Mapping boundary spaces

Analysis and evaluation of Beijing Old City restoration measures in the name of resilience

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Key words

boundary space, mapping, response strategies, urban resilience, assemblages

Abstract

This study examines the intersection of housing renovation measures in response to natural disasters and environmental pressures with the urban development history of the Beijing Old City, as a basis for evaluating a recent planning initiative in the name of resilience: 'Relocation, Remediation and Improvement'. Using assemblage thinking, this study understands social resilience as an evolving response to development policies, thus shaping urban resilience as a multiple construct. From this perspective, urban resilience involves the virtual network in which past measures serve as potential contextual actors, creating contradictions and novel spaces in the actual. I refer to the transition from the virtual to the actual as a boundary space. I argue that housing renovation measures, as elements of socio-historical space, cannot be understood in isolation from the city's construction history, and propose a method for mapping these boundary spaces that allows for a social perspective on the evaluation of urban development measures. The extent to which the virtual network interact with actual assemblages represents the degree of freedom to produce new spaces in a neighbourhood and the degree to which residents are empowered. I caution that measures that disrupt boundary spaces run the risk of reducing urban resilience and residents' equity in shaping their own urban environments.

Introduction

Beijing's long journey of urban development has been inextricably linked with its resilience to natural disasters. The renovation of courtyard housing in the old city, as a response to natural disasters and environmental detention, has interacted with various urban development goals, including rapid urbanisation and economic strategies. Today, Beijing faces pressing environmental sustainability challenges. Urban resilience has become a focus of recent urban planning initiatives (BMCPNR, 2018). However, the subsequent 'Relocation, Remediation, and Improvement' (RRI) special initiative launched by the Beijing Municipal People's Government has also resulted in the displacement of vulnerable populations, raising issues of equity and humanitarian principles. Assessing the social impacts of resilience-oriented measures is therefore crucial.

Based on post-structuralist thinking, the analysis of social resilience has shifted to a dynamic social-ecological transformation process (Pickett et al, 2003). Current literature emphasises the capacity to respond to policy and institutional changes and recognises the role of power, politics and participation in the context of increasing uncertainty and surprise (Keck and Sakdapolrak, 2013). While technical responses to changes in the urban environment may involve power, politics and participation, they should also be considered as social change that triggers further responses. In other words, the analysis and evaluation of building interventions for urban resilience need to consider their impact within the dynamic social space of the city, which can be long-lasting and subject to change.

Assemblage thinking provides a theoretical tool for dealing with complex actors and associations. Its integration of non-human actors (Latour, 2005) and non-linear causality (DeLanda, 2006) draws our attention to the ongoing formation of assemblages. The challenge is to find a position for historical action in contemporary actuality. Ignacio Farias (2014) has pioneered the idea that the latent virtual actors that theoretically provide the impetus for change and the emergence of new heterogeneous associations (Deleuze, 1966/1991) can participate in actual assemblages through emotions, memories, senses, etc., but assemblage thinking has not provided a method for analysing specific virtual connections in the past. How intangible vectors of social change such as power relations, understandings of policies, positions of interest, personal experiences, etc. are actualised over time and how they relate to actors of the moment in specific situations are questions that need to be considered.

This paper first theoretically specifies the relationship between historical measures and actual situation and develops a concept of boundary space as a basis for social resilience. Taking disaster response measures as a starting point, it then unravels the changing meanings of resilience in three interwoven strands: the history of housing renovation in Beijing Old City, the history of housing construction, and the history of property ownership and economic relations. Through interviews and photo diaries collected from two sites in Beijing Old City between 2017 and 2023, the connections between the virtual network and actual assemblages in situations of use are mapped. Finally, the diversity of boundary spaces and the correspondence between the virtual network and actual assemblages are revealed in order to develop a new method of evaluation from the perspective of social resilience, concerning the equal right of residents to co-create their own urban environment.

Boundary space as the connection between the virtual and the actual

Assemblage thinking treats all influences, whether human, non-human or non-physical, as equal and heterogeneous actors interacting to create specific situations (Latour, 2005). Within this framework, human responses to the environment are viewed as response assemblages formed by the assembly of various biophysical and human elements into context-specific associations that both influence and are influenced by human responses (Briassoulis, 2017). This proposition emphasises both the contextual nature of how people respond to environmental change and the role played by non-human elements, and thus differs from traditional expert-based assessments of ecosystems or socio-constructivist studies of societal institutions and discourses on sustainability and resilience (Farias, 2017).

Based on this development, Farias (ibid.) further states that "knowledge cannot be conceived of or imagined outside specific assemblages" (189). The study of human responses should not be based on fitting into already established socio-ecological systems, but should be concerned with practises that change the socio-ecological composition by examining its capacity to rearrange heterogeneous relationships and define what is to serve as coexistence and common in a common world.

