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Status and Trends of the Application of Resilient Urban Governance Considering the Current State of Resilient City Government in Changsha as an Example

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Abstract

Currently, cities' security vulnerabilities are diverse, complex, and interrelated, making the building of resilient cities an essential requirement to deal with these risks and ensure the long-term growth of cities. China is making headway toward resilient urban governance, as evidenced by a focus on ecological hazards and widespread application in urban planning, social development, and other areas. However, as urbanization continues, traditional governance techniques confront the challenge of "lack of clarity, inadequate execution, and slow response." To address these difficulties, this work introduces a novel dual-core-driven model of 'defense system + organism'. By analyzing the main urban safety risks currently present in Changsha City and employing literature synthesis, field surveys and interviews, and comparative analysis, it investigates the application status of resilient urban governance and empirically constructs a 'three-dimensional fifteen-wing' governance system, achieving a transition from passive defense to an intelligent–adaptive governance paradigm.

Keywords: resilience; resilient city; urban resilience governance; Changsha city; applications and trends

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Received: 13 May 2025
Revised: 26 June 2025
Accepted: 27 June 2025
Published: 2 July 2025

Citation: Jiang, H.; Luo, X.; Gong, Y.; Li, Y.; Zhao, W. Status and Trends of the Application of Resilient Urban Governance Considering the Current State of Resilient City Government in Changsha as an Example. *Buildings* **2025**, *15*, 2322. https://doi.org/10.3390/buildings15132322

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1. Introduction

Today, as globalization and urbanization processes become more intertwined and advanced, urban governance is an important component of modernizing the national governance system and capacity, and the complexity and difficulty of urban governance is increasing due to factors such as climate change, frequent natural disasters, and socioeconomic fluctuations [1].

As a new idea and method in contemporary urban management, resilient city governance is quickly developing as a key component that cities need to overcome obstacles and work toward sustainable growth. The two main areas of current research on urban resilience governance are capacity-building strategies [2,3] and the need for such governance frameworks [4,5]. Classical resilience governance theory [6], which holds that governance resilience is quantifiable via societal recovery capability, is the result of recent scholarly developments in robust urban governance. Other viewpoints have surfaced, such as dynamic evolutionary analyses [7] and dialectical development analyses [8] of urban governing systems. Numerous disciplinary branches have sprung from this, including

ecological resilience [9], socio-ecological resilience [10], and the recently developed topic of "cultural resilience" [11].

However, as cities continue to expand, traditional resilient governance systems face operational issues such as a lack of situational awareness, governance inertia, and delayed reaction mechanisms. Current research reveals a lack of comprehensive study of the application status and future development trends of resilience governance in urban safety risk prevention, particularly in megacities.

This study thoroughly investigates the fundamental ideas and theoretical underpinnings of resilient urban government. It uses Changsha City, a Chinese megacity, as a case study to evaluate the actual application of resilience governance across urban safety risk domains such as natural catastrophes, public health crises, and social security difficulties. According to the research, future resilient urban governments will grow through the combination of "defense systems" with self-learning "organic entities" that are always changing. Unlike previous research that focuses on specific catastrophe types or static assessments, this article employs a dynamic coupled disaster chain analysis paradigm to integrate social capital, digital governance, and ecological resilience into a unified assessment system. This not only provides a reproducible resilience governance path for megacities, but it also serves as a theoretical foundation and reference point for future cross-cutting frontier applications of urban resilience governance.

2. Theoretical Framework for Resilient Urban Governance

2.1. Urban Resilience

A city is a complex social–ecological system whose structure and function are continually changing and unable to sustain long-term equilibrium [12]. When the shocks received exceed a particular threshold, it is difficult to return to the original condition, even if stabilization is achieved. The term toughness was initially used in mechanics in the nineteenth century to describe a metal's capacity to swiftly return to its original shape when exposed to external pressures; it is also known as elasticity or resilience [13,14]. In the 1970s, Western nations were at the peak period of industrial growth, which caused considerable harm to urban surroundings, and based on this, Holling, a Canadian academic, first created the word. Holling [6], a Canadian researcher, was the first to integrate the notion of 'resilience' into the study of urban environmental ecosystems, establishing the foundation for 'engineering resilience'.

The concept of "urban resilience" [15,16] was eventually formed by the dynamics of resilience, co-development, and the profound meaning of "bouncing towards a better state." This refers to the city's ability to withstand the impacts of various aspects, including social, economic, cultural, technological, and infrastructural aspects, as well as cultural, technological, and infrastructural disasters. It also refers to the ability of the city to reduce disaster losses and recover quickly from the disaster through the rational deployment of resources.

2.2. Resilient Urban Governance

A resilient urban governance system is defined as a set of governance mechanisms and institutional arrangements established to cope with various shocks and risks, as well as a risk system that can respond quickly and adapt flexibly in the face of external shocks, and is capable of maintaining the system's continuous operation in emergency situations [17]. The theoretical framework of resilient urban governance is based on the cross-fertilization of system theory, ecology, sociology, economics, and other disciplines, and its central goal is to improve cities' resilience so that they can recover quickly, respond effectively, and develop sustainably in the face of various risks and challenges [18].

