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Spatial governance for COVID-19 prevention and control in China’s development zones

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ABSTRACT
Mandatory policy networks are an important collaborative governance model for crisis response. To reveal the operation and effectiveness of public sector-led crisis governance at the development zone level, this study draws on collaborative governance theory to develop a theoretical framework that reveals the external constraints, collaborative dynamics, collaborative actions, and collaborative outcomes of crisis governance in development zones. Based on qualitative research methods, this study analyzes pandemic prevention policy documents issued during the pandemic by China’s national economic and technological development zones and their localities to reflect the complete process of governance. The findings indicate that a mandatory policy network, guided by a local governance framework, facilitated the rapid achievement of collaboration in development zones in responding to the crisis. Top-down leadership developed over time in the public sector, and the responsiveness and innovation of enterprises and social organizations played an important role in collaborative governance. Wins at each stage of the governance process are necessary for the continuation of collaborative actions and can drive the adaptation of a collaborative approach in development zones.

1. Introduction
Coronavirus disease 2019 (COVID-19) has evolved into a global public health crisis since its outbreak in early 2020 and has significantly affected the health, economic, environmental, and social domains (Mofijur et al., 2021). While global economic growth has been recovering from its contraction, the emergence of new COVID-19 variants could prolong the pandemic and trigger new economic disruptions (IMF, 2022). Industrial parks and industrial enterprises are important carriers of production and manufacturing, and their governance during the pandemic has been related to the balance between global economic development and pandemic prevention and control. Many businesses in Europe and the US have been affected by COVID-19 in terms of supply chain disruptions, reduced demand for products and services, and supply and input shortages (De Vet et al., 2021; Sharon, 2021). In emerging economies, such as Ethiopia, the pandemic has severely impacted the production and sale of companies located in industrial parks, and the availability and cost of foreign inputs and the availability of local labor have been widely reported as constraints on industrial production (Mengistu, Krishnan, Maaskant, Meyer, & Krkoska, 2020). A large number of studies have focused on the governance strategies and effectiveness of states, cities and communities (Huang & Li, 2022), but relatively few have focused on spatial governance and policy response at the industrial park level during the pandemic.

Industrial parks gather a large number of enterprises and are an important engine of economic development. Industrial parks represented by special economic zones (SEZs), export processing zones (EPZs) and free economic zones (FEZs) hold great significance for developing countries in their efforts to attract foreign direct investment (FDI), promote employment and achieve industrial structure transformation (UNIDO, 2018). For example, there were at least 5383 SEZs in 147 economies worldwide as of 2019, which had created approximately 90 to 100 million direct jobs and contributed to the economic growth of the countries where they were located (UNCTAD, 2019). In 2019, national development zones accounted for approximately 23.2 % of China’s gross domestic product (GDP) (Ministry of Commerce of China, 2020). By developing industrial estates (IEs), cities also benefit from economies of scale in land development, construction and public facilities (Côté & Cohen-Rosenthal, 1998). Therefore, because a pandemic may be long lasting, it is important to pay attention to the pandemic prevention and control measures and crisis management of industrial parks to ensure the economic recovery of the city and the country.

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In 2020, China was the only major economy to achieve positive growth in the context of a general global economic contraction (IMF, 2020). One of the reasons for China’s growth during the COVID-19 pandemic was that development zones at all levels (national, provincial, municipal, etc.) were able to quickly resume work and production owing to effective pandemic prevention and control and spatial governance (Zhou, 2020). By the end of April 2020, more than 99% of China’s manufacturing enterprises and 88.4% of its micro-, small and medium-sized enterprises had resumed work. China’s top-down hierarchical governance and the extensive cooperation of the public are considered key to the success of pandemic control (Liu, Lin, Shen, & Lu, 2021). The active organization by the public sector of the development zone and comprehensive public sector cooperation with enterprises and social actors in pandemic prevention and production issues contributed to the rapid restoration of the production order of manufacturing enterprises in the crisis situation.

Our research question is as follows: How does public sector-led crisis governance work in China’s development zones? By reviewing and drawing from the relevant literature on collaborative governance, this study takes the policy responses of China’s national development zones in the context of COVID-19 as the object of study to explain how the public sector promotes collaborative governance at the development zone level. It aims to supplement global research on the COVID-19 response at the microlevel by studying the pandemic prevention and control policies of development zones and manufacturing enterprises. We also extend the comprehensive framework of collaborative governance to the study of industrial park governance, which will contribute to the literature on governance transformation led by the top-down hierarchical governance of centralized countries, represented by China.

2. Literature review

2.1. Policy response and spatial governance during the COVID-19 pandemic

During the COVID-19 pandemic, the policy responses of governments played a positive role in controlling the crisis and mitigating its negative effects. However, there were varying degrees of effectiveness. As countries moved into different stages of the pandemic and new scientific evidence rapidly emerged, policymakers constantly updated their policies to respond in a more accurate and timely manner (Nicola et al., 2020). The policy response to COVID-19 expanded from public health to all aspects of social and economic activity. Additionally, the diversity of national governance structures, cultures and public perceptions (Roy et al., 2020; Samuel, 2020) led to differences in policy decisions (Weible, Nohrstedt, Cairney, Carter, & Stone, 2020) and governance effectiveness. Countries with strong central leadership, such as China and South Korea, had stronger governance efficiency in coordinating cross-sectoral response (Nicola et al., 2020), legislation and government budgets (You, 2020), making it possible for them to implement the necessary response measures. In federal countries, local governments had a greater degree of freedom in policymaking and governance, but decentralized governance led to conflicts in the allocation and use of limited resources (Daszak, Keusch, Phelan, Johnson, & Osterholm, 2021; Steele, 2020). Compared with other regions, the effectiveness of pandemic prevention policies on the African continent was greatly reduced due to poverty and shortages of pandemic prevention materials (Yaya, Otu, & Labonte, 2020). Government policy responses have proven to be key to containing the crisis, but whether these policies can be implemented poses a challenge for pandemic governance.

