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Multi-Subject Collaborative Mechanism for Grassroots Public Safety Governance: A Case Study of the "2·18" Fireworks Explosion Accident in Xiangyang

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ABSTRACT

Grassroots public safety governance is a fundamental part of the modernization of national governance. The "2·18" fireworks and firecracker explosion accident in Xiangyang, Hubei Province in 2026 caused heavy casualties, exposing a systemic failure of community safety defenses. Drawing on collaborative governance theory, this paper constructs a three-dimensional analytical framework of "actor - authority - interaction" to dissect the mechanisms of multi-actor collaborative failure in the accident. The study finds that business entities have shifted from safety guardians to risk sources, with profit-seeking behavior and a fluke mentality leading to institutional dysfunction. The administrative system is characterized by fragmented powers and responsibilities, where formalistic supervision fails to address substantive risks. The interaction among multiple actors is disconnected, and information silos together with misaligned incentives result in a "core-periphery" differential structure of the collaborative network. Accordingly, this paper proposes a three-in-one optimization path: clarifying the list of powers and responsibilities, enabling collaboration through technology, and building a governance model based on common participation, shared responsibility, and collective benefits, so as to promote the transformation of grassroots safety governance from fragmentation to holistic collaboration.

KEYWORDS

Grassroots Public Safety; Fireworks and Firecracker Safety; Collaborative Governance; Grassroots Resilience.

1. INTRODUCTION

In the modern risk governance system, the community is not only the physical end of social governance but also the "first scene" of risk perception and the "last kilometer" of safety protection. Yet during the Spring Festival of 2026, the "2·18" fireworks explosion accident in Xiangyang, Hubei Province claimed 12 lives, tearing open the hidden cracks in grassroots public safety regulation at a terrible price. This accident was not an isolated incident but rather a systematic failure of the grassroots governance logic when dealing with a special commodity that superimposes "folk attributes" and "high-risk characteristics". When hazardous goods enter the weak regulatory zone of urban-rural fringe, phenomena such as over-stocking, illegal test-firing, and certificate discrepancies remain rampant despite listed supervision and high-pressure inspections, exposing the internal structural tension of the existing regulatory system.

This paradox gives rise to the research question. Despite a high-pressure "strict regulation" and "full coverage" system, the community safety frontline still collapsed. Before the accident, the local regulatory authorities had conducted a "shop-by-shop" inspection, yet failed to prevent the tragedy. The gap between "procedural compliance" and "substantive safety" reflects a deep dilemma in

grassroots safety governance. The root cause lies in the inability of overlapping responsibilities among emergency management, market supervision, and public security departments to translate into regulatory synergy, and the breakdown of the responsibility chain among operators, producers, and the public at critical moments. Empirical research on cross-regional collaborative governance shows that "collaborative emergency response" policies can significantly reduce the death toll from production safety accidents without producing a "performance crowding-out" effect on economic growth, offering an important reference for breaking this deadlock[1]. Against this background, this paper focuses on the following core issues: How should the authority and responsibility boundaries of multiple actors be scientifically defined in the micro-community domain? Why do existing collaborative mechanisms fail? And how can a highly adaptive grassroots safety resilience governance model be reconstructed?

Existing studies mostly focus on macro-level emergency management system construction or policy document analysis[2-4], paying insufficient attention to the actual interaction mechanisms of multiple actors in the micro domain. Especially in the regulation of hazardous goods, the literature emphasizes the completeness of institutional design while neglecting the informal logic of grassroots implementation[5]. This study attempts to fill this gap by introducing collaborative governance theory to explore the constraints of asymmetric power relations on grassroots collaboration, and to reveal the deep mechanism of "institutions present but governance absent". Through an in-depth review of the 2026 Xiangyang accident, this paper not only aims to understand the common shortcomings of rural and urban-rural fringe regulatory models nationwide but also to provide empirical support and theoretical insights for reshaping grassroots resilience governance.

2. THEORETICAL FOUNDATION AND ANALYTICAL FRAMEWORK

2.1. Collaborative Governance Theory and Its Applicability in Grassroots Emergency Management

Collaborative governance is an emerging interdisciplinary theory rooted in synergistics from the natural sciences and governance theory from the social sciences. Synergistics, founded by Hermann Haken, reveals how subsystems within an open system achieve a transition from disorder to macroscopic order through non-linear interactions under the guidance of "order parameters" at critical points[6,7]. Governance theory supplies the social dimension, emphasizing the reconciliation of interests through multi-actor interaction and consensus rules. At the application level, the definition by Ansell and Gash is most representative: collaborative governance is a process in which public institutions engage non-state actors in formal, consensus-oriented, and deliberative decision-making to execute public policies or manage public affairs[8]. This provides six criteria for identifying actor interactions in grassroots safety governance: initiated by the public sector, participation of non-state actors, direct decision-making, formal relationships, consensus orientation, and public attribute.

