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Resilient strategies and public service innovation in Shanghai: A case study approach

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Abstract: This study aims to explore the urban resilience strategies and public service innovations approaches adopted by the Shanghai Government in response to COVID-19 pandemic. The study utilized a combination of primary and secondary data sources, such as government reports, policy documents, and interviews with important individuals involved in the matter. The current research focused on qualitative data and examined the different aspects resilience, including infrastructure, economy, society, ecology, and organizations. The findings indicate that infrastructure resilience plays a crucial role in maintaining the stability and dependability of essential public facilities, achieved through online education and intelligent transportation systems. Implementing rigorous waste management and pollution control measures with a focus on ecological resilience has significantly promoted environmentally sustainable development. Shanghai city has achieved economic resilience by stabilizing its finances and providing support to businesses through investments in research, technology and education. Shanghai city has enhanced its organizational resilience by fostering collaboration across several sectors, bolstering emergency management tactics and enhancing policy execution.

Keywords: service innovation; organizational resilience; COVID-19; crisis management theory; government policy

1. Introduction

In recent years, the COVID-19 outbreak has had a profound effect on urban infrastructure, leading to the development of more intricate operational systems within cities (Iqbal and Ahmad, 2021). The interplay of disaster-inducing elements and safety hazards has escalated, culminating in considerable damage and economic detriment. Urban areas can withstand disasters and emergencies, respond effectively, recover efficiently, maintain regular urban operations, and improve risk management through the strategy of building resilient cities (Béné et al., 2018; Meerow et al., 2016). The COVID-19 crisis has reignited interest in resilient city construction, emphasizing the need for broader and more effective risk prevention measures against "black swan" and "gray rhino" events (Fang et al., 2020; Taleb, 2007). Ensuring the safety of urban residents' lives and properties, as well as the smooth operation of cities, has become a shared responsibility and aspiration of cities worldwide. Despite their diverse goals and aspirations, global cities are united in their pursuit of resilience and safety (Cutter et al., 2013; Meerow et al., 2016)

China was profoundly impacted by the COVID-19 pandemic from 2020 to 2023. Many cities and provinces, as well as the autonomous regions, suffered from government restrictions, healthcare shortages, and economic downturns (Liu et al., 2020; Zhang, 2021). Shanghai city, a prominent metropolis in China known for its size

and economic prosperity, encountered distinct difficulties within the COVID-19 outbreak. The city enforced stringent containment efforts to suppress the transmission of the virus, which encompassed substantial limitations on travel, quarantine protocols, and large-scale testing initiatives. These efforts successfully curtailed the transmission of COVID-19, however they also caused different levels of disturbance to everyday life and the economy. Businesses, particularly small and medium-sized enterprises (SMEs), have encountered significant obstacles because of decreased consumer demand and disruptions in the supply chain caused by the outbreak (Iqbal et al., 2024). Furthermore, healthcare organizations experienced heightened strain due to the abrupt rise in cases, resulting in a temporary scarcity of medical resources and staff (Chenchen-Shi et al., 2020).

As China's economic center, Shanghai city has successfully implemented urban resilience strategies and public service innovations, providing valuable lessons for other cities. These efforts have helped prevent severe economic losses and enhance sustainable development, public safety, social stability, and government management (Hu et al., 2022; Zheng et al., 2022). In the short term, this research aids decision-makers in resource allocation during changes in urban resilience strategies (Iqbal and Piwowar-Sulej, 2023). Long-term, it enhances urban resilience and public service permeability, reducing disaster impacts and losses (Zheng et al., 2022). Shanghai city's experience during the pandemic highlights the importance of technology, data analysis, and effective communication in managing crises. By investing in digital infrastructure and fostering collaboration among government, businesses, and the public, Shanghai city has quickly adapted to changing circumstances and implemented targeted interventions (Hu et al., 2022). This holistic approach has positioned Shanghai city as a leader in resilience strategies, offering a model for other cities to emulate.

Analyzing the resilience strategies and public service innovations of the Shanghai city Municipal Civil Affairs Bureau during the pandemic reveals successful practices and valuable lessons for other cities. By learning from Shanghai city's experience, other cities can enhance their crisis management, foster public trust, and strengthen social cohesion. The insights gained can guide cities in developing resilient strategies, ensuring continuity of services during crises, and promoting a more agile, responsive, and innovative public service system. This collaborative effort contributes to building a resilient urban governance system that prioritizes the well-being of residents and ensures preparedness for future emergencies.

Future research could examine the COVID-19 pandemic in detail in urban resilience and explore its impact on issues such as health, logistics and supply chains (Büyüközkan, 2022). Measuring the effectiveness of urban resilience strategies requires working on the development of systematic conversation assessment tools (Smith et al., 2020); the integration of multiple layers of governance and policy such as multi-sectoral cooperation and citizen engagement during an epidemic (Zhang and Li, 2021); the practical use and challenges of big data, artificial intelligence, and e-government in public services (Chen et al., 2021); how to mobilize the whole community to participate in the role of local organizations so as to achieve effective governance (Liu and Wang, 2020); how urban resilience strategies during epidemics are short-term innovations are integrated into long-term strategies and continuously

updated (Lee and Kim, 2021); the impact of cultural factors on resilience strategies in each region (Wang et al., 2022); and the public's perception of and trust in government resilience strategies (Li and Zhang, 2023). This research objective is to analyze the evolution of urban resilience strategies and public services in Shanghai city before and after the pandemic, integrating urban resilience strategy theory, new public service theory, and governance theory. It seeks to identify key lessons and best practices to inform future policy making by examining the effectiveness of these strategies and services. Emphasizing the integration of big data and information technology, the study explores how cities can ensure the continuity and effectiveness of public services during crises through flexible, adaptive strategies and enhanced decision-making (Iqbal and Piwowar-Sulej, 2024). It underscores the importance of collaboration with private sector partners and community organizations, leveraging real-time data, and investing in technology infrastructure to maintain accessible and efficient public services. The research ultimately advocates for innovative and collaborative approaches to build more resilient cities capable of withstanding and recovering from unexpected events. specific objectives of this research are as follows:

- To explore city resilient strategies for public service provisions being effectively implemented during the pandemic.
- To identify public service innovations emerged from city resilient strategies.

2. Theoretical background

This study sought to integrate urban resilience theory, public service theory and crisis management theory. Urban resilience theory (URT) pertains to the capacity of urban systems to sustain or promptly restore their functions, structures, and identities in response to natural disasters, socio-economic disruptions, and environmental shifts. The idea highlights the capacity of urban systems and their component socio-ecological and socio-technical networks to handle disruptions, adjust to alterations, and swiftly restore their operations across different timeframes and geographical areas (Meerow et al., 2016). This theory focuses on the capacity of cities to adjust, manage, and recover from different disruptions, including the ability to act proactively before, during, and after an event to preserve or restore urban operations (Heinzlef et al., 2020). This requires cities to be able to adapt and innovate by self-organizing and adjusting at various time and space scales (Sharifi, 2019). Urban resilience is a concept that focuses on the capacity to adjust and thrive in the presence of various challenges and unpredictability. This includes the ability to absorb shocks, preserve functionality, and restructure as needed to ensure long-term sustainability (Walker et al., 2006).

