

The Relationship Between Innovation Districts and the Management of Shrinking Cities

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Abstract

As the population gradually gathers in large cities and the population aging continues to be severe, urban shrinking has gradually become a global trend. While the population is shrinking, cities are facing problems such as vacant land, declining architectural appearance, declining employment rates, loss of urban vitality, and the loss of urban vitality due to declining employment rates. Seeking the balance between urban resources and demographic changes in the process of urban construction has become an important condition for sustainable urban development. Currently, China's strategies for shrinking governance mainly focus on three aspects: form and style control, land use change, and financial policy support. However, these strategies have a strong dependence on external regulation of the system, poor sustainability, and a lack of stimulation for internal vitality of the system. Existing studies have pointed out that the "innovation districts" composed of universities and research institutes as the main "anchor" innovation elements are an effective method to activate the surrounding districts of the city. "Anchor" institutes have an effective and sustainable means of urban shrinking governance. Therefore, this study focuses on the development paths and construction priorities of innovation districts by reviewing the relevant international experiences of innovation districts in shrinking governance, combined with different development backgrounds. Innovation districts are divided into opportunity development type, policy guidance type, and strategy construction type. The feasibility of innovation districts as a strategy to alleviate urban shrinking is explored from four construction focuses: spatial layout, network carrier, service system, and policy support. Corresponding strategies are proposed for cities with different development conditions in China to use innovation districts for urban governance. This study takes the construction of innovation districts as the starting point, activates urban shrinking areas through the implantation of innovation elements. This study combines practical situations to address urban problems caused by population contraction, providing new ideas for urban contraction governance and sustainable development.

Keywords

Innovation districts, Urban shrinkage, International experience

1. Introduction

Since the mid-20th century, urban shrinkage has expanded from Western countries to a global scale. The agglomeration effect in megacities has escalated living costs, triggering population outflow, structural imbalances, and declining employment rates (Yi, X.X. 2020). The mismatch between resources and population growth has further resulted in building vacancies within urban built-up areas, accelerating spatial decay. The lack of maintenance in these vacant areas leads to resource waste, environmental degradation, and a continual decline in economic levels. Currently, the Chinese government and researchers focus on three main strategies for addressing shrinkage: managing urban form and aesthetics, changing land use, and providing financial policy support (Zhou, K. 2020). Among these, management of urban form and financial support heavily relies on external factors, while changes in land use can better stimulate the endogenous motivation for regional sustainable development.

In the early 1990s, technological innovation and the knowledge economy gradually garnered attention as significant driving forces for sustainable development (Vasquez-Urriago, A.R. 2016). Internationally, the spatial carriers of innovation have undergone multiple transitions: early-stage isolated industrial parks in suburbs were replaced by urban creative communities, while recent trends focus on open, multifunctional "innovation cells" that emphasize connectivity (Wang, Wang, Y.L. 2020; Yigitcanlara, T. 2020).

As a novel paradigm in urban innovation spaces, the concept of innovation districts was initially proposed by the Brookings Institution in 2014. This model positions universities and research institutions as "anchors," fostering an integrated ecosystem that combines enterprises, capital, and service providers to achieve synergies in industry-academia-research collaboration. These districts feature compact structures, convenient transportation, mixed functions, developed commercial activities, and ample employment opportunities, forming a new economic space within cities (Zhuo, Z.L. 2023) (Dong, L.X. 2023).

Amidst the increasing emphasis on technological innovation in China's urban development, driven by national strength (General Office of the State Council, 2024), innovation districts play an active role in promoting the aggregation, transformation, and flow of innovation elements. They also help stimulate internal vitality and drive the development of surrounding areas. Many countries have incorporated innovation districts as a key strategy in urban planning. There is a consensus in academia regarding the importance of high-quality development of innovative functions within urban spatial systems (Zhang, X. 2017). Existing studies predominantly focus on conceptual frameworks (Deng, Z.T. 2017), theoretical systems (Pan, W.W. 2019), and economic evaluations of international cases (Shi, Y.S. 2022), yet few explore context-specific pathways for implementing innovation districts in China's heterogeneous urban environments.

This study adopts innovation districts as a framework, comparing international models and adapting them to local contexts. It explores their potential in repurposing vacant spaces under urban shrinkage governance, offering a new paradigm for fostering endogenous regional vitality. This approach aims to attract, integrate, and develop innovation elements to activate the endogenous motivation of regions and promote sustainable development.

2. Development process of innovation districts and their relationship with shrinking cities

2.1. Development process of innovation districts

The development of innovation systems in urban areas has undergone a series of changes, transitioning from initially closed and isolated characteristics to open, diverse, and integrated forms, as illustrated in Figure 1.