Introducing this theory into grassroots emergency management reveals that the emergency system is not naturally orderly but relies on a self-organizing process based on institutional arrangements and trust building. When key elements are missing, the system falls into a "collaborative failure" trap characterized by overlapping functions, information silos, and buck-passing[9]. In the Chinese context, collaborative governance is not only an academic proposition but also a strategic choice for the modernization of national governance. From "social collaboration" to the "improve the social governance system" deployed by the Third Plenary Session of the 20th CPC Central Committee, the policy evolution outlines the core logic of "political leadership, government guidance, multi-actor collaboration" - which emphasizes both the order-giving authority of the administration and the endogenous vitality of social actors[10]. However, collaboration also entails cost traps and structural fragility. On the one hand, collaboration requires certain conditions and long-term cultivation; excessive transaction costs may make it an expensive governance choice[11,12]. On the other hand,

collaboration is a highly fragile structure; the heterogeneity of actors makes it easy to disintegrate due to interest disputes[13].

To address the above problems of authority-responsibility structure and interaction loss, some scholars have proposed the "hamburger-type collaborative supervision" ideal model, suggesting that emergency governance should form a three-layer nested pattern of "top-level coordination and control, middle-layer professional support, and grassroots implementation feedback"[14]. This model can safeguard the authority of top-level design while releasing the flexible judgment space of professional middle-layer agencies and effectively strengthening information feedback from the grassroots.

2.2. The "Actor-Authority-Interaction" Analytical Framework

Based on the theoretical context above and drawing on the "differential-order - collaboration" logic, this paper constructs a three-dimensional analytical framework of "actor - authority - interaction" to examine the deep dilemmas of multi-actor interaction in the Xiangyang accident.

First, actor identification is the logical starting point for collaborative governance. In the social field, the grassroots public service system is highly complex and objectively requires multi-actor cooperation[15]. All participants in grassroots governance - including government, business entities, social intermediaries, and the public - can be divided into different layers in a concentric circle according to their relationship with the meta-governor[16]. The plurality and heterogeneity of these actors require the governance system to accommodate policy demands from different risk perspectives, thereby effectively converting dispersed social resources into safety regulatory capacity. In short, the actor dimension answers the question of "who participates" (legitimacy).

Second, authority-responsibility configuration determines the stability of collaboration. After clarifying the participating actors, collaborative governance requires a structure with aligned authority and responsibility. In reality, an "asymmetric dilemma" often occurs - those with power may shirk responsibility, while those who bear responsibility lack corresponding resources[17]. Furthermore, in emergency management research, disorder in duties can be divided into three types: overlapping duties (ambiguous boundaries at the textual and executive levels), duty gaps (fragmentation caused by poor communication between departments), and duty sinking (higher-level governments shifting responsibilities downward without matching resources, creating a "small horse pulling a large cart" dilemma for grassroots units)[9]. Therefore, the analysis of authority and responsibility centers on using institutional design to clearly stipulate the ownership of powers, resource allocation, and coordination responsibilities for emergency actions, ensuring that even when specific service tasks are delegated, the government can still maintain a safety bottom line through institutionalized mechanisms. This dimension answers the question of "on what basis" collaboration operates.

Third, the interaction dimension is the driving engine of collaborative governance. With actors and an authority-responsibility framework in place, effective interaction mechanisms are needed to drive collaboration. This dimension focuses on the linkage patterns among multiple actors in information sharing, resource allocation, and emergency actions. Collaborative effectiveness depends not only on institutional perfection but also on the frequency and quality of interactive communication[18]. Specifically, when institutional design is sound and information channels are unimpeded, collaborative effectiveness increases significantly; conversely, even with sound institutions, if communication mechanisms are missing, collaboration is difficult to achieve. By building negotiation platforms and establishing whole-process linkage mechanisms, the interaction dimension aims to integrate originally isolated administrative stocks into dynamic governance increments, thereby achieving self-organizing management of complex crisis systems. This dimension answers the question of "how to achieve linkage" (effectiveness).

