

The emergence and evolution of volumetric innovation districts in Taipei City

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## Abstraction

While securing the volumetric properties becomes the strategic agency to transform area-based territorial development toward three dimensions of urbanization, what are the governance practices underpinning the growth of volumetric properties in an innovation district, and how are governance tensions shaping the volumetric politics of the urban innovation economy? This governance dimension of a volumetric city remains less explored in area-based urban innovation district literature. This paper contributes to exploring the volumetric growth and analyzing the governance practices in innovation districts by drawing on volumetric urbanism. Drawing on a qualitative analysis of Taipei City's Nan-Gang as an innovation district in the context of a 'not-so-global' city, this paper analyzes the place-specific geopolitical economic context and governance practices shaping the volumetric politics of the urban innovation economy. This paper argues that the emergence of a volumetric innovation district is driven by a transformative urban project aiming at the urban-industrial upgrading nexus. Meanwhile, state-led calculative governance uses urban volumetric strategies to stimulate the valuation of volumetric properties and generate governance tensions while supporting the innovation district's growth.

Keyword, volume, innovation district, calculative governance, urban economy

## 1. Introduction

Launching urban innovation policies to revitalize the local entrepreneurial ecosystem of emerging industries as a new engine of digitalizing innovation and smart urbanization has become a critical research issue of urban innovation economic development (Davidson et al. 2023, Zukin 2021, Florida, Rodríguez-Pose and Storper 2021). The urban innovation district as the territorial dimensions of policy instrument recently has been promoted as the crucial urban redevelopment strategy (Heaphy and Wiig 2020, Katz and Wagner 2014, Kayanan, Drucker and Renski 2022, Drucker and Kayanan forthcoming). While the territorial practices are enhancing the stickiness of the urban tech economy, the vibrant qualities of local territories are secured by cultivating innovation activities and entrepreneurship (Florida, Adler and Mellander 2017, Zukin 2021), encouraging high-density land mix-use (Spencer 2015), anchoring collaborative networking with important institutions (Pancholi et al. 2020) and place branding initiatives (Nathan, Vandore and Voss 2019). However, the planning of urban innovation districts remains an area-based horizontal extension without a nuanced understanding of the relationship between the building of volumetric urban spaces and the related governance dynamics. Remarkably, the production of volumetric urban spaces has flourished in global cities (Hewitt and Graham 2015, McNeill 2005) and East Asia cities (Hou 2012, Wang 2020). Policymakers manipulate the volume technologies as an urban development capacity to construct high-rise built environments (McNeill 2019, McNeill 2020) and further generate vertical gentrification and displacement (Lauer mann 2022). Drawing on the geopolitical perspective of volumetric thinking (Elden 2013), innovation districts are not only secured as the urban valuation engine through state-led strategic urbanization (Moisio and Rossi 2023) but also increasingly evolved into the volumetric territory to support the urban tech

economy. While innovation districts are increasingly constituted by volumetric properties and reconceptualized as the vertical extension of a territory, the window of innovation opportunities would accompany the uneven development and socio-economic inequalities as governance tensions have little been noticed in the governing innovation districts (Kayanan et al. 2022, Morisson and Bevilacqua 2019). In other words, less study is given to the three dimensions of the innovation district. Let alone the complexities among place qualities, volumetric urban properties, and governance dynamics are relatively unexplored. Based on this research deficit, this paper asks two questions: what are the governance practices underpinning the growth of volumetric properties in an innovation district, and how are governance tensions shaping the volumetric politic of the urban innovation economy?

This paper contributes to reconceptualizing the innovation district by integrating volumetric urbanism thinking (McNeill 2019, McNeill 2020) and filling this research gap for exploring the ‘volumetric properties’ in an innovation district by developing an analytic framework. The empirical case study focuses on Taipei Nangang District, a former industrial district, now a ‘volumetric’ innovation district (VID) deployed by state-led urban infrastructures to contain diverse knowledge-intensive industries and financial increments. Meanwhile, this strategic innovation district has emerged as the signal of Taipei’s innovative economic development by mobilizing a transformative urban project with various policy ideas, ranging from economic, urban development, cultural, and science-technologic policy across different levels of governance. Unpacking the governance practices, compared to global cities and peripheral cities, need to be situated in the ‘not-so-global’ city context. The place-specific contextuality presents an urban politic-economic development in search of industrial and urban upgrading. These latecomers’ particularities need to be appropriately regarded as a distinctive contextualization lens to rethink

how the volumetric properties are becoming critical components to creating the innovation district as a ‘space of expectation (Doucette and Park 2017)’ in Taipei’s urban development. The Taipei case was based on a place-specific context angle and contributed to articulating local particularities to explore the complexities of the volumetric innovation district and its governance tensions. This paper fabricates an analytic framework of the volumetric innovation district. It draws on the ‘following the volume’ as a qualitative research method (introduced later) to explore the building of volumetric properties in an innovation district. Three research strategies lie in conducting semi-structured in-depth interviews with urban planners, academic researchers, and policy actors during 2022-23 and planning document analysis on the development of Taipei’s innovation district.

Compared to the neo-liberalism urban innovation district, this paper argues that the volumetric innovation district is constituted by a transformative urban project to frame, construct, revitalize, and extract the value of volumetric properties driven by multiple paths of state-led policy mobility. Three findings are presented as follows.

