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Construction of Data-Driven Urban Conflict Prevention and Governance Model

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ABSTRACT

The surge of urban operation data provides a new opportunity for prior identification and accurate intervention of contradictions and disputes. Based on the data of 12,345 work orders, police receiving, and judicial mediation in a sub-provincial city in recent three years, this paper constructs a closed-loop model of "perception-prediction- intervention-feedback": it opens up semantic mapping and synchronization of cross-departmental heterogeneous data, integrates multi-scale spatio-temporal characteristics, and embeds LightGBM-Text cellular neural network (CNN) dual-channel model to realize minute-level prediction, differentiate intervention according to risk level, and optimize the closed-loop through visual dashboard. The six-month A/B test shows that the dispute response time is shortened by 36.9%, the incident resolve rate is increased by 22.6%, and the satisfaction of the masses is increased by 18.1%. Under the premise of clear responsibilities, the model realizes efficient multi-sectoral linkage and adaptive governance and provides a replicable paradigm for social governance in megacities.

KEYWORDS

Data-Driven, Urban Governance, Prevention of Contradictions and Disputes, Early Warning, State Machine, Dual-Channel Model

INTRODUCTION

Contradictions and disputes with small scale, strong suddenness, and rapid evolution have become the key indicators to test the social resilience of megacities, precisely because the complex urban systems make them vulnerable to small shocks (Tolstykh et al., 2022; Yeh & Chen, 2020). The traditional governance model focuses on post-event hierarchical circulation and manual judgment. Faced with the real dilemma of the surge in scheduling and the overlapping of departmental functions, this model often focuses on repeated scheduling, information distortion, and lagging disposal and increases governance costs and social risks (Chen & Greitens, 2022; Gu et al., 2025). Although the popularity of digital infrastructure promotes the integration of multi-source heterogeneous data—including hotline work orders, public security alarms, judicial mediation, social media, internet of things sensors, and so on—it provides data support for risk precursor identification. However, most of the existing platforms are still limited to keyword searches or static threshold warnings, which makes it difficult to achieve minute-level awareness and cross-departmental collaboration (Abbasian Dehkordi et al., 2020; Adepoju et al., 2022; Costa et al., 2024). At present, grassroots governance generally faces systemic challenges such as a lagging discovery, slow response, and inefficient disposal. This

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highlights issues such as poor cross-sector collaboration, inadequate accuracy in risk identification, and a lack of forward-looking interventions (Nobambela & Yekani, 2025; Ortega & Behague, 2022).

Although some cities have introduced intelligent allocation systems, these systems tend to be confined to a single data source or static rule engine, making it difficult for them to capture the spatiotemporal dynamic evolution of disputes and neighborhood spillovers (Hashem et al., 2023; He et al., 2023). Especially in sensitive scenarios such as during nighttime, during holidays, or in old neighborhoods, these systems have a weak perception of hidden conflicts such as family cold violence and neighborhood grudges, which results in a large number of risks being incorporated into the governance process after escalation; they thus miss the best intervention opportunity (Li et al., 2024; Willis & Nold, 2022).

In essence, the core problem of current smart city governance is not data integration but cognitive integration (Kourtit, 2021; Repette et al., 2021). Although the centralized management of government data has been realized in forms, there are obvious differences in structure, standards, and update frequency in different fields, which makes it difficult to support a refined analysis that requires rapid response and real-time collaboration (Munoth et al., 2022). At present, most commonly used prediction models only rely on a single structural feature or a simple text classification method and do not fully integrate multi-dimensional influencing factors such as spatial location relationships, historical event trajectories, and real-time emotional tendencies (Hatami et al., 2025). At the same time, there is an obvious disconnect between governance decision-making and model analysis results. Even if the risk identification and assessment are completed, due to the lack of a unified and standardized implementation mechanism, it is difficult for the assessment conclusions to be transformed into governance measures that can be implemented differently, which makes it difficult for intelligent analysis to be truly transformed into governance effectiveness (Eneqvist & Karvonen, 2021; Xie et al., 2021). Therefore, building a whole-process intelligent governance system that can integrate multi-source traffic data, quantify various influencing factors, and automatically trigger policy implementation has become a key issue that needs to be solved in smart city governance.

In view of the difficulties in integrating multi-source data and the disconnection between risk prediction and actual disposal in current urban governance, this study not only constructs an end-to-end intelligent governance system integrating multi-source data fusion, quantitative analysis of driving factors, and automatic strategy triggering, but also puts forward a framework that can guide computing research theory and system design. Specifically, the dual-channel deep learning model not only is used for minute-level risk prediction, but also reveals the interaction mechanism among structured data, spatial characteristics, and semantic information, providing a theoretical basis and design template for building an adaptive and automated governance system. With the help of lightweight ontology and streaming extraction, transformation and loading (ETL) technology, achieve the semantic unification of multi-source data, integrating diverse datasets such as the 12,345 citizen hotline, public security information, and judicial mediation. On this basis, spatiotemporal and semantic features are extracted, and a dual-channel, deep learning model composed of light gradient boosting machine (LightGBM) and tiny-bidirectional encoder representations from transformers (Tiny-BERT) and a cellular neural network (CNN) is input to realize minute-level risk probability prediction (Barik et al., 2025). The risk state machine is driven by dual thresholds to automatically match differentiated governance strategies such as community consultation, legal consultation, and multi-department collaborative intervention. The main contributions of this paper are reflected in three aspects; the technical level breaks through the limitations of traditional single-modal analysis and realizes the deep fusion of structured data and semantic information. We design a risk state machine at the mechanism level, directly transform the model prediction results into executable governance measures, open up the key links from risk prediction to implementation, and form a data-driven closed-loop feedback mechanism. At the practical level, through a six-month A/B comparison experiment, this governance mode can compress the average response time from 96 minutes to 61 minutes and increase the incident pre-resolution rate