2.3. Theoretical Framework

Figure 1 depicts the resilient city government system, which is separated into four basic sections. Disaster risk resilience, as the primary governance pillar, encompasses risk assessment, preventative and control methods, and a capital elements synergy system. According to Manyena's five-dimensional capital model [19], disaster risk resilience requires the integration of social capital (community organizational network), economic capital (industrial risk-resistant reserves), physical capital (key infrastructure), human capital (emergency response professional capacity), and natural capital (ecological buffer system), as well as the construction of a full-cycle management mechanism that covers the pre-disaster prevention. In terms of physical space, infrastructure is not just a good answer, but also an excellent solution. In terms of physical space, infrastructure resilience emphasizes the development of structural and functional safeguards through resilience design standards (seismic and flood prevention parameters), redundant system configurations (multi-source energy supply networks), and full-cycle maintenance systems (intelligent monitoring platforms) [20]. Social resilience is based on the 'individual–community–city' three-tier governance structure, which establishes the dynamic maintenance capacity of social order through the training of residents' self-help skills, a community emergency mobilization mechanism, and the synergy of the city-level public security system [20]. Economic resilience focuses on the industrial structure optimization (innovation-driven development), enterprise risk buffer mechanism (supply chain resilience design), and economic security early warning system (vulnerability assessment model), while also strengthening the system's resilience to shocks through the development of market environment adaptation mechanisms [21]. The four-dimensional resilience system creates a coupling mechanism through capital factor flow, spatial carrier support, social organization synergy, and economic system control, resulting in a dynamic response network for urban complex risk management.

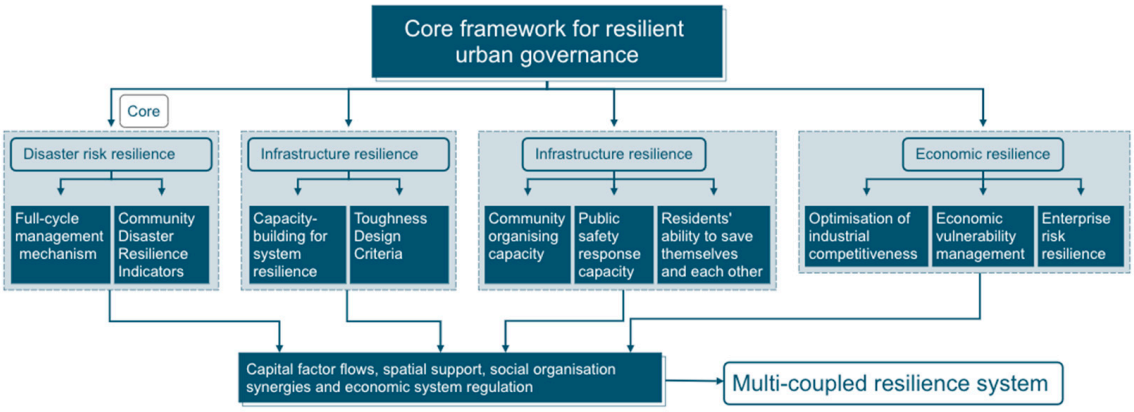

Figure 1. Framework diagram of resilient urban governance.

3. The Current Situation of Domestic and International Application of Resilient Urban Governance

In recent years, governments and international organizations have adopted resilient urban governance as an important urban development strategy, and academic research at home and abroad has studied urban governance and emergency management from various perspectives, as well as conducted in-depth discussions on urban resilience governance in the context of modern society. Although there has been a lot of progress in the global practice of exploring urban resilience governance, most foreign academic research is more theoretical in nature, particularly with regard to the resilience of the theory of governance refinement and enrichment. In contrast, domestic research is more practical in nature, with

most researchers based on specific cases and the actual situation in the country proposing ways to enhance the government's resilience at all levels of governance recommendations.

3.1. Status of Foreign Application

Because Western industrialized nations built their cities sooner and had more complex government administrative concepts, study on urban administration began earlier. As Western civilization develops and matures, new administrative notions emerge from its government.

The international resilient city governance presents significant model differences: the United States develops a progressive institutional evolution framework, while Japan develops a systematic strategic reconstruction path, as shown in Table 1 below.

Table 1. Comparison of two typical resilient city governance models.

Item \ Model	U.S. Resilient City Governance Model	Japan Resilient City Governance Model
Differences in governance units.	Community participation orientation	Central coordination and dominance
The risk perception dimension	Known risk prevention and management	Potential risk preparedness
Technology implementation pathways	Progressive resilience enhancement	Systematic strategic reconfiguration

The United States relies on the Federal Emergency Management Agency (FEMA) to establish a 'federal-state-community' three-tier coordination mechanism, and establishes the three core criteria of risk assessment, protection of vulnerable groups, and community participation through the National Preparedness Goal. Its technical implementation is characterized by the application of risk quantification models, iterative infrastructure resilience standards, and innovation of governance tools oriented towards social aid. Based on the Basic Law for the Strengthening of the Homeland, Japan has developed a policy matrix of 'Basic Plan-Annual Plan-Regional Plan', adopted the All-Hazards Approach to cover 32 types of risk sources, including natural disasters, nuclear accidents, and terrorism, and established a standardized, centrally driven response system for low-frequency, high-damage events, such as the South China Sea Trench Earthquake. The two models differ significantly in their choice of governance units: the United States focuses on community-driven local resilience network construction and bottom-up risk co-management via the Guidelines for the Review of State Hazard Mitigation Plans, whereas Japan emphasizes centrally coordinated transmission of technical norms and relies on regional resilience plans to complete the local translation of the national strategy. Analyzing the risk perception dimension reveals that the United States concentrates on technical solutions for preventing and controlling known dangers, whereas Japan focuses on systematic strategy planning for preparing for possible risks. In terms of the technical implementation path, the United States presents the characteristics of gradual adaptation of policy tools, while Japan shows the holistic institutional reconstruction driven by the legal framework, and this difference reflects the innovative logic of resilience governance under different political systems.