According to Deleuze's philosophy (1968/1994), things in the past engage in actual assemblages as potentials. They are sensed but not yet perceived or imagined. As soon as they are perceived, imagined or articulated, they transform into something else and become part of the actual. This process is called actualisation by Deleuze. The things that acquire a recognisable image through their transformation are essentially differential relations. They combine to form a whole, which Deleuze calls the virtual. Deleuze (1966/1991) argues that past events and experiences can be recalled through the actualisation and differentiation of the virtual, creating new images in new heterogeneous connections. However, what is actualised is unpredictable and cannot be manipulated, as actualisation does not follow a linear causality (DeLanda, 2006). Therefore, urban studies inspired by assemblage thinking focus on

uncertainty and emphasise the immediacy of assemblages rather than looking for regularities (McFarlane and Anderson, 2011). Thus, evaluating response measures, therefore, is not about creating presupposed criteria, but about tracking the irregular transformation of these past actions and their intersection with concrete assemblages through associative practises.

The concept of boundary space represents the transition from the virtual to the actual. In contrast to the tangible or abstract limitations in spaces, boundary space goes beyond perception and opens up to the virtual. However, the focus is not on the unknown aspects of the pure virtual, but on how specific historical measures acquire different images in different actual situations. In this research, specific historical measures serve as *contextual actors* in the virtual. Their various images are *immaterial actors* participating in actual assemblages.

The differentiated images of the virtual in actual assemblages are a sign of freedom in the actualisation process (Deleuze, 1966/1991). A diverse boundary space thus signifies the comprehensiveness of urban development measures and stands for the freedom of the individual to participate in the social responses to ecological measures with their own interpretations. This not only ensures an equal right to space (Lefebvre, 1996), but also exemplifies the social resilience of cities. The evaluation of response measures influenced by different factors requires a thorough investigation of which contextual actors actively contribute to concrete actual assemblages, which remain potential, and whether they have the freedom to actualise themselves in other situations.

Renovation of Beijing's Old City in the urban development history

History of disaster response: begins with repair and ends with demolition

The historic Old City of Beijing, spanning 62.5 square kilometres and celebrated for its cultural significance, has grappled with persistent maintenance challenges since the founding of the People’s Republic of China in 1949. At that time, many of its courtyards were already deteriorating, with roughly 60% of the 10.9 million square meters of courtyard houses in poor condition, and 5% at risk of collapsing (Ni, 2009).

In the 1950s, the Beijing Municipal Government initiated repairs on publicly-owned houses to prevent collapses and leaks, particularly during heavy summer rains. The Housing Management Bureau (HMB) was established in 1952 for this purpose, and by 1956, 379 275[1] rooms had undergone repairs, preventing any public housing collapses during rainstorms that year. In contrast, private homeowners had little incentive to maintain their properties, resulting in 12 900 room collapses and 24 fatalities in 1956 (BMCLHC, 2000). To address this crisis, public housing and temporary shelters, funded by rents from public housing, were constructed to accommodate homeless individuals. In 1958, the HMB took over non-owner-occupied housing, repossessing 199 000 rooms, most of which were in poor condition, but they lacked funds for maintenance (ibid.). By 1965, the number of dangerous and leaking houses had doubled compared to 1949 (Lv et al., 2003).

During the Cultural Revolution (1966-1976), all urban housing became publicly owned, increasing public housing by half a million rooms or 7.65 million square meters. However, the HMB was abolished until 1972, in which year 4 064 houses collapsed during a July rainstorm, while 70% of the remaining courtyard houses were in disrepair (BMCLHC, 2000). On July 28, 1976, a magnitude 7.8 earthquake struck Tangshan, 160 kilometres from Beijing, causing 385 house collapses and 37 803 serious damages in the Old City. Large-scale repairs followed, and 104 000 room courtyard houses were repaired by November, accommodating 330 000 people in tents, with a city-wide earthquake-resistant reinforcement program was launched.

[1] Rooms, or Jian, are the traditional building unit for houses. A room is about 12 square metres.

In the 1980s, the focus shifted from repairing to demolishing and constructing multi-floor residential buildings in the Old City. The government encouraged Danweis[2] to freely build on suitable land for welfare housing since 1974, "resulting in the demolition of some good houses while disrepair ones were neglected" (BMCLHC, 2000: 243). It wasn't until 1986 that the government imposed restrictions on unplanned construction and emphasized renovating old houses, but by then, more than 7 million square metre courtyard houses had already been demolished.

