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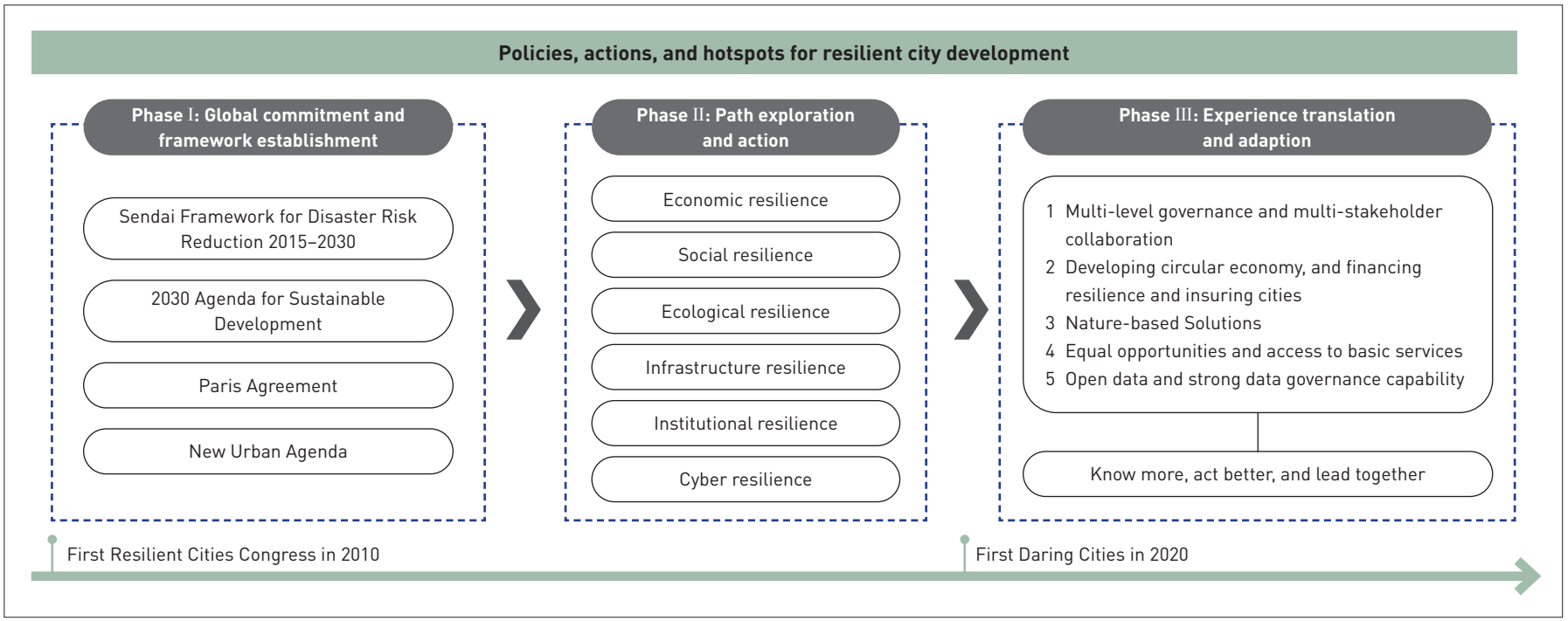
From Resilient Cities Congress to Daring Cities: Policies, Actions, and Hot Trends of Resilient City Development

Na CHEN[1,2,*], Zhuojun LEI[1,2], Hui XIANG[1,2], Jin PENG[3], Bernd NENTWIG[4]

1 School of Architecture and Planning, Hunan University, Changsha 410082, China
2 Hunan Key Laboratory of Urban and Rural Human Settlement Science in Hilly Areas, Changsha 410082, China
3 School of Management, Technical University of Munich, Munich 80333, Germany
4 Faculty of Architecture and Urbanism, Bauhaus University Weimar, Weimar 99423, Germany

*CORRESPONDING AUTHOR
Address: No. 97, Pailou Road, Yuelu District, Changsha 410082, Hunan Province, China
Email: chenna825@hnu.edu.cn

GRAPHICAL ABSTRACT



ABSTRACT

The Resilient Cities Congress (2010 ~ 2019) and the Daring Cities (2020 to present) were the pioneering annual global platforms showcasing the latest advancements in international research and practices of resilient cities. They have been instrumental in fostering the growth and collaborative efforts of resilient cities across the globe. Drawing from the materials and scholarly work presented at these congresses, this research comprehensively reviews the evolution of resilient cities over the last decade through the lenses of policies and actions, summarizing the cutting-edge and current trends. The journey of global resilient cities unfolds in three phases of global commitment and framework establishment, path exploration and action, and experience translation and adaption. Resilience building and financing based on multi-level actions, multi-stakeholder collaboration, and community participation have consistently been the core themes of the Resilient Cities Congress series. Emphasizing the leading role of local governments in such actions and taking into account the social, environmental, and economic dimensions, multi-disciplinary and cross-sectoral cooperation and innovation is the key to achieving resilience and overall sustainable development. Moreover, in response to the

new challenges and opportunities of the digital age, efforts to strengthen the cyber resilience by building a healthy and safe cyber environment are vital enhancers of sustainable urban development. Finally, the article reflects how the insights and accomplishments stemming from the Resilient Cities Congress series can inform resilient city research and practices in China. It advocates for a strategic approach that aligns with China's unique conditions and urban characteristics, encouraging the adaptation and contextualization of resilient initiatives to craft localized and region-specific plans for building resilient cities across the nation.

KEYWORDS

Resilient City; Daring City; Policy Review; Action Path; Hot Trends; Cyber Resilience

HIGHLIGHTS

- Reviews the global resilient city development from 2010 to present based on the Resilient Cities Congress series and Daring Cities
- Summarizes the hotspots and actions of resilient city development and focuses and key paths of resilient city construction
- Discusses emerging opportunities, challenges, and strategies of resilient city development, such as cyber resilience in the digital era
- Discusses the experience and achievements of the Resilient Cities Congress series and their implications for China's resilient city research and practice

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1 Introduction

In recent years, with rapid urbanization, the global landscape of science and technology, industry, energy, and finance has undergone profound changes. Concurrently, emergencies or sudden events including natural disasters (e.g., heat waves, droughts, storms, floods, sea level rise, hurricanes, earthquakes, pandemics), human-induced disasters (e.g., oil spills, nuclear contamination, ecosystem collapses), and socio-economic crises (e.g., political conflicts, social frictions, and economic downturns) are posing unrelenting threats to regional environment and security. The concept of "resilient city," as an important principle in contemporary urban planning, emphasizes that the capacity of urban systems to absorb the impacts and pressures caused by uncertain events while maintaining essential functions, structures, and characteristics[1]. The construction of resilient cities has become an indispensable approach to achieving sustainable urban development.

The Resilient Cities Congress, initiated by ICLEI (International Council for Local Environment Initiatives)–Local Governments for Sustainability (ICLEI hereafter), was first held in Bonn, Germany in 2010, as the first annual global forum dedicated to resilient cities studies[2]. In 2020, the Resilient Cities Congress was renamed the "Daring Cities," with the aim of building on the legacy of the Resilient Cities Congress series, enhancing the leadership role of governments, researchers, business leaders, and community organizers in urban decision-making process when responding to emergencies or sudden events, and forming new methods of urban governance and multi-stakeholder partnership models[3]. The Resilient Cities Congress series has urged and witnessed the development and transition of resilience concepts, making it become a mainstream policy and paradigm influencing planning decisions and urban governance from simply a topic of urban planning[4]. The Resilient Cities Congress series not only provide a global platform for governors, officials, and scholars concerned with resilient city research and practice to exchange research results, showcase practice cases, and share technological innovations, but also continuously track the progress of local achievements in sustainable development and resilience goals. However, few studies have conducted systematic review or experience summarization from the materials and outcomes of the Resilient Cities Congress series and relevant policies and actions in the overall process of resilient city development. Therefore, this study comprehensively compiles the latest international consensus, research hotspots, and action cases gathered at the Resilient Cities Congress series and Daring Cities from 2010 to 2023, and accordingly divides the global

resilient city development into three phases, and summarizes the global experience of resilience actions, offering a cutting-edge perspective and empirical references for China's resilient city development.