(1) The geopolitical economic context of the innovation district planning reflects that state-led industrial upgrading, as well as urban upgrading strategies, are both crucial planning characteristics of a latecomer city that dramatically drive the evolution of industrial district to reshape the volumetric spatial relationship between verticality, surface, and subterranean in an innovation district (2) The implement of various governance practices constituted as state-led calculative governance which is involved with the agency-based multiple participations and their valuation works, including state-led policy framing, developers lift-up work, and the cluster effecting of knowledge-intensive industries. (3) Deploying different volumetric properties generates governance tensions regarding scalar and temporality. Thus, unpacking the volumetric properties in an innovation district opens new

insights to explore the complexities among the production of volumetric urban space, the power of the state, and governance technologies. This paper could contribute to innovation district policy.

The argument of the volumetric innovation district has been structurally organized in the following sections. The first section critically reviews the urban innovation district literature and teases out three research deficits of policy implementation regarding agency-oriented volumetric properties construction. The second section reconceptualizes an analytic framework on the volumetric properties in the innovation district by integrating volumetric urbanism. The third section addresses the context and particularities of developing Taipei Nangang as a volumetric innovation district and analyzes its governance practices and tensions. The final section summarizes the crucial findings and related discussions.

## 2. Rethinking the innovation district: a critical review

### 2.1 Neoliberal version of innovation district policy: a global best practice?

The innovation district has become a spatial policy instrument to foster territorial qualities as the trigger of urban tech economic development (Kayanan et al. 2022, Drucker and Kayanan forthcoming). Evolving from the classic concept of small-medium firm-center industrial districts (Markusen 1996), the innovation district emphasizes that the intensive and spontaneous interactions of innovative firms within a territory then constitute a window of opportunities as what Storper (1997) argues ‘firm-territory nexus.’ While the ideology of neoliberalism inter-city competitiveness emerged in a globalizing context, the clustering relationship of small-medium innovation firms became the territorial mechanism of stimulating socio-economic interactions, as a stickiness, and underpinning the territorial innovation growth according to the calculation of patents (Clark,

Huang and Walsh 2010). Beyond the firms' perspective, the geographies of the creative economy, ordinated from the contributions of Jane Jacobs' diversification and Edward Glaeser's human capital theory, recently began emphasizing that the importance of urban-firm nexus strongly underpins variant work-live-play urban environments as the attractors of knowledge-intensive entrepreneurship and innovative activities (Florida et al. 2017, Florida, Mellander and Stolarick 2008). The urban nexus legitimates the planning discourse of innovation districts as a territorial strategy for containing the creative class and developing knowledge-intensive industries (Katz and Wagner 2014). Scholars attempt to clarify the definition, typologies, successful elements, and governance dynamic of the innovation districts, attempting to tease out the best practice (Yigitcanlar, Adu-McVie and Erol 2020). However, the IDs policy follows the cluster and network elements of the territorial innovation model (Asheim and Gertler 2005) to design volumetric properties, representing what Markusen(1999) indicated that fuzzy concepts are 'characterizations lacking conceptual clarity and difficult to operationalize', which are questioning whether the IDs policy could effectively stimulate urban tech-led economic growth. Despite this skepticism exists in academic debate, the global circulations of the IDs policy are still materializing as the amounts of state-led mega-projects, eventually aiming at urban revitalization (Jones 2017, Heaphy and Wiig 2020).

However, the innovation districts are not static territorial entities. Instead, it dynamically evolved with the constant constructions of volumetric properties. There are three strategic agencies related to the production, organization, and revitalization of volumetric properties, driving the evolution of the innovation district. First, policymakers could mobilize multiple urban policies to frame the legitimacy to produce the volumetric properties in an innovation district. Since collective urban infrastructures enhance the centralization of land use

intensification (Scott 2019), the urban innovation district is becoming the container of volumetric urban infrastructures through government-led place-makings, such as rezoning land mix-use, transit-oriented development, fiscal policy, subsidies, social housing initiative, and anchoring institutions. These place-making strategies dramatically shift the IDs to a space of policy intervention where ‘policy mix interactions occur (Flanagan, Uyarra and Laranja 2011)’. Flanagan et al. (2011) claim that the policy mix interactions have been conceptualized as multi-actor and multi-level agencies that could explore the policy tensions and conflicts among different domains and levels of governance. While the innovation district is the geographical dimension of policy practices at a certain period, the lens of policy mix interaction could unpack the multi-actor policy interventions to the evolution of an innovation district. As Davidson et al. (2023) use the case of Melbourne’s innovation district, addressing the emerging use of urban experimentation policy is shifting the potential of innovation districts from containing innovative firms to experimental sites of implementing transformative innovation policy to connect innovation objectives with societal and environmental goals.

Second, the growth of innovation districts would attract local developers to capture and extract the land value through intensifying and organizing volumetric urban spaces. Under the place-making context of the Great Paris case, Gomes and Pérès (2022) explore the hybridization of urban innovation and spatial planning as a policy tool that integrates the relational work of real estate developers to align with the political ambitions of urban innovation projects by mobilizing their industrial networks, as well as constituting the valuation to support the evolution of an innovation district. Meanwhile, Rosen and Alvarez León (2022) argue that the rise of the digital growth machine uses four ways to integrate the organizational logic of digital platforms to drive new forms of



land capital accumulation. They are (1) enhancing urban tech economy growth by attracting and containing tech firms in an area of land intensification. (2) The emerging real estate platforms capture the land-related profits without intensifying land use. Meanwhile, (3) platforms play as new intermediator transforming the urban labor market relationship, and (4) generating new urban digital rendering to affect land and asset-related value. While integrating the logic of digital technology with land development in an innovation district, the developers do not have a traditional role in capturing the profit of built-to-sell properties through land development intensification; instead, they are involved with strategic actions of innovation firms to realize the valuation of the urban innovation district.