The new public service theory highlights principles such as prioritizing service over control, emphasizing the public interest, employing strategic thinking, promoting democratic action, encouraging citizen involvement, and stressing fairness and democracy (Denhardt and Denhardt, 2003; Liu, 2010). It aligns with contemporary needs, according to Ding Huang, by focusing on public spirit, citizen participation, and responsive public institutions (Ding, 2004; Huang, 2012). These theories collectively support the New Public Service's focus on serving the public interest, fostering civic engagement, and promoting democratic governance (Liang and Zeng, 2007; Osborne et al., 2016).

Emergency management entails coordinating responses to public emergencies, which frequently take the form of crisis management. Efficient crisis management necessitates prompt measures to mitigate damages, manage the situation, and restore stability (Robert, 2001). Mitroff and Persson (1993) emphasized the significance of gathering and distributing information in times of crisis. Robert (2001) views crisis management as an essential societal principle and set of ethical guidelines that necessitate prompt and discerning decision-making to effectively handle potential dangers faced by a business. Theoretical foundation of emergency management provides a structure by which organizations can analyze how they prepare for, respond to and recover from emergencies. This paper applies this theoretical framework to an analysis the Shanghai pandemic action emergency measures. Classification based on performance of immediate and long-term crisis management strategies, preparedness, mitigation responses, recovery efforts It is critical to examine how resources are coordinated man the management of these resources, along with what actions emergency response teams undertake on site for delivery public service sot be constitution a safe and secure environment.

This theoretical framework provides a robust foundation for examining Shanghai's response to the viral outbreak. Urban resilience theory elucidates the capacity of cities to adapt to change, while new public service theory advocates for flexible and innovative community-driven public service systems that can effectively manage emergencies (Leuprecht et al., 2018). Additionally, emergency management (EM) theory offers a structured approach to strategy effectiveness based on specific levels of emergency management, facilitating a systematic assessment of the competing crisis response strategies. Collectively, these theories support a comprehensive analysis aimed at evaluating the effectiveness of Shanghai's strategies in enhancing disaster resilience and transforming public services in the context of the pandemic.

2.1. Urban resilience

The term resilience originates from the Latin word "resilio", which signifies "to revert back to the initial state" (Herrman et al., 2011, p. 15). Resilience, originally a term used in mechanics to refer to an object's capacity to return to its original state after being deformed, has now been adopted in other fields such as ecology, sociology, and economics (Cai, 2012; Shao et al., 2015; Zheng, 2013). Engineering resilience is concerned with a system's ability to withstand shocks and recover quickly, while still retaining its capacity, structure, and function (Eraydin, 2016; Gunderson, 2000). Urban resilience pertains to the capacity of urban systems and their social and political networks, including community management, to sustain or rapidly recover their normal functions, adjust to changes, and restore expected functions in the presence of disruptions, thereby improving their present or future adaptability (Meerow et al., 2016). This notion is elucidated by conducting a comprehensive analysis of existing literature, which involves describing and assessing the ability of urban areas to withstand and recover from various shocks and stresses. This analysis also involves identifying the specific sorts of resources and traits that are essential for urban systems to exhibit resilience. While definitions may differ depending on the context, the focus

is typically on the ability to effectively address and handle various threats such as severe weather, pandemics, floods, and earthquakes (Table. 1). Some definitions also highlight the importance of sustainable urban development and making systemic changes to enhance public services (Klein et al., 2003; Pendall et al., 2010; Paulo and Luís, 2019).

Table 1. Summary of urban resilience definitions.

Summary of Definition	Source
The capacity of urban systems to maintain or quickly return to desired functions in the face of disturbances and adapt to change.	Meerow, Newell, & Stults, (2016)
The ability of cities to absorb, recover, and prepare for future shocks, promoting sustainable development and inclusive growth.	OECD, (2018)
The ability of urban systems and their networks to maintain or quickly return to desired functions, adapt to change, and transform limiting systems.	Resilience Alliance, (2010)
The capacity of individuals, communities, institutions, business, and systems within a city to survive, adapt, and thrive despite chronic stresses and acute shocks.	The Rockefeller Foundation, (2015)

Source: Author's work.

After discussing the concept of urban resilience, its manifestation can be seen in various aspects such as the diversity of urban functions, the flexibility of urban organization, the variety of urban elements, and the intersection of urban networks. As early as 2007, the Resilience Alliance proposed that the study of urban resilience should include the urban facility environment, metabolic flow, governance network, and social level (CSIRO, 2007). Among these, the urban facility environment serves as the material foundation, supporting the functioning of cities and improving the quality of human life. The governance network primarily focuses on the self-organization and social adaptability of cities and societies. The social level encompasses social capital, social care, and the mitigation of social injustice (Cai, Guo, et al., 2012). These four priority areas highlight different aspects of **Figure 1**).
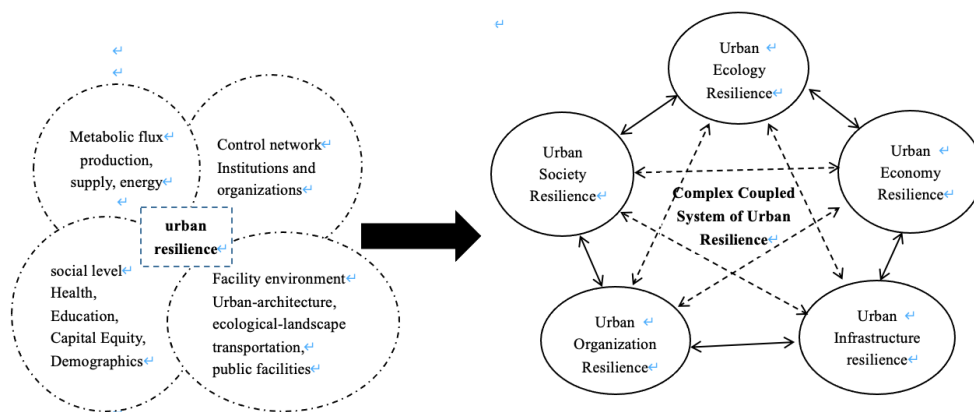
Figure 1. The concept of urban resilience (Zhao et al., 2022).

Urban resilience is an intricate, interconnected system that includes various components such as the urban economy, society, ecology, and infrastructure. The capacity of urban systems to adjust, recuperate, and acquire knowledge from various

natural and human-induced risks is crucial for both current and future circumstances. This method highlights the collective involvement and cooperation of various stakeholders, such as residents, communities, businesses, governments, and non-governmental organizations (Zhao and Liu, 2020). Urban economic resilience is specifically defined by the presence of a varied range of economic activities, the degree of employment, and the capacity of the economic system to operate effectively during periods of uncertainty or danger. Urban social resilience is a measure of how well various social groups can handle and bounce back from risk factors. Urban institutional resilience pertains to the management and governance prowess of local government institutions, namely their aptitude to arrange, oversee, strategize, and act during and following crises. Urban ecological resilience pertains to the capacity of ecosystems to assimilate alterations prior to reconfiguring into novel formations (Chen et al., 2017). Urban infrastructure resilience pertains to the capability of urban systems to endure and rebound from disturbances, encompassing the ability to maintain essential services such as transit, water and energy supply, healthcare, and other facilities.