In summary, the "actor-authority-interaction" three-dimensional framework forms a closed-loop logic: actor identification defines the scope and layers of participants; authority-responsibility

configuration provides the institutional basis for stable operation; and interaction mechanisms activate the governance momentum for continuous linkage. The three support each other, providing a clear handle for in-depth analysis of the internal mechanisms of multi-actor failure in the Xiangyang accident.

3. CASE PRESENTATION: PROCESS AND CHARACTERISTICS OF THE "2·18" EXPLOSION ACCIDENT IN XIANGYANG

3.1. Accident Process

At 14:24 on February 18, 2026, a fireworks and firecracker explosion occurred at "Qianhe Department Store" in Jinfu Village, Zhengji Township, Yicheng City, Xiangyang, Hubei Province. After the fire broke out, local rescue forces responded quickly. The first firefighters arrived at 14:33 and immediately began search, rescue, and fire control. However, due to the particular nature of fireworks, the explosion was extremely violent, posing a great challenge to rescue operations. The open fire was completely extinguished by 15:12, with a fire area of about 100 m^2; the shop was almost completely destroyed.

A comprehensive investigation confirmed that the accident killed 12 people. Apart from the shop operator, the other 11 victims were customers or visiting relatives from Sichuan, Zhongxiang, and the local area, including five minors. This casualty structure is extremely tragic - people who should have been enjoying family reunion lost their lives while buying New Year's goods. From a public crisis perspective, this tragedy highlights the vulnerability of the public as direct "disaster victims" - individuals are weak and lack self-rescue and mutual aid capabilities, being almost powerless in the face of a sudden crisis[19]. The shop involved held a valid "Fireworks Business (Retail) Permit" and did not physically constitute the prohibited pattern of "shop below, living above". However, its location in a densely populated village area and on a traffic artery meant that a local explosion quickly turned into a major public safety incident. The surrounding residential density and the afternoon timing (high pedestrian flow) contributed to the escalation of the tragedy.

3.2. Accident Causes

The causes of the explosion can be divided into immediate triggers and systemic deep-seated risks. On the immediate level, it is highly probable that the operator seriously violated the mandatory "limited quantity storage" provision of Article 23 of the "Measures for the Implementation of Fireworks Business Licenses" by over-stocking[20]. The seasonal nature of fireworks sales - demand surges during the Spring Festival while the approved stock is based on ordinary sales - creates an inherent tension. Driven by profit motive, the operator took the risk and hoarded a large quantity of fireworks, creating a potential explosion source. In addition, it cannot be ruled out that the operator or customers illegally test-fired at the shop entrance - a chronic problem at the grassroots retail level confirmed by repeated unannounced inspections by the Ministry of Emergency Management, serving as the ignition trigger.

At the deep-seated level, first, the safety boundary of the business premises was blurred. Although physically separate from residential areas, its proximity made it a potential hazard as a densely populated place. An explosion would have a far larger impact than the shop itself. Second, the operator's severe lack of safety management was the core weakness. Survey data show that residents' mastery of emergency skills is extremely low; in the operator, this was transformed into a deliberate ignorance of risk control[21]. This capacity deficiency is a micro-reflection of the grassroots governance dilemma: no matter how perfect the institutional design, it is hard to implement when the operator lacks basic safety awareness and emergency capacity[22]. From a risk society perspective, enterprises often make decisions based on a narrow cost-benefit view, leading to a sharp conflict

between their business behavior and the public interest[23]. Safety investment increases costs without direct return; in the absence of effective supervision, the rational "economic man" will naturally choose to cut safety costs. This micro-behavioral logic is the root of macro-risk accumulation. Finally, if subsequent investigations confirm that the accident involved product quality defects (e.g., fuse or powder quantity), it would mean that risks had transmitted from the manufacturing end to the consumption end, implicating cross-regional and cross-departmental regulatory failures - precisely the blind spot of collaborative governance.