Space Type	Location	Characteristic	Facilities	Environment	Leading Unit
Industrial Park	- City dge - Convenient external transportation	- Relatively closed and isolated - Composed of industrial and residential components	- Abundant land resources - Basic production and living facilities	The natural environment outside the park is relatively good	- Government lead - Enterprise lead - Collaboration between government and enterprises
High-tech Park	- Urban outskirts or suburbs - Nearby universities and research institutions - Convenient internal public transportation	The interaction between enterprises, universities, and research institutions is very limited	- Laboratory, research center, technology center - Incubator, maker space - Complete living facilities	- Beautiful natural environment - There is a public communication space available	Collaboration between universities, private enterprises, and governments to design and establish
Creative Community	- City boundary or near the central area - Convenient internal public transportation	- Diverse cultural industries - The creative industries are closely interconnected	- Complete living facilities - Flexible office space	There are some cultural and living facilities	Collaboration between private enterprises and governments
Innovation Districts	- Within or at the center of the city - The facilities for internal environmentally friendly transportation are fully equipped	- Functional complexity and diversity - The close connection between enterprises, research institutions, and universities - Openness and social integration	- Shared Office Space - Shared laboratory - Rich supporting facilities for daily life	- Diversified public spaces that promote communication - Integrated development and sustainability within and outside the region	- Triple helix (school+enterprise+government) - Four fold spiral (school+social organization+enterprise+government)

Figure 1. Development Process of Innovation. Source: Author.

As urban innovation spaces develop, the emphasis on service functions and knowledge transfer within these spaces has increased. Surabhi Pancholi identified that public spaces can facilitate knowledge transfer. In 2014, the concept of innovation districts was proposed by Professor Bruce Katz of the Brookings Institution (Katz, B. 2014), highlighting the importance of integrated development and sustainability both within and outside the region. On an immaterial level, innovation districts serve as compact, comfortable gathering areas that strengthen the connections between service facilities and knowledge elements, positively impacting the development of surrounding regions by breaking the isolation of innovation systems. Materially, these districts rely on universities and research institutions to diversify the previously singular functional model of knowledge spaces, integrating multiple functions within the district and emphasizing the establishment of complex regional systems.

Currently, international research on innovation districts is relatively comprehensive regarding mixed development, policy orientation, and development strategies, providing useful references. In China, studies on innovation districts are still limited, primarily focusing on concept interpretation, international case analyses, and planning paths. Researchers like Zeng Zhiming have analyzed the construction of regional innovation districts supported by U.S. universities from three dimensions: knowledge production, institutional support, and talent cultivation and aggregation (Zeng, Z.M. 2023). Zhou Kebin and others have clarified specific measures for achieving industrial upgrading, spatial improvement, and vitality stimulation, offering theoretical insights for the transformation and renewal of China's industrial zones (Zhou, K.B. 2022).

2.2. The relationship between innovation districts and shrinking cities

Population loss, imbalanced population structure, economic recession, declining employment rate, deteriorating urban environment, and vacant land and housing in urban shrinkage areas. The advantages and positive effects of innovation districts during construction can enhance population attraction and land utilization, thereby improving the negative impact of urban shrinkage. Therefore, this article discusses the construction of innovation districts as a new approach to urban shrinkage governance.

Research on international cases shows that the construction and development of innovation districts are closely related to urban development status. The urban elements available in different city development contexts influence the construction and growth of innovation districts. This study categorizes innovation districts into opportunity-driven, policy-guided, and strategy-based types of urban shrinkage, aiming to provide references for Chinese cities developing innovation districts in varying contexts, as shown in Figure 2.