2 The Concept and Connotation of Resilient City

The concept of "resilience" was first proposed by ecologist Crawford Stanley Holling to measure the ability of ecosystems to absorb changes of various factors and still persist[5]. Later, with the expansion of its application scope from Systems Ecology to Engineering, Social Sciences, Economy, and other fields, the connotation of "resilience" has been continuously enriched[6][7]. Broadly speaking, the concept of "resilience" has evolved from "engineering resilience" (before 1973) to "ecological resilience" (1973 ~ 1998) and further to "social-ecological resilience" (after 1998), while developing richer conceptual and extended meanings as the adaptive cycle framework established in the social-ecological resilience phase has been adopted by other disciplines[8]. Specifically, engineering resilience emphasizes the capacity of a system to return to its original state, measuring resilience in terms of how quickly a system recovers to equilibrium after disturbance, and is considered a form of "centripetal" stability.[5][9][10] Unlike the single ultimate equilibrium state underscored in engineering resilience, ecological resilience recognizes the existence of multiple equilibrium states, measured by the extent or degree of disturbance a system can withstand before transitioning from the current state to another; it views equilibrium as a series of polycentric, progressive development stages, and emphasizes the capacity of sustainability.[5][9][11] Social-ecological resilience, emerging from the theory of "complex adaptive system," views equilibrium as a decentered, cyclical evolutionary process, while resilience as the capacity of complex social-ecological systems to adapt to changes and stay within critical thresholds in response to pressures and constraints[12]~[14]; which can help cities better balance the sustainable development in environmental, social, and economic dimensions. Although the research scope and connotations of the above concepts differ, the academia widely recognized that the essence of "resilience" is a system's capacity to absorb external shocks and maintain its main functions during crises[15].

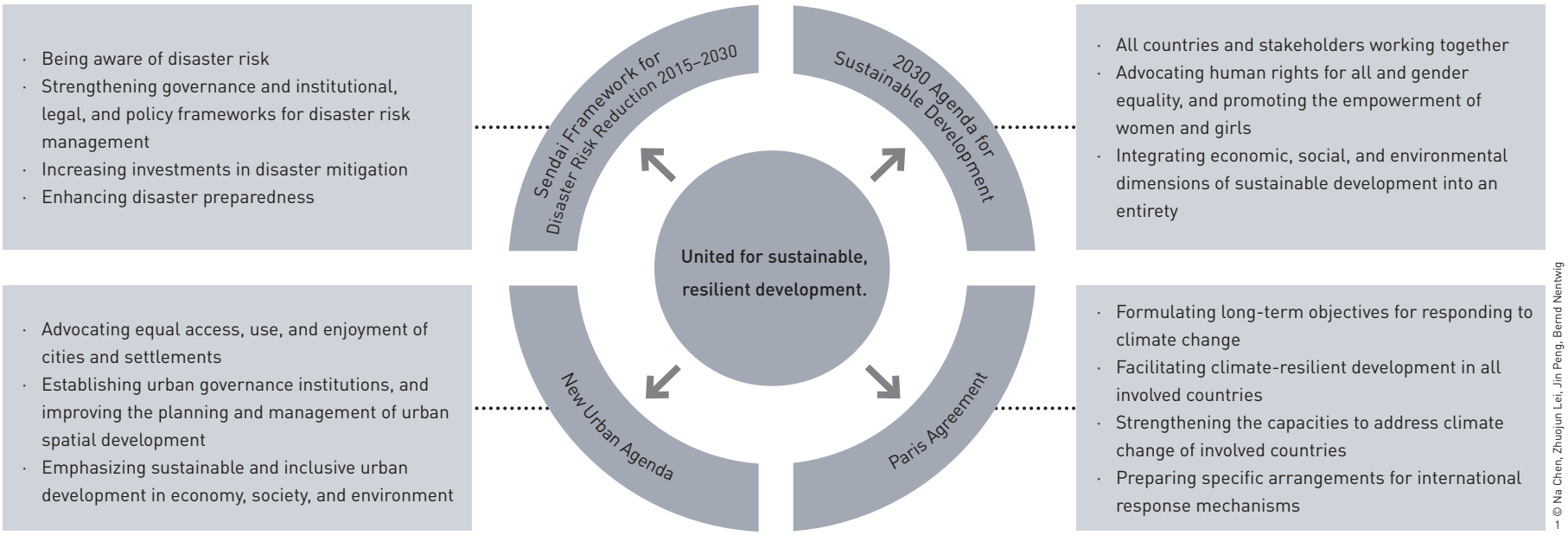
With the gradual integration of resilience concepts into the studies on cities, as typical social-ecological systems, coupled with related application in the fields of urbanization, urban systems, sustainable development, and climate change response, "resilient city" has begun to receive widespread attention from scholars at home and abroad[16]. ICLEI posits that resilient cities are those capable of absorbing and recovering from any shock or stress, while maintaining their essential functions, structures, and identity, adapting and thriving to continual changes[2]. The construction of resilient cities, as an important component of urban planning and governance, is also an effective complement and extension of sustainable urban development[17].

3 Evolution and Development of Resilient Cities

3.1 Global Commitment and Framework Establishment: City Transformation and Paradigm Shift (2010 ~ 2016)

With the joint efforts of countries around the world over these years, "all levels of government are now united to decrease disaster risk and losses, to reduce the impacts of climate change, and to pursue inclusive, sustainable, and resilient development," covering social, economic, and environmental sustainability[18]. Global frameworks developed during this period include the Sendai Framework for Disaster Risk Reduction 2015–2030 (adopted in 2015), which established four prioritized areas for actions and shifts the focus of the disaster response from loss management to risk reduction[19]; the 2030 Agenda for Sustainable Development (adopted in 2015), which announced 17 Sustainable Development Goals (SDGs) and 169 targets, determined to end poverty in all its forms and dimensions[20]; the Paris Agreement (adopted in 2015) based on sustainable development and poverty eradication, which established a long-term goal to achieve a balance between anthropogenic emissions and removals of greenhouse gases, and aimed to make financial flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development[21]; the New Urban Agenda (adopted in 2016), which proposed a vision of cities for all by building urban governance structure, to promote a paradigm shift toward more resilient, sustainable, inclusive, and equitable development[22] (Fig. 1). The establishment of such global commitments and frameworks highlights the importance that governments and international organizations attach to sustainable and resilient development, while pointing the way to a global urban transformation that sees local governments as key stakeholders and contributors. It also promotes multi-level governance and multi-stakeholder collaboration, which stress the "leadership role" of national governments, while recognizing the significance of decentralization and national urban policy[23].

Upon established resilient city studies[4], this study decomposes the resilient city system into economic, social, ecological, infrastructure, institutional, and cyber subsystems[24][25], and



1. Global commitments and frameworks for resilient city development.

corresponds to the 17 SDGs[20] to the six subsystems (Table 1). It can be found that the first five subsystems are concerned correspondingly with the urban economic and industrial systems[26], the community/public capacity to cope with stresses[27], the maintenance of ecosystem services[28], the resilience of the built-up urban structure and key infrastructure[27], and the capacity of governmental and non-governmental organizations to act on risks in a preventive/organizational and managerial manner[29]. For cyber resilience, the sixth subsystem, the development of information technology has brought unprecedented opportunities and challenges to cities: on the one hand, the Internet of Things (IoT), big data, and cloud computing have improved the efficiency of city management, the level of city intelligence, and the quality of city life; on the other hand, there might be severer risks in information and communications technologies, as cyber-attacks and leakage of sensitive city information and personal privacy data have increased dramatically[30][31]. Cyber resilience, which emphasizes the ability of communication technology systems to maintain services in the face of cyber-attacks, natural or man-made disruptions[4], is becoming an indispensable supplement to the SDGs. Focusing on cyber resilience not only ensures safer cities, but also promotes innovation and explores the path of digital transformation in cities.