3.3. Accident Response

After the accident, the governance response quickly escalated from the local to the national level. The Hubei provincial authorities immediately activated the emergency production safety coordination mechanism, with provincial leaders rushing to the front line to direct rescue and aftermath work. The State Council Work Safety Committee listed the accident for supervision, and the Ministry of Emergency Management, together with public security and fire departments, formed an on-site supervision team, strengthening the central government's "unified decision-making power" under crisis through cross-departmental mechanisms[24]. Subsequently, Xiangyang City launched a net-like inspection of the entire fireworks supply chain, attempting to plug regulatory loopholes through "backward tracing". However, behind the efficient post-disaster response lies a serious "governance paradox": the Yicheng City government's official website shows that in January of the same year, the local emergency management department conducted a "shop-by-shop" inspection of more than 110 retail shops in the city[25]. The inspection covered certificate validity, storage conditions, fire-fighting equipment, etc., basically covering all risk points for fireworks retail. Yet less than a month after the inspection, a major accident still occurred.

This coexistence of "full inspection coverage" and "major accident breakthrough" reveals the disconnect between inspection format and governance effectiveness in grassroots safety governance - in some regions, the crisis management system remains at a crude stage of merely responding to higher-level demands without real effectiveness. In other words, the "discrepancy between name and reality" of governance practice versus legal responsibility turns routine supervision into a ritual of formalism. Inspectors focus on whether certificates exist and fire extinguishers are present, but fail to detect hidden over-stocking; operators comply only for the moment of inspection and return to the old ways afterward. This internal friction and fragility of regulatory effectiveness constitute the most thought-provoking institutional cause of the Xiangyang accident. Of note, this formalism is not an isolated case. In the field of fireworks regulation, the cycle of "inspection - rectification - re-offense" repeats, and the safety defense line is like a blank sheet of paper. The tragic lesson of Xiangyang lies in tearing away this formalist veil at the cost of 12 lives.

4. CASE ANALYSIS: PRESENTATION OF MULTI-ACTOR COLLABORATIVE MECHANISMS

The above case presentation shows that the Xiangyang accident was not an isolated incident but a concentrated outbreak of imbalanced multi-actor relationships in grassroots public safety governance. To deeply analyze the internal mechanism of this failure, this section applies the "actor-authority-interaction" framework in a logical sequence: first examining the "actor alienation" of the operator, then the "fragmentation of authority and responsibility" of the administrative system, and finally the "interaction rupture" among governance subsystems.

4.1. Actor Alienation

Actor alienation means that a governance participant deviates from its legally defined role and functional attributes, instead pursuing conflicting and even destructive value goals. In the community

safety ecosystem, the fireworks retailer, as a micro-market actor, should act as a safety "gatekeeper" - at the foremost post of hazard detection and with instant prevention capability. However, the Xiangyang accident reveals the operator's role alienation - the operator's cognitive bias leads to relational deviation in practical interaction[17]. When the operator narrows its role to that of a pure market profit-seeker, stripping away its moral and legal responsibility for public safety, the safety red line becomes nominal under profit-driven behavior. From the perspective of social trust, the stability of safety governance is highly dependent on the value commitment of actors; the operator's deviation from public safety responsibility essentially undermines the trust foundation of community governance[26], creating a structural crisis where once a hidden danger turns into a tragedy, social trust is difficult to restore.

This actor alienation manifests in three specific aspects. First, the profit logic of over-stocking and risk externalization. Fireworks sales are highly concentrated seasonally, while the approved stock is based on ordinary sales, creating an inherent tension. Under profit-maximization incentives, rational operators often produce "negative externalities" - they externalize the potential explosion risk to society while keeping the illegal gains for themselves[23]. This behavior pushes the whole society to the risk critical point, turning a shop that should serve residents into a high-risk hazard point. Second, the cognitive bias and fluke mentality of illegal test-firing. The accident review shows that the operator had a systematic perceptual bias toward handling hazardous goods - chronically underestimating the frequency of low-probability, high-consequence events while overestimating its own control ability[18]. The psychological hint of "nothing has happened for so many years" led the operator to illegally test-fire in a grassroots environment without professional protection, making fluke the psychological trigger of the tragic accident. Third, the "institutional idling" of safety management. The chaos of expired equipment and disordered stacking revealed in the "shop-by-shop" inspection mirrors the operator's dual lack of willingness and ability to participate. This participation deficit is constrained both by the micro-factor of "civic deficiency" and the macro-factor of insufficient supply of safety incentives[22]. For the operator, strict safety management means a one-sided cost increase; in a game with no positive incentives, it naturally tends to adopt a perfunctory avoidance strategy. This management collapse not only paralyzes internal governance of the enterprise but also makes it a weak node in the industrial chain[27], allowing upstream production risks to seep into micro-communities through the breached retail end.