2.2. Main characteristics of Urban resilience

The literature has identified 11 key characteristics of urban system resilience: redundancy, diversity, efficiency, robustness, connectivity, adaptability, resources, independence, innovation, inclusiveness, and integration (Allen and Bryant, 2011; Godschalke, 2003; Kim and Lin, 2016; McClellan et al., 2012; Spaans and Shuihout, 2017). Different authors' studies have different ideas about what resilience means. Some of these ideas are buffering and robustness, social capital and resources, governance overlap and redundancy, strict feedback and innovation, and variability and adaptability (Allan and Bryant, 2011; Godschalk, 2003). By implementing techniques to restore urban resilience, we may create efficient and strong methods for cities to handle and adjust to all types of crises, including neighborhoods mobility. Within this framework, urban resilience should be defined by local stakeholders as a dynamic and adaptable approach that creates suitable formal structures (such as legal and governmental frameworks) through institutional measures and embraces a proactive stance towards the local population (Godschalk, 2003; McClellan et al., 2012).

2.2.1. Urban ecological resilience

Urban ecological resilience is crucial for balancing human activities and the urban environment, ensuring ecological security, and enhancing resilience through ecosystem services like provisioning, regulation, culture, and support. The key ecological parameters impacting urban resilience include the nature, quality, and spatial attributes of the environment. Natural ecosystems exhibit greater resilience and quicker recovery when faced with disruptions (Chen and Xu, 2022). Improving the natural environment can mitigate secondary disasters and strengthen urban resilience (Iqbal et al., 2022). Factors jeopardizing urban resilience include the decline of public green spaces, inadequacies in waste disposal systems, energy distribution disturbances, and ecosystem overloading (Zhu et al., 2022). Scientific and reasonable spatial design can ensure the long-term viability of urban areas. Robust ecological

networks enhance landscape connectivity, ecosystem service value, and environmental protection (Sharifi, 2019). Currently, ecological construction significantly reduces flood risk, mitigates the urban heat island effect, improves air quality, and protects biodiversity, becoming a crucial part of urban planning strategies to enhance resilience (Iqbal et al., 2021; Meerow and Newell, 2019).

2.2.2. Urban social resilience

Social resilience, a component of evolutionary resilience, combines sociology and resilience theories. It refers to the capacity to rebound when social systems face significant damaging forces (Adger, 2000; Iqbal et al., 2024). Research on social resilience has progressively expanded to include several dimensions such as community capacity, resilience, learning capacity, innovation ability, and coping capacity (Ribeiro and Gonçalves, 2019; Saja et al., 2019). Pandemics and other public health catastrophes require specific planning and construction centered around social resilience mechanisms (Hamdan et al., 2023). A stable social environment, encompassing various aspects such as health, education, capital, equity, demographics, employment, and safety, strengthens social resilience (Iqbal and Piwowar-Sulej, 2023; Jabareen, 2013). Furthermore, the involvement of several stakeholders is crucial in the development of resilient cities, where government, social organizations, communities, and people all contribute to urban resilience (Shevell and Denov, 2021; Therrien et al., 2021; Tian et al., 2021; Vogel, 2006). The engagement and cooperation among these stakeholders establish a framework of multi-stakeholder involvement and collaborative governance that enhances the city's overall resilience.

2.2.3. Urban economic resilience

Urban economic resilience is essential for both establishing and sustaining urban resilience. It not only provides the necessary resources and economic stability to create resilience, but it also plays a critical role in regulating and maintaining urban resilience. Research has shown a direct relationship between the urban economy and resilience. The extent and manner of economic growth have a beneficial influence on urban resilience, as do the development of infrastructure, social maturity, and the city's capacity to handle disruptions (Bai et al., 2019). Urban resilience is contingent upon elements such as economic variety, financial capacity, and economic vigour (Chen, 2019). Furthermore, a city's economy exhibits reduced reliance on the external economy while still retaining a robust connection to the outside world. This enables the city to effectively access a greater number of economic resources and mitigate potential disruptions (Cutter et al., 2014). The production-supply-consumption cycle contributes to a moderate level of economic efficiency in economic activities, which in turn speeds up the development of urban resilience. Conversely, higher levels of economic growth may result in increased production capacity, increased reliance on the environment, and escalating socioeconomic expenses, all of which can impede the progress of urban resilience (Bristow and Mohareb, 2020). Various aspects within the urban economy, such as the extent and arrangement of development, diversity, potential, dynamism, and capital reserves, shape urban resilience. Furthermore, the economy's capacity for innovation, its reliance on external factors, and its operational efficiency influence urban resilience.

2.3. Public service innovation

Public service innovation entails the use of novel concepts, technologies, approaches, and organizational structures. Its aim is to enhance the effectiveness, excellence, and fairness of public services while also addressing the increasing demands of the public (Mulgan and Albury, 2003). The development and execution of novel procedures, goods, services, and delivery approaches for providing public services lead to substantial enhancements in results, effectiveness, and quality of public services (Mulgan and Albury, 2003). Innovation involves incorporating new ideas or modifying existing ones in a different context to boost the effectiveness of public service delivery (De Vries et al., 2016). According to Rogers (2003), innovation is defined as an idea, activity, or thing that is considered new by an individual or group that adopts it. The concept of innovation also highlights the process of spreading the invention to others (Rogers, 2023). The public sector commonly employs this definition, particularly in relation to the dissemination of policies and the acquisition of policy knowledge. According to Osborne and Brown (2011), the public sector can use innovation to improve the quality and efficiency of services by implementing new or enhanced methods of management and delivery (Osborne and Brown, 2011).

3. Research methodology

3.1. Context and data collection

The statistical analysis of "resilient city" related literature in the China Knowledge Network (CNKI) database from 2003 to 2023 yielded a total of 2412 related documents. By using the "search" function of CNKI and filtering the topic of "resilient city," the visualization of research directions shows that the number of related research studies has shown an explosive growth trend in the past 20 years. The number of articles related to resilient cities was low in the first phase (2000–2014), with articles concentrating between 1 and 6, indicating that academics had not yet recognized the role it could play in the field. Thus, current study focuses on the resilient city context in China.

This study analyzes several different types of data such as primary data and secondary data to thoroughly evaluate the effectiveness of the city's urban resilience strategies and public service innovations implemented during the Shanghai pandemic. This study conducted comprehensive interviews with government officials, public policy experts, community secretary, community social workers, and social organization managers. Researchers collected primary data through direct and detailed interviews with Shanghai residents, volunteers, and property staff. The research employed secondary sources to obtain contextually pertinent data. The information sources comprised governmental reports, policy documents, and notifications released by the Shanghai Municipal Government.

3.2. Data collection approach

This study utilizes in-depth interviews, a qualitative research methodology well-suited for investigating intricate social phenomena, particularly when a profound comprehension of human experiences and viewpoints is necessary (Yin, 2018).

Documentation research entails a methodical analysis of existing material to collect pertinent information about a specific research question. Document data Analysis refers to the systematic gathering of pertinent documentary material for the purpose of study. The procedure involves identifying, retrieving, and organizing documents for research analysis. Collecting documentary data is crucial to guaranteeing that the data is thorough and accurately reflects the population (Rapley and Rees, 2018). This study primarily utilized documentary data collection to analyse urban resilience during the pandemic.

3.3. Participants

The sampling methodology employed in this study was purposive sampling, which is a strategic approach aimed at selecting participants who possess significant knowledge relevant to the research inquiry, as opposed to employing a random selection process (Patton, 2014). In the context of investigating public service innovation during the Shanghai pandemic, this study sought to integrate government officials, community clerks, community volunteers, and ordinary citizens viewpoints who had relevant experiences or backgrounds (Palinkas et al., 2015). To facilitate a thorough data collection process, it is essential for researchers to first articulate the research question and identify the specific information required, subsequently selecting participants with diverse experiences to ensure inclusivity by incorporating samples from various socioeconomic backgrounds within the community (Etikan et al., 2016; Palinkas et al., 2015).