3.2 Path Exploration and Action: Collaborative Initiatives and Practice Monitoring (2016 ~ 2019)

In 2016, New Urban Agenda, a global framework for resilient city development was adopted, marked the shift of focus of resilient city development from establishing global commitments and framework towards collaborative implementation of plans and finding of pathways[32]. International collaborative initiative such as Transformative Actions Program, Climate KIC initiative[18], Connecting Nature[33][34], UrbanByNature, and East Asia Clean Air Cities[35] have been launched to strengthen the basis for the engagement and cooperation at national, regional, and local levels. These efforts have deepened the ground for the comprehensive development of resilient cities among multi-stakeholders including public and private sectors, communities, and citizens, clarified the respective responsibilities. During this period, a great number of countries and cities, together with relevant international organizations focused on the dimensions of economic, social, ecological, infrastructure, institutional, and cyber resilience of resilient city construction, and facilitated the widespread practice for inclusive, sustainable, and resilient urban development.

This study summarizes the hot topics of global resilient cities research and practice and selected action cases gathered by the Resilient Cities Congress series (Table 2)[4][18][32][35][36]. It is witnessed that the development of resilient cities actively responds to urgent

Table 1: The linkages between resilient city subsystems with 17 SDGs

Resilient city subsystem	17 SDGs
Economic resilience Financing resilience; insuring cities; circular economy; green production, consumption, employment, and economic development	**Goal 1:** End poverty in all its forms everywhere **Goal 8:** Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all **Goal 12:** Ensure sustainable consumption and production patterns
Social resilience Inclusive social governance; health and food security; enhanced social cohesion; cities for all	**Goal 2:** End hunger, achieve food security and improved nutrition and promote sustainable agriculture **Goal 3:** Ensure healthy lives and promote well-being for all at all ages **Goal 4:** Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all **Goal 5:** Achieve gender equality and empower all women and girls **Goal 11:** Make cities and human settlements inclusive, safe, resilient and sustainable
Ecological resilience Response to the impact of climate change on ecological environment; Nature-based Solutions; ecosystems and biodiversity conservation	**Goal 13:** Take urgent action to combat climate change and its impacts **Goal 14:** Conserve and sustainably use the oceans, seas and marine resources for sustainable development **Goal 15:** Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
Infrastructure resilience Critical infrastructure projects such as lifeline engineering and building renovations; energy security and innovation; sustainable mobility	**Goal 6:** Ensure availability and sustainable management of water and sanitation for all **Goal 7:** Ensure access to affordable, reliable, sustainable and modern energy for all **Goal 9:** Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
Institutional resilience International cooperation driving global balanced development, multi-level governance and multi-stakeholders collaboration	**Goal 10:** Reduce inequality within and among countries **Goal 16:** Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels **Goal 17:** Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development
Cyber resilience Integration of multi-source big data; digitalization; artificial intelligence; Internet of Things (IoT)	

NOTE

City insurance refers to the initiatives, actions or measures that ensure local and regional governments to identify mixed sources for funding their resilience and sustainability projects (e.g., grants, private sector loans, bonds, taxes), while helping them understand insurance industry's role in integrated disaster and climate risk management (source: Ref. [4]).

climate change at the policy level, manifested in the formulation of climate-adaptation planning and strategies, providing scientific and overarching guidance for the implementation of actions.
At the practical level, the focus is on risk management and the development of various urban subsystems by carrying out risk assessment and disaster prevention to reduce losses, while identifying high-risk and vulnerable areas for targeted promotion of resilience, adaptability, and recovery of cities. In the development of resilient city subsystems, it prioritizes advocating for cooperative mechanisms based on multi-level governance and by multiple actors including private enterprises, insurance sector, communities, and the public. Active exploration is conducted in fields of the circular development of green economy, fair and inclusive social governance, Nature-based Solutions, eco-mobility, infrastructure upgrading and energy security, food health and sanitation management, and open data sharing and governance in the age of digitalization, aiming to pursue the coordination and sustainability of economic, social, and environmental development.

3.3 Experience Translation and Adaption: Daring Exploration and Innovation (2020 to present)

In 2020, the Resilient Cities Congress was held as online forums

Table 2: Action cases of resilient city construction collected by the Resilient Cities Congress 2016 ~ 2019 and their associations with the resilient city subsystems

Year	Action case	Associated resilient city subsystem					
		Economic	Social	Ecological	Infrastructure	Institutional	Cyber
2016	Guimarães, Portugal: Municipal Strategy for Adapting to Climate Change			√	√		
	Dhulikhel and Dharan, Nepal: Climate Adaptive Water Management Plans for Cities in South Asia			√	√		
	Copenhagen, Denmark: a Storm Surge Plan and several flood simulations and risk assessments			√	√		
	COP 22: Marrakech Partnership for Global Climate Action, to catalyze action amongst nations and climate stakeholders to develop action plans and principles for the Sustainable Development Goals					√	
	Baltimore, USA: Baltimore Food Waste and Recovery Strategy	√	√				
2017	Kampala, Uganda: local government worked with grassroots refugee organizations to improve infrastructure in vulnerable areas and help refugees integrate into the local job market and the society	√	√		√		
	Munich, Germany: Climate Insurance Initiative and Climate Risk Insurance Plus	√		√		√	
	Amman, Jordan: promoted community engagement to help refugees integrate into the society	√	√				
	Stuttgart, Germany: introduced tax incentives and specific financial packages to complete its green roof expansion strategy	√		√			
	Ulaanbaatar, Mongolia: joined the Building Efficiency Accelerator program to accelerate local government's implementation of building efficiency policies	√			√		
	Edmonton, Canada: proposed Open City Initiative, which sets up an open data catalogue to provide an interactive and open-source database for climate change adaptation and resilience strategy			√		√	√
	Germany: developed the Smart City Charter, which establishes four key guidelines for digital transformation		√		√	√	√
2018	Denver, USA: 2018 Denver Food Action Plan, to promoted food equity, security, and sustainability	√	√				
	Zamboanga City, Philippines: improved its capacity responding to typhoons by identifying and protecting key biodiversity areas			√			
	COP 24: Talanoa Dialogues, calling for multi-level governance		√			√	
	ICLEI: CitiesWithNature, inviting cities and their communities and experts to share policies, plans, commitments, actions, and results related to nature and ecosystems services		√	√		√	
	UNEP and ICLEI jointly launched the Insurance Industry Development Goals for Cities, exploring financing resilience and insuring cities in response to disaster risks	√				√	

(Continued)

Table 2: Action cases of resilient city construction collected by the Resilient Cities Congress 2016 ~ 2019 and their associations with the resilient city subsystems (Continued)