Thirdly, the role of entrepreneurs and their agencies enables the revitalization of volumetric properties. Kayanan (2021) indicates that the deficits of innovation district strategies lie in overemphasizing the neoliberal goal of urban economic growth rather than cultivating a localized entrepreneurial ecosystem, eventually 'displacing the entrepreneurs who were once the focal point of the innovation district (p.11). While new production activities in a territory define an innovation district, some critics argue that policymakers should elaborate on the startup-led governance arrangements to encourage bottom-up innovation, such as a series of face-to-face entrepreneurial activities, hackathons, and meetups grounding in an innovation district (Zukin 2020, Zukin 2021) as Zukin (2021) uses New York City as a crucial tech hub to address the narratives and building of bottom-up flourishing entrepreneurial capacities that lie in flooding global cities' venture capitalists. The IDs, then, are not only the containers of innovation activities and entrepreneurship but also organizationally constitute the startup ecosystem that revitalizes the volumetric properties, since the acquirement and assessment of entrepreneurial finance for

startups enormously rely on face-to-face interactions with venture capitalists at the micro-level urban built environment (Florida et al. 2017, Zukin 2020).

## 2.2 Decontextualizing the innovation district policy: three research deficits

As planning innovation districts is a territorial technology driving the valuation of strategic urbanization (Moisio and Rossi 2023), the state interventions, developers' valuation, and entrepreneurs' organizational works are crucial to producing the volumetric properties in innovation districts. However, the current research remains an area-based analysis focusing on a territorial horizontal extension without a nuanced understanding of volumetric properties and their governance dynamics. Governance tensions and conflicts also arise from volumetric politics due to the innovation district's endless stacking amounts of volumetric properties. Three research deficits are less integrated into the analysis of innovation districts due to the decontextualized implementation of urban innovation districts.

First, innovation district policy is simplified as a single path of innovation-led governance practice. While borrowing fashion policy ideas to formulate a series of spatial economic projects becomes the policy routine of neoliberal urban economic development, it neglects the substantial influence of geopolitical economic context. Mobilizing multiple policies is crucial to envisioning the elite-dominated urban transformation. While the widespread adoption of creative cities idea (Kong 2014), the policy promoters borrow the multiple paths, routes, or trajectories of various city ideas to legitimate the growth of the volumetric properties within an innovation district, stimulating the value extraction of urban development. As Peck (2011) advocates social-constructivist policy mobility and claims that 'different historical-geographical conjunctures are associated with distinctive, social

forms of policy mobility(p.794)' From this argument, not only is the geo-economic logic of capital accumulation dominated the policy mobility and mutation of the IDs, but also are the geopolitical calculation and local conditions involve with. since geopolitical economic context help explaining the multiple paths and trajectories of policy mobility that are conducted to constitute the volumetric innovation district.

Second, current research neglects the innovation district as a space of exception and needs to recontextualize the role of state interventions in shaping valuation and marketization by securing volume properties. The transformative urban policy in the East-Asia context simultaneously creates the 'spaces of exception (Doucette and Park 2017)' As Doucette and Park (2017) argue that the 'space of exception' refers to the use of 'special and exceptional treatment and privileges' that are crucial to place-specific spatial projects. This strategic urbanization then generates the valuation, as Moisisio and Rossi (2023) argue, meaning that the economic value of the urban field is not naturally given. However, the state selectively constructs the valuation of the spatial project linked to the governance of knowledge-based capitalism. Following the valuation logic, state intervention uses 'a heterogeneous set of policies, strategies, and public investments, plays a vital role in the constitution and mobilization of the urban valuation engine (Moisisio and Rossi 2023, p.3).' It implies fostering an innovation district as a volumetric urban development project by using governance practices to evaluate industrial upgrading and urban transformation. Compared to neoliberalism entrepreneurial urbanism, current research needs to explore how state and developers constitute the valuation of volumetric space to speed up the capital accumulation and realize the elite-dominated imagination of urban development.

Third, innovation district literature neglect to understand the governance tensions and conflicts as volumetric

politic. The volumetric innovation district policy builds an innovation space or district for systematic knowledge capital accumulation. Sustainable spatial transformation is not happened without addressing governance tensions and uneven development (Kayanan et al. 2022). Indeed, some discussions mention governance tensions. Such as the exclusion/inclusion in community participation and innovation (Kayanan et al. 2022), which are hidden in the governance process of an innovation district. Parnreiter (2022) notes that the 'Janus-faced genius of cities' in a transformative urban context hides the uneven development, socio-economic inequalities, and environmental pollution in urban economic development. Scholars interested in this transformative urban economic development strategy then have suggested focusing on the institutional response to these governance tensions (Kayanan 2021, Davidson et al. 2023)

### 2.3. Reconceptualising the innovation district through the lens of volumetric urbanism: an analytic framework

Due to the research deficits, urban development research should pay more attention to the volumetric properties in an innovation district. This paper constituted the argument of the volumetric innovation district by integrating the following conceptual discussions.