Table 2. Participants list.

Participants	Number	Tools
Government officials	03-persons	In-depth interview
Community secretary	03-persons 4,5,6	In-depth interview
Social workers	04-persons 7,8,9,10	In-depth interview
Social organization manager	02-persons 11,12	In-depth interview
Community volunteer	02-persons 13,14	In-depth interview
Property staffs	05-persons 15–16, 17,18,19	In-depth interview
Community Residents	10-Salarymen	In-depth interview
	10-Retired persons (≥ 60 years)	In-depth interview
Public policy expert	02-persons 40,41	In-depth interview

Source: Author's own work (2023).

The analysis utilizes data from three complementary and corroborating sources to present the specific situation in a relatively objective and detailed manner. The first source is the officially published local chronicles and literature research materials, primarily the Shanghai city Information Yearbook. The website's design exhibits a strong versatility and a streamlined appearance, effectively conveying information related to digital governance, digital life, and digital security. The subjects are all civil servants responsible for formulating and implementing resilience governance and public service policies in Shanghai city. Leaders who have participated government officials, community secretaries, social workers, social organization managers,

community volunteers, property staff, and public policy experts, who are affected by policies, especially vulnerable groups, are interviewed primarily to understand the process of promoting related work. Multiple interviews are conducted with individuals at different times. through in-depth interviews and semi-structured interviews. The focus of the study was on the effectiveness of government urban resilience strategies, as well as the efficiency and quality of public service provision (**Table 2**).

3.4. Data validity

Throughout the data analysis phase, the author used a process of data triangulation to ensure the date's validity. This involved conducting in-depth interviews, researching relevant documents, and analyzing document data. Triangulation helps confirm the findings, reduce deficiencies from one method or one source, provide more insights, quickly pay attention and eliminate inconsistent data, and improve the validity and credibility of the study (Bans and Tiimub, 2021). The authors selected a minimum of three respondents for each interview group to minimize bias. Additionally, they substantiated and verified their findings by referencing official data. The writers meticulously recorded the interviews, subjected them to thorough analysis, derived suitable interpretations, and identified recurring themes. To strengthen the findings, the authors transcribed the initial interview transcripts into Chinese and translated some interview declarations that were directly relevant to this study into English.

3.5. Data analysis

The data analysis of interviews and in-depth interviews in this study mainly is thematic analysis, Subject analysis is a method of identifying, analyzing, and reporting on subjects in data. It minimally details, transferring the data recordings and paper transcripts of the interviews to a secure location, and then converting the interview data from audio to text. interview transcripts and data were analyzed using a thematic analysis approach. Data analysis process evolves around steps such as data familiarization, initial code generation, theme development, review of potential themes, and theme definitions. First, the authors transcribed the data from the digital files and the interview notes into text. The authors familiarized themselves with these materials by reading them and connecting them to the analytical framework. Second, the authors developed initial insights into the content and identified intriguing aspects. The authors utilized some of the initial code to aid in developing informal themes. Third, these codes helped the authors develop themes by grouping them systematically. Initially, there were many interrelated ideas, but the authors selected only those associated with the analytic framework. This phase refocused the analysis on a broader thematic level than the codes and involved categorizing the different codes. Fourth, this study ensured the accuracy and appropriateness of all themes for further elaboration, they were carefully examined and connected to the interview data. The selection of themes is a refinement of these themes, and authors need to read all the organized excerpts for each theme and consider whether they form a coherent pattern. Fifth, themes were defined to provide the reader with a sense of clarity that will help one to read and understand the meaning of these themes. By the end of this

process, each theme refined by the author is given a concise name that helps the reader grasp the theme's significance.

4. Findings

This study utilized a thematic analysis of the interview data to identify key themes. The author analyzed the interviews in five specific fields: ecological resilience, social resilience, organizational resilience, economic resilience, and infrastructural resilience.

5. Ecological resilience

In the process of responding to the pandemic, the Shanghai Municipal Civil Affairs Bureau had implemented an ecological resilience strategy through the PDCA cycle for waste management and environmental monitoring to adapt to new challenges and allocate resources effectively. This strategic framework not only enhances the resilience of society and institutions but also highlights Shanghai's strengths in urban system strategies and governance innovation (Fayez and Alanazi, 2022). Moreover, this approach considers the interconnection between human and environmental health, emphasizing the importance of sustainable interventions and environmental education in fostering sociological resilience (Chang, 2023). However, if hospital wastewater and solid waste are not properly managed, the risk of secondary transmission of the pandemic through water and air pathways may increase, potentially undermining the effectiveness of pandemic control efforts.

Based on the data analysis, the 2020–2023 pandemic in Shanghai posed significant challenges to urban resilience. In response, the Shanghai Municipal Government developed an urban resilience strategy, including the eco-resilience strategy focused on garbage sorting, wastewater treatment, solid waste management, and medical waste disposal. These initiatives presented challenges in terms of policy effectiveness by the government.

5.1. Strengthening waste management and pollution control

Effectiveness of proactive waste management measures has a significant impact on ecosystem biodiversity. To reduce the negative impacts on biodiversity, it is possible to adopt ecologically appropriate waste disposal techniques and implement steps to save or rehabilitate impacted ecosystems. In addition, waste management facilitates the practice of recycling and reusing materials, reduces the use of natural resources, and alleviates strain on ecosystems while improving their ability to recover. Efficient waste management also decreases the release of pollutants, therefore reducing the environmental impact and enhancing the stability and resilience of ecosystems.

Shanghai city has implemented stringent waste segregation procedures to address the significant increase in trash and medical waste during the pandemic. These methods aim to efficiently separate and treat home garbage and medical waste, thereby minimizing the potential for cross-contamination. Interviews with respondents established the veracity of these measures.

"We do face challenges in sewage treatment and domestic waste treatment. The volume of sewage treatment has declined in some areas due to reduced movement of people." (A government official, Interview#03).

"Urban sewage treatment, domestic waste treatment and other aspects have been affected to varying degrees. Due to reduced personnel movement, water inflow to some sewage treatment plants has decreased." (A public policy expert, Interview#41).

To prevent the spread of the pandemic, Shanghai city's garbage disposal process follows the policy by requiring that pandemic-related medical waste be handed over to a unit with the qualification of a hazardous waste business license for centralized disposal. Pandemic-related medical waste should be disposed of through incineration. Priority should be given to disposing of medical waste and garbage generated in sensitive areas such as sentinel medical institutions, isolation observation points, and fever clinics. The frequency of collection can be increased as needed. After arriving at the disposal site, it should be burned as soon as possible.

"For items that cannot be incinerated immediately due to capacity limitations, the company arranges for designated personnel to transfer them along with other medical waste, ensuring that everything is incinerated on the same day" (A Social organization manager, Interview#11).

"*The garbage of quarantined personnel will be collected and processed by dedicated personnel."* (Property staffs, Interview#19).

"Due to the pandemic, changes in hospital medical waste and residents' home life have led to an increase in the amount of special medical waste and domestic garbage" (A government official, Interview#1).

Official data from the Shanghai city Municipal Government shows that 100% of medical waste and medical sewage was collected, transported, and disposed of in a timely and efficient manner during the outbreak, ensuring that ecological resilience strategies were effectively pursued, and public services were efficiently implemented during the outbreak.

