

# Research on the Promotion Path of Collaborative Emergency Response Capability of Smoke-Free Cities in the Digital Age

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**Abstract:** In recent years, major public safety incidents occur frequently in smoke-free cities. Under the complex and severe situation, the emergency preparedness capacity of smoke-free cities in China needs to be improved. In this paper, 50 fire emergency plans in smoke-free City F are taken as samples, and the qualitative comparative analysis method of clear set (csqca) is applied to explore the improvement path of emergency preparedness ability. Three influence paths are obtained to improve the emergency preparedness ability, which are information resource integration mode, business collaboration pre control mode and system route mode. The results provide reference for improving the effectiveness of pre disaster prevention, enhance the emergency preparedness capacity of smoke-free cities and improving the effect of emergency management.

**Key words:** emergency preparedness capability, emergency plan, qualitative comparative analysis, smoke-free city

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## INTRODUCTION

Putting the people's health in the priority position and implementing the strategy of healthy China is a great wealth of general secretary Xi Jinping's connotation of modernization of the state governance system and governance capacity. The Central Committee of the Communist Party of China and the State Council published the outline of

"healthy China 2030" for the first time. In order to implement and promote the outline, the healthy China action Promotion Committee issued the "healthy China action (2019-2030)", and put forward 15 major special actions, including tobacco control action. Building a smoke-free city is not only an important measure to maintain people's health<sup>1</sup>, but also an inevitable requirement for building a healthy China and improving

people's well-being<sup>2</sup>. So far, there are 30 smoke-free cities in China that comply with the Convention, including Shanghai, Beijing, Guangzhou, Shenzhen and Tianjin. The overall urban management level and residents' quality of smoke-free cities have reached a high level, but major fire accidents still occur frequently. The "11.15" accident in Shanghai and the "8.12" accident in Tianjin appear in the public view. After the outbreak of each accident, the government has carried out profound reflection and fully realized that there are problems in risk warning, prevention and control command, resource allocation, multi-agent participation and so on. In addition, when dealing with emergencies, the connection between multiple links is not close enough, the pre control effect is not good, the disposal effect is not strong, but the difficulty of public safety management is increasing. Under the complex and severe situation, the emergency preparedness capacity of smoke-free cities needs to be improved.

With the advent of the digital era, based on the new digital infrastructure, the development of structured big data, blockchain, Internet of things, cloud computing, mobile Internet, artificial intelligence and other technologies is mature. These innovative elements have become the key capability foundation of full perception, full intelligence, full computing and full ecology for emergency management. Under the digital background, the national level issued the strategic planning framework for the orderly development of public emergency management between 2018 and 2022. In this document, the importance of the idea of "network power" is clarified from the strategic level, and the modernization ability of emergency management should be enhanced as a whole through the promotion of scientific and technological information level. Data driven to improve the level of public services and social governance, digital emergency, building a digital emergency ecology is an urgent need for emergency management, but also an important link to comprehensively enhance the level of emergency security services and improve the emergency service system<sup>3</sup>.

In the implementation of emergency

management ability, the improvement of emergency preparedness ability is the logical starting point<sup>4</sup>. Only by doing this, can the government produce a strong collaborative governance ability<sup>5</sup>. In the construction of emergency preparedness capacity, emergency plan is an important policy carrier, but every major accident makes people question the emergency preparedness capacity of governments at all levels. What factors cause this situation? What is the logical relationship between each factor that will restrict the improvement of emergency preparedness ability? Is there a causal relationship? Therefore, this paper makes an in-depth analysis of the explanatory result variables of the promotion of urban collaborative emergency response capability, aiming to find the most reasonable combination path for it, and analyze how to improve the effectiveness of pre disaster prevention, so as to enhance the emergency preparedness capability and significantly improve the effect of emergency governance. This is the embodiment of the theoretical and practical significance of this paper.

This paper uses the qualitative comparative analysis method, which is a research method that can reflect the advantages of case oriented and variable oriented methods at the same time. It has strong comprehensiveness and is conducive to put forward effective strategies. In this study, this method is used to select 50 fire emergency plans from F City for in-depth analysis, conduct in-depth analysis of urban emergency preparedness capacity. Provide holistic cognition through case comparison, find laws in contingency to explain specific research results, and explore different paths of emergency preparedness capacity-building.

## RESEARCH DESIGN AND MODEL CONSTRUCTION

### Research hypothesis

Throughout the world, comparing the emergency preparedness and management capabilities of various countries, the United States has always been the leader<sup>6</sup>. The "target capability list" and "preparation guide" of the United States were implemented nationwide in 2017. The influencing

factors of emergency preparedness capability were analyzed from three aspects of individual, organization and external environment, and six key elements were identified, including personnel quality and risk early warning<sup>7,8</sup>. In this study, the six variables are identified as antecedents and introduced one by one.