The high concentrations of people and activities in cities made them a major battleground for pandemic crises (Sharifi & Khvanari-Garmisr, 2020) and the basic unit for the development and implementation of mobility restriction policies (Bonaccorsi et al., 2020; Ren, 2020; Wang et al., 2022). In the event of a surge in cases, lockdown policies of varying strictness were implemented at the city level, including policies of complete alienation, community containment, business shutdowns (Hu et al., 2021), or closures of only urban public spaces, especially third spaces—places that are neither work nor home (Martínez & Short, 2021), or reductions in mobility by controlling the ratio of working from home to working from the office (Tuti, Nurmandi, & Zahra, 2022). However, only some cities chose to monitor public compliance and violations (Jain et al., 2022). Within cities, measures such as personnel control, material supply and strengthening of health services were implemented mainly at the community level (Doyle, Hynes, & Purcell, 2021). When the lockdown and resilience measures provided many cities with resilience, many city governments and policy think tanks (McGuirk, Dowling, Maassen, & Baker, 2021) began to formulate recovery strategies and projects to promote urban reopening and economic recovery. The development of the proximity economy (Tricarico & De Vidovich, 2021) and the revival of tourism (Ntounis, Parker, Skinner, Steadman, & Warnaby, 2022) were important strategies for urban recovery. The effect of applying emerging technologies to smart cities and urban digital transformation also became significant in the middle and later stages of the pandemic (Liu, Liu, Xu, & Zou, 2022; Yang & Chong, 2021).

Spatial governance for industrial parks and manufacturing enterprises is beneficial for ensuring the continuation of production activities and mitigating the negative impact of the pandemic (Carrascal & Valenzuela, 2022). The cross-regional mobility of workers increases the possibility of contact with infected persons or the chance of infecting others. However, the policy response regarding industrial space around the world has mainly focused on economic promotion, and effective governance measures for industrial space are still relatively lacking in most countries and regions (Amdeaselassie et al., 2020; Tran et al., 2020). For example, most European governments have tried to increase the resilience of enterprises through policy interventions to protect workers' incomes and business mobility in small and medium-sized enterprises (SMEs) (Juergensen, Guimón, & Narula, 2020), but measures to mitigate the spread of the pandemic in production spaces have been insufficient. A survey of enterprises in Ethiopian industrial parks (Mengistu et al., 2020) found that the policy support received by enterprises was mainly limited to economic policies, such as tax measures. Therefore, the existing policy responses and governance measures have played a relatively limited role in maintaining the normal production order of industrial parks and enterprises.

2.2. Spatial governance structure of China’s development zones

The development zone in China is an industrial agglomeration led by the government (Ye, Li, Zhiang, & Zhu, 2020) in the process of the gradual opening up of the country; therefore, its governance has a distinctly top-down structure (Feng & Yin, 2011). Initially, the management committee, as an administrative agency, led the construction and development of the development zone and ensured flexible and efficient spatial governance. With the deepening of marketization, the spatial governance structure of the development zone has gradually diversified (Yu, 2013). The evolution of the forces of the government and the companies responsible for development has led to the differentiation of spatial governance into three types of structures: government-led, government-enterprise cooperation and enterprise-led (Jiang, 2016). The original practice of the management committee leaders concurrently taking charge of the development company has gradually been abandoned. With the administrative organization of development zones gradually delegating power to society (Han, Cai, & Zhao, 2021), guiding more stakeholders to participate in governance has become a new trend. The development company leads economic affairs, while the government and its agencies hold the core position in the administrative and social governance of the development zone. Even in enterprise-led development zones, some administrative functions are performed by the superior government or neighboring governments. As the development zone transforms from an area with a purely economic.
function into an area with a comprehensive composite function (Liu, 2004), the object of spatial governance gradually expands from industrial space to the community and other living spaces.

Under the impact of COVID-19, development zones in China took on the dual tasks of pandemic prevention and control and enterprise production. There are a large number of enterprises in development zones, and the sources and residences of employees are scattered, creating severe governance challenges. On the one hand, the public sector improves its governance efficiency by improving the offerings of one-stop service centers and by building “smart parks” (Long, 2020). On the other hand, it issues emergency management measures, establishes medium- and long-term strategic research and early-warning mechanisms (Zhu, Yao, & Zhou, 2020), and formulates production incentive measures to guide all actors to jointly implement the normal governance of development zones. With the effect of various pandemic prevention and production resumption policies in development zones, the governance system involving public sector leaders, enterprises and third parties is expanded and practiced in the development zones. Therefore, the study of crisis management in China’s development zones from the perspective of policy response can reveal the importance of the public sector for collaborative action.

2.3. Collaborative governance

Collaborative governance is a governance arrangement that crosses public-private boundaries, where a consensus-driven, considered, collective decision-making process is used by stakeholders to formulate or implement public policies and manage public affairs (Ansell & Gash, 2008; Emerson, Nabatchi, & Balogh, 2012). The need for collaborative action arises when organizations or individuals cannot accomplish a goal on their own (Thomson & Perry, 2006). Collaboration can be achieved through both informal and formal negotiations (Thomson & Perry, 2006; Wang, Xiong, Yang, Zhu, & Cheng, 2020). The practice of collaborative governance has always been considered to be rooted in the European and American public spheres (Amsler, 2016; Batory & Svensson, 2020; McGuire, 2006; Thomson & Perry, 2006). At the same time, however, some practices have undeniably appeared in developing countries in accordance with their individual institutional environments, and the importance of collaborative governance networks with mandatory participation has been highlighted due to a weak public participation base (Kossmann, Behagel, & Bailey, 2016; Yin & Zhi, 2020).