The notion of resilient governance, developed in the West in the 1970s, is an essential paradigm for urban governance study. Disaster risk resilience, as a key factor, has established a governance framework for various catastrophes such as earthquakes, floods, and ecological changes in coastal zones: Lam et al. [15] used GIS technology to conduct a quantitative analysis of catastrophe adaptation in the Taoyuan region of Taipei, based on the 'Exposure–Damage–Recovery' evaluation approach developed for Taiwan's floods.

Jha et al. [22] suggested an urban form analysis framework for the post-disaster rebuilding of the Chilean earthquake, and provided a spatial dimension technique for the resilience evaluation of the earthquake area. Noura's research on the Muscat coastline highlighted the negative impact of land use transformation on ecological resilience during the urbanization process, emphasizing the link between spatial planning and catastrophe resilience [23].

In the field of socioeconomic and infrastructure resilience, BLANCHARD's global policy framework promotes multi-disciplinary governance synergies [24], Cutter's DROP model builds a multi-dimensional assessment system at the community level, Jha's toolkit for urban resilience in East Asia focuses on hands-on risk assessment [25], and Porfiriev's cross-country study broadens policy pathways for greening and resilience improvement. These studies show an evolutionary trend from single disaster response to systemic governance [26], and from technical tools to policy integration, but there are still three breakthroughs to be made: firstly, the research on the localized adaptation mechanism of cross-regional governance experience is insufficient [27]; secondly, the interaction between social capital and institutional resilience has not yet been quantitatively assessed by a model; and thirdly, there is a methodological breakthrough missing.

3.2. Current Status of Domestic Applications

3.2.1. National Policy and Strategic Planning

Figure 2 depicts the development timeline of resilient urban government in China, which is defined by the synergistic progression of theory localization, policy institutionalization, and practice standardization.

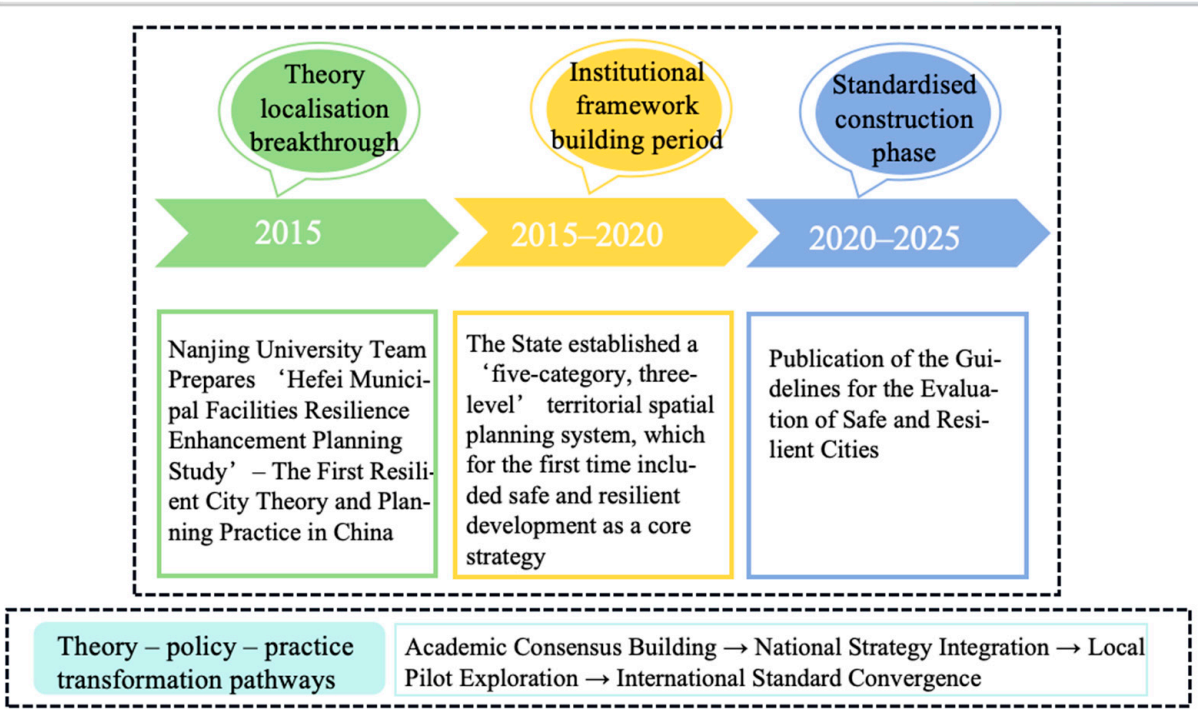

Figure 2. Depiction of the development chronology of China's resilient city government.