(1) Risk warning. It means that when the disaster does not officially occur, we should grasp the uncertainty of the risk, and predict whether the risk event will cause casualties and equipment damage in combination with the laws revealed in the early stage and the experience summarized<sup>9</sup>. Zhang Xiaoming<sup>10</sup> and others said that risk early warning means that government departments, for the purpose of avoiding disaster damage, send early warning information to the society or specific groups of people and take measures to eliminate potential risks. Li Weiquan<sup>11</sup> pointed out that effective risk early warning can timely predict potential risks and avoid potential risks evolving into real losses. In this paper, risk early warning is regarded as one of the key contents in the study of emergency preparedness capability, which is a major factor that will affect the emergency preparedness capability.

(2) Information sharing. It means that under the premise of accurately grasping the original information, efforts should be made to collect more comprehensive information from the outside, screen and use these information, strive to obtain more new information with its assistance, timely transmit emergency intelligence to relevant personnel, and enhance the ability of information dissemination and sharing. In response to public emergencies, timely and effective information communication and integration is very important. Some scholars comprehensively combed the application of social media information in the preparation of emergency plans, information dissemination and diffusion, knowledge extraction and content trust. Xia Zhijie<sup>12</sup> said that if emergency management wants to have a good ability of information sharing, social media will play an immeasurable role in providing more information to decision-makers to make the most effective behavior plan in the shortest time. Therefore, in the research of emergency

preparedness capability, information sharing is regarded as a major antecedent factor, which will affect the emergency preparedness capability.

(3) Organizational system. It means that in the process of formulating the emergency plan, we should timely adjust the organizational system, enhance the rationality of the command and coordination structure, ensure that we can have the organizational structure to achieve the goal and complete the mission, so that all departments can timely respond to the management plan, and improve the standardization of various actions. Some scholars<sup>13</sup> believe that in the process of dealing with all kinds of emergency, in order to produce good results, we must implement the institutionalized organization mode. The efficiency of emergency governance depends on two aspects, namely, whether the system is flexible and whether the authority allocation is reasonable. In addition, Silva J Kernaghan s<sup>14</sup> builds the technology platform and application system platform, which helps to provide the necessary basic database support and guarantee for the operation of the organization, so as to enhance the flexibility of the disposal process. Therefore, in the study of emergency preparedness capability, this subject regards the organizational system as an important factor to explore the relationship between this factor and emergency preparedness capability.

(4) Resource preparation. Resource preparation refers to the ability to prepare various resources and provide support under the premise of accurately grasping the gap between resource demands. Zhang Yong Ling<sup>15</sup> believes that emergency management must be implemented after the occurrence of emergencies, and the most important thing is to have sufficient emergency resources. However, all emergency resources should be timely, and all resources will be gradually consumed in the implementation of emergency management, which will have an impact on the improvement of emergency preparedness ability. Liu Mao<sup>16</sup> said that every link of emergency management should be guaranteed in terms of resources, not only to ensure the adequacy of resource supply, but also to timely dispatch, storage and transportation, so as

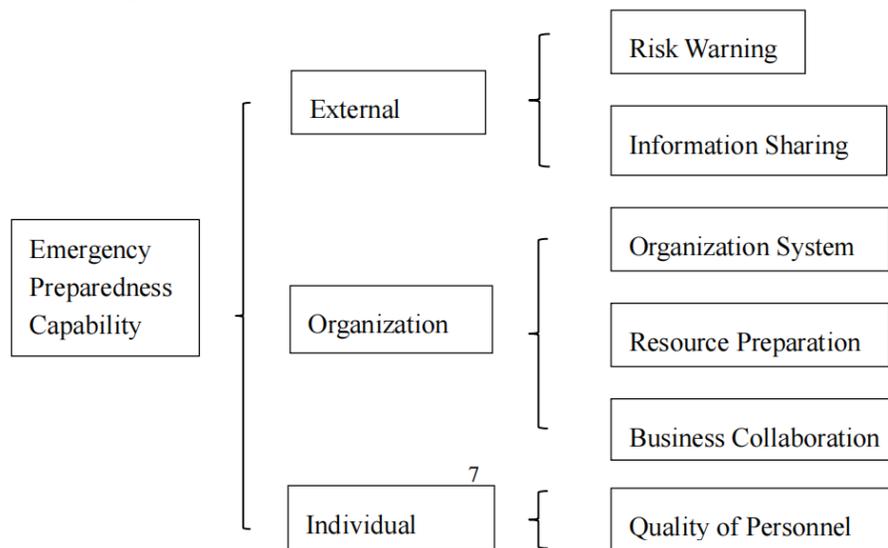
to integrate the scattered resources. In the analysis of emergency preparedness capability, resource integration is regarded as a antecedent factor to explore the relationship between it and emergency preparedness capability.

(5) Business collaboration. It refers to the linkage and coordination ability formed among all participants in emergency management, including identification of identity, formation of preparation system, delineation of responsibilities and joint decision-making, so as to enhance the close cooperation among various departments. Doberstein<sup>17</sup> said that the implementation of emergency management can not be completed only by a certain department, but by multiple departments, which needs to enhance the cooperation ability between departments, which should be reflected in information, capital, technology and other resources. Li Zezhou<sup>18</sup> through the active optimization of core advantages, various departments are combined with the most reasonable structural form to form an organic whole with complementary advantages and matching, upper and lower linkage, and collaborative response to disasters. In the analysis of emergency preparedness capability, business collaboration is regarded as a antecedent element to explore the relationship between business

collaboration and emergency preparedness capability.