In the operation and transformation of industrial parks, multi-stakeholder participation in governance has been advocated. For example, broad enterprise participation in eco-industrial park development can be ensured through the involvement of local entrepreneurs and employers’ associations or in other ways (Heeres, Vermeulen, & De Walle, 2004). Research has shown that top-down policy implementation and an institutional setting do not necessarily hinder multiparty participation in industrial park governance. Local governments can establish local networks and provide institutional guarantees for the operation of park projects (Wang, Deutz, & Chen, 2017). However, the inefficiency of regulatory agencies can lead to the stagnation of stakeholder engagement in governance (Wang, Zhang, Worden, Cao, & Li, 2021). However, relatively few studies have dealt with the operational processes of collaborative governance in industrial parks, especially in crisis situations.

The prevention and control of COVID-19 in development zones is a complex public issue that could not be addressed by a single public, private or nonprofit organization; hence, the need for collaboration was apparent (Liu & Xu, 2018). According to Charlie, King, and Pearlman (2013), there are two types of collaborative governance networks. First, in action-oriented networks, initiatives come from private institutions or communities that participate in generating collaborative actions to solve problems and achieve goals. Second, in policy and planning networks, public agencies or governments initiate collaboration by coordinating relationships with other stakeholders to develop and implement action plans. Action-oriented networks are well developed in Western countries and have played a significant role in pandemic response (Beland, Rocco, Shi, & Waddan, 2018; Hombsy, Liu, & Warner, 2019). Social organizations and the private sector acted even before governments did (Royo, 2020). In contrast, policy and planning networks have been more prominent in China’s pandemic prevention practices, including those in development zones.

2.4. Research framework

The integrative framework for collaborative governance described by Emerson et al. (2012) includes the system context, the collaborative governance regime (CGR), and collaborative outcomes. The system context creates opportunities and constraints for collaborative governance and affects collaborative dynamics and performance both initially and over time. The drivers emerging from the system context, including leadership, institutional incentives, interdependence, and uncertainty, help to start and orient the CGR. The CGR involves collaborative dynamics, which guide collaborative action. These actions will affect the system context and promote the adaptation of the CGR to the system context. Combining the integrative framework for collaborative governance with crisis governance in development zones, we developed a theoretical framework to explain the operation of collaborative governance in development zones in response to the pandemic (Fig. 1).

Previous studies have suggested that the higher-level policy framework is an important system context for collaborative governance (Emerson et al., 2012). The impact of the pandemic shows clear geographic heterogeneity (Vallee, 2022), and it is necessary to maintain synergy between urban functional area governance and local governance. In addition, the development zone management committee is a subsidiary agency of the local government in China (UNIDO & CAITEC, 2019), and local governance plays a prominent role. Therefore, we propose the following hypothesis:

H1. Local policies influence the public decision-making of development zones to cope with the crisis while guiding and constraining the collaborative actions of stakeholders.

We divide the collaboration dynamics in development zones into the formation of a governance structure and the development of a governance path. Research shows that leadership is critical to initiating and convening collaborative governance across multiple parties and in implementing decisions and agreements in times of intense deliberation or conflict (Emerson & Gerlak, 2014). In a crisis, the public sector must not only respond quickly but also use policies to attract and encourage the principled engagement of the private sector (Zhu et al., 2020), labor unions and volunteers. Stakeholders can better achieve their own goals by participating in the collaborative governance of development zones through joint plans and actions (Bode, 2006). The shift from government-led to social participation has become an important trend in urban spatial governance. However, the government is irreplaceable in the face of crises due to its key resources and power, and the development and promotion of formal governance paths rely on administrative authority (Wang, 2022; Wang et al., 2020). The grid-based governance widely used in China in response to the pandemic is a product of administrative authority. Therefore, we propose the second hypothesis:

H2. The strong leadership of the public sector in crisis governance in development zones facilitates the rapid participation of stakeholders and the design and implementation of formal collaborative procedures and rules.

Actors develop specific governance strategies, including personnel control and space control, to reduce the sources of infection (Zheng, Li, & Sun, 2021) while addressing the difficulties and challenges faced by production and daily life. These strategies constitute the basis for important spatial governance collaborative actions in urban spatial
governance in response to the pandemic. Emerson et al. (2012) proposed that impacts and adaptation are components of collaborative outcomes. In the context of pandemic prevention and control in development zones, first, the pandemic is controlled in stages, and the order of production and life is restored, which are important outcomes of collaborative action. Second, the adaptability of collaborative governance arrangements can be reflected by the dynamic interaction between actors' collaboration approach, governance strategies and the crisis situations during different phases of the pandemic (Kapucu & Garayev, 2011). Based on the effectiveness of crisis governance in China's development zones and the existing characteristics of alternating governmental and social roles in urban spatial governance (Wang, 2022), we propose the third hypothesis:

**H3.** Collaborative action in development zones creates a virtuous cycle of governance by effectively mitigating the pandemic and promoting an adaptive adjustment of collaborative dynamics.

### 3. Data and methods

The purpose of this study is to examine the operation and outcomes of collaborative governance under public sector leadership in development zones during a crisis situation. To fulfill this purpose, we used textual analysis and case studies. On the one hand, we studied policies related to the prevention and control of the pandemic and the resumption of production in China's national economic and technological development zones and their localities since the pandemic outbreak. Among all development zone levels in China, national development zones are relatively large, with a higher number of enterprises and a larger population that contribute more to the national economy (Tang, Wu, & Zhou, 2018). National development zones provide a good demonstration effect for provincial and municipal zones. The prevention and control systems of national development zones are also representative. Therefore, we analyzed the policy texts of national development zones to reveal how the public sector organizes collaborative governance at the development zone level. Then, we compared development zones and local policy texts to explore how the local governance frameworks influence collaboration in development zones.