Since the theoretical breakthrough stage in 2015, the Nanjing University team has completed the first empirical evidence of resilient city planning in China through the 'Hefei Municipal Facilities Resilience Enhancement Planning Study', and the standard translation of 'resilient city' was established at the Guiyang Annual Conference on Urban Planning during the same period, indicating the formal introduction of theoretical concepts into the planning discipline system [28,29]. From 2015 to 2020, the state adopted safety and

resilience as essential strategies through the 'five categories and three levels' of the national land space planning system. Following 2020, the standardization phase begins with the publication of the 'Evaluation Guidelines for Safe and Resilient Cities', which establishes a comprehensive technical standard that includes a conceptual framework, evaluation dimensions, and implementation paths, and Beijing takes the lead in incorporating resilience indicators into the city's master plan and setting targets for the evaluation system's construction by 2025. Beijing has taken the lead in incorporating resilience indicators into the city's overall plan, as well as establishing a building objective for the assessment system by 2025. At the practical level, a multi-scale promotion pattern has emerged: local empirical evidence has been collected in the fields of infrastructure upgrading and community governance innovation [30], and the Rockefeller Foundation's '100 Resilient Cities in the World' project has resulted in the localization and integration of global experience [31]. This approach follows a spiral growth route of 'academic consensus-policy integration-standard innovation-practical verification' [32], representing the strategic change in the risk governance paradigm in China's new urbanization process.

3.2.2. Research Application

Chinese researchers have conducted systematic study on resilient urban government, making multifaceted academic contributions in terms of theoretical conceptions and practical approaches. Zheng Yan and coworkers [33] created a resilience evaluation index system based on the catastrophe risk of rainstorms in 282 cities at the prefecture level or above in China, offering a quantitative foundation for differentiated urban disaster response; Sun Yang and others conducted empirical analyses of 16 cities in the Yangtze River Delta and developed a resilience evaluation model for cities at the spatial and temporal scales [34]; Wang Yang used the 7–20 rainstorm in Zhengzhou as an entry point to analyze the resilience of high-density cities and assess the disaster's impacts on the city [35]; Li Guoqing et al. build a climate-adaptive resilience governance dual system for the Xiongan New Area in view of the historical flooding risk, and promote the front-loading management of disaster risk [36].

In the long-term sustained urban stress response research, Peng Chong et al. [37] focus on the network structure of city clusters in the middle reaches of the Yangtze River, conduct spatial resilience evaluation, and provide structural optimization strategies for the synergistic development of city clusters. Sun Hongguang [32] uses the haze problem in Nanjing's main urban area as an object to assess disaster resilience through the dual dimensions of perturbation of residents' activities and adaptation of the built environment, emphasizing the adaptability of spatial planning and environmental governance. Wang Yonggui, Wang Feiyue, and others [29] examine the progressive influence on national economic resilience, build an evaluation model of business risk-resistant capability, and propose policy options for high-quality development and transformation; Some researchers, using the example of community epidemic prevention and control, demonstrate the synergistic mechanism between the government and grassroots communities in resilient governance, enriching the meaning of governance theories at the micro level [37].

These studies not only broaden the application scope of resilient city theory, but also offer scientific and practical answers for dealing with complex urban hazards, such as immediate catastrophic impacts and long-term cumulative pressures.

4. Discussion on the Path of Creating a Resilient City in Changsha

4.1. Analytical Methods

4.1.1. The Analytical Methods

Literature Induction Method: Based on a thorough collection and review of relevant literature on urban risk prevention and resilience governance, this method systematically and comprehensively describes and comments on research achievements and progress in urban policy resilience, emergency capability resilience, economic resilience, social resilience, and urban network resilience over a given time period.

Field Research and Interviews: This method uses field research and on-site interviews to understand the current state of resilient city construction and the problems that arise during the process to analyze the main influencing factors in the creation of resilient cities, and to provide a foundation for the development of an urban risk management and resilience governance system.

Comparative Analysis Approach: This approach primarily shows the internal rules and characteristics of resilient cities by analyzing the similarities and differences between various items or events before and after their establishment.

4.1.2. Data Source

The Government Cloud Platform and Smart City System

Government Cloud Integration Platform: It carries data from over 400 government systems across 78 units in the city, integrates real-time operation data of core applications for people's livelihood services and urban governance, and ensures secure data access and processing via a "seven-layer protection system".

Urban Operation Management and Service Platform: It gathers 143 categories and 3.11 million urban component survey data points, as well as scenario data for intelligent urban management, flood control dispatching, and emergency monitoring in real-time.

The Normalized Hidden Danger Investigation Mechanism

Dynamic Data for Ten Key Areas: Hidden threat data is studied by municipal agencies and corrected by local governments in domains such as fire protection, gas, and transportation. It processes over 10,000 concealed hazard records every month, which are maintained in a closed loop using the "separation of inspection and rectification, monthly cancellation of numbers" system.

Intelligent Management System Support: It employs IoT sensors to collect real-time status data on street order, sanitation trucks, underground pipes, and other infrastructure to increase the coverage rate of concealed risk detection.