Firstly, volumetric innovation districts produce and deploy volumetric spaces highly related to the state's power that presents the geopolitical economic interventions on volumetric urbanization. While well-established research of innovation districts already presented a 'flatten' area analysis that exemplifies the urban horizontal extension for containing urban tech economy, securing the volume as a subjectivity of territorial qualities also presents a geopolitical contextual influence as Elden (2013, p.38) draws on the geopolitics perspective and illustrates Eyal Weizman's research on the exploration of vertical geographies of Israeli settlements, with a

particular focus on the construction of Israel's cities based on the influential positions of occupied highlands to monitor the military dynamics of neighboring countries. Elden argues that 'thinking about power and circulation in terms of volume opens up new ways to think of the geographies of security (p.49)' Drawing on the complexity between verticality and state's power (Harris 2014, Hewitt and Graham 2014), volumetric urbanists further argue that urban development should pay more attention to three dimensions of territory for the understanding of how multidimensional spatial relationships, verticality, ground, and subterranean, are being relationally organized to response the politic-economic dynamics of urban development (McNeill 2020, McNeill 2019). Thus, urban planning is a territorial technology that focuses on producing volumetric urban spaces, connecting with the state's power which controls, calculates, and evaluates the volume to achieve territorial qualities (McNeill 2019).

Second, state strategies constitute calculative governance to produce and extract the value of volumetric urban space. While the innovation district is then regarded as a territory with volumetric urban space, volumetric urbanism suggests the calculation regime of volume is central for reconceptualizing state strategy as calculative governance that strategically mobilizes technological experts to expand the volume of a territory. McNeill (2019) refers to the role of metrics exemplifying the Singapore government's calculation logic and developmental capacity. He further indicates that Singapore's state strategy lies in realizing 'land platforms in expanding the logistics of Singaporean territory'; creating 'the importance of controlled environments for maximizing the value of interiorized territory'; and 'the creation of a calculative regime for governing underground space (McNeill 2019, p.852). However, not only is the state involved, but also are firms and developers participating in the valuation of an innovation district. Given the growth of volumetric properties, the valuation of a territory is shaped by the

various form of valuation works enacted by the roles of the state, developers, and firms, resulting in various values and flows being created and hybridized within an innovation district.

Third, the various forms of valuation work generate different forms of governance tensions as the volumetric politic of an innovation district. While a volumetric spatial strategy is prevalent to understand an urban innovation district's valuation process, the governance tensions are also central to unpacking various logic of value and valuation processes and need further debate due to multi-actors' involvement and selections. Thus, the volumetric innovation district generates winners and losers in the industrial upgrading process, reflecting the global-local scalar tension, inclusion-exclusion tension in community participation, and fast-slow temporal tension of urban development.

While three conceptual discussions are crucial to understanding the spatial organization of volume, and its politic-economy context, three volumetric spatial mechanisms should be analyzed as the following axes. The first analysis axis lies in analyzing the contextual influence on the case study. It attempts to respond to the contextualization of urban space in order to unpack the volume-state nexus in contemporary urban studies. This paper asks how the place-specific context influences the state-led planning policy rationale in building Nangang as an innovation district. The second axis focuses on the agency-based valuation work analysis in terms of the state, developers, and firms. This paper asks what and how state and firm strategies are used to drive the valuation of a volumetric innovation district. The third axis lies in the governance tensions behind the volumetric innovation district.

### 3. Research strategy

This paper's methodology begins exploring the innovation district's 'volumetric properties' by following the volume as the method. As a term, the volume refers to various forms of volumetric urban space constituted, deployed, and transformed to reposition the urban development as a volumetric politic. The qualitative method explores the complex relationship between the production of volumetric urban spaces and governance dynamics in Taipei's Nangang District. Two research strategies were conducted to tease out the paper's argument and to scrutinize the governance practices underpinning the volumetric properties in an innovation district and the roles of strategic agencies in driving the evolution of the volumetric geographies of an innovation district. To understand the policy-volume nexus, the author first explores the geopolitical economic context of developing Taipei's innovation district by conducting a document analysis to trace the contextual influence on the planning of the innovation district. Through a qualitative analysis of historical reports, planning literature, and historical images, this data analysis primarily would present how the geopolitical economic context shapes the volumetric particularities in Nangang. To explore the volumetric properties, the paper's analysis primarily relies on in-depth semi-structured interviews with government officials from the Urban Development Bureau, and planning researchers, real estate developers, which focus on the policy domains, the level of governance, policy discourses, and governance tensions in shaping a volumetric innovation district.

#### 4. Case study: the emergence of a volumetric innovation district

From the place-specific context, the transformative urban development in the East-Asia cities context increasingly results in a relational and volumetric production of spatial organization. Taipei is no exception. The NanGang district, situated near the central bossiness district, is positioned as the crucial district of Taipei

technology industry corridor (Taipei City Government, 2022). To enhance the place branding of the Nangang district, the Taipei City Government launched the Eastern Gateway Project. It focused on deploying a broad spectrum of controlled environments toward a heterogeneous nature of urban innovation districts, such as transit-oriented retail development, cultural flagship projects, conference and exhibition centers, software industry parks, and national biotechnology science parks (Taipei City Government 2021). Due to various volumetric properties of urban spaces, the related policy actors at local and national levels of governance were involved in the construction process of Nangang as the innovation district, attempting to secure the sectoral diversity and contain the clustering of software, live popular music, biotechnology industries by providing high-rise building environment.