In sum, actor alienation originates from misaligned incentives. When the cost of violating the law is significantly lower than the potential gain, the operator's endogenous motivation to defend the safety bottom line will be completely dissolved. Therefore, to restore the operator to its "gatekeeper" role, the incentive structure must be reconstructed so that safety becomes a rational choice aligned with the actor's own interests, rather than a mere administrative burden.

4.2. Fragmentation of Authority and Responsibility

Fragmentation of authority and responsibility refers to the phenomenon that when dealing with complex public affairs, governance powers and corresponding responsibilities are cut into small pieces that are not subordinate to each other, have blurred or overlapping boundaries, and are scattered across different administrative departments and levels, making it difficult for the governance network to form systemic synergy. In fireworks safety governance, the allocation of authority and responsibility often falls into the "departmental and territorial division" trap of bureaucracy, generating structural regulatory vacuums. Research indicates that grassroots emergency collaboration commonly experiences resource imbalances due to disordered, gapped, or sinking duties[28]. These patterns appear in the Xiangyang accident in three layers.

First, overlapping and gapped duties coexist. Fireworks regulation involves three main departments: emergency management (business licensing and premises safety), market supervision (product quality and certificate consistency), and public security (transport and firing control). Logically, they

should form a complete regulatory chain through mutual cooperation. In practice, however, due to the lack of deep linkage mechanisms, collaborative effectiveness is severely dissipated. Before the Xiangyang accident, inspections were mostly carried out by the emergency department alone. When it reviewed storage conditions, the market supervision department did not simultaneously trace product channels; when public security controlled transport, it did not share violation records with emergency management. This "everyone sweeps their own doorstep" fragmented model, plus the inability to share license information and test results in real time, meant the regulatory system could not piece together a complete risk profile of the enterprise, ultimately leading to a failure of full-coverage safety.

Second, duty sinking creates a "small horse pulling a large cart" dilemma. The excessive downward shifting of duties and mismatch of resources constitutes a structural weakness of safety regulation[29]. In fireworks regulation, this contradiction manifests as a "power-capacity mismatch" between county-level functional departments and township offices: county emergency departments have enforcement power but cannot reach the grassroots due to dispersed manpower, while township institutions that know the frontline best have territorial responsibility but lack enforcement qualifications. This institutional tension - "those who see cannot manage, those who can manage cannot see" - leads to serious response lag between hazard detection and enforcement. When the county's "power without knowledge" and the township' "responsibility without power" intersect, territorial regulatory responsibility becomes suspended - no one delves into responsibility during routine supervision, yet during accident accountability, responsibility is pressed downward layer by layer.

Third, formalism erodes governance effectiveness. The deep consequence of fragmented authority and responsibility is the emergence of a formalistic regulatory culture centered on "ledger compliance". In the pre-accident "shop-by-shop" inspection, the focus tended to be on visible, easily quantifiable surface issues such as fire extinguisher validity and certificate display. Such inspections can quickly produce perfect administrative records to meet performance assessments, but they cannot penetrate core risks that are highly concealed and costly to detect, such as over-stocking. Operators exploit the "task-completion" mentality of inspectors by hiding hazardous goods to evade regulation. This "procedural compliance" at the expense of substantive safety reflects the rational choice of grassroots law enforcers under the shadow of blame avoidance in a context of fragmented authority and responsibility, ultimately rendering the seemingly dense regulatory system ineffective in the face of real risk.

4.3. Interaction Rupture

Interaction rupture refers to a phenomenon in a multi-actor governance system where, due to blocked information transmission or misaligned incentives, government, enterprises, social organizations, and residents fall into isolated "silos", failing to form governance synergy and eventually causing the governance network to collapse. In the Xiangyang accident, this interaction mechanism should have acted as a "shock absorber" for grassroots public safety, but it broke at the critical node of risk prevention due to dual failures of information and incentives. Empirical research shows that grassroots emergency networks typically exhibit a "core-periphery" structure: government departments occupy the core with dense connections, while social forces, small business operators, and other peripheral actors have very sparse ties with the core cluster[26]. This structural isolation originates from information asymmetry leading to a trust fracture, causing severe gaps in risk identification and perception among different actors[30]. The government possesses policy information but lacks frontline perception; operators have on-site information but no incentive to report; residents perceive risks but lack feedback channels. This extreme imbalance in information distribution directly prevents interaction.