(6) Personnel quality. In the implementation of emergency management, the ability, professional quality and character of individuals in the face of all kinds of crisis events are the manifestation of personnel quality. Wang J<sup>19</sup> realized that whether individuals can actively participate in disaster preparedness activities is related to their crisis experience. The cultural level, emergency skills and theoretical knowledge proficiency of grassroots emergency personnel will have an impact on their performance in dealing with crisis events. Emergency preparedness capacity building will be affected by the professional ability of the staff. The establishment ability, education level, emergency knowledge mastery and training of the grassroots emergency personnel have a significant impact on the emergency plan preparation ability<sup>20</sup>. In the analysis of the emergency preparedness ability, this paper takes the personnel quality as a antecedent factor to explore the relationship between it and the emergency preparedness ability.

Under the background of digital era, this study will focus on the above elements to build a research framework as shown in Figure 1.



**Figure 1** theoretical framework of the path to enhance emergency preparedness capability

## Research method

Qualitative comparative analysis (QCA) comes from the field of Natural Science in the 18th or 19th century. QCA is a case-based method. Its theory is based on "configuration comparison" and "set theory". It can deal with both small sample problems and medium or large sample problems, it has obvious advantages in solving the problem of multiple concurrent causality. At the same time, QCA method is also a research method based on set theory. It analyzes the relationship between the configuration and the result under the necessary and sufficient conditions. Therefore, it focuses on the asymmetric causal relationship between the two, breaking through the limitations of traditional quantitative research based on the symmetry of correlation coefficient.

Emergency preparedness capability in collaborative governance network is a complex issue induced by "multiple concurrent causation", which has the characteristics of complex causes. Therefore, this paper uses qualitative comparative analysis (QCA) as the main analysis tool for multiple causal analysis. In this study, the emergency preparedness ability of multiple cases is compared, and the six antecedent factors described in the previous article are focused on in the process of comparison, which is intended to combine them together in the most appropriate path. In the past, scholars used traditional empirical analysis method in this study<sup>21</sup>. There are two main shortcomings: one is to put forward higher requirements for the number of samples, the other is to explain the logical relationship between individual variables and dependent variables, which can not rationalize the interaction between many variables. In this study, the non-linear asymmetric relationship between the six elements and the emergency preparedness ability is formed. If only the binary method is used to analyze, we can not sort out the interaction effect between many variables. Therefore, qualitative comparative analysis is carried out.

## Case selection

In this paper, 50 fire emergency plan texts are

selected from F City for research. The competent department has conducted a comprehensive evaluation on these plans texts, among which 12 are "unqualified" and 38 are "qualified". The proportion of "qualified" texts is consistent with the requirements of qualitative comparative analysis method, which can be used for research.

## Variable assignment and measure

The fundamental purpose of this study is to grasp what factors will affect the emergency preparedness ability, compare the effects of different factor combinations, and take six factors as antecedent factors, such as risk early warning, organization system, information sharing, resource preparation, business cooperation and personnel quality, combined with the assumptions put forward above. The explained result variable is the strength of emergency preparedness ability, that is, it takes the research and judgment results of emergency plan text as the standard<sup>22</sup>.

## Outcome variables

When assigning value to the result variable, the emergency preparedness ability is assigned according to the evaluation result given by the competent department. Specifically, if the competent headquarters gives a "qualified" evaluation after comprehensive measurement, it means that this plan can produce a strong emergency preparedness capability, and its value is determined as "1"; On the contrary, it means that the plan is difficult to produce a strong emergency preparedness capability and needs to be rectified, with a value of "0".

## Conditional variable

In order to ensure the validity of the content when assigning the conditional variables, this study not only based on the mature scale developed by other scholars, but also adjusted each item in the questionnaire according to the specific situation, so as to get the questionnaire as shown in Table 1. Each antecedent element contains a certain number of items, and the number of items is 24.

**Table 1**  
**Summary Of Questionnaire Design Items**

| Antecedents                 | Item | Measurement Index   |
|-----------------------------|------|---|
| Risk warning(RA)            | R1   | Identify the risk of fire source and analyze the dangerous situation of specific situation      |
|                             | R2   | How to release early warning information according to standards                                 |
|                             | R3   | Guide defensive fire operations   |
|                             | R4   | Classification of warning levels and coverage accuracy  |
| Information sharing(IS)     | I1   | Collect information and maintain the platform   |
|                             | I2   | Recognize and use new external information  |
|                             | I3   | Firefighters store and deal with new information  |
|                             | I4   | Grasp the best action opportunity according to the external new information                     |
|                             | I5   | High quality professionals share rescue experience in time                                      |
|                             | I6   | Using information technology to realize information sharing among multiple departments          |
| Organizational system(OS)   | O1   | Professional and standardized emergency response process and Fire Rescue Behavior               |
|                             | O2   | Take action according to the development of fire  |
|                             | O3   | Construction of technology platform, application system and database                            |
|                             | O4   | Construct the main responsibility list in the process of dealing with specific situations       |
| Resource preparation(RI)    | RI1  | Evaluate the emergency resource demand and assign tasks to each department                      |
|                             | RI2  | Identify key resources and infrastructure   |
|                             | RI3  | Team building   |
|                             | RI4  | Professional equipment preparation  |
|                             | RI5  | Reasonable distribution of materials and provide support  |
| Business collaboration(B C) | B1   | Cooperation between the planning department and other departments                               |
|                             | B2   | Business communication mechanism among multiple departments                                     |
|                             | B3   | The degree of cooperation between fire department and other departments in formulating the plan |
| Personnel                   | P1   | Knowledge reserve   |