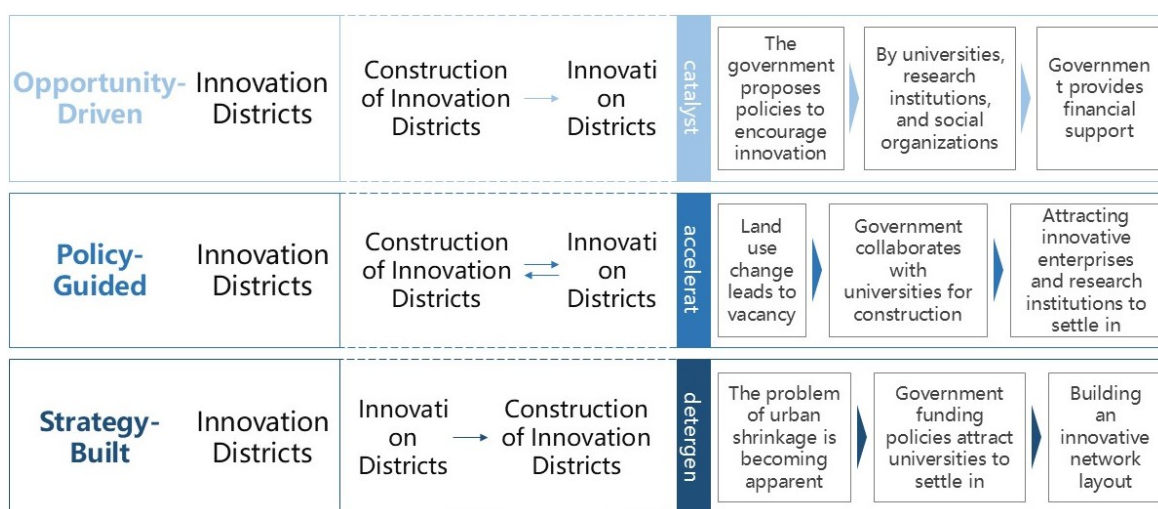


Figure 2. Classification of innovation districts. Source: Author.

3. Opportunity-driven innovation districts

Opportunity-driven innovation districts have a rich history and focus on preserving cultural and district characteristics during their planning and development to enhance residents' pride and sense of belonging. The Macquarie Park Innovation District (MPID) in Australia exemplifies this classification. Its development strategy emphasizes spatial layout and network frameworks. The land use transitioned from original Indigenous land to a rural village and later underwent redevelopment to form a mixed residential area. Although the district temporarily lost vitality due to population decline, the construction of the innovation district has attracted a return of residents.

3.1. Spatial layout

The "anchor" institutions, such as universities and research organizations, often serve as the core of innovation development, responding to government innovation policies by facilitating knowledge exchange and promoting the conversion of research to revitalize surrounding areas. This creates a knowledge network formed by multiple strong magnetic innovation points within the region, focusing on balancing the spatial layout among these "anchor" institutions to promote equitable development across the district.

In Macquarie Park, universities are a key focus in developing the innovation district, with Macquarie University being particularly significant. The university emphasizes mixed land use, enhancing the movement of district residents within the knowledge "anchor" points and visualizing student research (City of Ryde Council 2022).

Opportunity-driven innovation districts create an innovative atmosphere through the collaboration of existing "anchor" institutions, attracting emerging innovative enterprises and educational organizations. They emphasize building community relationship networks centered around universities, encouraging students to engage with the community. As Macquarie Park's facilities improve and knowledge elements within the district become more active, the clustering of innovation elements attracts more enterprises, fostering knowledge and innovation exchanges between universities and businesses.

However, during planning and construction, the efficient flow of knowledge within the region may lead to an invisible exclusion of low-educated and disadvantaged groups from public spaces, resulting in social inequality. As the innovative talent in Macquarie Park continues to grow, the existing elderly residents may struggle to adapt to the fast-paced lifestyle and activities. Additionally, an excessive emphasis on constructing innovation companies during planning can hinder the integration of the district with surrounding areas, gradually turning it into an isolated "knowledge island" within the city (Pancholi, P. 2020).

3.2. Network frameworks

Opportunity-driven innovation districts often possess a strong academic atmosphere and a foundational academic social network during their early development stages. Incorporating innovation elements to build more diverse, complex, and stable social networks is an effective means to reduce gentrification.

In the initial planning phase, universities typically lead the planning and implementation efforts. Subsequently, development relies heavily on government funding and policy support. These districts often strengthen the sustainability of urban governance by creating multi-stakeholder social networks. Macquarie Park, for instance, has established a network that promotes collaborative development among the community, businesses, government, and academia. In the later stages of construction, the government made significant financial investments to develop a comprehensive basic service system.

With the advancement of planning, Opportunity-driven innovation districts have begun to emphasize the diversity of land use within the area, aiming to provide residents with a more convenient living environment while integrating the district into the overall urban development. Macquarie Park focuses on the functional mix of land use and integration with surrounding areas, planning diverse housing options to reduce commuting distance for innovative talents. The construction of highways and railways has enhanced connectivity within and outside the region, while the development of shopping centers and living stations has continuously improved the quality of life for residents.

4. Policy-guided innovation districts

Policy-guided innovation districts rely on government innovation policies in their development process. Implement policies to attract higher education talents and attract technical talents. In addition, policies that promote public participation have facilitated the connection between existing regional conditions and planned development.