"This includes standardized collection, storage, transportation, and disposal of medical waste to achieve 100% full coverage of environmental supervision and service of medical facilities. Additionally, it is crucial to ensure 100% timely and effective collection, transportation, and disposal of medical waste and medical sewage" (A government official, Interview#2).

The above interviews demonstrated that there is higher special medical waste and domestic garbage along with lower sewage water which on one side requires designated personnel to transfer such waste on the other side, there is lower waste management and sewage treatment activities. On the same line, local government appointed designated personnel to collect and remove garbage from the quarantined premises. There was also need to arrange designated personnel were also called to immediately incinerate premises because of the fear of Covid-19 spread.

5.2. Reduced use of Urban green space

The pandemic has brought about significant changes in public spaces, most notably a substantial reduction in the use of public green spaces. Government

restrictions, health concerns about the virus's spread, and the emphasis on safe and essential activities have all contributed to the decline in usage. This reduced use of public green spaces has negatively impacted public health by limiting opportunities for outdoor exercise and social interaction, thereby adversely affecting residents' overall well-being. The authors learnt why by conducting interviews with the interviewers.

> *"During the pandemic, my family and I rarely visited public open places for physical activity due to concerns about potential transmission from large gatherings of people."* (A residents, Interview#22).

Interview analysis revealed that the fear of cross-infection was the primary reason for the low usage of green spaces during the pandemic. They could implement several approaches to address this issue. One effective solution would be for green space management departments to adopt an appointment system via mobile apps, which would help control the flow of visitors and thereby reduce the risk of infection.

6. Social resilience

Social resilience is essential in addressing pandemic since it influences a society's ability to manage, adjust, and recover from a crisis. Social resilience enables individuals and groups to effectively manage emergencies, minimize the adverse effects of crises, and expedite the recovery process by fostering mutual aid within the community, maintaining vital services, and providing psychological and emotional assistance. By enhancing social resilience, societies can improve their ability to successfully address present issues and be better prepared for future crises, ensuring long-term social stability and sustainable development (Adger, 2000; Berkes and Ross, 2013).

During the pandemic, the Shanghai Municipal Civil Affairs Bureau implemented a series of social resilience strategies aimed at enhancing the coping capacity and resilience of communities. The Shanghai Municipal Civil Affairs Bureau fostered cooperation and support among residents and promoted community mutual aid networks. The Shanghai Municipal Civil Affairs Bureau effectively assisted vulnerable groups, ensuring the availability of basic living resources and the continuity of social services. In addition, Shanghai Municipality mitigated the negative impact of social isolation by utilizing digital platforms to maintain social connections and provide remote services. The Shanghai Civil Affairs Bureau (2020) demonstrates how these social resilience strategies use collaboration, technology, and innovation to maintain the stability and health of society during a crisis (Shanghai Civil Affairs Bureau, 2020).

6.1. Pandemic monitoring and management capacity enhancement

The process involves enhancing the capacity of healthcare systems, public health agencies, and governments to effectively monitor, detect, respond, and manage pandemics. This refers to a range of measures and strategies aimed at enhancing the preparedness and resilience of healthcare systems to tackle the challenges presented by large-scale infectious disease outbreaks, like the pandemic.

Between 22 April and 27 April 2022, Shanghai designated around 20,000 daily nucleic acid sampling locations, deployed over 100,000 sampling teams, and established a maximum capacity to process more than 5 million test tubes for nucleic acid detection. Shanghai also announced 534 regular locations for nucleic acid sampling. The conference was on pandemic prevention and control in Shanghai on 27 April 2022.

One interviewee mentioned that there was a high level of community participation during the pandemic and that the social resilience strategies and policies implemented by the Shanghai Civil Affairs Bureau were well executed.

> *"We received newly procured sustenance and essential items bi-daily, which alleviated our distress. The distribution process was highly efficient, with the elapsed time between placing an order and getting the items typically not surpassing 48 hours".* (A resident, Interview#27).

> *"The Civil Affairs Bureau swiftly augmented the testing organization with supplementary testing equipment and more staff assistance, resulting in a significant increase in the daily testing capacity from 200 to 2,000."* (A government official, Interview#3).

The Shanghai Municipal Civil Affairs Bureau greatly improved its ability to monitor and manage the epidemic during the outbreak by efficiently allocating resources, enhancing testing capacity, and protecting the population's well-being.

6.2. Community services and supports strengthened

The Shanghai city Municipal Bureau of Civil Affairs has enhanced the capacity of community services by strengthening community preventive measures and providing residents with health counseling, medical assistance, and material support for living. strengthen the construction and operation of community service centers to provide more diversified social services, including medical services, psychological counseling, legal services, etc., to meet the diversified needs of residents. through interviews with community officials and community volunteers, community workers and staff of social organizations, the Shanghai city Municipal Bureau of Civil Affairs has given a full confirmation of the implementation of the measures provided by the city, and the government's work in the implementation of the process of work, in line with the general the government's implementation of its work is in line with the fundamental interests of the public.

> *"in terms of elderly care and medical care, online consultation and telemedicine services have been launched to reduce direct contact between people in terms of community assistance and unemployment, community grid management has been strengthened and more precise assistance measures have been provided".* (A Government official, Interview#2).

> *"..... established an emergency rescue system. By integrating medical resources, we have strengthened the construction of first-aid stations, equipped them with first-aid equipment and personnel, and improved the response speed and success rate of emergency rescue."* (A Government official, Interview#1).

"For elderly people with limited mobility, specially sent nucleic acid testing personnel will go directly to their homes to do nucleic acid testing to reduce the chance of cross-infection." (Volunteer, Interview#13).

The authors in the interview revealed that the Shanghai municipal administration has introduced online counselling and medicine services to reduce direct contact and lower the risk of infection. At the same time, they improved the community grid's management to provide more precise support measures. The municipal administration implemented an emergency rescue system and consolidated medical resources to enhance the efficiency and effectiveness of rescue operations. We have organized nucleic acid testing professionals to visit the homes of older individuals with restricted mobility to minimize the risk of cross-infection.

6.3. Building a support network for vulnerable groups

During the pandemic, the Shanghai Municipal Civil Affairs Bureau implemented a comprehensive *"policy to find people" network system* to support vulnerable groups such as the elderly, disabled, and low-income families. This system integrated online early warning mechanisms with offline community assistance, enabling precise relief efforts. We expanded community assistance advisors in both urban and rural areas, using regular visits and policy consultation to identify and assist individuals in need. The initiative also involved social organizations, professional social workers, and community members in identifying and reporting cases. This approach met the basic needs of disadvantaged groups, such as food, clothing, and shelter, and established a safety net to safeguard their well-being during the pandemic.

"Using the 'Policy to find people' network system, we can accurately identify vulnerable individuals in our community, including the elderly, disabled, and low-income families, who are experiencing hardship. Regular telephone maintenance ensures that their fundamental requirements are properly met". (A community worker, Interview#8).

"Daily necessities are basically guaranteed, but we are worried about the risk of unemployment or loss of income". (A resident, Interview#33).

According to the interviews, the *'Policy to find people' network system* solution assists community workers in precisely identifying vulnerable populations experiencing distress. Community workers maintain regular telephone communication to adequately fulfill the fundamental needs of these groups. However, despite the provision of necessities, some residents, especially the elderly, continue to worry about potential job loss or income reduction.