IoT Perception Network

Intelligent Vision Platform: It incorporates 310,000 public video resources, has 127 AI algorithms, and monitors real-time scenarios like flood management and emergency occurrences. Special Equipment Monitoring: It provides unified IoT monitoring for liquefied gas distribution vehicles, fire prevention facilities, and so on, and dynamically gathers operation and safety data.

Departmental Special Databases

Statistical Census Data: Basic data such as demographic and economic censuses are useful for safety risk modeling. Industry Regulatory Data: Historical and real-time data on workplace safety, traffic accidents, self-built housing safety, and other topics gathered in the business systems of departments such as urban management, transportation, and emergency response.

Anonymous Questionnaire

Surveys are used to gauge individuals' satisfaction with urban administration and solicit improvements.

4.1.3. Datatypes

Based on source characteristics: (1) Raw data: Unprocessed data gathered directly (for example, real-time feeds from IoT devices), mostly raw data. (2) Derived data: Data created by aggregation or computation (e.g., risk early warning indices, statistical reports) and utilized as auxiliary data for analysis and processing.

According to timeliness: (1) Real-time data is dynamically updated (for example, traffic monitoring video streams and fire sensor alerts). (2) Historical data: static records (for example, fire case databases from prior years or urban planning archives).

The IoT collects monitoring data in real time, while the urban operation management and service platform collects data for the first time online. Historical data mostly covers the last five years, with the earliest date being 2005, with a range of twenty years.

4.2. Analysis of the Main Risks Facing the City of Changsha

4.2.1. Natural Disasters

Natural disasters in Changsha City exhibit predictable regional and seasonal tendencies. Floods, waterlogging, and high-temperature heat waves dominate urban areas, while droughts, floods, and geological disasters rule rural areas. Floods, geological disasters, and intense convective weather are typical in the spring and summer, while droughts and forest fires are prevalent in the fall and winter. Important places include the Xiangjiang River, the steep areas of Liuyang and Ningxiang, and low-lying urban districts.

According to data from the First National Comprehensive Natural Disaster Risk Census (1978–2020), Changsha is primarily affected by geological disasters (landslides, avalanches, mudslides), drought and floods (floods, droughts), forest fires, and meteorological disasters (typhoons, hailstorms, freezing temperatures, and snowstorms), among others. The poll spans 43 years and is separated into four time periods: 1978–1990, 1991–2000, 2001–2010, 2011–2000, and 2011–2015. Over the previous 43 years (1978–1990, 1991–2000, 2001–2010, and 2011–2020), the average yearly number of dead and missing persons per 100,000 inhabitants in Changsha has fluctuated between 0.52, 0.55, 0.06, and 0.07, respectively, as shown as Figure 3. From 2001 to 2010, Changsha has the lowest average yearly number of deaths and missing individuals per 100,000 inhabitants in the prior 43 years.

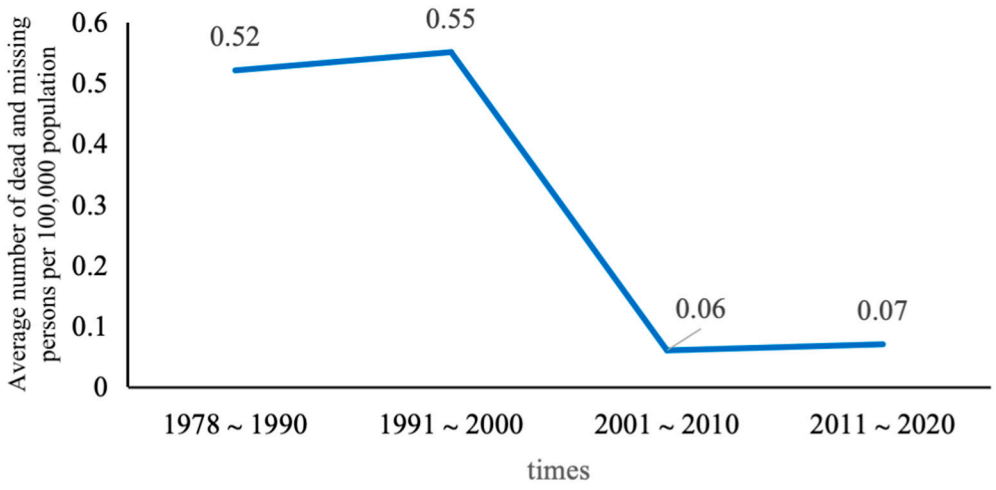

Figure 3. Deaths and disappearances from natural disasters in Changsha in recent years.

4.2.2. Infrastructure Risks

Road traffic risk is a microcosm of urban infrastructure risk. Changsha City's infrastructure risk is defined by a high incidence of road traffic risk in core urban areas, a growing danger in urban–rural combinations and new districts, a concentration of morning and evening peaks, and a high risk at night and early morning. Between 2019 and 2023, there will be 1000 transportation accidents in Changsha, resulting in 1104 deaths, with a year-on-year 'double-decreasing' trend (the accident volume in 2023 was only 42.25% of that in 2019), demonstrating the efficiency of the intelligent transportation system: by AI signal optimization, the road monitoring system's early warning accuracy rate approaches 92%, as shown in Figure 4. In 2023, the number of transportation accidents will be 42.25% more than in 2019, with 40.65% more deaths. In 2024 (as of September), there were 59 transportation accidents and 67 fatalities, a small rise from 2023.