Kendall Square is adjacent to the Massachusetts Institute of Technology and began to develop into an industrial center centered on manufacturing in the mid-19th century. In 1950, it was upgraded to an industrial park, and in 1989, a part of it was redeveloped into a multifunctional campus, forming the

prototype of the innovation zone (Deng, Z.T. 2018). The area integrates laboratories and office spaces used by universities and companies, allowing businesses to access highly educated talent while combining commercial and public spaces to accommodate residents' daily activities.

4.1. Spatial layout

Policy-guided innovation districts utilizes innovative vitality to rapidly transform abandoned land, fully utilizing the transportation, facilities, functions, and employment opportunities in the area. However, most employment opportunities are often targeted towards people with higher education, which may hinder the development of a diverse population structure.

In the development of Kendall Square, the main strategy focuses on the comprehensive development of three types of spaces: residential, office, and informal public gathering spaces. This comprehensive approach helps to create a livable environment for knowledge workers, promote an atmosphere of "work study life recreation" (Gaoa, T. 2023), and attract more knowledge workers. It also promotes the competitive development of regional knowledge output and creates a positive cycle for improving the regional environment.

4.2. Policy support

Policy-guided innovation districts are constructed under the guidance of government policies and financial support, led by schools, enterprises, or social organizations. These areas are accelerators for upgrading and optimizing certain areas in the city center. This development is based on a strong policy driven spatial framework that requires comprehensive consideration of economic, demographic, and land use factors to utilize existing knowledge elements and reserve space for future development. However, due to strong government intervention, sustainable development may face challenges in the later stages, which may lead to policy driven contraction.

At Kendall Square, the government has invested heavily in public space development and implemented various incentive measures to retain innovative talent. In addition, local governments have also planned and constructed infrastructure and public transportation. The gathering of enterprises, the strengthening of facilities, and the gathering of talents have made Kendall Square a comfortable, livable, and vibrant area filled with knowledge elements, prompting some previously relocated businesses to return to their original entrepreneurial locations.

5. Strategy-built innovation districts

Strategy-built innovation districts focuses on attracting high-tech companies to enhance regional vitality and solve urban problems, with a focus on updating transportation systems, infrastructure, and land use. With the development of London, there are signs of decline in the city center. Initially, the British government's urban renewal approach involved large-scale demolition and reconstruction, which damaged the structure of the old city.

In the new wave of urban renewal, the construction of innovation zones relies on "anchor" institutions such as universities and research institutions. In these cases of strategic construction, regions often face population decline before planning, and strong policy guidance may lead to social inequality and regional isolation due to rising land prices in the later stages of development.

The London Silicon Ring, located on the old streets of East London, reflects this phenomenon. This area is gradually becoming known for its poor building quality, dirty urban environment, and concentration of low-income residents, but it also provides affordable rent, convenient transportation, and proximity to six

world-renowned universities. With the development of innovation zones, London Silicon Ring has become one of the most densely populated areas for technology companies and talent in the UK.

5.1. Service system

The attraction and retention ability of innovation districts for talents in the later stage mainly depends on the level of the service system. The construction of the service system not only includes the allocation of infrastructure and public service facilities but also includes the number and types of housing, laboratory configuration, and Internet services. Building a walkable road structure and a diversified housing system is an inevitable requirement to meet the needs of a reasonable population structure.

London Silicon Ring has become the third-largest technology enterprise cluster in the world through its development this year. The overall environment of the district has been greatly improved, providing a large number of employment opportunities for innovative talents and driving the renewal of related commercial facilities in the surrounding areas. However, as tech companies expand their spatial and land needs, rising property prices have led to gentrification, spatial segregation, and the marginalization of certain groups, resulting in social inequality and regional isolation.

5.2. Network frameworks

Strategy-built innovation districts emerge from the renewal of vacant areas, using these districts as catalysts to address existing issues. The construction of the district aims to incorporate knowledge elements without disrupting the region's original social networks, ensuring sustainable development. Updating the spatial conditions emphasizes the preservation and transmission of existing social networks and memories, creating informal spaces for interaction that blend work and academia.

When planning the London Silicon Ring, utilize existing advantages and improve urban issues through the construction of innovation zones. This involves artistic renewal to enhance the urban landscape, reshape regional perception, and upgrade infrastructure to meet urban needs. By attracting technology, digital, and creative enterprises, the region has cultivated a cluster effect. In addition, tax incentives alleviate the burden on startups, while transforming old buildings into unique public spaces helps protect the city's memory.