6.4. Increased volunteer activities

Volunteerism is crucial for developing social resilience, as it allows communities, particularly those who are vulnerable, to effectively organize, respond, and adjust to evolving dangers in a timely manner. Throughout the Shanghai pandemic, volunteers were ubiquitous, engaging in a wide range of activities, including aiding in the daily functioning of the Fangcang shelter hospital (The temporary medical facilities established in China during emergencies primarily treat mild cases to alleviate the burden on hospitals）, delivering medical assistance, and offering support to medical

personnel and community workers. Volunteerism has evolved from a solitary coping strategy to a crucial strategic asset for improving community resilience, encouraging social collaboration, mitigating risk, and supporting sustainable preventive actions by engaging a wide range of people from all sectors of society.

During the pandemic in Shanghai city, especially during the home quarantine period, the volunteers' main tasks were to do a good job in checking and registering, temperature and code testing, nucleic acid testing, order management, material distribution, garbage sorting, anti-pandemic propaganda, disinformation and foreign language translation, etc., and they worked together to build a solid barrier for the prevention and control of the pandemic, which was generally praised by the citizens and the public. The author interviewed three volunteers, and under the unified coordination of the Civil Affairs Bureau, the volunteer activities were carried out in an orderly manner, which protected the daily lives of the residents.

"Prior to the pandemic, my involvement in community volunteering was sporadic. However, during the pandemic, I actively participated in distributing essential supplies, assisting widows and orphans in procuring medications, and arranging for their medical requirements." (A volunteer, Interview#13).

"During the pandemic, the community observed a notable escalation in the number of volunteers, expanding from a small cohort to a considerable assemblage of several hundred people. During the pandemic, they organized and conducted nucleic acid testing by going door to door, and they also helped those who were in home quarantine buy necessary supplies." (A community secretary, Interview#5).

Based on the interviews, there was a substantial rise in the participation of community volunteers during the pandemic. During the outbreak, those who had previously only sometimes participated in community volunteering activities became more engaged. They actively contributed by giving essential items, assisting widows and orphans in purchasing medication, and organizing their medical requirements. Simultaneously, the quantity of community volunteers had a quick growth, transitioning from a tiny cohort to a multitude of hundreds. Volunteers coordinated and carried out door-to-door nucleic acid tests, as well as procured essential supplies for residents under house quarantine, showcasing the communal resilience in addressing the pandemic.

6.5. Innovative digitization and intelligence in public service models

During the pandemic, the Shanghai Municipal Civil Affairs Bureau developed a comprehensive digital platform, offering one-stop, multi-channel online services for citizens, including marriage registration, social assistance, and charitable donations. The Bureau also actively promoted the platform's convenience and guided the public on using these services through its official website and We-chat public account, ensuring full online processing of civil affairs matters.

The Civil Affairs Bureau has expanded the range of civil affairs services available online, now including services like marriage registration, social assistance, and charitable donations. This expansion aims to enable the public to conveniently complete necessary procedures and applications at home through the digital service

platform. The efficiency of residents has been enhanced through digital management, which was also reflected in interviews with residents.

"During the pandemic, when my unit laid off employees, I promptly applied for unemployment insurance through the internet platform. You can conveniently complete the online procedure from home, eliminating the need to visit the Civil Affairs Bureau". (A Resident, Interview#27).

"In case of emergencies, we report directly to the secretary of the neighborhood committee, who then reports to the superior department." (A community worker, Interview#7).

For businesses that require offline handling, the Civil Affairs Bureau has enhanced the online reservation system by increasing the number of available time slots and processing windows. This allows the public to select their preferred time for conducting business more flexibly, thereby preventing crowds and excessively long waiting times.

The Civil Affairs Bureau has established an online consultation platform and expanded the team of online customer service representatives to offer the public advice and guidance on marriage registration, social assistance, and other services. They aim to address public inquiries, offer timely assistance, and provide necessary support. The Civil Affairs Bureau (CAB) has intensified its promotion of online services through traditional media channels like television, radio, and newspapers, as well as social media platforms. The aim is to enhance public awareness and acceptance of online services and to encourage the public to actively utilize the digital service platform. on this point, some interviewees said:

"……the government launched one-stop services to promote E-government services, which made daily life more convenient for residents. The one-stop service also saved time for our statistics, and the application can facilitate residents' daily travel." (A community worker, Interview#9).

"I saw the promotion of the Civil Affairs Bureau's online services on television, and I easily completed my application for social assistance through WeChat. The online customer service also provided detailed guidance, which saved me a lot of trouble." (A resident, Interview#36).

The government's launch of one-stop E-government services has significantly improved daily convenience for residents, streamlining tasks like social assistance applications. As highlighted by a 61-year-old resident, the Civil Affairs Bureau's online services, promoted through television, allowed for easy application completion via We-chat with helpful guidance from online customer service, saving both time and effort.

During the pandemic, Shanghai's public service model underwent a progressive transformation from the conventional government-led approach to a collaborative model that engaged government, market, and social forces. We-chat, a digital platform, facilitated the collaboration and management of public services by combining resources and mobilizing the active involvement of grid workers, volunteers, property businesses, and citizens. The notion of "One Network Administration" has successfully motivated all stakeholders and established a unique model of collaborative governance. The software effectively facilitated self-centered group purchases by the community, which supported the government's efforts to

tackle the pandemic and enhanced the city's resilience. This form of digital governance emphasis the importance of collaboration, diversity, synergy, and shared responsibility. It aims to collectively protect the safety and stability of the city.

"During the pandemic, the 'One Network Administration' platform facilitated real-time monitoring of the health condition of community members. We successfully tracked the needs of individuals in home isolation using the platform. As soon as signs of fever appeared, the system promptly alerted them and informed medical personnel to provide quick follow-up." (A community worker, Interview#8).

"The 'One Network Administration' system enables us to efficiently identify and prioritize high-risk groups, particularly residents who have had contact with confirmed cases. The technology has the capability to automatically identify individuals who require close monitoring and alert us to schedule follow-up visits". (A community secretary, Interview#5).

Interviews revealed that the *'One Network Administration' platform* had a crucial impact on community administration during the pandemic. The platform facilitated the real-time monitoring of residents' health conditions by community workers, particularly those in home isolation. In cases of symptoms like fever, the technology promptly triggered an alert and notified medical personnel for swift follow-up. Furthermore, the platform effectively detects and prioritizes populations at high risk, particularly those who have had contact with proven cases, and ensures prompt monitoring of individuals who require targeted surveillance. These characteristics greatly improve the effectiveness and precision of pandemic prevention and control.

Digitization and intelligence have become the cornerstones of the new generation of digital technology. The feasible approach to enhancing urban society's resilience through digital empowerment entails integrating various fundamental urban operational data and utilizing intelligent data analysis tools to efficiently identify potential risks in urban operations. Shanghai is comprehensively advancing the urban digital transformation process across different subsystems of urban life.

6.6. Improvement of the social security system

Enhancing the social security system during the pandemic ensures that affected populations can maintain a basic standard of living, including access to food, medical care, and housing. This support helps alleviate economic strain, stability incomes, and promote social stability. By providing unemployment benefits, deferring contributions, and offering temporary assistance, the government aims to reduce disparities and enhance societal equity. Strengthening societal resilience is crucial for effectively managing future emergencies, mitigating social unrest, and fostering a sense of security and well-being among residents, ultimately contributing to social harmony and development.

To support individuals facing employment challenges, specialize social workers in community committees provide personality counselling and vocational training and oversee the dynamic management of these groups. Those participating in skills training or obtaining vocational certificates are eligible for full subsidies to enhance employment ability. Social workers also coordinate inter-departmental collaboration

to implement employment assistance measures effectively. Through comprehensive community surveys and timely registration, they gather crucial data on employment conditions and service needs, ensuring targeted and efficient support for disadvantaged groups.