On the other hand, to further study the results of collaborative governance, we collected additional documentary information and investigated a typical development zone case. Due to travel constraints during the pandemic, we selected the Xuzhuang High-Tech Zone in situ as an empirical case to help us obtain a comprehensive picture of the spatial and temporal evolution of governance measures based on the information contained in the policy texts. Located in the Xuanwu District, Nanjing, China, the Xuzhuang High-Tech Zone was one of the first specialized software parks in China. Relying on meticulous prevention and control measures, more than 98% of enterprises resumed work and construction on all projects resumed in early April 2020 (Nanjing Daily, 2020). The dynamic and effective governance strategy of the Xuzhuang High-Tech Zone is a typical example of the adaptability of collaborative action in China's development zones.

#### 3.1. Data

For this study, we collected policy documents of China's national economic and technological development zones and their localities from January 20, 2020, to June 7, 2020. The starting point was when the National Health Commission of China first publicized the number of cases, and the ending point was when China released the document "Fighting COVID-19: China in Action". Policy documents related to the spatial governance of development zones during the COVID-19 pandemic were collected from the official websites and official WeChat public accounts of development zones. The policy documents were selected on the basis of the following principles. First, the policy was formulated and released publicly by the development zone's party working committee, management committee, subordinate functional departments, leading prevention and control institutions, development companies, labor unions, etc. Second, the policy was related directly to the theme of spatial governance in response to the pandemic. Third, the types of policies included opinions, methods, rules, regulations, announcements, notices, circulars, guidelines, and letters, while news articles and policy interpretations were not included. In this study, 341 policies were selected from 86 national economic and technological development zones in China. Additionally, we collected antipandemic policy documents issued by the localities where these 86 development zones are located. Among them, the Yangpu Economic and Technological Development Zone is directly managed by the Hainan provincial government. Other development zones are managed by their respective municipal governments, covering 58 cities in total. Since some of the official municipal government websites retained only policy documents from 2021, a total of 427 local policy documents from 45 cities and one province were collected.

According to the division of China's COVID-19 prevention and control phase established in "Fighting COVID-19: China in Action", the number of policy documents released in development zones generally increased and then decreased (Fig. 2). During the outbreak period (January 20–February 20, 2020), China's development zones issued a
large number of policy documents, with the number showing inverted U-shaped growth. The number of policies at this stage was 246, accounting for 72.14% of those included in this study. During the stable period (February 21–March 17, 2020), the number of policy documents issued by China’s development zones decreased significantly and showed a characteristic of declining fluctuations. The number of policies at this stage was 57, accounting for 16.72% of those included in this study. During the fading period (March 18–April 28, 2020), the number of policy documents issued by China’s development zones continued to decrease until the number of policies reached 31, accounting for 9.09% of those included in this study. During the normalized period (since April 29, 2020), the number of policy documents issued by China’s development zones was the lowest, at only 7, accounting for 2.05% of those included in this study. The general trend of the number of local policy documents issued by China’s development zones was the lowest, at only 7, accounting for 2.05% of those included in this study. However, during the outbreak period, the number of policy documents at the local level peaked on February 7, when they focused mainly on the services needed for enterprises to resume work and production. The number of development zone policies peaked on February 1, when they focused on restricting face-to-face government work for businesses and the public.

Data on the impact of collaborative governance were obtained mainly from official statistics and reports and news media reports. Job market changes during the pandemic were obtained from publicly available data from the National Bureau of Statistics. The measures and effectiveness of China’s response to the pandemic were made public in the document “Fighting COVID-19: China in Action”. This study used data on the participation of social forces from that report. In addition, data on the resumption of work in development zones were obtained from news media reports.

In October 2020, we collected information on the Xuzhuang High-Tech Zone using semistructured interviews and field observations. We visited office buildings and enterprises on site to observe the implementation of prevention and control measures. We also conducted 8 semistructured interviews with park-level planning managers, property managers, and managers of enterprises to understand the response of the park and industrial enterprises at different stages of the pandemic.

3.2. Methods

The data analysis consisted of two parts. First, we adopted the grounded theory research method to form the theoretical model through policy data collection, coding and categorization, and theoretical saturation tests (Glaser & Strauss, 1967). Grounded theory is an inductive process. Around the theme of “spatial governance in China’s development zones”, the content of policy texts was coded, analyzed and compared. We focused on highly repetitive text content during the encoding process. The higher the frequency of the coding, the more important and universally meaningful that content was in explaining the spatial governance of the development zone. Based on the coding results, we extracted the core elements of spatial governance in the development zone and the structural relationships between the elements. We used the qualitative research software NVivo11 Plus to assist in the coding process and ensure the standardization and systematization of the data analysis process.

We randomly selected 2/3 of the policy documents and coded the content paragraph by paragraph and sentence by sentence according to the principle of “gradual coding”. A total of 2011 preliminary codes were identified, and 489 independent initial concepts were abstracted. After merging, reorganizing, and refining identical or similar initial concepts, we extracted 90 categories. Table 1 presents a sample of the coding.