#### 4.1. Recontextualising the volumetric properties of Nangang as an industrial district

Before being a modern and high-rise innovation district, the place-specific context influenced the construction of volumetric properties. It constituted the three dimensions of territorial qualities in the Nangang district. First, the Nangang district was early known as the black town, characterized by the agglomerations of small-medium manufacturing plants and related air pollution generated by diverse production systems, such as mining, metal-making, car tires product, and fertilizer firms. Mass manufacturing firms shaped the industrial landscape and significantly contributed to early export-oriented economic development in Taiwan. As one famous poet who formerly was a Nangang Fertilizer Factory chemical engineer, he described everyday life in a manufacturing landscape.

Like sunlight, the thunderous roar of countless engines pierces through the dense network of pipelines and cascades down, clinging to the darkened steel skin of its relatives. Moved by this spectacle, they sway and resonate, their echoes lingering like the vibrations of a harp's strings. In the corridors, the shadows of the



layered structures create a chessboard pattern upon me. The billowing white clouds of steam rise and brush against me with a refreshing coolness, a delicate fragrance akin to a blooming lily (Li 1966).

By interpreting this poem with volumetric thinking, industrial fog, and air pollution could be identified as volumes' fluid and moist ontological forms, constituting the crucial elements to identify urban industrial land use terrain. However, this imagination and volumetric characteristics of an industrial district reflect the geopolitical economic context in Taiwan, in which the role of the state prioritized the local economic development over the qualities of the built environment, which further generated air and soil pollution intensively, characterizing Taipei central industrial district during the 1970s-80s. Second, Taipei's the built environment performs a vertical land mix-use in the Nangang district. Since Taiwan's industrialization-driven urbanization in the 1970s, mass civic housing was built following the volumetric fabric of Taipei's urban industrial district and constituted a pattern of the residential-industrial mix. Compared to the resident-industry division in North American cities, Taipei presented its unique and vibrant characteristics of urban land mixed-use developments. The vertical mix of residential-industrial land use in Nangang mainly influences local dwellers' work-live geographies. Compared to the modern residential spaces in high-rise buildings (Baxter 2017), the everyday industrial land use shaped and hybridized the experiential aspects of residential environments to become the local particularity of volumetric space. Third, the urban railway infrastructure was allocated to enhance land use intensification. In the export-oriented regional economy development, allocating urban railway infrastructures are central to the logistic of the industrial district but also creates an intangible dividing effect, even devaluing the land use. The place-specific context shows that unpacking volumetric dimension of an industrial district not only lies in the ground of the manufacturing cluster based on the geopolitical economic calculation but also represents the voluminous relationship between the

verticality, ground, and subterranean in Nangang as an industrial district.

#### 4.2. Transforming Nangang as the volumetric innovation district

In this context of a latecomer city, the innovation district development is not resulted from the goal-oriented innovation policy through a comprehensive planning process of the science park, rather than much rely on urban development capacities given to transform the industrial district into an innovation district by which various policy and the deployment of urban infrastructures in order to drive the evolution of volumetric innovation district in the context of a ‘not-so-globalizing’ city. Taipei is a latecomer city that is neither the global city that handles the centralities of globally mobile capital nor the peripheral city that embodies the under-development of economic activities. Instead, a latecomer city was situated in a hybridity character of urbanity that seeks to upgrade urban economic development with existing industrial advantage through using the various rhetorics of innovation, creativity, startup, and knowledge economy as the political legitimacy of urban development discourses to formulate policy. Three volumetric strategies are used to constitute Nangan as an innovation district.

First, the state’s volumetric engineering dramatically fostered the emergence of a volumetric innovation district to solve industrial pollution and drive urban transformation. This volumetric engineering was central to extending and securing the territory qualities of Nangang District since central and local governments collaborated to launch two major volumetric engineering, namely river straightening projects and the underground railway project. The first project dramatically rearranges the land ‘surface’ to control the river flooding risk by readjusting the river basin. This project also created new land development to contain inner city residential demand. The second project was a response to industrial transformation through digging into the ‘underground railway’ to

create urban development capacities for containing new production and consumption space.

The second strategy lies in transforming the industrial district's flattened ontology to high rise and volumetric properties of an innovation district. In the 1990s, Nangang underwent significant industrial restructuring and hollowed out the urban industrial land due to Taiwan's deindustrialization crises. In search of an industrial upgrading policy, the central government established the Software Industry Park as a new science park model and built up the clustering of the software industry by copying the success of the Hsinchu science park model. Differentiating the Hsinchu model driven by science and innovation policy expertise, the Minister of Economic Development followed the governance path of exported-oriented industry policy and launched an industrial upgrading strategy to reposition Nangang as an 'urbanized' innovation district through building up a commerce and trading function of software industry park. In this mega project, Figure 1 shows significant volumetric properties deployed with various valuation works of urban planning, ranging from the convention and exhibition center to rezoning the financial park, retail shopping mall, and luxury housing. These volumetric urban spaces supported the vertical integration and horizontal linkage among various industries in client-oriented software production in the Nangang district.