|             |    |                              |
|-------------|----|------------------------------|
| quality(PQ) | P2 | Crisis management experience |
|-------------|----|------------------------------|

This study can be divided into three stages: first, 50 fire emergency plans were selected from F City, and they were identified as the analysis object, and were supported by five experts and scholars, who scored 24 items in the questionnaire. These experts and scholars have a wealth of theoretical knowledge reserves, but also accumulated empirical analysis experience, the score range is 1-5 points. For the description of each item, according to their own cognitive score, if very disagree, then count 1 points, as the lowest score; if you agree very much, it will be counted as the highest score of 5 points, and there are three points between the highest score and the lowest score. In this questionnaire, each antecedent element has its corresponding items. Five experts need to score these items one by one and ensure the independence of scoring. The total score of each item is calculated as follows:

$$s_c = N_1 + 2N_2 + 3N_3 + 4N_4 + 5N_5 \quad (1)$$

$N_1, N_2, N_3, N_4, N_5$  It means the number of experts with different scores in a question,  $N_1 + N_2 + N_3 + N_4 + N_5 = 5$ . The average score of 50 plans in this item can be obtained as follows:

$$S_t = \frac{\sum_{i=1}^n S_{ci}}{5 * 50} \quad (2)$$

In the above formula, the number of plans is 50, expressed by n. On this premise, the scores of 50 plans in the six antecedent factors are calculated

$$S_a = \frac{\sum_{i=1}^k S_t}{k} \quad (3)$$

Because the number of items of each antecedent element is different, K is used in the above formula. After calculating with the above formula, the comprehensive score of each antecedent element shown in Table 2 can be obtained.

| Serial Number | Antecedents               | Item | Score | Comprehensive Score |
|---------------|---------------------------|------|-------|---------------------|
| 1             | Risk warning(RA)          | R1   | 3.85  | 3.70                |
|               |                           | R2   | 3.75  |                     |
|               |                           | R3   | 3.58  |                     |
|               |                           | R4   | 3.61  |                     |
|               |                           | I1   | 4.00  |                     |
| 2             | Information sharing(IS)   | I2   | 3.65  | 3.56                |
|               |                           | I3   | 3.95  |                     |
|               |                           | I4   | 3.50  |                     |
|               |                           | I5   | 3.15  |                     |
|               |                           | I6   | 3.10  |                     |
| 3             | Organizational system(OS) | O1   | 3.85  | 3.83                |
|               |                           | O2   | 3.90  |                     |
|               |                           | O3   | 3.60  |                     |

|   |                            |     |      |      |
|---|----------------------------|-----|------|------|
|   |                            | O4  | 3.95 |      |
|   |                            | RI1 | 3.95 |      |
|   |                            | RI2 | 3.97 |      |
| 4 | Resource preparation(RI)   | RI3 | 3.85 | 3.88 |
|   |                            | RI4 | 3.89 |      |
|   |                            | RI5 | 3.75 |      |
|   |                            | B1  | 4    |      |
| 5 | Business collaboration(BC) | B2  | 3.85 | 3.93 |
|   |                            | B3  | 3.95 |      |
|   |                            | P1  | 3.75 | 3.85 |
| 6 | Personnel quality(PQ)      | P2  | 3.95 |      |

The 50 emergency plans in this study are all from F City, the six antecedent elements are assigned by clear set binary attribution, taking the mean value as the watershed, the excess is "1", and

the deficiency is "0". The items in each antecedent element were scored, and the scoring situation was sorted out, thus, the assignment of each antecedent element shown in Table 3 is obtained.

| Antecedents               | Measurement Standard   | Assignment |
|---------------------------|--|------------|
| Risk warning(RA)          | The average value is 3.70, which is greater than or equal to the average value, indicating the formation of a sound risk early warning mechanism | 1          |
|                           | The average value is 3.70, which is lower than the average value, indicating that there is no sound risk early warning mechanism                 | 0          |
| Information sharing(IS)   | The average value is 3.56, which is greater than or equal to the average value, indicating the formation of a sound risk early warning mechanism | 1          |
|                           | The average value is 3.56, which is lower than the average value, indicating that there is no sound risk early warning mechanism                 | 0          |
| Organizational system(OS) | The average value is 3.83, which is greater than or equal to the average value, indicating the formation of a sound risk early warning mechanism | 1          |
|                           | The average value is 3.88, which is lower than the average value, indicating that there is no sound risk early warning mechanism                 | 0          |
| Resource preparation(RI)  | The average value is 3.88, which is greater than or equal to the average value, indicating the formation of a sound risk early warning mechanism | 1          |
|                           | The average value is 3.88, which is lower than the average value, indicating that there is no sound risk early warning mechanism                 | 0          |
| Business collaboration(B) | The average value is 3.93, which is greater than or equal to the average value, indicating the formation of a sound risk early warning mechanism | 1          |