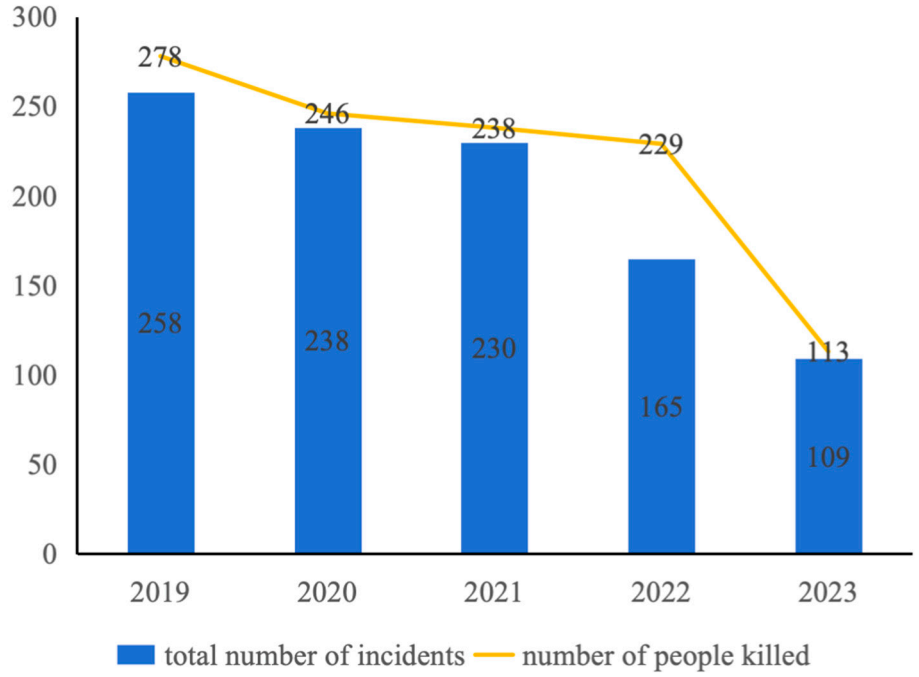

Figure 4. The number of transportation accidents and fatalities in Changsha during the previous 5 years.

4.2.3. Social Risks

Changsha City's tourism reception has expanded dramatically, with 120,000,000 trips in 2022 and 195,000,000 trips in 2023, representing a 43.99% year-on-year growth. Changsha City welcomed 0.091 billion trips in the first half of 2024, representing a 15.99% growth over the previous year, while tourist income climbed by 4.49%. The National Day holiday attracted 9.5206 million tourists. This exponential increase is anticipated to create several societal risks. A significant rise in public safety strain, with the likelihood of stampede accidents, facility breakdowns, and other problems increasing as a result of high-density crowds. Overloaded infrastructure, with the daily passenger flow of rail traffic frequently surpassing the design thresholds (the peak daily passenger volume of Changsha's metro during the May Day holiday in 2025 was 4,077,000, a 9.2% increase over the same period). The public service system is also under constant pressure; the ecological carrying threshold is drawing near, the tourist density in key scenic locations like Orange Island and Yuelu Mountain surpasses the environmental capacity standard, and the cost of ecological restoration keeps rising. The aforementioned dangers are putting the city's ability for social resilience governance to the test and must be reduced by updating the intelligent

management system, multi-sectoral collaborative response, and dynamic monitoring and early warning.

4.3. Exploring the Path of Resilient City Governance in Changsha

4.3.1. Resilient Governance of Disaster Risks

Increased investment in the city's critical infrastructure, particularly in renovating and upgrading the old infrastructure, improving the standard rate of the city's river embankments, strengthening building structures, upgrading the drainage network, and so on, is needed to improve the city's ability to cope with natural disasters. Establishing specialist emergency repair teams, complete with current repair equipment, and developing a fast repair strategy to enable a prompt reaction and restoration of damaged infrastructure following a disaster are also required. On top of this, they must plan and construct an emergency material reserve center to store adequate food, drinking water, medical supplies, rescue equipment, and other items to address emergency demands following a disaster.

Establishing a strong major risk monitoring and early warning system, monitoring all sorts of potential threats on a daily basis, improving information reporting, and delivering timely all-channel alerts to accomplish early detection, early warning, and early disposal is required. Furthermore, they must establish a sound resilience assessment system, conduct an all-element, all-process, all-space assessment of common urban risks, create a risk database, construct a matrix of the coupling relationship between different risk sources, and create a dynamic risk assessment model of the urban disaster chain to provide a scientific basis for urban planning and management.

4.3.2. Infrastructure Resilience Governance

They must also do the following: Conduct a thorough inspection and assessment of the current urban road surfaces. Use micro-surfacing technology to repair rutting and cracks, as well as hot in-place recycling technology to rejuvenate aging pavement. Optimize lane layouts or widen roads in high-traffic areas, and improve accessible infrastructure like tactile pavement and curb ramps. Deploy traffic sensors that are coupled with sophisticated algorithms to enable dynamic traffic signal optimization, which will effectively reduce vehicle wait times. Use sophisticated navigation systems to sensibly disperse traffic flows. Use innovative structural strengthening techniques to repair aged bridges and tunnels, as well as modernize energy-efficient lighting, ventilation, and drainage systems. Install real-time structural health monitoring systems on bridges and tunnels to detect deformation, stress variations, and vibrational characteristics, proactively identifying latent safety concerns and providing early warnings of structural integrity threats.