By the late 1980s, infrastructure development allowed for the construction of about 5 million square metres of housing per year in new residential areas, laying the groundwork for the relocation of residents from deteriorating residential areas. The 1990s saw the start of a major redevelopment of the old city, which gained momentum in the early 2000s with the introduction of more financial compensation measures. Between 2001 and 2004, 1.6 times more residents were relocated than in the 1990s. Thus, the history of housing repair in the Old City became dependent on the history of construction.

Despite nearly eliminating rainy-season collapses in public and private housing around 1990, criticism of disaster response post-Cultural Revolution was mainly negative concerning urban planning and heritage preservation (Wu, 1988). "The approach of thorough Old City renovation has no economic basis and is impractical. The trend of renovation without protection still prevails" (Wu, 1994: 23). In 1990, the Beijing municipal government designated the first 25 historical and cultural preservation zones in the Old City. However, traditional courtyard houses continued to be demolished in large numbers outside these zones. A 1994 statistic shows that over two-thirds of the 3 300-square-meter floor area in the Old City was new, leaving less than 2 million square meters of old houses from before 1949, including palaces, garden mansions, and courtyard houses (Wu, 1994: 39). By the end of the 2000s, only 430 hutongs (33%) retained their traditional patterns, while 685 (52%) had partially retained them, and 15% of hutongs had been completely rebuilt (Ni, 2009).

History of housing economy: from welfare housing to commercial housing.

During the 1950s and 60s, housing repairs and new construction were relatively balanced due to economic limitations. The Housing Management Bureau (HMB) effectively managed rental housing, enhancing utilization efficiency and reducing disrepair-related hazards. However, with only around 10% of construction investment allocated to housing, the Old City's houses continued to deteriorate (Zhang, 2019). Before 1958, the number of public housing units was limited, and rents covered maintenance costs adequately. After 1958, a state-owned, low-rent urban housing system emerged, with reduced construction investment of just 4.82% and lower rents (Lv et al., 2003).

The Cultural Revolution prioritized major repairs and neglected minor ones. Additionally, 1.3 million square meters of low-quality improvised buildings were constructed but later fell into disrepair. Housing rent arrears reached 2.68 million yuan, leading to the cancellation of financial subsidies for house repairs and hastening deterioration. After the HMB's restoration in 1972, measures to address dilapidated houses were implemented, with 79.1% and 82% of rents allocated to repairs in 1973 and 1974, respectively (BMCLHC, 2000).

Early housing reforms aimed to decentralize investment and attract contributions from Danweis (workplace-based units) and individuals. Danwei investments accounted for 60-70% of total urban housing investment in the early 1980s. National per capita living space increased from 3.6 square meters in 1978 to 6 square meters in 1985-1986 (Lv et al., 2003).

[2] Danwei, a social institution that integrated labour management, production and distribution of production and living materials, housing and social welfare.

However, most individuals still couldn't afford commercial housing, and rents were lowered in 1979, hindering housing repairs.

Not until the late 1980s did policies to raise rents come into effect, by which time disparities between public housing and private market rents were significant. Some public-owned houses were converted into retail shops, dramatically increasing rents about a hundred-fold. Driven by the high interest, illegal sub-renting of public housing persisted until 2016, stimulating informal building and safety issues. Many tenants were migrant workers, 40% of whom lacked housing subsidies and were forced to live in low-cost, overcrowded, and unsafe courtyards (Zhang, 2019).

Since the 1990s, efforts were made to stabilise the housing market and reduce living standards disparities. Affordable housing projects were launched in 1991, but housing shortages persisted (lv, et al., 2003). Starting in 1995, low-rent housing was provided in public and Danwei-owned buildings and new neighbourhoods. Affordable housing for social equity remained a key goal of housing development into the new millennium.

These policies and measures relating to property rights and the economy show that the repair of old and dilapidated houses as a resilience measure is closely linked to the changing property ownership and economic strategies during Beijing's rapid urbanisation. Financial constraints prior to economic reform led to a focus on new construction, inadvertently contributing to increased dilapidation. Construction during the Cultural Revolution exacerbated the damage, requiring immediate corrective action. From the late 1970s to the early 1990s, strategies prioritised promoting investment for urbanisation and economic growth over maintenance, resulting in numerous demolitions. In the mid-2000s, the renovation of dilapidated housing was framed as a resilience measure, but residential relocation and real estate development took precedence, sacrificing Beijing's architectural heritage as the city relied on land development for economic growth.

History of informal construction: first encouraged, then suddenly demolished.

The rapid growth of urban population in China since its founding resulted in a nationwide housing shortage. This situation created competition between renovating traditional courtyard houses and constructing multi-story buildings, especially considering limited investments. In the 1960s, the HMB allocated vacant land and demolished plots to for housing construction. In 1974, a redevelopment plan was initiated to replace traditional courtyard houses with 5-6 story buildings. However, this approach proved costly and slow. A more efficient measure was introduced, allowing residents to extend their properties, leading to the "Joining spacing under eaves, Pushing-out outer walls, Expanding the constructed areas" (JPE) approach in the late 1970s (Lv et al., 2003). This resulted in the construction of around 2 million square meters of low-quality sheds and the indiscriminate demolition of houses in the 1980s under the guise of renovation.