Combined with the actual process of the Xiangyang accident, the interaction rupture appears in four aspects. First, institutional barriers to information sharing. Data silos constitute the technical obstacle to interaction[31]; the regulatory data of emergency management, market supervision, and public security are stored separately and are incompatible. Even in administrative collaboration pilot areas, cross-regional and cross-departmental data sharing still faces high institutional costs[19], and integration at the grassroots county level is even more difficult. Second, the formalistic tendency of joint enforcement. Due to the high coordination costs arising from departmental autonomy[21], joint enforcement often degenerates into "campaign-style" inspections lacking substantive content. Under existing performance pressure, each department tends to treat cross-departmental collaboration as an "extra burden on performance", generating a "free-riding" mentality - participating in inspections but not actively removing obstacles, selectively ignoring problems that are not within its own duties. Third, the participation vacuum in public-private cooperation. Social forces are extremely limited in safety governance; the operator's "surface-level rectification" and the weak sense of community among residents together lead to the atrophy of social oversight channels[9]. Fourth, the deep misalignment of interaction incentives - the underlying cause of the rupture. Under the administrative logic of "being responsible upward", departmental incentives come from completing superior-assigned tasks, not from the breadth of cross-departmental interaction. When collaborative behavior is seen as a "negative asset" that increases accountability risk and requires extra effort, each actor's choice of "sweeping its own doorstep" becomes a rational choice under institutional arbitrage.

In summary, interaction rupture is not purely a technical or capacity issue, but a structural difficulty of institutional incentives. To resolve this rupture, the value distribution system of grassroots governance must be reshaped, transforming interaction from an "extra burden" into an "internal need", thereby systematically activating the governance network.

5. OPTIMIZATION PATHS FOR GRASSROOTS PUBLIC SAFETY GOVERNANCE

In response to the above dilemmas - actor alienation, fragmentation of authority and responsibility, and interaction rupture - this section proposes three corresponding optimization paths, forming a closed loop from dilemma diagnosis to countermeasure design.

5.1. Clarifying the List of Powers and Responsibilities: Responding to the Fragmentation Dilemma

In response to the regulatory vacuum caused by fragmented authority and responsibility, the first path is to clarify the list of powers and responsibilities as a starting point to redefine the responsibility coordinates of grassroots safety governance. Research shows that optimizing emergency collaboration requires advancing dimensions such as duty specification, guarantee mechanisms, and implementation effectiveness, and that clear ownership of powers and action boundaries is a prerequisite for generating synergistic effects[9,24]. The effectiveness of collaborative governance depends largely on the clarity and operability of institutional design[32]. Four aspects should be deepened.

First, compile a cross-departmental collaborative list of powers and responsibilities. Following the "whole life cycle" governance logic of fireworks, precisely define the functional boundaries of emergency management, market supervision, and public security at the retail end. Emergency management should anchor "premises safety and stock red line", focusing on licensing and physical environment monitoring; market supervision should focus on "product quality and compliance tracing", severely cracking down on illegal circulation; public security should strengthen "transport safety and firing control". Through an institutionalized two-way information notification mechanism,

isolated one-way supervision can be integrated into a systemic synergy, ensuring closed-loop linkage in overlapping areas and avoiding governance vacuums.

Second, break the territorial management trap of "responsibility sinking". It is essential to break the asymmetric dilemma of mismatched power and resources by deeply embedding safety regulation into the grassroots grid governance system. Strengthen the "risk sentinel" role of grid members to ensure that the county and township levels fulfill their main responsibility of "cracking down on illegal production and sales". Specifically, explore granting township-level institutions appropriate administrative enforcement authority or on-site disposal power, accompanied by specialized resource support, to institutionally resolve the execution embarrassment of "those who see cannot manage". Build a vertical collaboration pattern of "county guidance, township inspection, grid response", effectively shifting governance focus downward.

Third, refine the operator's subject responsibility list. Through a safety commitment system and public responsibility list, convert abstract legal obligations into concrete action guidelines. The list should not only clarify prohibited acts but also detail "standard operating procedures", covering stock limits, fire safety rules, emergency response, staff training, and other key elements. Introduce a credit governance mechanism linking the operator's compliance record to credit files and linking it to financial loans and insurance premiums, raising the cost of violations to force a return to the safety gatekeeper role.