Year	Action case	Associated resilient city subsystem					
		Economic	Social	Ecological	Infrastructure	Institutional	Cyber
2019	Ningbo, China: the first Urban Resilience and Climate Adaptation Training Series for Chinese cities, conducting a preliminary assessment on the city's resilience of disaster prevention and mitigation	√	√	√	√	√	
	AMARE-EU: announced four European pilot cities to develop low-cost and easily-applicable solutions for community participation and multi-cultural inclusion for urban vulnerable groups		√		√		
	ICLEI East Asia: the Green Circular Cities Coalition, creating opportunities for cities and regions in East Asia and Europe to go beyond the linear "take–make–dispose" extractive industrial model towards a more sustainable environment with improved quality of life	√		√			

and was renamed the "Daring Cities," with the focus shifted towards summarizing the existing resilient city actions over the past few years and the sharing of exemplary efforts and innovative resources. Building upon the experience and legacy accumulated in the previous decade, Daring Cities, co-organized by the municipal government of Bonn, Germany and ICLEI–Local Governments for Sustainability, continues to mobilize multiple-level governments and multiple stakeholders to boldly explore urban risks and disaster response strategies[37]. In the face of various "black-swan" risks, "daring" signifies ambitiously exploring and addressing uncertainties, and represents a unanimous belief and a firm call for action on crises such as climate change, which needs the engagement from UN, leaders of involved nations, local governors to communities and the public[3]. The 2023 Daring Cities saw the participation of more than 322 cities from 97 countries. It gathered perspectives on global climate actions, with activities such as the Voices of Daring Cities and Daring City Podcast, to turn pioneer cities' empirical exemplary action experiences into common resources adaptable and practical by other cities and communities[38].

In addition, the Daring Cities highlights the critical role of all-level decision makers of cities in urban disaster risk reduction and climate adaptation capabilities, and the importance of building allied partnerships. It provides a new framework for resilient city action framework and a reference for governance methods. Under the belief of "know more, act better, and lead together"[3], the framework emphasizes the sharing and acquisition of case knowledge to improve the understanding of climate change crises and coping strategies, and to support and motivate effective actions. Supported by this foundational framework, the Daring Cities has discussed about a number of themes such as Nature-based Solutions, circular economy, food systems, social cohesion, sustainable urban mobility, and the opportunities and challenges posed by digitization, and promoted and shared exemplary local actions, resilience-building cases, and experiences in responding to disaster risks[3].

Synthesizing the cases of global pioneering resilient city and regional construction cases from the Daring Cities, the experience of resilience actions can be summarized in the following five aspects.

1) Multi-level governance and multi-stakeholder collaboration. Improving multi-level governance mechanisms at the global, national, regional and local levels, carrying out multi-level actions, and guiding and promoting cooperation among governments, private sectors, and communities are key to addressing the challenges of disaster risks and enhancing cities' resilience and adaptability against disasters.

2) Developing circular economy, and financing resilience and insuring cities. To alleviate environmental pressures, it is critical to develop circular economy that relies on eco-friendly resources,

promote green production, consumption, and employment modes, and reduce carbon emissions; moreover, improving the financial literacy of local governments, enhancing effective communication with financial institutions and the insurance industry, and formulating local financing mechanism for adaptive resilience programs and ensuring adequate financial support are necessary conditions for building resilient cities.

3) Nature-based Solutions. Enhancing urban ecological resilience by restoring, protecting, and managing ecosystems and biodiversity, enabling cities and natural ecosystems to effectively adapt to and mitigate crises such as climate change, are fundamental to the construction of resilient cities.

4) Equal opportunities and access to basic services. To enhance social resilience that is essential to resilient city construction and matters people's well-beings, it should prioritize the fulfillment for the needs of vulnerable groups and addressing issues such as poverty, social exclusion, and unemployment among resettled urban residents; strengthen infrastructure construction to ensure that all residents have equal access to safe food, health care, medical service, education and employment opportunities, etc.; and improve the social cohesion, inclusiveness, and engagement of cities and communities.

5) Open data and strong data governance capability. Main measures include harnessing the application potential of multi-source big data and communication technologies to efficiently support governments in open, transparent, and reliable urban planning decision-making and governance; addressing cybersecurity and data privacy issues by increasing investment and maintenance of the protection and technology of reliable information, improving the relevant industry standards, and regulating the environment for cyber resilience development. Also, maintaining critical reflection on the progress of new technologies, paying attention to the limitations and negative effects of data and algorithms, recognizing the irreplaceability of human's independent thinking and analytical decision-making, and scientifically utilizing the synergistic effect of artificial intelligence to empower the digitalization, intelligence, and sustainable development of resilient cities are also important.

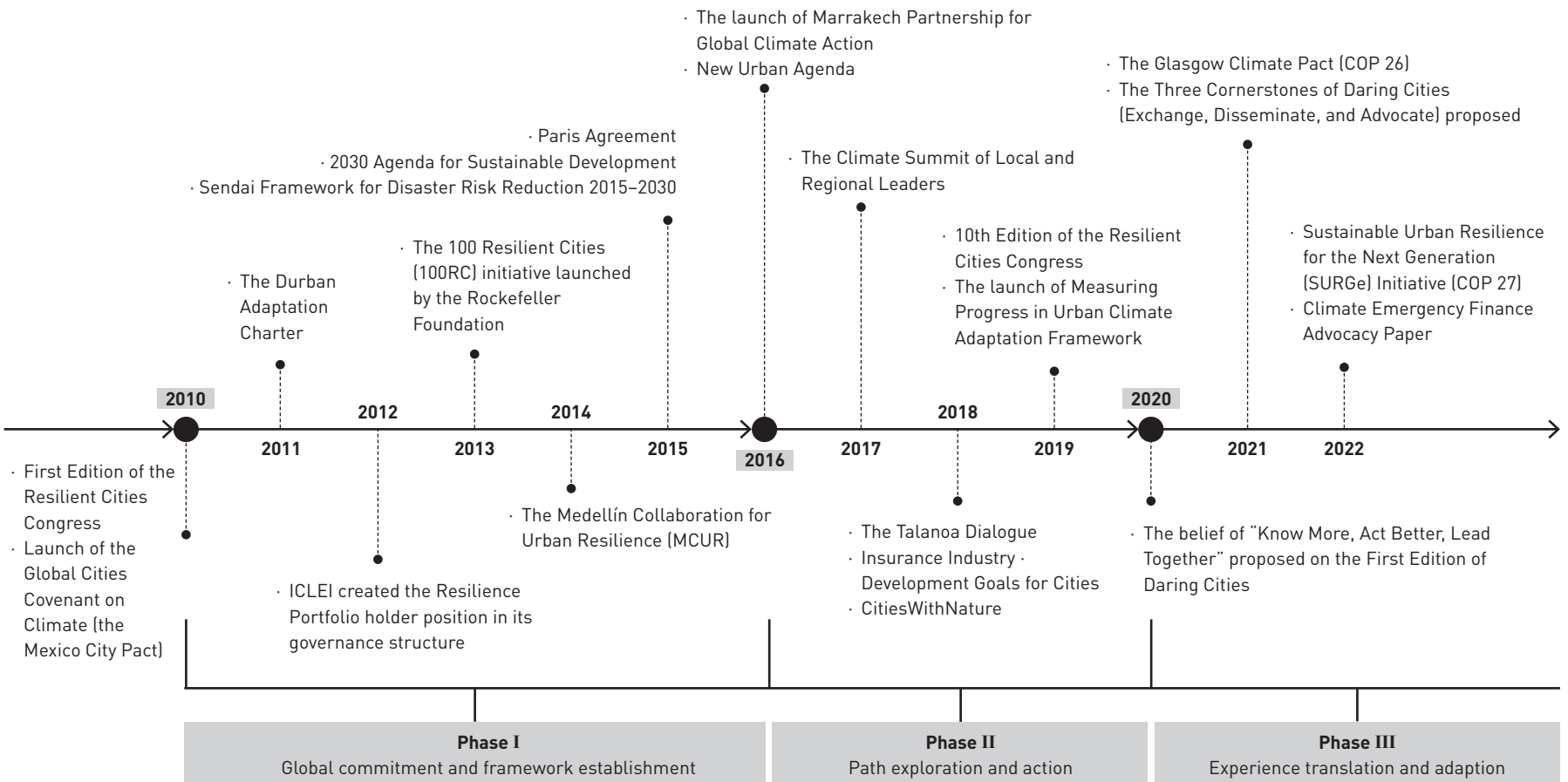
4 Conclusions and Discussion

According to UN's statistics and projections, 68% of the population will reside in urban areas by 2050, and the growth of the world's urban population in the next few decades will be concentrated in developing regions of Africa, South Asia, East Asia, and Southeast Asia[39]. In this context, the construction of resilient cities emerges as a critical aspect for achieving sustainable urban development, particularly in developing countries[4] which are socially and economically fragile, insufficient to withstand disaster risks, and more vulnerable to external disturbances and negative impacts. Thus, there is an urgent need for these countries to learn from and adopt the experience of resilient city development into effective local actions.