In the late 1980s and 1990s, the commercialisation of housing shifted the motivation for building extensions from living needs to economic speculation. This led to the conversion of residential spaces into small businesses and the addition of commercial spaces to homes for rent. This was further complicated by the encouragement of laid-off workers in the 1990s to create openings in outer walls, converting residential space for small businesses. In the mid-1990s, as the demolition of old houses peaked, more additions were built for compensation.

In the 2000s, the government encountered difficulties in generating profits from land leasing as urbanization progress in major cities slowed down. To address this, initiatives were introduced to stimulate entrepreneurship for tax income. Start-ups and co-working spaces were allowed to register in residential spaces (Zhu and Lu, 2018). Informal constructions continued to flourish in the Old City, driven by its unique aesthetics and cultural appeal.

The situation was turned over by the 2016 'Relocation, Remediation and Improvement' (RRI) initiative aimed to demolish illegal constructions, remove street vendors, and eliminate unauthorized businesses and house rentals while sealing informal wall openings. Within eight months, 38.34 million square meters of informal construction were demolished, and around 15 600 openings were rectified (BMDRC, 2017). This led to a shortage of low-rent housing and compromised social equity in the downtown area.

Spontaneous construction in old cities is closely intertwined with housing renovation and economic policies. While it attracted individual investments and temporarily eased housing shortages, it also raised safety concerns. Balancing urban resilience and social equity proved challenging, particularly given the urgent housing shortage. The encouragement of spontaneous construction from the 1960s to the early 1980s not only contributed to physical disorder but also set a precedent for further extensions and changes in the Old City's social structure, necessitating population reduction as a precondition for renovation. Consequently, the issue of social equity was addressed during the initial stages of large-scale renovation in 1990. However, the situation shifted once more with the 2016 initiative, which seemed to prioritise economic interests over social equity.

In summary, the significance of the response measures accompanying the housing policy in this socialist developing country is manifold. The approach to disaster response shifted from repair to demolition. Rapid urbanisation meant that unregulated construction, driven by necessity, livelihood, investment or culture, conflicted with urban safety objectives. In the 1980s, housing maintenance had to be reconciled with increased resettlement housing, raising equity issues for low-income groups. Insufficient funding led to poor repairs and chaotic construction, making it difficult to reconcile housing maintenance with social equity initiatives. Therefore, evaluation of these responses cannot be based solely on environmental success, nor are they always consistent with social equity goals. The distinctions between destruction or preservation, formal or informal, and collective or private interests are often blurred.