Fourth, activate the supervisory responsibility of public participation. By reshaping the sense of community, promote the transformation of grassroots governance from "government-led mobilization" to "socially endogenous self-discipline", turning residents from potential risk bearers into governance participants. Establish a "community safety observer" system, involving resident representatives in periodic safety inspections. At the same time, improve the closed-loop feedback mechanism for hazard reporting, ensuring that residents' risk perceptions are promptly converted into government actions, building a safety line of common participation, shared responsibility, and collective benefits.

5.2. Technology-Enabled Collaboration: Responding to the Interaction Rupture Dilemma

Digital technology is not just a tool update but signifies a paradigm shift in social connection and organizational logic. In response to information silos, digital technology should be used to empower process reengineering and build a full-chain digital supervision platform for fireworks. As a fast-responding technical foundation for emergency systems, the digital resilience base provides real-time visualization and precise early warning through data integration[30]. Four actions are needed.

First, build a unified cross-departmental data exchange hub. The core of digital supervision is to break down departmental walls and achieve "one-network collection" of information across the entire chain of production, procurement, warehousing, logistics, and sales. Drawing on advanced experiences such as the "four platforms for grassroots governance", integrate data resources from emergency management, market supervision, public security, and other departments, and establish cross-connection mechanisms under standardization principles. This deep cross-departmental data coupling significantly enhances the system's sensitivity to potential risks, pushing grassroots safety governance from passive "post-incident response" to active "pre-incident early warning"[33].

Second, integrate an intelligent dynamic monitoring system. Based on the digital platform, build an "AI visual recognition + grid closed-loop linkage" intelligent module. By deploying smart sensing devices at retail terminals, use image recognition algorithms to automatically identify violations such as "three excesses and one alteration" (excess stock, excess scope, excess persons, unauthorized alteration) around the clock. Once abnormal stacking or environmental hazards are detected, the system automatically triggers an alert and pushes it precisely to grid members' mobile terminals,

driving on-site verification. This “algorithm warning + manual verification” collaborative model effectively compensates for the shortage of grassroots law enforcement capacity.

Third, implement full-life-cycle product traceability. Establish a “one product, one code” management system for fireworks, giving each product a unique digital identifier covering its entire trajectory from factory to retail. By comparing purchase and retail data, regulatory authorities can automatically identify abnormal storage suspicion and precisely target channels of illegal market entry. This full-chain traceability not only improves the efficiency of tracing problematic products but also creates a technical deterrence against illegal operations, enhancing supply chain transparency and safety.

Fourth, develop an interactive public participation matrix. Digital empowerment should target not only administrative supervision but also social mobilization. Develop mobile applications to lower the institutional threshold for residents to report hazards. The platform should serve not only as a “collector” of risk feedback but also as a “broadcasting station” for safety knowledge and early warnings. This technology-driven interaction model can effectively enhance residents’ risk prevention awareness, integrating isolated individuals into a digital community of safety.

5.3. Co-Construction, Co-Governance, and Sharing: Responding to the Actor Alienation Dilemma

In response to actor alienation, especially operator role failure and insufficient social participation motivation, this path adopts the modern governance concept of co-construction, co-governance, and sharing to build a community safety community where “everyone has a duty, everyone does their part, and everyone enjoys the benefits”. The new form of social governance highly depends on the state’s cultivation and integration of social forces; introducing “nudge” mechanisms and political leadership can effectively enhance the endogenous self-consistency of community governance and reduce governance costs[34]. Four dimensions should be pursued.

First, strengthen community safety education. Target key populations in rural and urban-rural fringe areas by replacing traditional “irrigation-style” publicity with experience-based campaigns based on real scenarios, addressing the general lack of emergency skills among residents. Organize regular emergency drills, warning education, and simulated evacuation activities, enabling residents to strengthen risk perception through personal experience, shifting safety awareness from “passive notification” to “active internalization”. In particular, through the “small hands holding big hands” mechanism, embed emergency knowledge into the adolescent education system, thereby promoting intergenerational transmission of safety literacy across families and communities.

Second, smooth channels for public participation. Establish institutionalized community safety councils, such as “police-public deliberation rooms” and online consultation platforms, involving resident representatives, operators, grid members, and functional departments in safety decision-making. To break the “apathy deadlock” of social participation, improve precise reporting incentive mechanisms with both material rewards and spiritual recognition, transforming the public from risk “bystanders” to governance “participants”. Ensure that all types of hazard information can be fed back in real time and quickly closed, maximizing the effectiveness of social oversight.