6. Results

The construction of innovation districts plays a crucial role in addressing issues arising from urban shrinkage, such as economic decline, urban sprawl, exacerbated social inequalities, and ongoing environmental degradation. Different types of innovation districts exhibit varying developmental characteristics in their initial phases due to the influence of multiple factors. This paper analyzes development strategies corresponding to these districts through four dimensions: spatial layout, network carriers, service systems, and policy support, as illustrated in Figure 3. By synthesizing these aspects, the study extracts and summarizes applicable planning strategies from international experiences that can inform urban shrinkage governance in Chinese cities.

	Opportunity-Driven Innovation Districts	Policy-Guided Innovation Districts	Strategy-Built Innovation Districts
Spatial Layout	Location Selection	Location Selection	Location Selection
	Innovative Elements	Innovative Elements	Innovative Elements
Network Frameworks	Cultural Framework	Cultural Framework	Cultural Framework
	Social Activation	Social Activation	Social Activation
Service System	Pre-existing Facilities	Pre-existing Facilities	Pre-existing Facilities
	Availability of Space	Availability of Space	Availability of Space
Policy Support	Public Initiative	Public Initiative	Public Initiative
	Public-private Partnerships	Public-private Partnerships	Public-private Partnerships
	Tax Incentives	Tax Incentives	Tax Incentives

Figure 3. Key Strategies for Different Types of Innovation District Development. Source: Author.

6.1. Spatial layout

Innovation districts shape a multidimensional and open urban innovation spatial system pattern by leveraging the positive effects of proximity and innovation spillover brought about by the aggregation of innovation elements within the region. The multi-dimensional and open spatial layout has a great impact on the construction and later development of innovation districts. As an innovation district with strong complexity, multidimensionality, and collaboration in urban systems, it is conducive to forming a networked development model and providing potential for sustainable development in the later stages of development.

Using innovation districts as accelerators to upgrade and optimize certain areas in the city, it is necessary to comprehensively consider factors such as economy, population, and land in planning, fully utilize the advantages of existing innovation elements, and reserve space for the later development of the district, reducing resource waste caused by the large gap between planning and reality due to the lack of timely adjustment of planning policies.

6.2. Service System

In the later stage, the ability of innovation districts to attract and retain talent mainly depends on the level of the service system. The construction of the service system includes not only the configuration of infrastructure and public service facilities but also the number and types of housing, laboratory configuration, and Internet services. When it comes to affordable housing prices, most residents choose to live in places that are walkable, bike-friendly and have short commuting times to avoid congestion and

time-consuming long-distance commuting. Building walkable road structures and diverse housing systems is an inevitable requirement to meet the demands of a reasonable population structure. By utilizing the existing resources of the city, the buildings within the site can be renovated and updated by matching the types of housing with the job opportunities provided in the district.

6.3. Network Frameworks

Public spaces in innovation districts serve as the physical network that carries social networks and cultural structures, acting as a hub for knowledge flow and research transformation. These spaces connect knowledge elements like businesses and educational institutions, including squares, green spaces, streets, museums, exhibition halls, co-working spaces, public dining areas, cafés, and entertainment zones.

As more knowledge elements are integrated into innovation districts, building diverse, complex, and stable social networks becomes an effective strategy to reduce gentrification. Developing a pedestrian-friendly road network can attract residents to engage in public activities, facilitate the flow of people, and accelerate the transformation of research.

When updating existing spaces, preserving and preserving the original social networks and memories is beneficial for combining community life activities with knowledge innovation, creating informal communication spaces, and providing interaction opportunities for residents during working hours.

6.4. Policy Support

The construction of innovation zones relies on the government's innovation policies. Policies related to talent attraction, tax incentives, and residential incentives are beneficial for attracting individuals with higher education, while public-private partnerships, financing incentives, and tax policies help attract innovative enterprises. In addition, policies that promote public participation have facilitated the connection between the current situation and planned development in the region. In the construction of policy driven innovation zones, strong government policy guidance is crucial. Incorporating public participation into policy frameworks can reduce redundant construction and resource waste caused by delays in adapting to real-world conditions.

7. Conclusion

At present, research in China mainly focuses on theoretical case studies. This study takes the construction and planning of innovation zones as the starting point, aiming to activate vacant urban areas by integrating knowledge elements to solve the problems caused by vacancy. Based on different types of innovation zones, applicable strategies for urban shrinkage governance under different backgrounds have been proposed. The goal is to determine a more suitable planning direction for the future development of China's innovation zones and provide new ideas for effectively implementing urban shrinkage governance and sustainable development.

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