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Necessities and challenges to strengthen the regional infrastructure resilience within city clusters

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Abstract

Building resilient infrastructure and making cities and human settlements inclusive, safe, resilient and sustainable are the important elements making up the goals of the 2030 Agenda for Sustainable Development. Economic development and population growth have brought diverse needs of citizens for urban mobility resulting in various forms of urbanization including suburbanization, urban sprawl, and local or cross-border city clusters, and this has generated greater citizens' demands for quality, resilient, safe and secure infrastructure services. As infrastructures of different cities within a cluster are highly interdependent and interconnected, any minor disruptions of a single infrastructure component within a city could lead to unpredictable knock-on effects on its neighbors. Despite great research efforts being attributed to community and city resilience, there are limited studies focusing on regional infrastructure resilience within the city clusters, in particular those cross-border city clusters like the Pearl River Delta city cluster of China.

This paper aims to investigate the necessities and challenges of strengthening regional infrastructure resilience within the city clusters by applying and extending an integrated framework for resilience management of internetwork city infrastructures developed by the authors. The necessities, gaps and challenges will be explored from multiple perspectives not least the organizational structure, people, policy, management process, technology and supporting system, as well as the decision-making and performance management perspectives. Two typical city clusters in China are selected for case studies. Programs and practices of the cities within the two clusters pertinent to sustainable development, climate change, urban planning, built environment management and hazard management are critically examined and analyzed to produce a panoramic view on the necessities and challenges. The findings of this research shall invoke more innovative researches and solutions to enhance national, regional and city resilience, as well as building regional sustainability.

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1. Introduction

Urbanization is one of the most transformative drivers for economic growth as well as social and cultural development in modern society. Well-planned and properly managed infrastructures *viz*. buildings, transportation, water and energy are crucial to underpin sustainable urban development. Nowadays, cities account for over 70% of global GDP and consume over 60% of global energy. It is estimated that by 2050, two thirds of world's population will be living in cities with 41 mega-cities expected to emerge [1].

Over the last century, dramatic and rapid changes of our society including the geographic, economic, social, physical, governance and technological aspects have given rise to the emergence of a variety of spatial patterns of cities such as urban agglomerations, city clusters, city-regions, urban corridors, polycentric cities, regional networked cities, and cross-border metropolitan regions [2]. Well-known examples include the Pearl River Delta and the Yangtze River Delta regions in China and the Singapore–Johor Bahru–Bintan growth triangle [3]. While these diverse urban configurations play vital roles in promoting economic growth, the cities within these patterns are facing unprecedented demographic, environmental, economic, social and spatial challenges to meet the greater citizens' demands for quality, resilient, safe, secure and sustainable infrastructure services.

In recent years, city-region and cluster-based economic development approaches have resurged as a promising way to help cities and regions' enhance competitiveness, stimulate innovation, conserve and share public resources, reduce business transaction costs, and tackle environmental and social problems towards sustainable development. In China, an acceleration of city cluster development has been formulated as the government's national strategy to implement the National New-type Urbanization Plan targeting to improve its urbanization ratio to 60% by 2020 [4].

Building resource-efficient, reliable, well-connected, safe, smart and resilient infrastructures and making cities and human settlements inclusive, safe, resilient and sustainable have become the core elements making up the objectives of the 2030 Agenda for Sustainable Development and the Habitat III New Urban Agenda (NUA) [5]. The NUA also calls for member states to implement sustainable urban and territorial planning, build resilience, foster mitigation of and adaptation to climate change by using the integrated city region or city-cluster concepts.

With a growing frequency and severity of natural disasters and man-made hazards, various programs and initiatives have been launched by different governments and organizations to improve the resilience of critical infrastructure systems and develop pragmatic strategies to ensure a community can *"plan for, absorb, respond to, recover from, and more successfully adapt to new adverse events*" [6]. Examples of influential resilience initiatives include the Making Cities Resilient Campaign [7]; Rockefeller Foundation's 100 Resilient Cities Network (www.100resilientcities.org); and other national initiatives in the US, UK and Australia [8].

Building the regional infrastructure resilience of city clusters appears more challenging than uplifting the resilience of a single city. On one hand, infrastructures of different cities within a cluster are highly interdependent and interconnected at uncertain spatial and temporal scales. On the other hand, city-cluster resilience operation and management practices involve substantial complexities in terms of policy formulation, urban planning, integrated management of built infrastructure assets, and performance monitoring and evaluation for continuous improvement.

To address the research and practice gap, this paper aims to investigate the necessities and challenges of strengthening the regional infrastructure resilience within the city clusters. This study applies and extends an integrated framework for resilience management of internetwork city infrastructures developed by the authors. Drawing on published resilience literatures, government plans and published reports, Section 2 of this paper firstly reviews the previous related works of city cluster, city region, community and urban resilience. Data sources and methodology for conducting this research are then presented in Section 3. To explore the necessities, gaps and challenges, two representative case studies are discussed in Section 4 from multiple perspectives. In Section 5, the necessities and challenges are highlighted to provide relevant stakeholders an overall picture of the necessities and issues. Finally, the authors deliberate the open questions and the future direction for devising a generic regional resilience framework in order to facilitate deriving suitable resilience solutions reconciling with the profiles of different city clusters.