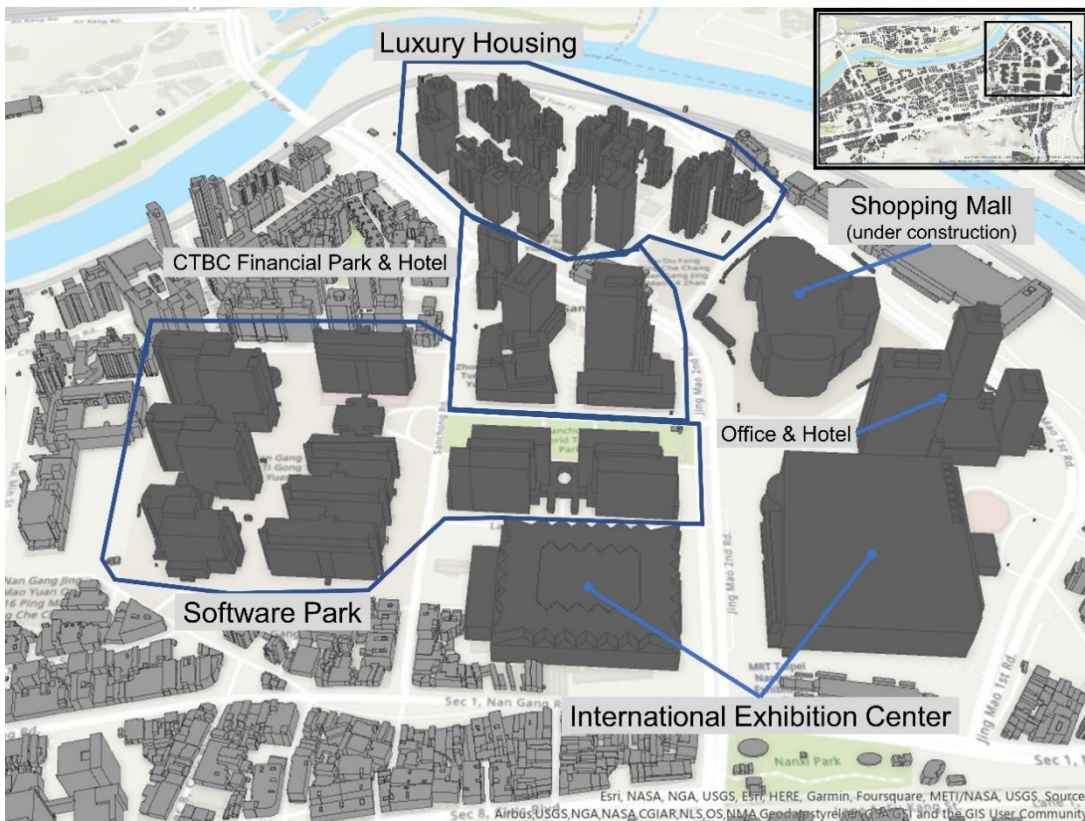


Figure 1 Spatial distributions of volumetric urban spaces in Nangang, Taipei.

By planning the Nangang Software Park (NSP) as a significant anchor of an innovation district, Policymakers successfully transformed the spatial clustering of small-medium manufacturing plants to articulate with emerging service industries without anchoring the integration of research and development resources and tax exceptions. According to the official survey (see Table 1), the NSP successfully attracted 471 technology companies as the crucial cluster organization due to more than 960 billion (NT dollars) and 22,000 employees in 2020. Compared to the previous survey in 2010, the number of firms and annual income grew by 35%. Although the software industry is being promoted as the engine of the urban innovation district, the software, technology, biotech, and IC design industry also constitutes a sectoral diversity in the NSP.

Table 1 The cluster of the technology industry in Nangang Software Park during 2010-2020

	Number of technology firms		Number of Employees		Income of Enterprise(Million; NT\$)	
	2020	2010	2020	2010	2020	2010
Industrial Sector	108	48	10,879	4,150	21,182,174	5,937,793
Service Sector	372	271	11,727	10,887	74,854,800	14,134,548
Total	471	319	22,606	15,037	96,036,974	20,072,341
Growth rate(%)		32.27%		33.48%		79.09%

Source: Taipei City Government(2021)

Third, the Nangang innovation district began a new chapter of volumetric spatial development in the 2000s. This state strategy adopted an urbanized science park model to reterritorialize the boundary of the innovation district by developing two biotechnology science parks: Taipei Bioinnovation Park and National Biotechnology Research Park (NBRP). Due to the research capabilities and advantage of Academia Sinica, the central government launched the planning of the National Biotechnology Research Park (NBRP), aiming at the niche market of the global biotechnology industry by positioning the NBRP as a crucial production system for drug discovery and preclinical studies. This niche market involves national-level industrial security in response to the covid-19 crisis. The Taipei City Government has also planned Taipei Biotech Park as a significant location of the biotech industry cluster through the Nangang Biotech Industry Cluster Development Project. Second, for the revitalization of the startup companies, the local government also has revitalized the two volumetric spaces<sup>1</sup> as the incubator and

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<sup>1</sup> Two industrial landscapes, named as the Bottle Cap Factory and N24 Taipei Ark, which were transformed as the innovation incubator for containing the smart city industry, from craft industry, blockchain technology industry,

experiments for startup companies. This start-up space planning originated from the inspiration of smart city policy, which attempts to symbolize Taipei's ambition for leading emerging industries. However, borrowing the smart city idea and urban living lab to create the volumetric spaces is a superficial because the embeddedness of emerging industry into local production system requires system-level agencies.