|                             |  |   |
|-----------------------------|--|---|
| C)                          | The average value is 3.93, which is lower than the average value, indicating that a sound risk early warning mechanism has not been formed       | 0 |
| Personnel quality(PQ)       | The average value is 3.85, which is greater than or equal to the average value, indicating the formation of a sound risk early warning mechanism | 1 |
| Emergency preparedness(EPC) | The average value is 3.85, which is lower than the average value, indicating that there is no sound risk early warning mechanism                 | 0 |
|                             | The competent department gives the "qualified" opinion after evaluation  | 1 |
|                             | After the evaluation, the competent department gives the opinion of "unqualified"  | 0 |

Assign values to each variable, and code all cases one by one according to the process of qualitative comparative analysis, so as to obtain the case dichotomy truth table shown in Table 4.

| Case | RA | OS | IS | RI | BC | PQ | EPC | FRE |
|------|----|----|----|----|----|----|-----|-----|
| 1    | 1  | 0  | 1  | 1  | 1  | 1  | 1   | 10  |
| 2    | 0  | 0  | 0  | 0  | 0  | 0  | 0   | 7   |
| 3    | 1  | 0  | 1  | 0  | 1  | 1  | 1   | 2   |
| 4    | 0  | 1  | 1  | 1  | 1  | 1  | 1   | 6   |
| 5    | 0  | 1  | 1  | 1  | 0  | 1  | 1   | 4   |
| 6    | 0  | 0  | 1  | 1  | 1  | 1  | 1   | 3   |
| 7    | 0  | 0  | 1  | 0  | 1  | 1  | 1   | 1   |
| 8    | 1  | 1  | 0  | 0  | 1  | 1  | 1   | 2   |
| 9    | 1  | 1  | 1  | 0  | 1  | 1  | 1   | 4   |
| 10   | 1  | 1  | 1  | 1  | 0  | 1  | 1   | 1   |
| 11   | 1  | 1  | 1  | 0  | 1  | 1  | 1   | 3   |
| 12   | 0  | 0  | 1  | 1  | 0  | 1  | 1   | 1   |
| 13   | 0  | 1  | 0  | 0  | 1  | 0  | 0   | 1   |
| 14   | 0  | 1  | 0  | 1  | 0  | 0  | 0   | 1   |
| 15   | 0  | 0  | 0  | 0  | 1  | 0  | 0   | 1   |
| 16   | 0  | 1  | 0  | 0  | 0  | 0  | 0   | 1   |
| 17   | 0  | 0  | 0  | 1  | 0  | 0  | 0   | 1   |
| 18   | 0  | 1  | 1  | 0  | 1  | 1  | 1   | 1   |

**EMPIRICAL ANALYSIS AND DISCUSSION**

**Necessary Condition Test**

In the qualitative comparative analysis, the necessary conditions should be analyzed first, and the necessary conditions should not be included in the analysis of sufficient conditions. Through the calculation of consistency and coverage, we can determine whether there is a necessary and sufficient relationship between variables. Consistency refers to the extent to which all cases used in the study reflect a given condition (or combination of conditions) that leads to the result; Coverage refers to the degree to which these given conditions (or combinations of conditions) explain the results (he Junzhi, 2013). The research objects of social science often have complex causality, so it is inevitable that there will be errors in the

operation of variables, so researchers do not have to comply with the strict requirements of subset relationship. Larkin explained that the calibration value should be adjusted according to the standard of 0.1 during the analysis of necessary conditions, and the threshold of 0.9 is usually set for the necessary conditions. If more than 90% of the result variables belong to the same condition variable, it can be determined as the necessary condition of the result variable. In the analysis of the necessary conditions for whether a variable is a result variable, it can be seen from table 5 that the two elements of "personnel quality" and "information sharing" are 1.000 and 0.947 respectively, which means that for the result variable, these two elements belong to the necessary conditions.

**Table 5**  
**Results Of Necessary Conditions Of Antecedent Factors**

| Variable Name              | Consistency | Coverage  |
|----------------------------|-------------|-----------|
| Risk warning(RA)           | 0.5789470   | 1.0000000 |
| Organizational system(OS)  | 0.5526320   | 0.8750000 |
| Information sharing(IS)    | 0.9473680   | 1.0000000 |
| Resource preparation(RI)   | 0.7368420   | 0.9333330 |
| Business collaboration(BC) | 0.8421050   | 0.9411760 |
| Personnel quality(PQ)      | 1.0000000   | 0.9743590 |

**Core And Edge Variable Recognition**

According to the literature review and analysis, this paper sorts out the variables that affect the emergency preparedness ability, and obtains six variables: risk early warning (RA), organization system (OS), information sharing (is), resource preparation (RI), business collaboration (BC) and personnel quality (PQ). In order to enhance the effectiveness of inquiry, the two concepts of marginal condition and core condition are applied in this study, and the core and marginal conditions of each variable are identified one by one. The concept of core and edge is based on the causal

relationship between elements and results. If it has a strong impact on the results, it is the core condition; if there is no obvious influence on the result, it is the edge condition.