> *"It was observed that at least one individual from a zero-employment family secured employment within one month of identification, while individuals categorized as 'persons with employment difficulties' found employment within three months of identification."* (A community worker, Interview#10).

> *"The social workers facilitated my participation in skills training and helped me obtain a full subsidy to cover the training expenses. Thanks to their assistance, I obtained my occupational qualification certificate and successfully secured employment"* (A resident, Interview#23).

Special subsidies or allowances are allocated to vulnerable groups, including low-income families, individuals with disabilities, widows, and orphans, to address their specific needs and essential living expenses, the participants made observations.

> *"......Shanghai city launched remote virtual window services and one-stop services. Elderly care, medical care, community assistance, unemployment, employment, community governance, social organization management and other services can be solved through one-stop service. Elderly people at home can use one-stop service platform It has completed emergency calls and meal assistance services for the elderly."* (A community secretary, Interview#4).

During the pandemic, the Shanghai Municipal Civil Affairs Bureau swiftly adapted by implementing innovative approaches, such as online services and intelligent management, to address emerging challenges. By enhancing interdepartmental collaboration and leveraging digital platforms, the bureau improved service delivery and bolstered the city's resilience. Citizen participation and feedback played a crucial role in driving public service innovation, which in turn strengthened trust in the government and increased social cohesion. These innovations not only enhanced urban emergency response mechanisms but also laid a solid foundation for the city to navigate future challenges effectively.

6.7. Multi-dimensional governance mechanisms

The global spread of COVID-19 has caused a worldwide public health crisis. China, adopting a people-centered approach, implemented strict social isolation measures, achieving significant success in pandemic control. In Shanghai, a mega city in China, the municipal government made key adjustments to its prevention strategy, focusing on scientific, precise, and effective measures. The large-scale movement of people and increased demand for public services required enhanced social resilience strategies. It became critical to stimulate grassroots social cohesion, cooperative self-governance, and resource sharing. This led to the reorganization of social governance, promoting an open and collaborative governance model. The community's diverse governance approach enabled more efficient integration of resources during pandemic prevention and control.

During the pandemic in Shanghai, the most notable development has been the prioritization of a "people-centered" strategy to improve community government for

the welfare of citizens. The active involvement of several community members in combating the epidemic has been critical to community governance for pandemic prevention and control. This approach emphasizes the idea of governance, which prioritizes individuals' needs and well-being in managing the epidemic. The interview process exemplifies the government principle that prioritizes the needs and rights of human migrants.

> *"The daily prevention and control of the pandemic is carried out by the building team leader and building volunteers. The elderly and disabled residents. The building volunteers. ensure timely delivery of medications, government subsidies."* (A social worker, Interview#9).

Significant approaches to promoting social resilience during pandemic prevention and control primarily involve reviving aging communities. the major metropolis, is characterized by numerous historic neighborhoods. During the pandemic in Shanghai city, we facilitated the active involvement of community members in all aspects of community revitalization. We advocated for the idea of engaging in discussions, constructing, governing, and collectively sharing the community. This model enabled community co-management and co-governance through the collaborative efforts of the Owners' Committee, the Residents' Committee, and the property owners. The autonomous decision-making of the residents and the expert administration of the property owners enhanced this collaboration. Given the current pandemic situation, it is crucial to prioritize the enhancement of community infrastructure, including water, electricity and heating networks, as well as public service amenities.

Prioritize the unique needs of marginalized groups, including the elderly, the sick, people with disabilities, and expectant mothers, to introduce changes that improve accessibility and create communal areas to foster a more welcoming and caring environment. The distribution of daily necessities to vulnerable populations aims to alleviate their daily life challenges and enhance their capacity to sustain their livelihoods and overall well-being. Streets, neighborhoods councils, and communities have formed partnerships to create peer-to-peer support teams specifically focused on assisting special populations. The following responses were obtained through conversations with the interviewees.

> *"Our neighborhood committees have specialized social workers responsible for Assisting special groups, providing primary family hardship support, employment services, and other essential assistance for daily life protection. This ensures that the community's vulnerable groups receive basic protection within the jurisdiction."* (A community worker, Interview#7).

During the pandemic, Shanghai city introduced a system of intelligent multi-body participation in shared governance to encourage the active involvement of individual residents, businesses, institutions and public welfare organizations in community development. The main strategy was using the Internet, community We-chat groups, and other information channels to enable smart linkages between citizens and different stakeholders. Regularly organized online events foster a sense of community identity, ultimately offering a convenient and effective method of intelligent collective governance.

7. Economic resilience

The ability to respond effectively and maintain sound economic performance and development in the face of external influences such as economic constraints, challenges or disasters. The Civil Service Bureau can take appropriate measures to mitigate economic shocks, enhance market confidence, ensure social welfare and address various adverse factors through adaptability, resilience and innovation. This ensures the long-term stability of the economy and the sustainable development of society. Participants mentioned that Shanghai city's economy experienced a downturn after the pandemic. This was attributed to three main factors: increased pressure from the economic downturn, increased investment in science and technology education, and the development and policies effectiveness to alleviate business challenges.

7.1. Downward pressure on the economy

The spread of the pandemic led to production shutdowns, disruptions in industry chains, and stagnation and fragmentation in labor-intensive industries. In 2022, the external environment had a significant economic impact due to the pandemic shock. As a highly open mega-city, the city of Shanghai's economic indicators clearly reflected the impact of the pandemic. The spread of the pandemic led to production shutdowns, stagnation and fragmentation at the end of the industrial chain, affecting labor-intensive industries. Following the resurgence of the pandemic in August 2021, the city's housing occupancy declined, and overall retail sales of consumer goods declined compared to the previous year. This information is based on data from Shanghai City Bureau of Statistics, Statistical Information.

> *"......shopping is restricted and all purchases have been switched to online shopping. Retail sales of consumer goods and manufacturing exports will be affected."* (A community secretary, Interview#4),
>
> *"Concepts of consumption have changed significantly since the pandemic. They prefer to cook and eat at home rather than go shopping. Social activities have decreased significantly, while the investments in family education have remained unchanged."* (A social worker, Interview#9),
>
> and *"Offline retail has suffered. Shops are closed. International orders have fallen significantly. The impact on import and export trade was significant. The impact on education and technology has been minimal."* (Government official, Interview#2).

The interviews revealed the widespread impact of the pandemic on consumer behavior and the economy. Shopping behavior has changed enormously, with the shift from physical stores to online platforms. This had a serious impact on offline retail and foreign orders and led to significant setbacks in import and export trade. At same time, consumers showed a preference for dining at home and engaging less in social activities, while levels of spending on home education remained constant. The pandemic had significantly less impact on the education and technology industries, which showed a certain level of resistance. Due to the pandemic, the population's propensity for personal consumption has decreased in the short term and their disposable income has decreased due to the economic downturn.

7.2. Increased investment in science and technology education

During the pandemic, school closures forced many educational institutions to switch to online education. The online education industry has experienced explosive growth. The rapid rise of various online education platforms and education technology companies has increased the demand for various software and hardware resources. As a result, investments in technology and education have also increased. The outbreak also accelerated developments in artificial intelligence, big data and the Internet of Things. During the outbreak, large amounts of data were collected and analyzed to enable virus traceability, pandemic prediction, and more.