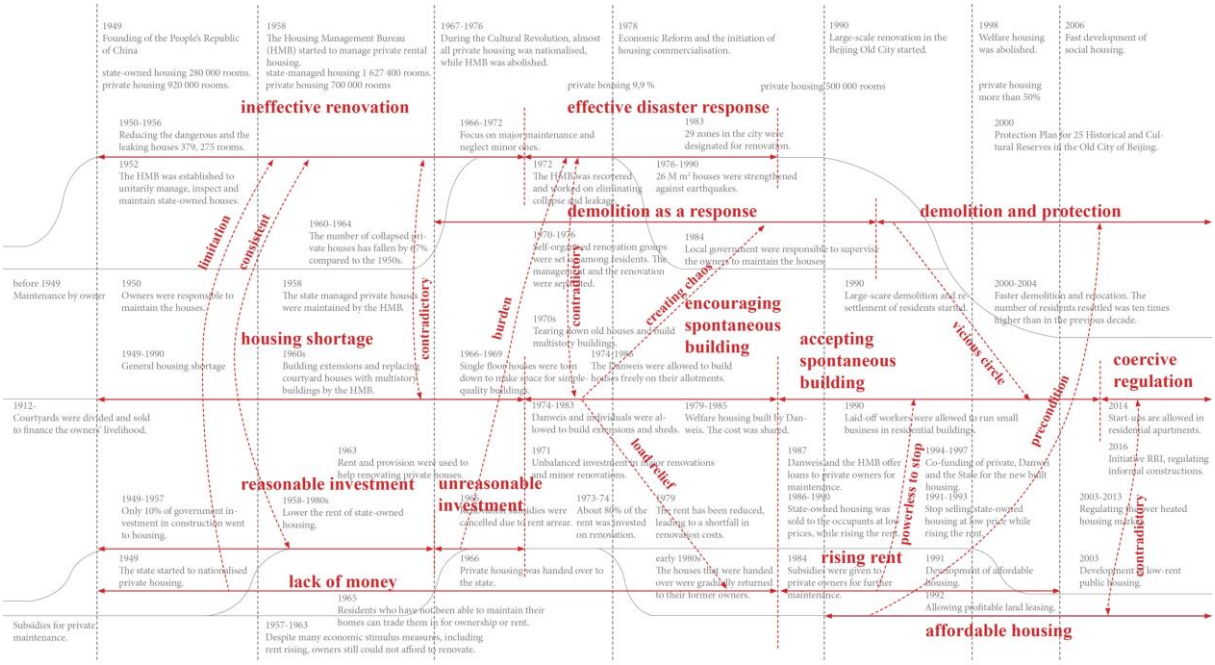

Figure 1: Disaster response along the three strands of housing renovation, housing construction and economic relations in the Old City.

Mapping the boundary spaces in concrete situations.

I've extracted key measures from Beijing's urban development history that have had a significant impact on the physical and social landscape of the Old City. These measures have been illustrated in a map along the three threads, highlighting their consistencies and contradictions (Figure 1). The multiplicity of the measures has been illustrated in their oscillating relationship. However, this map alone is not sufficient to evaluate them. Assemblage thinking emphasises the study of heterogeneous relationships within concrete constructs rather than abstract historical logic. These measures should be seen as potential 'contextual actors' that reside in contemporary urban spaces and form a virtual network. In what follows, I will establish a method for evaluating the resilience responses, based on the extent to which the virtual network is connected to actual assemblages in specific situations.

Based on my fieldwork in the Jiugulou neighbourhood of the Old City between 2017 and 2023, I will develop a mapping method for tracing associations in boundary spaces from the changing use situations. First, I will identify the residents' interpretation of the measures from interviews, treating them as specific and differentiated immaterial actors perceived by the residents. Their associations are part of the quasi-virtual network[3]. Next, I will analyse the assemblages formed by material actors, including objects, architectural elements and human actions, in the different situations that emerged in two locations. By combining this analysis with the map of the quasi-virtual network, we can understand how the assemblages in urban space and the virtual network relate to and interact with each other.

Tracing the quasi-virtual network

> "He (the former owner of the house) said that when the Korean War (1950-53) broke out, everyone donated their own property to support the state. So, they became public property... The original houses are massive, made of red pine... During the earthquake, the house shook loudly, but not a single brick was damaged... Now the houses are a big mess." (Interview with 'the story collector', 09.20.14, 14:38)

The resident's comment has briefly summed up the over-70-year transformation of a large courtyard in Houmachang Hutong, which has been divided into more than 500 households. After the founding of the PRC, to hand in a property to the state was ta general trend. Here, it is interpreted by the owner as *a donation*, an immaterial actor which alludes to the contextual actor of real estate nationalisation. The HMB *divided the* courtyard to accommodate multiple households. A virtual connect can be found between the HMB's management of stated-owned houses and the nationalisation of real estate. I connect these two actors on the map with a dotted line. Another clue is the judgement that *the old houses were of good quality*, which contrasts with *the current over-crowded chaos*. In this way, the connection between the division of the courtyard houses and the spontaneous extensions is established.

> "We didn't have a place to store the coal for heating. The government built the sheds uniformly, otherwise our own extensions would look massy. Later, the electricity system replaced the coal, but these sheds were not demolished. We still don't have enough space and we need the storage." (Interview with 'the daughter of the 90-year-old', 25.09.14, 12:00)

The government's renovation policy has become an excuse for residents to build their own extensions, and is linked to the *overcrowding of courtyards*. In the eyes of the residents, who have lived through the era of encouraging spontaneous construction, the difference between

[3] The virtual itself remains imageless; we can only trace its representations. Given that I have assigned an identity to each contextual actor, they become actualized. I refer to the traced representation of the virtual network as the quasi-virtual network.

the government's standard construction and the residents' spontaneous construction is only in appearance.

> "In this courtyard, there is more added area than original area. I pay… no rent for the outer half of my house because I built it myself. Why is it not restricted?... In the days of welfare housing, young couples were given only one room… Then they had children. They had to cook, so they built a small stove outside... Everything had to be built by themselves. There was no other way. In this way, the path became narrower and narrower…The fire engine would not be able to come into the yard… Neither can the ambulance…When it comes to demolition, every square metre counts, even the ones you build yourself." (Interview with 'teacher Zhao', 07.03.14, 17:50)

Teacher Zhao, another resident of the same courtyard, is well aware that these extensions are illegal. But they are also essential, *due to limited living space.* He connects the encouragement of spontaneous construction in the 1970s to the current demolition and relocation efforts. Zhao acknowledges that *government tolerance* contributes to the *chaos in the courtyards*, complaining that the Housing Management Bureau (HMB) should supervise spontaneous construction. He also links the *profitable* aspects of building extensions in demolition to the chaos.