Fourth, urban cultural strategy cultivates vibrant qualities as a cultural value. Compared to economic development, Policymakers considered the leading reputation of the popular music industry in Taipei by deploying the Taipei Pop Music Center as a specifically designed volumetric space for the niche market of the music industry in a digital era. As a provider of crucial music venues, the cultural policymakers, which follow the cultural policy logic of the creative city, attempt to constitute an affective volumetric space for pop music production and consumption. The idea of volumetric space borrowed from the UK's creative industry policy to address vibrant qualities, eventually enhancing the land use aestheticization in an innovation district.

#### 4.3 Volumetric Politics as the governance tensions in Taipei innovation district

The planning policy framing effect has successfully guided the development context of Taipei Nangan District toward a volumetric innovation district through a series of state-led urban strategies and policies. The production of these volumetric spaces presents that the multi-path policies, not a single policy path, originated from borrowing various urban policy ideas, such as science parks, clusters, smart cities, and creative cities. As the globalizing urban expertise, this planning policy framing successfully gathered different policy discourses to mobilize cultural-economic resources and interests to transform Nangan District as a crucial spot of the urban innovation economy. Critical governance practices include rezoning industrial spaces for high-value activities,

developing lifting-up strategies for high-rise buildings, deploying cultural flagship for a creative economy, and financialising consumption landscapes for shaping a vibrant urban environment. The policy framing effect is an institutional work that simultaneously changes the volumetric spatial relationship between verticality, surface, and subterranean and mobilizes the volumetric spatial strategies to transform the Nangan District into a capital-intensive urban innovation district. First, the framing of policy could constantly attract new ideas to revitalize old volumetric space. For example, Taipei began the involvement of the urban living lab concept, attempting to integrate socio-economic growth goals with industrial upgrading to re-anchoring spatial clustering of knowledge-intensive innovation activities for a new round of volumetric urban production. Second, the policy framing fosters state-led calculative governance. These volumetric properties aim to secure knowledge-intensive industries by presenting calculative governance supporting biotechnology, exhibitions, startups, and the music industry.

Two significant characteristics of state-led calculative governance could be defined and legitimating the production of volumetric urban space. First, the volumetric properties could generate positive benefits through the materiality of policy evaluation reports, such as the publication of the Biotech Industry Cluster Development Project 'estimated to generate an annual output value of over 50 billion NTD in the biotechnology industry'. Second, the calculative governance is virtually revealed to the public or startup entrepreneurs through a digital dashboard visually represented as the 'governing by number'. Such as, show the Taipei Innovation and Entrepreneurship Supportive Center show the one-stop service, funding, critical data, spatial distributions of entrepreneurial spaces, and global resource in Taipei City (Figure 2).



Figure 2 The calculative governance in a digital dashboard (Source: the author)

Compared to top-down governance, developers' land intensification practices extract the valuation of a volumetric innovation district. The cultural venue and related urban infrastructure attract the relational work of financial incumbents and real estate developers to participate in this urban transformation project. For example, the significant consortia that established its corporate headquarters in Nangang by following the above volumetric engineering and district planning, such as the headquarter of CTBC Financial Holding company as the local developer, for instance, developed a mixed-use leisure complex with a shopping mall. The surrounding innovation district, designated as a residential district in the software park, has attracted the growth of many luxury high-rise apartments. Real estate developers have capitalized on the valuation of volume as residential spaces from Nangang Software Park workers and have been influenced by notable public infrastructure and transportation networks, leading to a sustained increase in the valuation of this innovation district. Therefore, the direct and outcome of urban transformation policy often relates to maintaining the neoliberalism urban competitiveness and tailoring for



the mobile global capital accumulation rather than providing solutions to urban development problems without rethinking the place-specific context. The local government attempted to respond to the rising property boom by planning social housing for containing knowledge-intensive workers as a labor pool in supporting urban economic development.