Throughout the previous Resilient Cities Congress series, the development of resilient cities in the past decade has evolved from theoretical exploration, framework establishment, and formulation of target strategies towards the implementation of regional and local actions and follow-up assessment, while integrating theoretical research into political decision-making that has in turn driven the progress of urban sustainable development. During this period, more than ten authoritative international climate conventions and initiatives were launched (Fig. 2). Resilience building and financing based on multi-level actions, multi-stakeholder collaboration, and community participation have consistently been the core themes of the Resilient Cities Congress series, and also the pivotal areas for resilient city development. Emphasizing the role of local governments as the leading actors in such actions and taking into account the social, environmental, and economic dimensions, multidisciplinary and cross-sectoral cooperation and innovation is the key to achieving resilience and overall sustainable development.

Nowadays, with the development of big data and analytics technology, the construction of resilient cities not only requires deepening implementation at economic and social aspects, but also necessitates a series of effective measures in the field of cyber resilience to seize opportunities and mitigate risks, where information technology can and will play a vital role. For example, by promoting the integration and interactive sharing of multi-source data, enhancing information protection and technology governance capabilities, and improving technological governance mechanisms, a healthy and safe cyber development environment can be built and thus cyber resilience and the sustainable development of cities can be strengthened in the digital era.

Looking ahead, it is crucial to further promote local resilience actions and practices, and to put more efforts in filling the gaps of empirical research on resilient cities. It is of great practical significance to translate international resilience development results and action experience into localized efforts both in theory and practice at the national, regional, and city scales, so as to promote the full implementation of climate action and resilience building worldwide. China's resilient city research has gone from



2. The international climate conventions and initiatives launched over the past decade presented by the Resilient Cities Congress series (source: Refs. [3][4][37][38]).

the recognition and introduction of resilience-related concepts to its own theoretical establishment and application practice. Through the joint efforts by governments, scholars, and technicians, China has advanced the conceptual connotation development of resilient cities in economic, social, and ecological dimensions, yielding substantial research and practice results while the construction of resilient cities becoming a national policy and strategic agenda. However, at the macro level, there remains a gap between the interpretation of resilient city policies and the implementation in the multi-level governance process at national, regional, and local scales; also, the issue of unbalanced and inadequate development of resilient city construction is still outstanding. At the micro level, the spontaneous community governance capacity and the public's participatory initiatives in coping with the risks have yet to be tapped. These problems should be responded to through the establishment of a comprehensive, systematic, and adaptive framework and step-by-step action plans at multiple scales, from community, local, regional to national. The experiences and results contributed by the Resilient Cities Congress series not only provide methodological guidance for China's resilient city development and governance, but also offer a reference of pathways for more developing countries and transitioning countries. Notably, Chinese cities are often large in number and scale and with complicated and unique localities. Additionally, considering the differences in institutional, cultural, economic, and social backgrounds, as well as public needs, between China and the pioneer countries, there is an urgent need for China to formulate flexible and differentiated methods and targeted solutions in the process of resilient city construction.

Competing interests | The authors declare that they have no competing interests.

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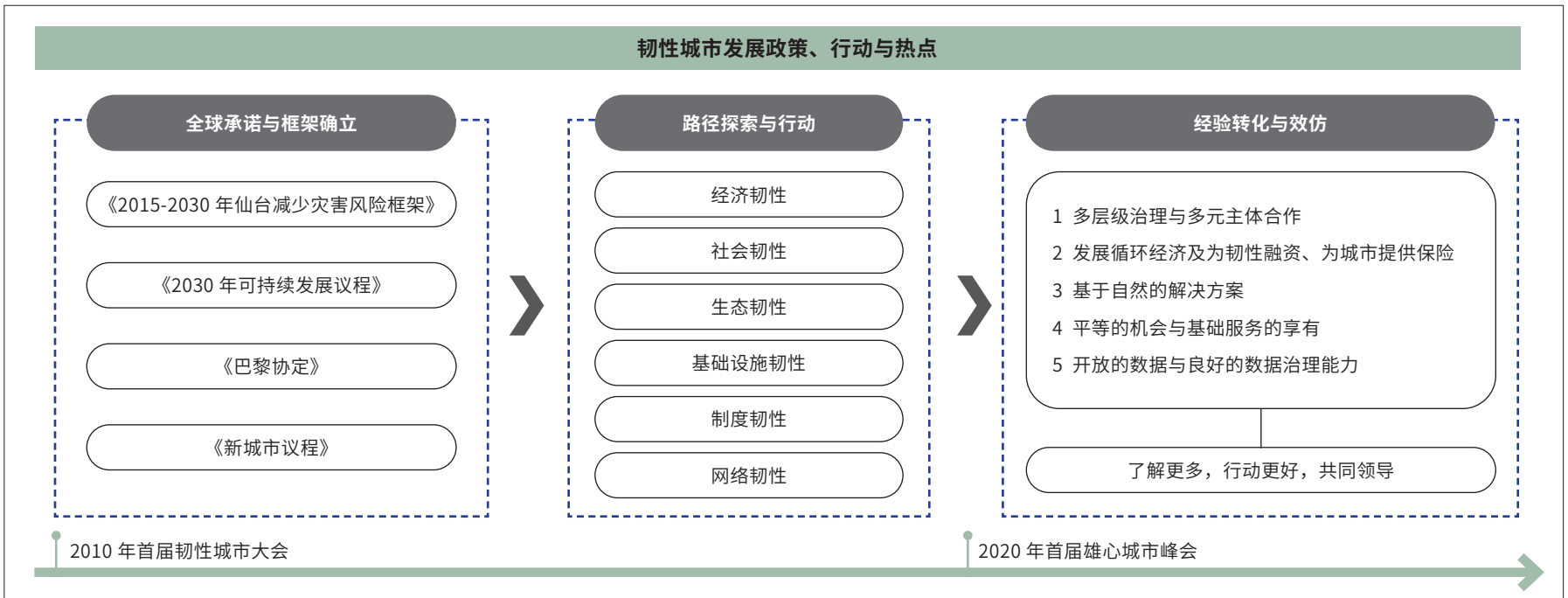
从韧性城市大会到雄心城市峰会：韧性城市发展政策、行动与热点

陈娜[1,2,*]，雷卓君[1,2]，向辉[1,2]，彭瑾[3]，伯尔德·南特维格[4]

1 湖南大学建筑与规划学院，长沙 410082
2 丘陵地区城乡人居环境科学湖南省重点实验室，长沙 410082
3 德国慕尼黑工业大学管理学院，慕尼黑 80333
4 德国魏玛包豪斯大学建筑与城市规划学院，魏玛 99423