> *"Investment in technology and education growth. This is because the city of Shanghai places great emphasis on and continually investment in technological innovation and education."* (A government official, Interview#1).

During the pandemic, the government increased funding for research and supported science and technology programs. To promote scientific and technological innovation, the government increased its investment in scientific research during the pandemic, focusing on funding scientific research projects related to the pandemic. Support for innovative enterprises and scientific and technological talents has also increased, encouraging them to actively participate in scientific and technological innovations. There have been breakthroughs that open additional opportunities for social development.

7.3. Refined and implemented policies for easing the difficulties of businesses

Due to the impact of the pandemic, the city of Shanghai has taken measures to reduce the burden on various types of business. Efforts are being made to reduce the burden on relevant industries, especially through the implementation of universal, such as value-added tax (VAT) credits and refunds, tax cuts, fee reductions, tax extensions, rent reductions and exemptions. Specifically, it includes four policy measures: First, the introduction of comprehensive VAT credit rebate refund. The second strategy is to improve the effectiveness of the tax and fee reduction policy by extending the scope of the "six taxes and two fees" reduction and exemption policy to small and micro-enterprises and individual industrial and commercial households. Thirdly, the deadline for filing tax returns has been extended. The fourth measure is to reduce or waive the housing rent for small and micro-enterprises, as well as individual commercial households. Small and micro-enterprises and individual commercial households renting government housing for production and business activities in administrative areas classified as medium to high risk for the pandemic in 2022 will be exempted from rent for six months. In other areas they are exempt from the three- month rent.

> *"During the pandemic, the Shanghai Municipal Government provided tax breaks and subsidies to small and medium-sized enterprises (SMEs) to stabilize jobs. This assistance helped our company overcome the difficulties."* (A social organization manager, Interview#12).

The government's efforts to alleviate the financial pressures faced by enterprises and promote business development and economic growth include providing funds

directly to enterprises or reducing their tax and fee burden. The Civil Affairs Bureau is offering direct financial grants to businesses affected by the pandemic to cover expenses such as rent, salaries and the procurement of pandemic prevention materials, thereby alleviating their financial burden. The Civil Affairs Bureau has established a special fund to support industries business significantly affected by the pandemic, such as hospitality, tourism and retail to help them cope with these challenging times.

8. Discussion

Through literature research and analysis of urban resilience strategies and public service innovations implemented by the Shanghai Municipal Civil Affairs Bureau (SMCA) during the pandemic, this paper identifies several key areas of effectiveness. We discuss each of these findings individually below, as they align with and significantly enhance the existing literature's perspectives.

8.1. Ecological resilience

This study reveals that Shanghai has made substantial progress in increasing its ecological resilience through reduced urban green space utilization and improved waste management practices. This study contradicts the work of Beatley's (2016) that emphasis on the significance of urban green spaces for the mental health of people and ecosystem services. Instead, it proposes that restricting the use of green spaces during pandemics can effectively mitigate disease transmission. It can assist in reducing the spread of diseases. This discrepancy may arise due to urban management's tendency to prioritize short-term, efficient emergency solutions over the long-term ecological advantages of green spaces during critical health crises. This study proposes that implementing Eco spatial management strategies (such as minimizing the use of urban green areas) can have a significant impact on preparing for pandemics and similar health crises. This discovery contributes to the current body of knowledge on ecological resilience, indicating that ecological resilience encompasses not just environmental preservation but also the capacity to address public health emergencies.

8.2. Social resilience

This study demonstrates that Shanghai has successfully enhanced its social resilience through the improvement of its social security system, the reinforcement of its ability to monitor and control epidemics, and the use of digital and intelligent public service models. According to van Dijk (2020) digital governance has the potential to worsen social inequality, particularly in regions with a substantial digital difference. This study reveals that digital public services in Shanghai exhibit a high level of efficacy, notably in their ability to effectively engage marginalized populations. This finding contradicts van Dijk's perspective to some extent such as Shanghai's robust digital infrastructure, coupled with the high level of digital knowledge among its residents, helps to alleviate the negative effects of digital governance. This study reveals that the use of digital public services and smart governance not only strengthens social resilience but also greatly enhances the effectiveness of providing support to disadvantaged populations. This implies that in a setting with improved

digital infrastructure and digital literacy, digital governance not only does not worsen inequality but also successfully improves social inclusion and resilience.

8.3. Economic resilience

According to this study, Shanghai has successfully stabilized its economic fundamentals and established the foundation for future economic expansion by increasing long-term investments in science and technology, education, and the adoption of relief measures. Nevertheless, certain literature, exemplified by N. Talab (2012) proposes that depending on government intervention could undermine the fragility of the economic system and restrict the market's capacity for self-regulation. This study demonstrates that Shanghai's economic strategy and government action successfully managed the impact of the pandemic shock, contrasting with Talab's perspective. Such as the city of Shanghai has a unique economic framework and a high level of proficiency in executing policies, making government involvement a highly effective method. This study emphasizes the significance of allocating resources to education to enhance economic resilience. It suggests that education is not only crucial for sustainable economic development but also serves as a vital tool for stabilizing the economy during times of crisis. This discovery enhances the current body of knowledge on the significance of fiscal policy and investment in research and technology. It also highlights the distinct role that investment in education plays in promoting economic recovery.

8.4. Limitations and future directions

This study has numerous limitations which offers horizons to future avenues. First, this study focuses on the city of Shanghai. Although the strategies and insights gained from this analysis are valuable, they may not be directly applicable to other cities, particularly those that have distinct differences in terms of their economy, social structure, or infrastructure conditions compared to Shanghai. Therefore, the findings may have limited applicability to other situations or populations. Future research might prioritize the exploration of strategies for effectively coordinating with diverse stakeholders to address complex and unpredictable threats within urban systems. Second, this study primarily examined the impacts of policy effectiveness. However, due to limitations in time and resources, it did not explore the potential immediate and long-term consequences of policy effectiveness. Subsequent research may provide additional information on these potential negative effects. Future studies could focus on investigating the use of environmentally friendly infrastructure, particularly in relation to the spatial distribution possibilities that match the China 2035 plan. Third, this study primarily examines the immediate response and short-term effects during the pandemic, but it does not thoroughly investigate how these resilience techniques and public sector improvements will be sustained in the long term. Consequently, the study is available for additional verification to determine if these strategies will be equally effective and flexible in future emergencies.

9. Conclusion

This study investigates the effectiveness of resilient strategies for public service innovation during the pandemic. The research focuses on exploring how these resilience strategies were effectively applied to ensure the continuity and effectiveness of public services, as well as identifying the innovative public service solutions that emerged from these resilient strategies.

The results of the study show that the Shanghai Municipal Civil Affairs Bureau has effectively improved the city's overall ability to withstand and recover from the pandemic by through the implementation a series of resilience methods and innovative public services. In terms of infrastructure, Shanghai ensured the reliability of key public facilities through the implementation of online education and intelligent transportation systems. In economic terms, it stabilized the financial situation and supported businesses through investments in science, technology and education and the implementation of relief measures (Piwowar-Sulej and Iqbal, 2023). Shanghai has strengthened its social security system and community support network, thereby strengthening its social resilience. Shanghai has advanced ecological sustainability by implementing strict waste management and pollution control measures, contributing to ecological resilience. These actions not only effectively addressed the various issues caused by the epidemic in Shanghai but also offered vital lessons and models for the city's long-term stability and management of future crises.

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