In the analysis, fsqca3.0 software can use the input data to obtain simple solution, intermediate solution and complex solution, as shown in Table 6. In the first two solutions, if a antecedent element appears at the same time, it can be determined as the core condition, otherwise it is the edge condition, but if a antecedent element only appears in one of the solutions, it also belongs to the edge condition.

| Table 6                             |              |                 |             |
|-------------------------------------|--------------|-----------------|-------------|
| QCA Analysis Results Of Antecedents |              |                 |             |
| Intermediate Solution               |              |                 |             |
| Configuration                       | Raw Coverage | Unique Coverage | Consistency |
| IS*RI*PQ                            | 0.7368420    | 0.1578950       | 1.0000000   |
| IS*BC*PQ                            | 0.7894740    | 0.1052630       | 1.0000000   |
| RA*OS*BC*PQ                         | 0.2368420    | 0.0526316       | 1.0000000   |
| solution coverage: 1                |              |                 |             |
| solution consistency: 1             |              |                 |             |
| Parsimonious Solution               |              |                 |             |
| Configuration                       | Raw Coverage | Unique Coverage | Consistency |
| IS                                  | 0.947368     | 0.157895        | 1           |
| BC*PQ                               | 0.842105     | 0.0526316       | 1           |
| solution coverage: 1                |              |                 |             |
| solution consistency: 1             |              |                 |             |

For a antecedent element, if it wants to be judged as the core condition, it must appear in the concise solution and the intermediate solution at the same time, but if it only appears in the complex solution, it is the edge condition. According to this standard, there are three edge conditions and three core conditions respectively. The former are RI, OS and RA, while the latter are PQ, BC and is.

**Conditional Combination Analysis**

From the analysis results of the necessity and sufficiency of the six elements, when explaining the results, the explanatory power of a single variable is relatively weak. Therefore, to implement configuration analysis on six variables, fsqca3.0 software is used to analyze 50 sample cases in this study, and 0.8 is set as the consistency threshold to obtain the antecedent configuration research conclusions shown in Table 7.

Consistency and coverage are important indicators in QCA analysis, which are used to

evaluate the relationship between different combinations of conditions and the interpreted results. In general, when the consistency and coverage reach 0.8, the combination of conditions is considered to have good correlation and can be used to explain specific results. The coverage index is used to measure the interpretation degree of antecedent configuration to the results, and there is no minimum threshold value. The following table 7 is the result analysis of the combination of the six antecedent elements of risk early warning (RA), organization system (OS), information sharing (is), resource preparation (RI), business collaboration (BC) and personnel quality (PQ) on the emergency preparedness capability. In Table 7, it introduces how the combination of the constituent conditions of each antecedent variable in this study can explain the emergency preparedness ability. The coverage rate of the three groups of conditional combinations is different, the lowest is 0.236, and the highest is 0.789, which means that the number of samples explained by the three groups of conditional combinations is different. Next, we will discuss them one by one.

**Table 7**

**Antecedent Configuration Of Emergency Preparedness Capability**

| Variable                   | C1    | C2    | C3    |
|----------------------------|-------|-------|-------|
| Risk warning(RA)           |       |       | ○     |
| Organizational system(OS)  |       |       | ○     |
| Information sharing(IS)    | ●     | ●     |       |
| Resource preparation(RI)   | ○     |       |       |
| Business collaboration(BC) |       | ●     | ●     |
| Personnel quality(PQ)      | ●     | ●     | ●     |
| CS                         | 1.000 | 1.000 | 1.000 |
| CV                         | 0.736 | 0.789 | 0.236 |
| NCV                        | 0.157 | 0.105 | 0.052 |
| OCS                        |       | 1.000 |       |
| OCV                        |       | 1.000 |       |

notes: For both cases with and without causal variables, denoted by ●, ⊗ respectively, the core and edge conditions are represented by big circle and small circle respectively. For some conditions that exist and do not exist, spaces are used.

The Three Conditions Are As Follows:

IS\*RI\*PQ, That is to say, they are in good condition in information sharing, resource possession and personnel quality;

IS\*BC\*PQ, That is, they are in good condition in information sharing, business collaboration ability and personnel quality;

RA\*OS\*BC\*PQ, That is to say, they are in good condition in risk early warning, organizational structure, personnel quality and business collaboration.

It can be seen from the above table that the consistency of the above condition combination meets the requirements, beyond the critical criteria, this means that all samples in each condition combination meet the requirements in terms of consistency, in other words, all the antecedent configurations can improve the emergency preparedness ability. At the same time, the total consistency index also meets the requirements, which indicates that antecedent configuration can include every combination of antecedent

conditions that will affect the emergency preparedness capability. Based on this, we can get the following three modes to enhance the emergency preparedness ability.