***通讯作者**
地址：湖南省长沙市岳麓区牌楼路97号
邮编：410082
邮箱：chenna825@hnu.edu.cn

图文摘要



摘要

韧性城市大会（2010~2019年）和雄心城市峰会（2020年至今）是首个聚焦国际韧性城市研究与实践最新进展的年度全球论坛，持续推动了全球韧性城市的发展与合作。基于大会相关资料及文献，文章从政策、行动与热点视角梳理了十余年来韧性城市的发展进程，总结了韧性城市发展的前沿重点及最新动态。概括而言，全球韧性城市的发展经历了“全球承诺与框架确立－路径探索与行动－经验转化与效仿”三个阶段。基于多层次行动、多利益相关者合作和社区参与的韧性建设及融资是历届韧性城市大会的核心主题；坚持以地方政府为核心角色，兼顾社会、经济与环境三方面，进行多学科、跨领域的合作与创新是实现韧性与整体可持续发展的关键所在；面对数字化时代的新兴挑战与机遇，建

设健康、安全的网络发展环境，从而有效提升网络韧性，是推动数字化时代下城市可持续发展的有力补充。文章最后探讨了韧性城市系列大会的经验与成果对中国韧性城市研究与实践的启示，建议针对中国国情与城市特点，推动吸收转化韧性行动经验，并积极实现各城市和地区韧性建设方案的本土化调整。

关键词

韧性城市；雄心城市；政策梳理；行动路径；热点趋势；网络韧性

文章亮点

- 从韧性城市大会和雄心城市峰会视角梳理了2010年至今全球韧性城市发展进程
- 梳理韧性城市发展热点领域与行动案例，总结韧性城市建设重点内容与关键路径
- 讨论数字化时代网络韧性等新兴韧性城市发展机遇、挑战及应对措施
- 探讨韧性城市系列大会的经验与成果对中国韧性城市研究与实践的启示

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1 引言

近年来，随着城市化进程的快速推进，全球科技、产业、能源、金融等方面的格局发生了深刻变化。与此同时，自然灾害（如热浪、干旱、暴雨、洪涝、海平面上升、飓风、地震、流行病）、人为灾害（如石油泄漏、核污染、生态系统崩溃）及社会经济危机（如政治冲突、社会冲突、经济危机）等突发事件对地区环境及安全也造成了极大威胁。“韧性城市”作为当代城市规划的重要理念，强调城市系统应该具有吸收不确定事件造成的冲击与压力，并维持其基本功能、结构和特征的能力[1]，建设韧性城市已逐渐成为城市可持续发展的必要实现途径。

为了共享国际韧性城市研究的最新进展，由宜可城—地方可持续发展协会（以下简称“宜可城”）发起的“韧性城市系列大会”于2010年在德国波恩召开，成为首个关于韧性城市研究的年度性全球论坛[2]。2020年，大会更名为“雄心城市峰会”，旨在继承韧性城市大会的传统与经验，并增强政府、研究人员、商业领袖及社区组织者等城市决策相关者在应对突发事件时的领导作用，形成新的城市治理方法与多元主体合作模式[3]。韧性城市系列大会敦促和见证了韧性理念的发展与变革，使之从城市规划的相关议题逐渐成为影响规划决策及城市治理的主流政策与范式[4]。韧性城市系列大会不仅为全球关注韧性城市研究与实践的政府管理者和专家学者提供了一个讨论研究成果、展示实践案例、分享技术创新的平台，还持续跟踪了各地在实现可持续发展和韧性目标方面的进展。然而，极少有研究对韧性城市系列大会及韧性城市发展整体进程中的相关政策与行动进行系统梳理与经验归纳。因此，本研究全面梳理了2010~2023年间历届韧性城市大会及雄心城市峰会汇集的最新国际共识、研究热点及行动案例，据此将全球韧性城市发展划分为三个阶段展开评述，并总结了韧性行动经验，以期为中国韧性城市的发展提供前沿视角与经验参考。

2 韧性城市的概念及内涵

“韧性”概念最早由生态学家克劳福德·斯坦利·霍林提出，用来描述生态系统吸收各种因素变化并保持稳定状态的能力[5]。而后，随着应用范畴从系统生态学扩大到工程、社会学、经济学等领域，“韧性”的内涵不断得到拓展[6][7]。概括而言，“韧性”概念由“工程韧性”（1973年前）逐渐向“生态韧性”（1973～1998年）和“社会—生态韧性”（1998年后）演变，同时因社会—生态韧性阶段的适应性循环框架被其他学科所采用而发展出更为丰富的概念与延伸意义[8]。“工程韧性”强调系统恢复到原始状态的能力，以系统受到干扰后恢复平衡状态的速度来测量韧性的强弱程度，被认为是一种“向心式”的稳定性。[5][9][10]有别于工程韧性追求的单一终极平衡状态，“生态韧性”认为存在多重平衡

状态，并以系统从当前状态向另一种状态转换前承受扰动的大小或程度来衡量，将平衡视为多中心、递进式的发展阶段，强调可持续发展的能力。[5][9][11]“社会—生态韧性”产生于“复杂适应系统”理论，认为平衡是一种去中心化的、循环式的演进过程，韧性则是复杂社会—生态系统为回应压力和限制条件而被激发的一种适应变化、保持在临界阈值内的能力[12]~[14]，有助于城市更好地平衡环境、社会和经济发展，实现可持续发展等目标。虽然上述概念所涉及的研究范围及内涵都存在显著差异，但学界普遍认为“韧性”最基本的含义是系统所拥有的化解外来冲击并在危机出现时仍能维持其主要功能运转的能力[15]。

随着韧性概念逐渐融入城市这一典型社会—生态系统的研究中，以及在城市化、城市系统、可持续发展和气候变化应对等领域的应用，“韧性城市”开始受到国内外学者的广泛关注[16]。宜可城认为，韧性城市是指能承受任何冲击或压力并从中恢复，同时保持其基本功能、结构和特征，不断适应变化、繁荣发展的城市[2]。韧性城市建设作为城市规划与治理的重要内容，也是可持续城市化发展的强有力补充和扩展[17]。

3 韧性城市的演进与发展

3.1 全球承诺与框架确立：城市转型与模式变革（2010~2016年）

在世界各国多年的共同努力下，全球达成了追求包容、可持续和韧性的发展共识，构建了“团结一致促进可持续和韧性发展”的承诺及发展框架，内容涵盖灾害风险管理，气候变化危机应对，社会、经济、环境可持续发展等[18]。这一时期形成的全球框架包括：《2015–2030年仙台减少灾害风险框架》（2015年通过），确立了四个优先行动领域，将灾害应对重点从管理损失转向减少风险[19]；《2030年可持续发展议程》（2015年通过），宣布了17项可持续发展目标和169个具体目标，旨在消除一切形式和表现的贫困[20]；《巴黎协定》（2015年通过），在可持续发展和消除贫困的基础上，确立全球应对气候变化威胁的长期目标为实现温室气体人为排放与清除之间的平衡，使资金流动符合温室气体低排放和气候适应型发展的路径[21]；《新城市议程》（2016年通过），提出“人人共享的城市”，建设城市治理机构，推进城市范式向更具韧性、可持续性、包容性和公平性的方向转型[22]（图1）。全球承诺及框架的确立凸显了各国政府与国际组织对于可持续发展和韧性发展的重视，也为全球城市转型指明了方向，将地方政府视为关键利益相关方和贡献者，提倡多级治理和多元利益相关者协作——在强调国家政府的“引领作用”的同时，肯定权力下放及国家城市政策的重要作用[23]。