After the open coding was completed, each open coding instance was

![Graph showing the number of policies in national economic and technological development zones and their localities at different COVID-19 prevention and control stages in China.](source)

**Fig. 2.** Number of policies in national economic and technological development zones and their localities at different COVID-19 prevention and control stages in China (Source: New confirmed cases from the official website of the National Health Commission of the People’s Republic of China).

| Policy content | Concepts | Categories |
|----------------|----------|------------|
| Notice on further strengthening COVID-19 prevention and control work in farmers’ markets | Mass monitoring and reporting | Information reporting and commitment |
| Encourage the general public to report violations of prevention and control regulations or other violations of laws and regulations. | Environment | |
| Guidelines for enterprises to conduct self-check on the implementation of routine pandemic prevention measures | Unitized transformation | Space unit management |

Table 1

Open coding example.
compared and analyzed individually with the other codes to identify the correlations between categories. Core categories were combined and discovered. Relationships among categories were determined based on the interactions between specific categories and relevant theories from the literature, and an understanding was obtained of the spatial governance mechanism of China’s development zones during the COVID-19 pandemic. Table 2 shows the coding system of China’s development zone policy texts (due to the large number of categories, only some categories are listed in the table). We discovered 14 core categories in total. By linking the literature and research, we further divided the core categories into three dimensions: spatial governance actors, prevention and control governance mechanisms, and spatial governance strategies.

Another one-third of the policy documents were used to conduct a theoretical saturation test, and the results showed that the existing categories were very rich and that no new important categories or relationships had formed. Therefore, theoretical saturation was relatively high.

To compare the content of spatial governance in development zone policy documents and local policy documents, we coded the local policy texts with reference to the development zone coding system. Through the analysis of local policy texts, we identified 1423 codes in total. The number of codes in each category can reflect the participation of each governance actor, the implementation of governance paths and the focus of governance strategies. The results of development zone and local coding were compared to explain the relationship between development zone governance and local governance.

Second, the effectiveness of governance in development zones needs to be studied in terms of both impact and adaptation. On the one hand, we illustrated the impact of collaborative governance in development zones by citing data on enterprises resuming work, receiving donations, and experiencing social participation. On the other hand, we used NVivo11 Plus software to assign release stage attributes to each policy document and then used a matrix query tool to further explore the adaptation of collaborative dynamics at different stages, including the participation and role changes of actors. Based on interviews and field observations, we mapped the locations of various types of pandemic prevention and control facilities in typical development zone cases at each stage to reflect the adaptation of governance actions to the dynamically changing pandemic.

4. Results

4.1. Collaborative dynamics of development zone governance

4.1.1. Governance structure

Table 3 shows the coding results for key actors and their responsibilities during the pandemic prevention process in China’s development zones. In response to the complex governance issues during the pandemic, the party, government, market and society were jointly involved in the spatial governance of development zones (Fig. 3). First, party and government forces at all levels of the development zone, consisting of the party working committee, primary party organizations, management committee and functional departments, played a leadership role in pandemic prevention and control. Party and government officials at the development zone level immediately set up a special leadership institution to guide and supervise pandemic prevention and control in the face of the crisis. The special leadership institution developed an overall plan of action involving multiple actors and guided the functional departments to mobilize and serve the nongovernment sector represented by enterprises. Second, the enterprises in the development zone became important actors under policy guidance. Enterprises communicated action plans to the public sector by formulating emergency plans and reporting employee information. The collaboration momentum was ensured by the agreement between the enterprises and the public sector on the goals of controlling the pandemic spread and restoring production order. In addition, as economic agents
employed by owners or residents, property management companies were responsible for implementing the governance of commercial buildings and property management communities. Third, social organizations and groups such as labor unions, women’s federations, and chambers of commerce embedded at all levels of the development zone and enterprises were involved in collaborative action through coordination, supervision, publicity, guidance, liaison, and fundraising. Neighborhood committees composed of social workers and temporary volunteer teams cooperated with various functional departments to implement community governance and serve vulnerable groups.

4.1.2. Governance path

Grid-based governance is a new model of urban governance in China and became an important platform for collaboration during the COVID-19 pandemic. Before the pandemic, grid-based governance focused on comprehensive community governance. Under the traditional “city/district-subdistrict-community” hierarchy, a “grid” was added, and communities were divided into a number of grid-like governance units. The government appointed grid administrators to collect and organize the information of the residents within the grid. Digital platforms were set up to digitize information about residents and the grid units. Functional departments could rely on these digital platforms to promptly identify and solve various livelihood issues within the grid. After the outbreak of the pandemic, spatial governance placed more emphasis on the full coverage of governance objects and the multidimensionality of governance work, which brought the advantages of grid-based governance into play. As shown in Table 4, although urban governance is still centered on community grid-based governance, some local policies have proposed including enterprises in the grid-based governance system.

With local coordination planning and development zones own exploration, China’s development zones established a grid-based governance system for enterprises. Table 5 shows the coding results of grid-based governance in the development zone. The grid-based governance system of the development zone reflects an obvious vertical hierarchical relationship. The first level is the “leader’s contract responsibility for the area (领导分片包干)”; that is, the development zone is divided into several areas, and the leaders of the management committee are assigned as those in charge of each area. The second level is the division of the grid. There are several grids in each area according to geographical location. The grid leaders and grid personnel are set for each grid. The grid is the smallest unit for organizing spatial governance, and the arrangement of pandemic investigation and publicity is directly based on the grid. In addition to production space, the development zone is laid out with supporting living space; thus, the grids are mainly enterprise grids and community grids.

There are differences in hierarchical management and staffing between enterprise grids and community grids. Compared with community grids, where the management personnel are mostly community workers and volunteers, enterprise grids are usually managed directly by functional departments, i.e., the “contract responsibility of functional departments for enterprises”. In the grid-based governance system of the development zone shown in Fig. 4, the head of the functional department serves as the grid leader, and the functional department personnel serve as grid personnel, i.e., “liaison officer for the enterprise”. Under the guidance of the “liaison officer for the enterprise”, some enterprises have innovated the hierarchical governance model of “enterprise responsible person & workshop director”. Other actors, such as labor unions, chambers of commerce, property management companies, and neighborhood committees, use the grid as a portal to establish cooperative and interactive relationships to achieve resource integration, information sharing and collaborative services.