Safety is another major concern, with worries about *fire hazards* from narrow aisles and stacked goods. In Zhao's account, expansion and safety contradict each other. The criticism of his own informal construction reflects the dilemma of the resident in the face of this contradiction. This underscores *the government's disregard for this situation*, particularly evident with the 2016 initiative aimed at rectifying informal openings and restoring street facades.

At the entrance to Dashiqiao Hutong, on the northern axis of the Old City, there's a bicycle and shoe repair stall. I interviewed residents at this stall just before the initiative began in the area.

> Cadre Wang: Some welcome it, some don't… That's the policy… How can ordinary people resist them?
>
> Teacher Li: Preservation? That's because the authorities think they should be protected… Wait until someone else comes [into power] and says, 'why don't we tear down all these shabby houses?' Then they'll all be demolished… They're all part of the chain of interests. I am telling you the truth… What have they done to really satisfy the common people? None!" (Interview with 'group at Dashiqiao entrance' 04.06.2017)

In their narratives, the RRI is perceived as a manifestation of the government's will. People view them as top-down *government actions* in which residents merely cooperate. Rather than associating them with preserving the hutongs, residents compare the current renovation measure to the demolition of houses in the 80s and 90s. While they acknowledge the government's unwavering stance on these actions, they find it irrational. They attribute the failure of urban governance to *corruption of officials* and note *the lack of policy consistency*, eroding policy credibility.

The stallholder at Dashiqiao Hutong mentions the 1990s' policy encouraging laid-off workers to create openings in walls. Today, the removal of openings and vendors has left many operators unable to continue, leading to layoffs and livelihood destruction. For them, the RRI exacerbates social inequality. Additionally, the initiative has reshaped the social space for residents. The distinction between Beijingers and *migrants* previously blurred through long-term everyday interactions, is now accentuated by divergent outcomes for those who stay and those who leave. The roles of the stallholder in *providing convenience* and *gathering residents* are on the verge of disappearing.

Through residents' narratives, historical measures have found resonance in the present-day Jiugulou neighbourhood. These immaterial actors, representing images of past contextual actors, have been identified and organized into a quasi-virtual network map (Figure 2). Some measures are interpreted into different immaterial actors, while not all contextual actors have actualised in the residents' narratives. Government actions from the mid-1950s to the mid-1960s, such as repairs, construction, and financial support remain potential. The areas with concentrated virtual connections include housing allocations since the founding of the state, demolitions, construction, and property rights changes after the Cultural Revolution until 2000, as well as the ongoing large-scale demolition and remediation efforts.

Disaster responses are mainly mentioned in terms of their contradiction with the current living conditions of residents. Despite the reduction in building collapses and leaks, residents express dissatisfaction with government responses, believing that their needs are not being adequately considered and addressed. This dissatisfaction, which stems from the long history of urban development efforts, often leads to personal criticism of officials. While these interpretations do not always follow a rational pattern, they do reflect the real concerns of residents. Their diversity highlights the multiplicity of historical interventions and enriches the virtual network. The distinction between abstract analysis and analysis focused on concrete assemblages is underlined by this map.