Third, introduce professional social forces. Give full play to the professional assessment role of market institutions. Through government purchase of services, commission professional safety organizations to conduct periodic “health checks” on retail terminals, and use the assessment results as hard indicators for license renewal and credit rating. At the same time, promote the work safety liability insurance system, using premium rate adjustments to guide operators toward proactive hazard rectification. Insurance companies, driven by the intrinsic motivation to reduce claims, will spontaneously conduct safety inspections and technical training for insured units, forming a beneficial supplement to government regulation and serving as a social risk “shock absorber”.

Fourth, strengthen the collaborative network led by institutional development. Give play to the role of local administrative units as "magnets" in safety governance, integrating the power of local officials, grid members, and volunteers to build a three-dimensional "institutional development + safety" network. Through the exemplary effect of local officials, take the lead in identifying hazards and implementing rectifications, mobilizing the public to build together. In this process, community-level governing bodies should act as interest coordinators, resolving collaboration conflicts among different actors, ensuring that the governance network achieves low-cost, high-efficiency virtuous operation under the leadership of institutional development.

6. CONCLUSION AND DISCUSSION

Against the background of deep transformation in the risk society, grassroots safety governance is no longer the responsibility of a single department but a common cause requiring multi-actor participation. Based on collaborative governance theory, this paper constructs a three-dimensional analytical framework of "actor - authority - interaction", and through an in-depth review of the Xiangyang "2·18" accident, draws the following core conclusions.

First, the role alienation of business entities is the micro-root of safety risks. The accident reveals the operator's imbalance in the game between "economic rationality" and "public responsibility" - driven by short-term profit motives, operators tend to pursue profit maximization by externalizing risks, leading to frequent red-line behaviors such as over-stocking and illegal test-firing. This alienation is essentially the erosion of public safety value by individual interests. When the lack of community sense and participation capacity intertwines, the external administrative pressure of regulation is often offset by the absence of internal motivation, ultimately resulting in an "idling" state of "formal compliance but substantive failure".

Second, fragmented authority and responsibility allocation is the institutional crux of governance failure. Horizontally, overlapping and gapped duties among emergency management, market supervision, and public security prevent regulatory forces from generating a chemical reaction, trapping them in a swamp of low-efficiency collaboration. Vertically, the shortage of grassroots law enforcement capacity combined with the downward pressure of responsibility creates a "small horse pulling a large cart" dilemma of duty sinking. This institutional constraint of "departmental and territorial division" leaves grassroots enforcement stuck at surface-level visible norms, unable to effectively penetrate hidden risks, reflecting the structural fragility of regulatory efficiency under bureaucratic loss.

Third, the rupture of multi-actor interaction is the key pain point leading to network paralysis. The current emergency network exhibits a notable "core-periphery" differential structure, with severe connection vacuums between the government core and peripheral social actors. Information silos block real-time risk information transmission, and misaligned incentives turn cross-departmental collaboration into a "campaign-style" performance motivated by blame avoidance. The heavy casualties in the Xiangyang accident are an extreme manifestation of the failure of social oversight mechanisms and the absence of public safety education, revealing the logical defect in the transformation from "administrative stock" to "governance increment".

Fourth, future grassroots safety governance should move toward a deep integration of "digital resilience" and "holistic collaboration". The key to breaking the current governance deadlock lies in constructing a three-in-one model of "clarifying the list of powers and responsibilities, technology-enabled collaboration, and co-construction, co-governance, sharing". Clarifying the list defines governance boundaries and lays the legal foundation for collaboration; digital technology reengineers organizational processes and opens the information channels for collaboration; activating social participation forces injects endogenous momentum into collaboration. The three support each

other and are mutually reinforcing, jointly promoting the leap of grassroots safety governance from single-administrative control to a resilient governance community.

In addition, this study has limitations. It is mainly based on publicly available materials for case review, lacking the granularity of fieldwork and the breadth of multiple cases. As the details of the accident are still being dynamically disclosed, some analytical conclusions require further empirical testing. Future research can expand in the following directions: first, conduct longitudinal comparisons of multiple cases to explore common patterns of hazardous goods regulation in different regions and time periods; second, introduce quantitative methods such as social network analysis (SNA) to scientifically depict the density and centrality of grassroots collaborative networks; third, conduct participatory observation at the front line and obtain more tension-rich micro-empirical data through in-depth interviews, with a view to continuously improving the theoretical map of grassroots resilience governance.

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