The commuting of enterprise employees requires a linkage between the enterprise grid and the community grid. In the grid-based governance of the development zone, the enterprise grid is responsible for daily pandemic prevention and supervision of employees during working hours, and the local community grid is responsible for management during off hours. The grid personnel for the enterprise grids and the community grids where the employees live are in close contact to dynamically monitor the location information and health status of the employees. By strengthening two-way communication and feedback between the enterprise grid and the community grid, the overall process management is implemented for employees, namely, “pandemic prevention linkage”.

4.2. Collaborative actions of development zone governance

The development zone responds to the negative impact of the pandemic from the two dimensions of personnel control and space control. Personnel control is a key strategy for pandemic prevention and control. It not only manages the daily activities of employees and
residents but also guides enterprises and business premises in resuming work and production in stages. Space control cooperates with personnel control through special space settings or special management of space sites. Fig. 5 shows the coding results of governance strategies in China’s development zones at various stages of the pandemic and compares them with local strategies.

During the outbreak period, the development zone implemented the most stringent and comprehensive governance actions focusing on closed-off management. Each development zone implemented access control, daily monitoring, and personnel activity control aimed at preventing the spread of the pandemic. Key enterprises and commercial premises that guarantee the production of pandemic prevention materials and people’s basic living standard resumed work and production in stages. Enterprises adopted measures to reduce personnel contact, such as scattered dining, staggered commuting, and working from home. In terms of space control, enterprises and households were used as isolation units to effectively block the flow of people, and convenient spaces such as temporary express delivery points were set up to meet the daily needs of employees and residents. Additionally, routine strategies such as regular disinfection, procurement of prevention and control materials, and establishment of quarantine observation sites were implemented. During the stable period, the public sector and social organizations jointly ensured that enterprises that met the conditions for pandemic prevention and control could resume work and production. As the flow of people increased, efficient and convenient governance tools such as health quick response (QR) codes were applied to control access. In the

| Categories                        | Policy number | Coding number | Example of policy content                                                                                                                                                     |
|-----------------------------------|---------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Leader’s contract responsibility for the area | 2             | 3             | Establish a system of subcontracting. Reasonably divide grid units based on the overall planning of villages/communities and related departments. |
| Grid division and management      | 16            | 26            | A group of liaisons for pandemic prevention and control will be selected from among city and county officials and stationed in industrial enterprises. |
| Liaison officers for enterprises  | 7             | 7             | A group of liaisons for pandemic prevention and control will be selected from among city and county officials and stationed in industrial enterprises. |
| Community grid management         | 37            | 48            | Refine management measures for community (village) grids. Improve the organizational system of pandemic prevention and control within enterprises and implement grid-based management measures. |
| Enterprise grid management        | 6             | 6             | Strengthen joint prevention and control and avoid blind spots.                                                                                                               |
| Pandemic prevention linkage       | 38            | 47            |                                                                                                                                                                                |
Tables 5
Categorization of grid-based governance in development zones.

| Categories                          | Policy number | Coding number | Example of policy content                                                                 |
|-------------------------------------|---------------|---------------|------------------------------------------------------------------------------------------|
| Liaison officers for enterprises    | 40            | 86            | Strictly implement the “one company, one person” contact system for pandemic prevention  |
| Pandemic prevention linkage          | 34            | 38            | Establish a pandemic prevention linkage mechanism between enterprises and towns, subdistricts, and villages. |
| Leader’s contract responsibility for the area | 14           | 30            | The members of the party working committee and the social work administration teams are responsible for pandemic prevention and control in the contract area. |
| Enterprise guarantee responsibility system | 22           | 26            | Enterprises should also establish a guarantee responsibility system to achieve rapid response and the effective implementation of pandemic prevention and control. |
| Grid division and management        | 20            | 26            | More than 400 km2 under the jurisdiction of the development zone are divided into 32 grid units to weave full coverage of the screening network. |
| Contract responsibility for functional departments for enterprises | 8            | 10            | Urge government departments contracting enterprises to maintain a sense of crisis at all times and make preparations for prevention and control. |
| Community grid-based management     | 6             | 8             | All communities should continue to extensively mobilize the masses and strictly manage grids. |
| Enterprise grid-based management    | 6             | 6             | Be responsible for the establishment of a grid-based management system for enterprises in the park and guide and inspect the pandemic prevention and control order of enterprises. |

4.3. Outcomes of collaborative governance in development zones

4.3.1. Impacts

The collaborative governance of China's development zones dealt quickly with various problems during the pandemic, ensuring the resumption of work and production and the restoration of normal order. In Jiangsu Province, for example, as of February 28, 2020, 97.1% of the industrial enterprises above a designated size in the province's 26 national economic development zones had resumed work. Among them, 100% of industrial enterprises above a designated size had resumed work in the Suzhou Industrial Park and Nanjing Economic and Technological Development Zone (China Commerce News, 2020). According to the National Bureau of Statistics, the surveyed urban unemployment rate began to gradually decline; after rising to 6.2% in February 2020, it dropped to 5.7% in June. Enterprises that resumed work had reemployed jobs for the unemployed.