本研究参考既有韧性城市研究[4]，将韧性城市系统分解为经济、社会、生态、基础设施、制度、网络六个子系统[24][25]，并将《2030年可持续发展议程》[20]中的17项可持续发展目标对应至六个子系统中（表1）。可以发现，前五个子系统分别关注城市经济与产业系统[26]、社区／公众应对压力的能力体现[27]、生态系统服务功能的维持[28]、城市建成结构和关键基础服务设施的抗灾能力[27]、政府和非政府组织对风险的预防／组织和管理行动能力[29]。就网络韧性而言，信息技术的发展为城市带来了前所未有的机遇与挑战：一方面，物联网、大数据、云计算等提高了城市管理效率、城市智能化程度和城市居民生活质量；另一方面，网络攻击、城市敏感信息及个人隐私数据泄露的风险也大幅提高，潜在的信息和通信技术风险急剧扩大[30][31]。网络韧性强调通信技术系统在受网络攻击、自然或人为破坏时维持服务的能力[4]，正在成为《2030年可持续发展议程》发展目标之外不可或缺的拓展与补充。重视网络韧性不仅可以确保城市更加安全，也可以促进城市的创新发展，探索城市的数字化转型道路。

3.2 路径探索与行动：合作计划和实践跟踪（2016~2019年）

2016年，韧性城市发展全球框架《新城市议程》通过，韧性城市发展的重点从建立全球韧性承诺及发展框架转向为协力实施计划与路径探索[32]。于是，为推进综合、可持续且具有韧性的城市发展，激发跨国、跨市和跨学科的创新和伙伴关系，国际上展开了“变革性行动计划”、“KIC气候倡议”[18]、“连接自然”[33][34]、“城市与自然共生”及“东亚清洁空气城市”[35]等系列合作计划，增强了国家、区域和地方层面，以及公私部门和社区、公众等多元主体间的共同参与及合作基础，深化并明确了韧性城市全面发展共识与各方职责。在此期间，众多国家和城市及相关国际组织在经济、社会、生态、基础设施、制度与网络韧性六个热点领域集中开展了广泛的韧性城市建设实践，积极合作推动城市包容、可持续和韧性发展。

本研究梳理了韧性城市系列大会汇集的全球韧性城市研究与实践的热点主题及部分行动案例（表2）[4][18][32][35][36]。可以发现，韧性城市发展在政策层面积极响应紧急气候变化，体现为气候适应性规划与战略的制定，为行动实施提供了科学的纲领性指导；实践层面则重点关注风险管理与城市各子系统的发展，一方面大力开展风险评估与灾害预防工作以减少损失，另一方面通过甄别高风险、脆弱性地区，有针对性地推动城市的抗灾能力、适应力与恢复力建设。在韧性城市子系统的发展中，首要的是提倡基于多层级治理与私营企业、保险部门、社区和公众等多元主体的合作机制，积极探索绿色经济循环发展、公平和包容性的社会治理、基于自然的解决方案、生态出行、基础设施提升与能源安全、粮食健康与卫生管理、数字化时代开放数据共享与治理等方面，追求经济、社会与环境的协调与可持续发展。

3.3 经验转化与效仿：大胆探索与创新（自2020年起）

2020年，韧性城市大会形式由线下会议转为线上论坛，并更名为雄心城市峰会，开始着重对过去几年广泛的韧性城市行动进行总结，致力

表 1：韧性城市子系统与《2030 年可持续发展议程》可持续发展目标对比

韧性城市子系统	与之对比的《2030 年可持续发展议程》可持续发展目标
经济韧性 为韧性融资，城市保险，循环经济，绿色的生产、消费、就业与经济发展方式	**目标 1：**在全世界消除一切形式的贫困 **目标 8：**促进持久、包容和可持续的经济增长，促进具有充分的生产性就业和人人获得体面工作 **目标 12：**采用可持续的消费和生产模式
社会韧性 包容性社会治理，健康与粮食安全，增强社会凝聚力，人人共享的城市	**目标 2：**消除饥饿，实现粮食安全，改善营养状况和促进可持续农业 **目标 3：**确保健康的生活方式，促进各年龄段人群的福祉 **目标 4：**确保包容和公平的优质教育，让全民终身享有学习机会 **目标 5：**实现性别平等，增强所有妇女和女童的权能 **目标 11：**建设包容、安全、有抵御灾害能力和可持续的城市和人类住区
生态韧性 气候变化对生态环境的影响及应对，基于自然的解决方案，生态系统与生物多样性保护	**目标 13：**采取紧急行动应对气候变化及其影响 **目标 14：**保护和可持续利用海洋和海洋资源以促进可持续发展 **目标 15：**保护、恢复和促进可持续利用陆地生态系统，可持续管理森林，防治荒漠化，制止和扭转土地退化，遏制生物多样性的丧失
基础设施韧性 生命线工程、建筑改造等基础设施建设，能源安全与创新，可持续出行	**目标 6：**为所有人提供水和环境卫生并对其进行可持续管理 **目标 7：**确保人人获得负担得起的、可靠和可持续的现代能源 **目标 9：**建造具备抵御灾害能力的基础设施，促进具有包容性的可持续工业化，推动创新
制度韧性 国际合作带动全球均衡发展，多层级治理结构，多方利益相关者合作	**目标 10：**减少国家内部和国家之间的不平等 **目标 16：**创建和平、包容的社会以促进可持续发展，让所有人都能诉诸司法，在各级建立有效、负责和包容的机构 **目标 17：**加强执行手段，重振可持续发展全球伙伴关系
网络韧性 多源大数据交互整合，数字化，人工智能，物联网	

注

城市保险指确保地方和区域政府拥有可资助其韧性和可持续性项目的多种资金来源（如赠款、私营贷款、债券、税收等）来实施倡议、行动或措施，它们也能帮助地方和区域政府了解保险业在灾害和气候风险管理中的综合作用（来源：参考文献 [4]）。

于呈现示范性的探索与创新资源供全球共享。在前十年所积累经验与资源的基础上，雄心城市峰会由德国波恩市政府和宜可城共同策划，继续动员多级政府与多方利益主体共同大胆探索城市风险灾害应对策略[37]。在各种“黑天鹅式”风险的威胁下，“雄心”意味着雄心勃勃地与各种不确定性进行有计划的大胆探索与博弈，代表着从联合国、各国领导人、地方领袖到社区、公众等对于对气候变化等危机应对行动的一致信念与坚定呼吁[3]。2023年雄心城市峰会有97个国家、322个城市参与。雄心城市峰会汇集了全球气候行动的相关观点，开展了“雄心城市之声”“城市交流播客”等活动，将基于实证的先锋城市示范性行动经验转化为其他城市和社区可适应和效仿的共同资源[38]。

此外，雄心城市峰会还突出了各类城市决策者在提升城市减灾防灾和气候适应能力行动中的关键作用及构建合作伙伴关系的重要性，提供了新的韧性城市行动框架与治理方法参考。该框架确立了“了解更多、行动更好、共同领导”三大支柱理念[3]，强调通过案例知识的分享和获取增进对气候变化等危机及应对策略的理解，支持和激励有效行动的开展。在基础框架的支撑下，雄心城市峰会探讨了基于自然的解决方案、