The first mode is the integration of information resources. Under the first mock exam, the importance of adequate resources is emphasized, we also attach great importance to personnel quality and information sharing, I’s considered that these three are the necessary conditions for enhancing emergency preparedness capability. The first mock exam is that when dealing with fire emergencies, as a result, the event itself is complex and uncertain, and can’t be completed by a certain department alone, with the support of information technology, the "information island" formed by each department should be linked together to form a huge "information continent", the information gap between departments can be gradually shortened, which is the premise of improving emergency response capacity<sup>23</sup>. With such a guarantee, the structure of fragmentation among various departments will be broken, and the

emergency resources can be integrated in time to form a perfect coordination mechanism and continuously improve the emergency preparedness ability.

In the process of cross Organization collaborative governance, it is beneficial to maximize the utilization efficiency of emergency resources by coordinating and integrating the interests and resources of all parties, so as to provide resource reserve guarantee for emergency preparedness. At the same time, information sharing mechanism can play a strong role in promoting accurate monitoring and resource integration. To improve the emergency preparedness ability, we need to get through the link between "digital fire protection" and "intelligent fire protection". Through information fusion and utilization, it is conducive to make up for the lack of systematic, scientific and forward-looking thinking in the past<sup>24</sup>. Therefore, through the integration of resources and information sharing and personnel multi factor blend, we can jointly promote the fire emergency preparedness ability to achieve a high level.

The second mode is business collaborative pre control mode. The first mock exam emphasizes that the three elements of information sharing, synergy and personnel capability will directly affect the improvement of emergency preparedness capability. This paper analyzes this path, it can be seen that only the joint participation of multiple subjects can effectively improve the emergency response capacity, different organizations should actively communicate in the process of business development, they should also share their information with other organizations. We should also educate and train the internal staff. If we do these things well, once there is an emergency, each organization can form a strong synergy effect, and the emergency preparedness ability can also be significantly improved. Therefore, this is a model that can integrate the advantages of the three antecedents.

Strengthen the business communication and information sharing among organizations, and improve the overall quality of emergency management personnel, so as to reduce the "functional barriers" from the stage of pre disaster

prevention, and further promote the collaborative response to complex emergencies, so as to promote the realization of a higher level of emergency preparedness ability<sup>25</sup>. It is of great importance to strengthen fire emergency preparedness by adopting the collaborative mode of "combination of sections and sections + comprehensive law enforcement", relying on the emergency linkage grid comprehensive management platform, focusing on business objectives as the guidance, realizing multi police joint service and "big grass-roots" governance forces in various directions, and making full use of grass-roots governance tentacles. Therefore, through business collaboration, information sharing and personnel multi factor integration, we can jointly promote the fire emergency preparedness ability to achieve a high level.

The third mode is the system route mode. The first mock exam emphasizes the importance of the four elements, if the quality of personnel is gradually improved, we can also develop a sound risk early warning mechanism, or is the organization increasingly institutionalized, and there is synergy between different departments, the ability of emergency preparedness will certainly be improved. In the practice of emergency management, risk early warning and pre control should be gradually improved, the premise is that the quality of personnel and the organizational system should be guaranteed, only in this way can business collaboration be formed. Therefore, in order to improve the ability of fire emergency preparedness, it is necessary to adjust the four antecedents.

Through the improvement of the institutionalized organization operation system, the establishment of risk investigation mechanism and early warning model, and the clarification of the responsibility of each subject, the closed-loop management can be realized. At the same time, the institutionalized emergency organization system should take the innovative emergency culture as the carrier. The reality of culture as a means is conducive to the integration and rational allocation of resources, and the information communication between organizations is also the embodiment of institutional culture in a sense. Based on this,

through institutionalized organization system, efficient business collaboration, perfect risk early warning and information sharing, we can achieve a high level of fire emergency preparedness.

## MAIN CONCLUSIONS

The report of the 19th National Congress of the Communist Party of China clearly points out that socialism with Chinese characteristics has entered a new era, and China has officially entered the decisive stage of building a moderately prosperous society in an all-round way. In the new era of opportunities and challenges, facing the complex situation and chain effect of superimposed risk factors. At present, the emergency disposal methods based on feedback control in smokeless cities no longer adapt to the historical development trend. In order to better deal with the abnormal management of smokeless cities, it is necessary to establish various pre control systems before the risk critical point, and adopt corresponding means to actively arrange and control the input and expansion of risk factors to the social system.

In recent years, after every major fire emergency has been reported by the news media, all walks of life can clearly perceive the failure of the plan, this also shows that the emergency preparedness capacity of government departments is relatively weak, what is the relationship between the factors that will affect the improvement of this ability? In the context of digital, how to improve the emergency preparedness ability of government departments in smoke-free cities? This has aroused people's deep thinking. This paper takes 50 emergency plans from F City and makes in-depth analysis, we have found out which modes can significantly enhance the emergency preparedness capability, after analysis, three effective models are obtained: trust; Business collaborative pre control mode should start from three aspects of personnel, information and collaborative effect to improve the ability of emergency preparedness; In the first mock exam, the system can give full play to the value of four elements, including sound risk warning mechanism, excellent talents, etc.