The active participation of market and social actors reduced the cost of governance for pandemic prevention and control. Through market-based mechanisms, enterprises solved the problems of material supply, logistics, and service guarantee needs for production and life. In particular, many enterprises upgraded and added new production lines to fill the enormous gap in market demand for pandemic prevention materials (Bai, Lin, & Wu, 2022). Many enterprises donated materials for the development zones and even the areas in China where the pandemic was serious, fulfilling their corporate social responsibility (Chen & Feng, 2022). Social actors played a unique role in resource integration, publicity, guidance, psychological counseling, and life care. As of May 31, 2020, China had received approximately 38.93 billion yuan in social donations and approximately 990 million material items (China's State Council Information Office, 2020). According to incomplete statistics, the number of registered volunteers participating in pandemic prevention reached 8.81 million (China's State Council Information Office, 2020).

4.3.2. Adaptation

The adaptation of governance arrangements in China's development zones to environmental changes reflects the sustainability of collaboration. Along with the gradual containment of the pandemic, there was an adaptation of both the collaborative dynamics and collaborative actions in development zones.

We analyzed the participation of party, government, markets, and social actors in different stages of pandemic prevention and control. Fig. 6-a shows changes in the participation of governance actors in the development zone. During the outbreak period, the dominant position of the public sector and the important role of market subjects stand out. The great demand for pandemic prevention personnel and materials also prompted social actors to participate in governance at the initial stage. From the stable period to the normalized period, the public sector remained the core actor, but the focus of action gradually transitioned from management and control to service (Table 6). After the normalized period began, market actors were engaged in normal production activities, while social actors provided continuous motivation and support to consolidate the spatial governance results. We further compared changes in the participation of actors between development zones and localities (Fig. 6). Local policies also emphasized the participation of multiple actors, but the focus was still on community-based autonomous organizations, such as neighborhood committees. Thus, spatial governance in development zones was also explored from the bottom up under local coordination.

In addition to the collaborative dynamics, the collaborative actions of stakeholders evolved adaptively, as was verified in both policy and practice. Fig. 7 shows the changes in various spatial governance strategies in the Xuzhuang High-Tech Zone. Enterprises, communities, and buildings gradually reopened as the pandemic changed, going through a process of closure to semiclosure and then opening. Specialized pandemic prevention sites also showed a corresponding trend of change,
first increasing and then decreasing. By the normalization period, although companies and entrepreneurial communities continued to implement health monitoring, more than half of the sites withdrew temporary quarantine points and resumed their original functions.

5. Discussion

We develop a theoretical framework for collaborative governance in development zones inspired by the literature and adapt it to the crisis response in development zones during the COVID-19 pandemic. The analysis of policy responses during the pandemic in China’s development zones confirms that collaborative governance arrangements are critical for crisis mitigation and the restoration of normalcy in industrial spaces, and the analysis exemplifies the effectiveness of the integrative framework for collaborative governance proposed by Emerson et al. (2012) in explaining crisis governance in urban functional areas.

This study demonstrates that the embeddedness of development zone governance in the local governance framework guarantees the efficient operation of collaboration, which confirms H1. Especially in centralized countries, local governance policies are an important policy-institutional context in the governance network that shapes collaborative governance in development zones. Some researchers have argued that the formation of government-led public-private partnerships requires lengthy planning and negotiation (Keers & van Fenema, 2018) and may not be achieved quickly in crisis situations because there is reduced autonomy in collaboration (Comfort, 2007). However, their studies have mostly been based on the context of Western countries, in which horizontal collaborative governance is more effective (Beland et al., 2018; Homsy et al., 2019) than hierarchical governance. The collaborative governance initiated by the public sector in China’s development zones is guided and safeguarded by local policies, resulting in top-down policy transmission and bottom-up governance innovation. This system is inextricably linked to the collectivist-oriented governance model prevalent in East Asian countries (He, Shi, & Liu, 2020).

We also find that a policy and planning network is conducive to crisis governance in development zones, which is consistent with H2. In contrast to the need for voluntary and shared motivation in action-oriented networks, the public sectors of development zones formulate policies and rules in advance (Kossmann et al., 2016) to guide the participation of stakeholders, which is the key to successful crisis response. As previous studies (Hayter & Nisar, 2018; Kossmann et al., 2016) have proposed, there is no single recipe for collaborative governance, and the CGR can emerge early without shared motivation. In crisis situations, the convening power of the public sector and effective collaborative institutional design can easily lead to full cooperation with the private sector and third-party actors. The public sector plays a key role in crisis governance (Benavides & Nukpezah, 2020) because of its resource and power advantages (Wang et al., 2020). In the case of China’s development zones, the application of grid-based governance facilitates the control and rapid solution of emergencies (Li, Zhang, & Xu, 2017) and provides an interface for the involvement of a wide range of actors. This study also demonstrates the important role of cooperation and innovation of the private sector and social organizations in crisis governance. Crises magnify the limited capacity of government actors to build partnerships, integrate resources and knowledge, and manage cross-sector collaboration (Comfort, 2007). The flexibility, innovation, and simple accountability of the nongovernmental sector (Wang, Qi, & Ran, 2022) can lead to more diverse and adaptive collaborative action in response to major crises.

The effectiveness and sustainability of the governance arrangements are reflected in the continued evolution of the pandemic and the dynamic interaction among the collaborative dynamics, the collaborative actions of development zones and pandemic phases, which confirms H3. Positive feedback from collaboration in the early stages positively influenced further collaboration. It has been emphasized that the collaborative process is cyclical rather than linear (Ansell & Gash, 2008) and that collaboration relies on a virtuous circle achieved among the various components (Chris, 2003), and our findings confirm this view.
As the pandemic in the development zone was gradually contained, the governance roles and affairs of the public sector and other actors, as well as governance strategies, adapted to address new problems (Emerson et al., 2012).