表 2：2016~2019 年间韧性城市大会汇集的韧性城市行动案例与相关韧性城市子系统对照

年份	行动案例	与之相关的韧性城市子系统					
		经济	社会	生态	基础设施	制度	网络
2016	葡萄牙吉马良斯市制定适应气候变化的市政战略			√	√		
	尼泊尔杜利凯尔市和达蓝市制定“南亚城市气候适应性水管理计划”			√	√		
	丹麦哥本哈根市提出“风暴潮计划”，对洪水风险进行模拟和风险评估			√	√		
	联合国气候变化大会第 22 次缔约方会议启动“马拉喀什全球气候行动伙伴关系”项目，倡导各国政府和利益相关者合作为可持续发展目标制定行动计划和原则					√	
	美国巴尔的摩市出台了“巴尔的摩食物浪费与食物回收战略”	√	√				
2017	乌干达坎帕拉地方政府与基层难民组织合作，改善贫困地区基础设施并帮助难民融入当地就业市场和社会	√	√		√		
	德国慕尼黑市提出“气候保险倡议”，推进“气候风险保险附加计划”	√		√		√	
	约旦安曼市利用社区参与协助难民融入社会	√	√				
	德国斯图加特市推出了税收优惠和特定金融方案，完成其绿色屋顶扩张战略	√		√			
	蒙古乌兰巴托市加入“建筑能效加速器”项目，加快地方政府实施建筑能效政策	√			√		
	加拿大埃德蒙顿市提出“开放城市计划”，建立“信息公开目录”，为气候变化适应性和韧性战略制定提供互动式开源数据库			√		√	√
	德国智慧城市对话平台制定《智慧城市宪章》，确立四项数字化转型的关键指导方针		√		√	√	√
2018	美国丹佛市提出“2018 年丹佛粮食行动计划”，促进粮食公平、提高食品安全和可持续性	√	√				
	菲律宾三宝颜市通过确定和保护其关键的生物多样性区域，提高了应对台风的能力			√			
	联合国气候变化大会第 24 次缔约方会议开启“塔拉诺阿对话”，倡导多层级治理		√			√	
	国际地方环境倡议理事会发起“城市与自然”倡议，邀请城市，社区和专家等利益攸关方分享与自然和生态系统服务相关的政策、计划、承诺、行动和成果		√	√		√	
	联合国环境规划署与宜可称共同启动“城市保险业发展目标”，讨论应对灾害风险的韧性融资与城市保险	√				√	

（续表见下页）

表 2：2016~2019 年间韧性城市大会汇集的韧性城市行动案例与相关韧性城市子系统对照（接上表）

年份	行动案例	与之相关的韧性城市子系统					
		经济	社会	生态	基础设施	制度	网络
2019	中国宁波市举行城市韧性和气候适应能力系列培训，完成了对宁波市城市韧性与防灾减灾能力的评估	√	√	√	√	√	
	AMARE- 欧盟项目在四个欧洲城市开展试点工作，开发低成本且易于应用的社区参与及多元文化包容性的解决方案，协助城市弱势群体参与城市的韧性建设		√		√		
	宜可诚东亚秘书处启动“绿色循环城市联盟”，为欧亚城市提供合作机会，摆脱传统“开采 – 生产 – 丢弃”采掘式的线性经济模式，迈向更具可持续性、生活质量更高的美好未来	√		√			

循环经济、粮食系统、社会凝聚力、可持续城市流动性与数字化带来的机遇与挑战等多项主题，推动并分享了相关应对灾害风险的模范性地方行动、韧性建设案例与经验[3]。

综合基于雄心城市峰会汇集的全球先锋韧性城市、地区建设案例，韧性行动经验可以概括为以下五方面。

1）多层级治理与多元主体合作：完善全球、国家、区域及地方等多层级政府治理机制，开展多层次行动，引导和促进政府与私营部门、社区间的合作是应对灾害风险挑战、提升韧性城市适应力与抗灾能力的关键所在。

2）发展循环经济及为韧性融资、为城市提供保险：发展依靠生态型资源的循环经济，创造绿色生产、消费、就业等经济方式，减少碳排放，缓解环境压力；提高地方政府金融素养，增进与金融机构、保险业的有效沟通，为当地制定适应性韧性融资机制，为韧性行动提供充足资金支持，这是开展韧性城市建设的必要条件。

3）基于自然的解决方案：恢复、保护和管理生态系统与生物多样性，增强城市生态韧性，使城市与自然生态系统有效地适应和应对气候变化等危机，这是韧性城市建设的基本要求。

4）平等的机会与基础服务的享有：重视弱势群体需求，解决城市中被安置居民的贫困、社会排斥和失业等问题；加强基础设施建设，确保所有居民享有平等的粮食、健康、医疗、教育和就业机会等服务，建设具有强社会凝聚力、包容性及高公众参与度的城市和社区，增强社会韧性是体现韧性城市这一社会体本质、关乎增进人民福祉的根本内容。

5）开放的数据与良好的数据治理能力：挖掘多源大数据与通信技术的更多应用潜能，使其高效服务于开放、透明、可靠的政府城市规划决策与治理；针对网络安全与数据隐私问题，加大对可靠性信息保护与技术的投入及维护，完善相关行业标准，规范网络韧性发展环境。同时，保持对新技术进步的批判性反思，关注数据与算法本身的局限性与负面效应。正确认识人的独立思维与分析决策的无可替代性，科学利用人工智能协同作用，赋能韧性城市数字化、智能化和可持续化发展。

4 结论与讨论

根据联合国的统计和预测，到2050年，68%的人口将居住在城市地区，而未来几十年世界城市人口的增长将主要集中在非洲、南亚、东亚、东南亚的发展中地区[39]。在此背景下，韧性城市建设是实现城市可持续发展的关键所在。尤其是社会、经济较为脆弱的发展中国家[4]，其抵御灾害风险的能力不足，所受外界干扰与负面影响的表现也更为显著，迫切需要学习韧性城市发展经验并转化为有效行动。

纵观历届韧性城市系列大会，近十余年来韧性城市的发展已经从理论研究、框架与目标策略制定等宏观层面，逐步落实到区域、地方的行动实施及后续评估，同时将理论研究上升到政治决策，反向推动城市可持续发展工作的开展。期间发布了权威性的国际气候公约与倡议十余项（图2）。基于多层次行动、多方利益相关者合作和社区参与的韧性建设及融资一直是历届韧性城市系列大会的核心主题，也是韧性城市发展的重点领域。而坚持以地方政府为建设行动中的核心角色，兼顾社会、环境与经济三方面，进行多学科、跨领域的合作与创新则是实现韧性与整体可持续发展的关键所在。

如今，随着大数据及分析技术的发展，韧性城市建设不仅需要在经济、社会等层面深化落实，还需在网络韧性领域采取一系列有效措施趋利避害，发挥信息技术高效助力韧性城市建设的潜能。例如，促进多源

数据的整合与交互共享；提升信息保护、技术治理能力；健全技术治理机制，建设健康、安全的网络发展环境，从而有效提升网络韧性，推动数字化时代下城市的可持续发展。

放眼未来，提升地方韧性行动和强化实践，大力填补韧性城市实证研究空缺至关重要。如何转化国际韧性发展成果与行动经验，结合各国、各地区和各城市的情况实现韧性理论和方法的本土化，对推动世界范围内全面落实气候行动与韧性建设具有重要现实意义。中国的韧性城市研究经历了从韧性概念认知、引入，到理论构建，再到应用实践的演进过程，在政府、专家学者与技术人员等共同努力下，积极推进了韧性城市经济、社会、生态等维度相关概念内涵的发展，并取得了较为丰厚的研究与实践成果，韧性城市建设已上升至中国国家政策及战略目标层面。然而，在宏观层面上，国家、区域及地方等多级治理过程中的韧性城市政策解读与建设水平差距有待弥合，发展不平衡、不充分的问题尚未解决；在微观层面，应对风险时自发的社区治理能力及公众参与能动性均有待挖掘。这些需要我们从社区、地方、区域、国家等多尺度寻求更全面、系统且适应性强的发展框架及循序渐进的行动计划。韧性城市系列大会的经验与成果分享不仅为中国韧性城市发展与治理提供了良好的方法论指导，也为更多发展中国家、转型国家提供了行动路径参考。然而，需要强调的是，中国城市数量、规模大，且特点复杂多样，加之与国际城市发展背景存在制度、文化、经济、社会及公众需求差异，在借鉴国际理论与经验实施韧性城市建设的过程中亟需制定灵活、分异化的方法与强针对性的解决方案。

图 1. 有关韧性城市发展的全球承诺与框架
图 2. 近十余年全球韧性城市发展历程（来源：参考文献 [3][4][37][38]）