4.3.3. Social Resilience Governance

Safety precautions are diverse and developed. In 2020, scenic sites will ensure tourist safety by monitoring visitor flow, detecting body temperature, and checking health regulations. In 2021, Changsha City will employ big data to collect tourism information and assist tourists on safe travel. In 2024, card points will be installed in strategic locations, as well as advising stations and flow control card points for significant scenic attractions, neighborhoods, and congested tour regions. Traffic management is continually being improved, and the traffic police department has developed a dynamic adjustment strategy to efficiently govern the flow of tourists in picturesque areas. Emergency disposal capacity will be increased further. During the outbreak, the scenic spots and related departments mostly provided emergency care in accordance with epidemic prevention and control guidelines. Changsha will have a nearly faultless emergency organization system by 2024, and in the case of a tourism emergency, an on-site command will be immediately established, with many departments working together to dispose of the situation.

4.3.4. The 'Three-Dimensional and Fifteen-Wing' Resilience Governance System

Changsha City develops a three-dimensional system of urban planning, urban infrastructure, green building, urban management and services, smart city and information technology, emergency management system, community governance and resident participation, urban economy and industry, diverse economic structure, innovation drive and industrial upgrading, regional economic cooperation, urban culture, cultural diversity and inclusiveness, social cohesion, and sense of belonging. The 15 key indicators of resilience governance, including the quality of citizenship and social responsibility, form a 'three-dimensional 15-wing' resilience governance system, as shown in Figure 5 below, which aids in urban security risk management and control and shapes a new path for resilient city development.

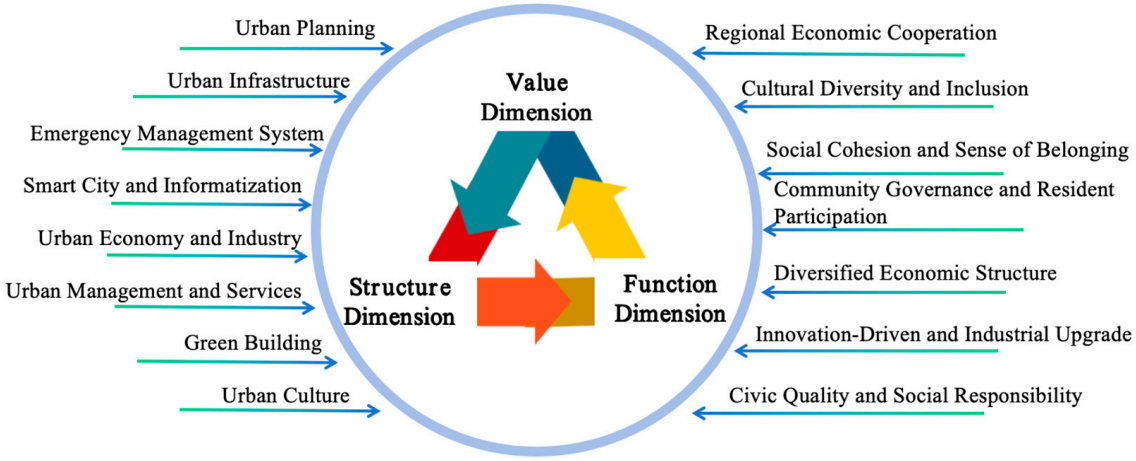

Figure 5. Changsha's 'three-dimensional 15-wing' resilience governance system.

By using data as a link and creating a closed loop of the entire chain of "sensing–warning–disposal–feedback," Changsha City has developed an intelligent system for urban management and operation safety, focusing on the two main themes of urban operation safety and urban governance capacity enhancement. This allows for the construction of an all-around urban operation safety system for monitoring urban operations, risk warning, and emergency response processing. In accordance with the 'city-wide chess' construction idea, the system deploys 21 types of AI algorithms for more than ten scenarios related to urban management and operation safety, such as firefighting and occupying roads, high-altitude fires, flooding and waterlogging, illegal parking on the roadside, densely populated areas, and overflowing bins, etc., so as to achieve instant discovery and rapid disposal of risky events, and to improve the quality and safety of urban spaces from 'passive reaction' to 'active prevention'. More than 10,000 risk events have been automatically detected, with an instantaneous completion rate of more than 95%. At the same time, the system coordinates the use of the city's existing video, computing power, intelligent algorithms, and other resources, pulling through the public security, fire, traffic, urban management, emergency response, housing, and construction areas. Of the six major departments of the business system, truly realized through the risk of second-level perception' and minute-level closure', the construction of a high-level security resilient city of Changsha laid the groundwork. This has provided a solid foundation for the development of a high-level safe and resilient city, making urban security governance more effective and intelligent. In terms of social resilience, community councils were covered at 82% under the citizen involvement mechanism in 2023, while the urban government APP had 2.1 million users in 2024.