This study has important theoretical implications for both complementing the literature on COVID-19 response and expanding the
contributes to understanding the crisis governance experience of other actors. Unlike IEs in Western countries, which study reveals how the public sector in development zones can lead previous studies, which have paid little attention to the spatial governance of development zones and industrial enterprises during the pandemic, this study adds to the relevant literature. First, it focuses on governance actions in development zones in crisis situations from a policy response perspective. Variability in pandemic containment policies within cities exists not only between communities but also across functional areas. Compared with other functional areas, development zones bear the dual responsibility of production recovery and pandemic prevention and control, and the movement of people across regions and even across borders increases the complexity of their governance. In the context of previous studies, which have paid little attention to the spatial governance of development zones and industrial enterprises during the pandemic, this study adds to the relevant literature.

Second, this study extends the literature of collaborative governance in the context of development zones, especially in crisis situations. The greater the imbalance of rights or resources among stakeholders, the more likely it is that they will not be able to participate effectively in governance (Ansell & Gash, 2008; English, 2000). Enterprises have a stronger voice than other stakeholders in the governance of development zones, and they have the management skills and knowledge to communicate more effectively and equally with the public sector. This study reveals how the public sector in development zones can lead collaborative governance with the broad participation of enterprises and other actors.

Third, this study of crisis governance in China's development zones contributes to understanding the crisis governance experience of government-led industrial parks. Unlike IEs in Western countries, which rely on institutions such as universities and research institutes (Li, Wu, & Zeng, 2019), the formation and management of China's development zones are subject to strong government intervention. In this crisis, the governance model of China's development zones shifted from "strong government" to "strong government and strong society". The organizations involved in governance, such as labor unions and the Communist Youth League, are also between the state and society by Western standards (Chen & Wang, 2014). This is in marked contrast to the common example of bottom-up coproduction (Mitlin & Bartlett, 2018) but is similar to the governance structure of industrial parks in countries such as Singapore.

The findings also provide clues for policies on the spatial governance of industrial parks and industrial enterprises in the post-pandemic era, especially in the context of a centralized state. The concerns about industrial parks and industrial enterprises triggered by the COVID-19 outbreak should not focus only on economic policies, and policy responses should expand from the industrial dimension to the spatial and social dimensions. First, public sector capacity is a necessary condition for crisis governance, so policy makers should focus on the public sector's leadership organizational strategies in industrial park governance. In countries and regions where hierarchical governance is rooted, mobilizing the private sector to participate in joint actions in an orderly manner and giving full play to the sector's innovative capabilities through policy issuance and implementation are an important way to enable collaborative governance. Second, since the pandemic will not end in the near future, policy makers need to make long-term plans for the prevention and control of COVID-19 in industrial zones and plan to establish sustainable and resilient collaborative networks to ensure the synergy of production and pandemic prevention. In China's development zones, policy development should focus on the establishment of regular prevention and control mechanisms and emergency management mechanisms and clearly define the roles of the nongovernment sector in each type of mechanism to provide important safeguards for production in the post-pandemic era.

### 6. Conclusion

Many countries and economies continue to struggle with emerging pandemics. While horizontal collaborative governance has been widely promoted, recent research has begun to highlight the important role of top-down coproduction and hierarchical governance in public crises that require rapid and decisive action (Liu et al., 2021; Miao, Schwarz, & Schwarz, 2021). However, pandemic-influenced governance research has focused on the national, city, and community levels. The implementation of policy goals and effective responses in industrial parks, which represent the dynamics of urban production, have been less
comprehensively addressed. The recovery of production activities on a global scale implies the continued governance of pandemic prevention and control within the industrial agglomeration space. Therefore, this study focuses on the governance response of development zones during the COVID-19 pandemic. Drawing on the literature on collaborative governance, we examine the operation and effectiveness of collaborative governance in a crisis situation in China’s national economic development zones from a policy response perspective. This study adds to the literature on pandemic response in development zones, extends the study of mandatory collaborative governance networks, and contributes to a deeper understanding of crisis governance in development zones in centralized countries.

In the context of centralized states, where hierarchical governance has long been entrenched, mandatory policy networks initiated by the public sector are an important collaborative governance model for development zones in response to pandemics. First, the local level provides policy guidance and authority for the governance of development zones. Mature top-down structures ensure that collaborative action in development zones does not lack leadership and make it easier for stakeholders to build trust in those leaders. Waiting for actors to engage in collaborative action themselves can take a long time (Kossmann et al., 2016), so policy networks can efficiently contribute to the development of collaborative dynamics and facilitate crisis response. In contrast to traditional hierarchical governance, enterprises and related social organizations will respond to the policy or voluntarily join the pandemic prevention and control, which is an important part of collaboration building. In addition, throughout the process of development zone governance, the wins at each stage are conducive to a virtuous cycle of collaborative governance. This is particularly important to ensure stakeholders’ confidence and trust in the action and to facilitate the adaptation of all parties and action strategies to the dynamically changing pandemic.

There are limitations to our study due to the restrictions on field observations during the pandemic. This study is based on a large number of policy documents and a practice case for analysis. Although we conducted observations and interviews in a typical development zone in our city, possible innovative collaborative actions in other zones were not fully examined. Future research should include more empirical work based on the policy findings of this study. This would enable us to understand how policies regarding collaborative action are implemented within development zones. In addition, in-depth interviews with various actors would be an important addition to the study and would help to reveal the specific contributions and challenges faced by stakeholders in public sector-led collaborative action, thus contributing to the sustainability of collaborative governance.

CRediT authorship contribution statement

Dongxue Li: Methodology, Data curation, Writing – original draft, Writing – review & editing. Shengbo Zhao: Writing – original draft. Xingping Wang: Conceptualization, Supervision, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The authors do not have permission to share data.

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