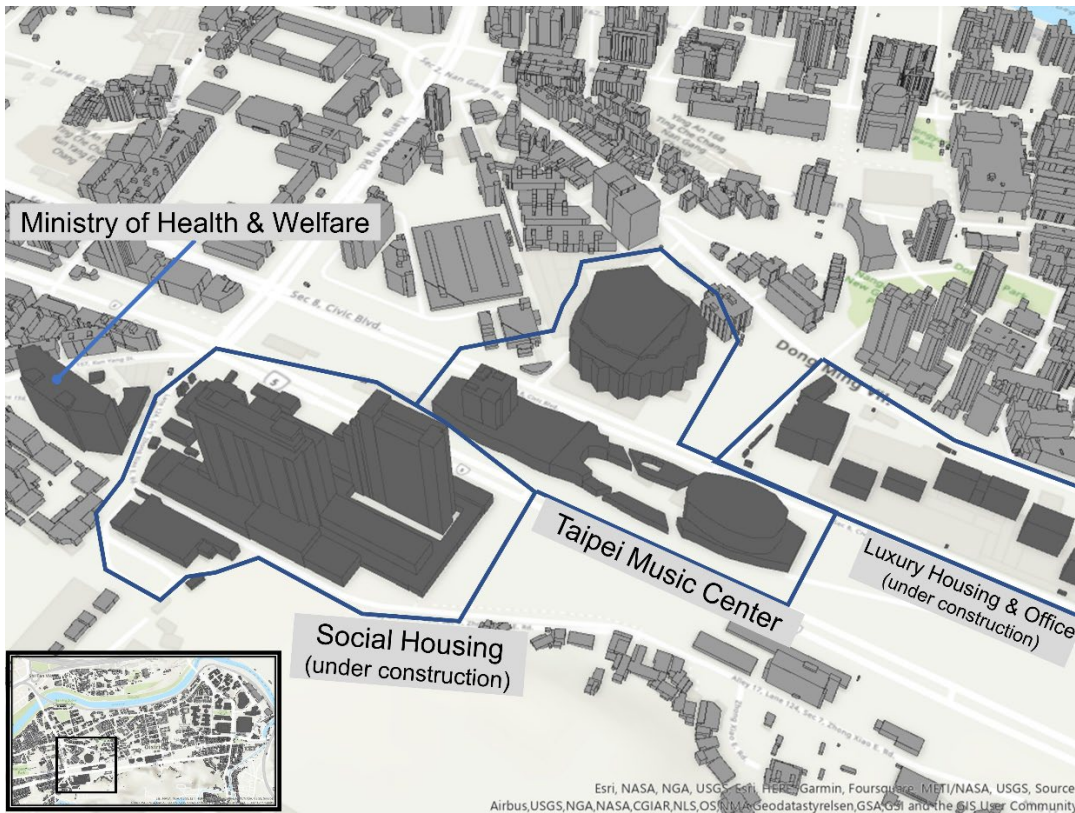


Figure 3 The dual development of real estate development in Nangang

Source: the author

The spatial centralization of volume properties encourages a new form of uneven development in an innovation district but also reflects the anxiety of urban development in a not-so-globalizing city context. This anxiety results in three governance tensions and planning policy deficits. First, upgrading strategies speed up industrial gentrification. Although the cluster of the knowledge-intensive industry has been secured through

deploying various volumetric properties in the innovation district, it overlooks the economic contribution of traditional industrial districts in the western area of Nang district that contain the 1,088 small manufacturing firms. The rent-rising pressure from these urban volumetric strategies would impact the vertical land-use mix, displace small firms, and lead to industrial gentrification. Second, mobilizing fast policies to develop an entrepreneurial-oriented urban development could not immediately cultivate a startup culture; However, building an entrepreneurial ecosystem for emerging industries requires institutionalization to foster entrepreneurial qualities, which is a slow process in terms of temporality. The anxiety reflects the dilemma of upgrading strategies in a latecomer city. Due to the lack of venture capital, reducing the entrepreneurial risk in small startup companies more rely on institutional change in fostering supportive entrepreneurial activities. However, the current innovation district lacks a systematic design or stimulates the bottom-up entrepreneurial governance arrangement. Third, the innovation district project involves global competition that requires negotiations between local and nation-level governments and aims at developing diverse sectors and achieving different policy calculations with different actions, deploying volumetric urban infrastructure to catchup the global niche market in the maintenance of the crucial position of a more vulnerable global supply chain.

## 5. Conclusion: learning from Taipei City

The 'volumetric' dimension of the innovation district and its security dimension of volumetric properties has been relatively unexplored in current urban and regional development research. This paper argues that innovation district as territorial innovation policy has constituted various volumetric urban spaces to shape the stickiness of the urban tech economy. Taipei's case addressed this research gap and demonstrated that a volumetric innovation

district had become a necessary spatial-organizational form for securing knowledge-intensive industry clusters. By questioning neoliberal versions of an innovation district, this paper has provoked three research deficits for exploring the volumetric spatial relationship in an innovation district. This paper seeks to reconceptualize the volumetric innovation district as an analytic framework by integrating volumetric city thinking. Challenging global best practice and universal implementations, Taipei is a 'not-so-globaling' city context, not the global city that dominates the global circulation of mobile capital as the local advantage for attracting knowledge-intensive industries, nor the global peripheries which embody the disadvantage of regional industry. In this context, Taipei's innovation district case illustrated the role of the state-led urban transformative project involved with industrial upgrading strategy to develop knowledge-intensive industries in a geopolitical economic context and driving an urban upgrading strategy for a high-rise built environment in an innovation district. This urban-industry nexus successfully rearranges the volumetric spatial relationship among the verticality, surface, and subterranean through state-led volumetric strategies.

In order to stimulate the volumetric growth as the signal of the urban development capacity, the state's volumetric strategies emphasize mobilizing international urban policy ideas as a discursive work for stacking volumetric urban spaces. Different paths of urban policy mobility, such as creative cities, smart cities and transit-oriented development (TOD), are being mobilised to emphasize land use intensification through stacking volume in shaping vertical urbanization. To justify the legitimacy, local government combines the industrial policy idea, such as the science park and cluster concept, constituting current policy discourses of volumetric urban spaces where 'policy mix interaction occurs (Flanagan et al. 2011)'. From this viewpoint, the Taipei case shows the

complex involvements of different policy domain from culture, economic development, science and technology, and urban development, then create a policy framing in supporting the volumetric growth in an innovation district and realize the valuation of sectoral diversity in the knowledge-intensive industry.

Third, the valuation of the volumetric innovation district generates governance tensions in territorial, temporal, and scalar dimensions that challenge the neoliberal version of innovation district policy as the best practice. It suggests that unpacking the governance tensions and socio-economic realities of innovation districts and recontextualizing them into the innovation district's geographies could generate a better policy design.

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