The conclusions of this study are as follows, it will bring the following enlightenment to the governme

nt departments to improve the emergency preparedness capacity:

The first is to enhance the information sharing, which should not only be reflected in different organizations, but also be carried out across regions. Only when the information communication is timely and effective, can the emergency preparedness work be carried out in an orderly manner. In response to emergencies, the interconnection of key information can greatly enhance the cooperation among the main bodies of the emergency business chain. However, the main barriers to information sharing are the lack of information exchange and sharing, lack of trust and fear of self-interest damage among government departments, which lead to the information of a single department in an independent and incomplete form, It has seriously affected the prevention and disposal effect of crisis events. Maintaining the interconnection of information is the basis of emergency decision-making, and information has a profound impact on every link in the process of emergency preparedness and governance. In the process of emergency preparedness, many related functional departments are involved, and information sharing can indirectly affect the performance of business chain by taking business chain design and integration as intermediary variables. Through the effective use of the obtained information, it can design and manage the emergency business process more efficiently than ever before, which has become one of the keys to the success of emergency governance. Therefore, the establishment of cross regional and cross organizational information communication and sharing mechanism and the construction of efficient and complete information communication channels are one of the preconditions for emergency preparedness. Therefore, we should strengthen the standardization of information, classify the information of relevant departments in the process of emergency preparedness, and clearly understand the different needs of department information and resources, Then it provides the basis for the classification and sharing of information, and improves the enthusiasm and information quality of department information

sharing. On this basis, we should strengthen the awareness of information sharing and coordination, adopt a distributed trust model to improve the dissemination of reliable information, compensate for the loss of benefits that may be brought by information sharing of various departments, improve the incentive mechanism of information sharing, and realize the full sharing of information.

Second, focus on business collaboration and resource integration to enhance emergency preparedness capability. The improvement of emergency preparedness ability is not the task of any department, but depends on the joint realization of multiple departments. The improvement of informatization level provides favorable conditions for the communication of multiple departments, and can carry out risk identification and pre control in the way of business linkage. In order to deal with emergencies better, the nature of public emergencies not only objectively requires organizational cooperation, but also subjectively encourages departments to create partners to share resources, information, personnel, funds and professional skills due to the limited resources and capabilities. In emergency preparedness capacity building, it usually relies on collaborative network, which is characterized by flexible and non rigid administrative structure and governance process mode. Collaborative departments have common organizational norms and values, and rely on information technology to achieve linkage and cooperation. In the face of the uncertainty and complexity of public emergencies, urban collaborative emergency preparedness, between different levels of government, across departments, as well as between the government and social forces, through information sharing and resource integration and other means, for potential or emerging crisis, carry out collaborative emergency preparedness for smoke-free cities, in order to effectively prevent, deal with and eliminate the crisis.

## RESEARCH LIMITATIONS AND PROSPECTS

Although there are innovations in the research theory

and methods, there are still three limitations to be further discussed and studied, which will be explained here. First of all, from the content and conclusion of the study, in the emergency preparedness stage based on feed-forward control, in terms of influencing factors of emergency preparedness ability, this paper mainly carries out multiple causality analysis on the antecedent factors of the basic level based on the positive ability dimension, and does not take into account the structural factors that need to play a role through mediating variables, It is difficult to fully cover all the factors that affect the emergency preparedness ability, so the follow-up research can be based on multiple dimensions to introduce other antecedent factors for further analysis. Secondly, from the perspective of research samples, this paper makes a qualitative comparative analysis of 50 fire emergency plans in F City under limited conditions. Whether the research results of fire emergency plans can accurately reveal the causal path of other types of emergency preparedness ability remains to be investigated. Therefore, more typical cases can be included in the follow-up study for richer analysis and explanation. Finally, from the perspective of research methods, the round analysis using QCA condition combination can subdivide the total case samples for many times, so as to draw more precise conclusions for different sub sample sets. But in this paper, we use the dichotomous variable of clear set qualitative comparative analysis, which is mainly based on the difference in nature or type to assign 0-1 value, which inevitably covers up the differences between some detailed quantitative data. Therefore, in the follow-up study, we can use the multi value set qualitative comparative analysis (MV QCA) to verify and make further exploration.

Based on the collaborative governance network, this paper taking the emergency preparedness ability of smoke-free cities as the research object, and uses the qualitative comparative analysis method to reveal the multiple paths of high-level emergency preparedness ability construction, so as to make the research on the mechanism behind the emergency governance more targeted. A complete causal interpretation needs a comprehensive study of the conditional variables and the underlying

mechanism. By studying the impact of the combination of conditions on the emergency preparedness ability, this paper helps to find the mechanism between the conditional variables and the interpreted results, and provides a certain theoretical support for the subsequent complete causal interpretation research, so as to lay the foundation for the construction of a more perfect causal study.

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