manipulate the rules, because the manipulator would need to exert influence on multiple parallel nodes simultaneously, which significantly raises the execution cost of opportunistic behaviors[4].

From the perspective of system information theory, the response of rule redundancy to conflict signals resembles a negative entropy input mechanism. The emergence of conflict is often accompanied by a sharp rise in uncertainty within the system, that is, the rapid accumulation of information entropy. Redundant rules transform the focus of conflict from irreconcilable disagreements at the value level to a path-selection problem at the technical level by providing multiple sets of solutions for achieving the same goal. This translation process reduces the cognitive load of the system, allowing each actor to reach agreement on procedural matters while retaining its own position. The multiple calibration points brought by redundancy continuously absorb small deviation signals during ongoing operations, preventing them from accumulating into systemic fractures. This negative entropy effect enables the collaborative system to maintain orderly operation for a relatively long period without external intervention, and conflict is no longer regarded as a malfunction to be eliminated but as normal feedback that triggers the switching of backup rules.

3.2 Hierarchical Coupling of Resource Sharing Platforms and Boundary Blurring

The resource sharing platform, serving as an intermediary field for the exchange of material and non-material codes among multiple actors, follows the assembly logic of hierarchical coupling in its construction. At the lowest coupling level, each actor only shares annotated content at the information level, such as resource inventories and schedulable time slots, while the resources themselves remain within each actor's own sovereign boundaries. At the middle level, sharing extends to the joint reserve of substitutable resources, with actors forming regional shared inventories. Although the ownership of resources remains traceable, cross-access is permitted. At the highest level, the platform achieves the symbolic substitution of resources: each actor exchanges the right to use its specific resources for the right to use others' resources, with the exchange standard determined by the platform's built-in conversion rules rather than the unilateral pricing of any single actor. The three levels progress step by step, and the maturity of each level determines the feasibility of climbing to the next higher level.

As the level of sharing increases, the originally distinct boundaries between actors undergo systematic blurring. When resource access no longer requires case-by-case approval but can be initiated based on the trust credit accumulated through long-term cooperation, the traditional dichotomy between resource ownership and resource use loses its explanatory power. Boundary blurring manifests in two interrelated dimensions: in the horizontal dimension, the overlap of functional areas among different actors increases, and operational domains previously monopolized by a single actor see cross-intervention by multiple parties; in the vertical dimension, the hierarchical gap between decision-making power and execution power is compressed, and on-site judgment in resource access replaces step-by-step escalation. This blurring is not equivalent to the loss of order; instead, it gives rise to a new type of order rules oriented toward accessibility. The effectiveness of resource sharing no longer depends on the total amount of resources but on the length of the access chain and the consensus threshold required to initiate access. Hierarchical coupling provides a gradual path dependence for boundary blurring, preventing the creation of a vacuum of rights and responsibilities caused by excessive blurring.

3.3 Threshold Determination for Mode Replacement in the Self-Organized Critical State

The collaborative operation model, in its long-term evolution, approaches a self-organized critical state, which refers to the boundary limit within which the system can accommodate local fluctuations without changing the overall structure. Within this critical range, daily conflicts and resource fine-tuning can be absorbed and resolved through existing rules, and the system exhibits resilience to external disturbances. The typical feature of the critical state is a power-law distribution of disturbance sizes: small adjustments occur frequently while large-scale reorganizations are rare. This distribution pattern suggests that the system has fully explored all permutations and combinations within the existing rule space. When disturbances continue to accumulate and the size distribution begins to deviate from the power-law curve, it indicates that the current operation model has approached the upper limit of its regulatory capacity, and fine-tuning is no longer sufficient to absorb the emerging tensions.

The threshold determination for mode replacement is precisely carried out at this self-organized critical point. The identification of the threshold relies on three observable variables: the average length of the conflict escalation chain, the number of communication rounds required for cross-actor coordination, and the proportion of uncalled redundant resources in the resource sharing platform. When a conflict spreads from a local point to more than half of the actors within less than two steps in the transmission chain, the critical threshold is approached. When the number of communication rounds required for coordination exceeds a certain empirical upper limit and continues to rise, the threshold is triggered. When redundant resources remain uncalled for a long period but the conflict frequency does not decrease or even increases during the same period, the conditions for mode replacement have matured. After crossing the critical threshold, the collaborative operation model enters a brief unstable window period, during which the binding force of the original rules significantly decays while the legitimacy of new rules has not yet been established. The mode replacement completed within this window period is not a random jump but unfolds gradually along the evolutionary direction of least resistance, and its final form is subject to the dual constraints of the path dependence of the existing institutions and the pattern of resource distribution.

Conclusion

Starting from the theoretical foundation of applied sociology, this paper systematically expounds on the structural conditions, interaction mechanisms, and evolutionary tendencies of the multi-actor collaborative operation model in community action bases. Field theory reveals how position differentiation and capital allocation provide a structural precondition for collaboration; the social network perspective clarifies the moderating effect of the connectivity logic of strong and weak ties on resource mobilization efficiency; and the reciprocal norm explains the spontaneous generation path of collective action order. On this basis, actor heterogeneity is transformed into collaborative resources through functional complementarity and hierarchical nesting; reputation constraints and supervision games in trust transmission constitute the guarantee for sustainability; and equilibrium adjustment strategies under asymmetric dependence alleviate distribution tensions. At the level of institutional elasticity, rule redundancy absorbs conflict energy through the negative entropy effect; hierarchical coupling of resource sharing platforms promotes boundary blurring; and the threshold determination of the self-organized critical state provides an observable basis for mode replacement. Future research can

extend in three directions: first, to explore the parameter sensitivity of the collaborative operation model in different types of fields and to test the transferability of this paper's analytical framework in heterogeneous contexts; second, to introduce dynamic simulation or computational modeling methods to quantitatively characterize the nonlinear features of trust transmission pathways, dependence gradient evolution, and threshold determination; and third, to focus on the issues of power structure and symbolic domination in collaborative operation systems, further integrating a critical sociological perspective to improve the explanation of unequal exchange relationships among multiple actors.

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