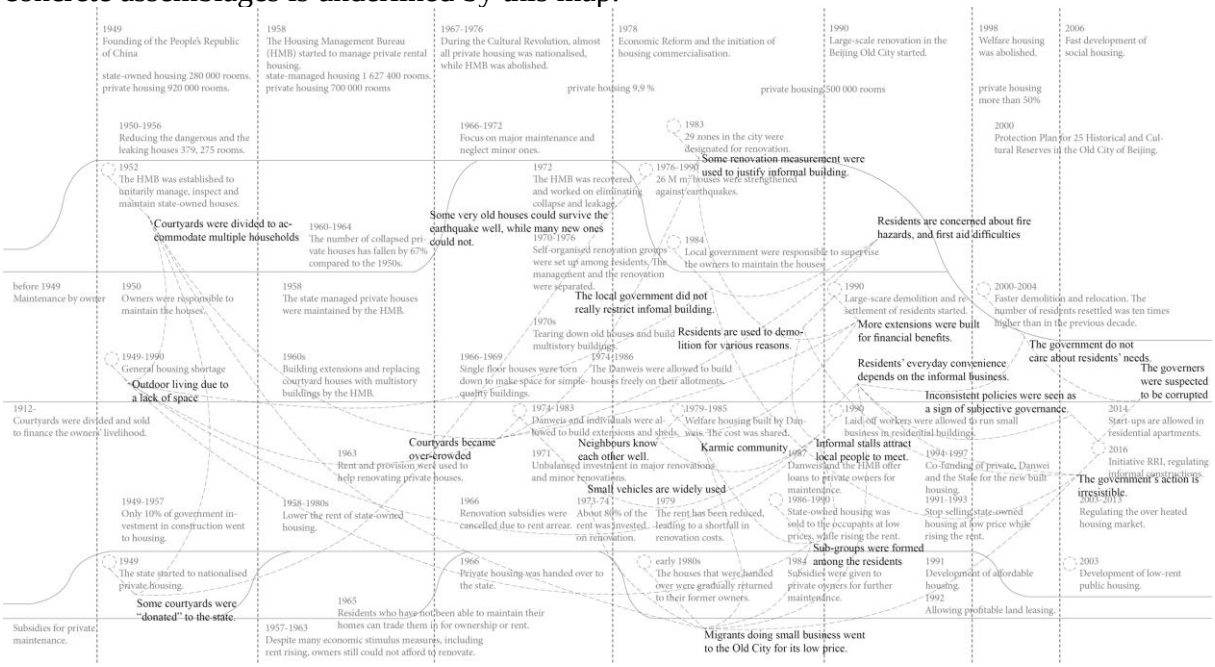

Figure 2: The quasi-virtual network map of the Jiugulou neighbourhood, including the associated contextual and immaterial actors.

Tracing the connection with the actual assemblages.

The stalls at the entrance to Dashiqiao Hutong have been a part of the area for more than three decades, forming a deep bond with local residents. On the south side of the street are the shoe repair and key cutting stalls, nestled against the facade of a small restaurant. The entrance to this restaurant is just around the corner, where queues of locals often gather for takeaway orders. On the north side of the street is the bicycle repair stall, conveniently located against an emergency subway exit. Both stalls are equipped with a wide range of tools and goods, which spill out onto the street during the day, making the hutong seem narrow. The residents who often gather at the stalls come from different places. Some live in the nearby hutongs, others have been relocated but return from time to time by bus.

Throughout the day, the objects on the street change their associations and interact with people's activities, creating spatial assemblages with different agencies. In the early morning, before the stallholders arrive, the shoe-repairer's sign, the locker and the chairs seem to *occupy* the street, suggesting the existence of the stall. As the day progresses, the regular residents take over the chairs, transforming their role into a *gathering* place for the residents. For residents unfamiliar with the group, even if the chairs are empty, the sense of territory conveyed by the objects may *deter* them from sitting down (Figure 3).

Figure 3: Situations at the shoe-repairing stall at the entrance of Dashiqiao Hutong before the RRI initiative (2015). Left to right: occupying, gathering and deterring.

The various assemblages also involve immaterial actors. For example, the arrival of the stallholder reflects the trend of *urban migration in the 1980s*. His business has been running well, because *bicycles and tricycles are more convenient vehicles in the Old City's narrow streets*. The chairs, the umbrella and the locker are associated with the immaterial actor of *stalls attracting residents*.