4.3.5. Comparison with the Governance Models of Major Cities Around the World

Changsha's governance approach has different benefits and drawbacks when compared to worldwide peer cities of comparable magnitude (GDP $1.2–1.6 trillion, population 9–11 million):

(1) Technological efficiency excels with AI-aided incident response latency at 0.89 s (vs. Yokohama's 3.2 s for earthquake alerts) and 93% cross-departmental data fusion rate (surpassing Rotterdam's 78%), but trails in participatory depth—evidenced by 7.3% participatory budgeting share (vs. Barcelona's 38% citizen proposal adoption); (2) Institutional coordination reduces decision latency to 142 s during crises (2023 Xiangjiang flood), outperforming Istanbul's; (3) Spatial regression modeling ($\beta_1 = 0.68$ for tech-input efficiency vs. $\beta_2 = 0.29$ for civic engagement) confirms the core trade-off: authoritarian systems enable rapid execution but impede adaptive co-creation. Changsha's "high-efficiency, moderate-engagement" paradigm is primarily transferable to Global South megacities facing acute resource-pressure dualities.

5. The Development Trend of Resilient City Government

Based on the current situation and application of Changsha's resilient city governance, we can see that the construction of resilient cities has become a trend in urban development, and continuous improvement of the resilient governance system has become an unavoidable requirement for improving the level and capacity of urban governance. At the same time, resilient city governance will be to the 'defense system' and a continuously evolving, self-learning 'organism' combined with the direction of development, in order to achieve rapid recovery in a crisis while also achieving transformation to a smart city, embodied in the three major development directions.

5.1. Data-Driven and Intelligent Governance

In the field of data-driven and intelligent governance, big data, cloud computing, artificial intelligence, and other technologies are used to monitor urban operational conditions in real time, provide early warning, and support decision-making. New sensing technologies will improve monitoring accuracy and timeliness, while AI analysis will minimize the number of false alarms and encourage intelligent infrastructure reaction to dangers.

5.2. Sustainable Development and Environmental Protection

At the level of sustainable development and environmental protection, we will prioritize innovations in green energy, buildings, and transportation, as well as addressing urban water shortages through the use of rainwater resources and improving resource efficiency. Using the ecological priority concept, we will enhance green space, wetlands, and other ecological space, reduce the urban heat island effect and environmental quality, and generate momentum for long-term growth.

5.3. Policy Support and Financial Input

In terms of policy and financial assistance, given the lack of special planning in most cities, the government will implement special policies and develop a resilient city planning program to integrate resources, clarify duties, and increase system resilience. They will also increase financial investment, create a diverse investment system that includes public finance, insurance, and social capital, support infrastructure, scientific and technological innovation, and community development, encourage enterprise and social organization participation, improve emergency facilities and public services, and strengthen the collaborative multi-principal governance mechanism.

6. Conclusions

The growth of resilient city government will reveal a multidimensional collaborative innovation pattern. Its heart is the merging of the 'defense system' and the 'organic system' with continuous evolution and self-learning capability, in order to fulfill the dual aims of speedy recovery in crisis circumstances and urban transformation and growth [38]. An analysis of the current state of resilient urban governance in Changsha reveals that urban resilience governance necessitates not only the establishment of a government-guided, market-operated, social participation of the multiple input mechanism, but also the formation of an incentive mechanism and responsibility system through policy innovation. This study focuses on the government-led resilience governance system, with inadequate micro-level investigation of community self-organization capacities and risk response behaviors among individual residents. Meanwhile, due to data constraints, several social resilience indicators (such as citizens' psychological resilience) have not been measured. To further understand multi-stakeholder collaboration mechanisms, future research should use a combination of methodologies. It should be emphasized that the Changsha Model stresses government-led system integration (such as millisecond-level data communication across many departments), and its effectiveness is dependent on a Chinese-style administrative mobilization system. Unlike community self-governance models in Europe and America, this method improves reaction time by technical empowerment (such as AI event identification), but the public's agenda-setting capacity is limited. Future research should focus on more inclusive risk co-governance approaches. Changsha's "millisecond-level perception-minute-level closure" mechanism has increased response efficiency by 67% (with an incident closure rate of 95%) when compared to Japan's centralized coordination model (post-disaster recovery cycle of 72 h), but it falls short of New York's community self-governance network in terms of public participation. Changsha's AI event detection system is equivalent to London's digital twin city in terms of technical governance, however the design of social resilience indicators falls short when compared to Rotterdam's "Resilience Index 2.0" in the Netherlands. This study demonstrates that megacities may overcome resource restrictions by leveraging technology–institution coupling (such as the "Three-Dimensional Fifteen-Wing" system) to attain high levels of urban resilience. Future resilient city governance is predicted to deviate from traditional engineering thinking and adopt a more participatory and evolutionary complex system governing approach, hence giving fresh support for urban sustainable development.

Author Contributions: Conceptualization, H.J.; Methodology, H.J. and X.L.; Software, H.J. and Y.G.; Resources, H.J. and Y.G.; Writing—original draft, Y.L.; Writing—review & editing, W.Z.; Supervision, W.Z. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by [Hunan Federation Of Social Sciences] grant number [XSP25YBC627]; [Changsha Federation Of Social Science Circles] grant number [2024CSSKZDKT05]; [Shaoyang County Emergency Management Bureau] grant number [2023-000437].

Data Availability Statement: Data are contained within the article.

Conflicts of Interest: Author Yongshen Li was employed by Hunan Xiangke Technology Research Institute Co., Ltd. The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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