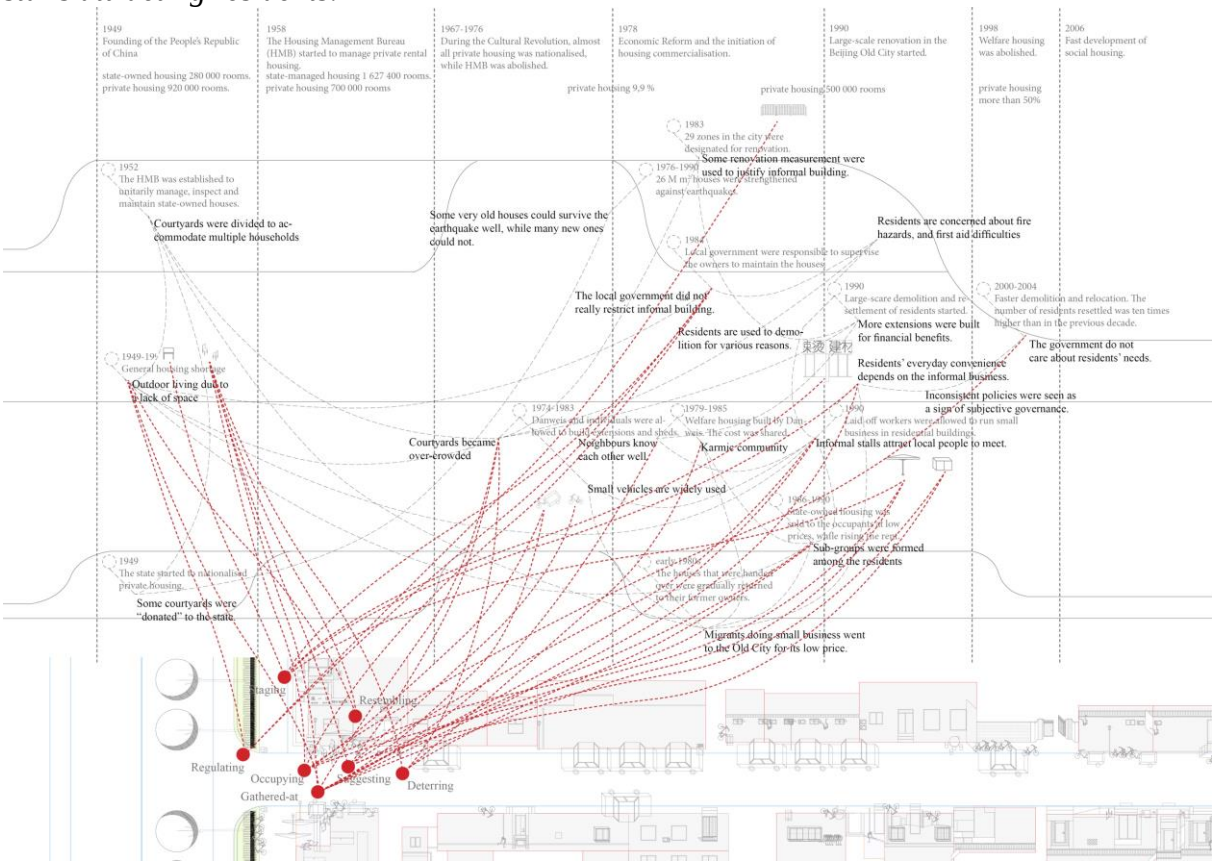

Figure 4: The map of the boundary space at the entrance to Dashiqiao Hutong, including the virtual network and its connection to the actual assemblages. (The irrelevant contextual actors have been removed for clarity).

To illustrate these connections, each material and immaterial actor is shown on the map next to the contextual actor that is most relevant to it. The effects of the actual situations are shown in the architectural drawing next to the contextual actors, with red lines connecting the two. In this way, the actual assemblages are linked to the quasi-virtual network, resulting in a map of the boundary space (Figure 4).

The map shows that prior to the implementation of the RRI at this location, both the quasi-virtual network and the actual assemblages are diverse. 10 of the 15 'nodes' in the former are actualised by immaterial actors participating in the latter[4]. Prominent nodes include the housing shortage since the founding of the country, the encouragement of spontaneous construction in the 1970s and 1980s, and the promotion of self-employment for laid-off workers in the 1990s. The dense network suggests that the urban space in the Jiugulou neighbourhood is quite porous, with open and free connections in its boundary spaces. Few actors and relationships dominate the movement from the virtual to the actual.

However, when the RRI initiative was carried out, there was a dramatic change in the actual assemblages. The removal of the stalls led to the disappearance of the various physical elements, replaced by a street camera and a flowerbed of roses. The two small restaurants around the corner have merged into one supermarket, and the windows facing the hutong have become walls (Figure 5). People's activities have also changed. There are no more queues of residents around the corner. The number of agencies has been reduced from seven to two: government *regulation* and *neglect* by passers-by. These changes disrupted the previous alignment between the real assemblage and the virtual network. The immaterial actors as nodes of the latter are no longer actual in the situations (Figure 6).

Does this discrepancy mean that by forcibly restricting the actual, the potential relationships can be eliminated? This may be true for a single location, such as the entrance to Dashiqiao Hutong, but in other parts of the Old City, despite the closure of entrance doors, shopkeepers adapted to operate through the small windows that remained, and residents continued to support their businesses. During my fieldwork in 2019, I happened to witness a demolition in progress in another hutong not far from Dashiqiao Hutong. Signs of repairs on the walls suggested that this wasn't the first demolition in the area. The physical appearance of the street oscillated back and forth. As a result, new objects formed new assemblages - the violation of regulations, the misuse of windows and ladders, the staging of QR codes for payment, in addition to the regulatory effect of the initiative (Figure 7). Two years later, the coercive effect of the RRI was less pronounced, and the diminished consistency of the virtual and actual actors was recovering (Figure 8).

The residents' adaptive methods have constructed new physical and social spaces, demonstrating that local restrictions can't completely suppress the actualising forces of virtual network. The virtual relations, as an overarching historical context of urban space, will continue to generate new situations in another location, introducing new material actors and assemblages. The contradiction between renovation and social equity created by the RRI became an opportunity to reshape the virtual and the actual, striving to restore coherence in the boundary space.

[4] The five contextual actors that aren't actualised are related to courtyard housing, which doesn't affect street life in this particular location. They will be actualised in other places. The actors in the virtual network and the actual assemblages align when all six locations of my fieldwork in this neighbourhood are considered

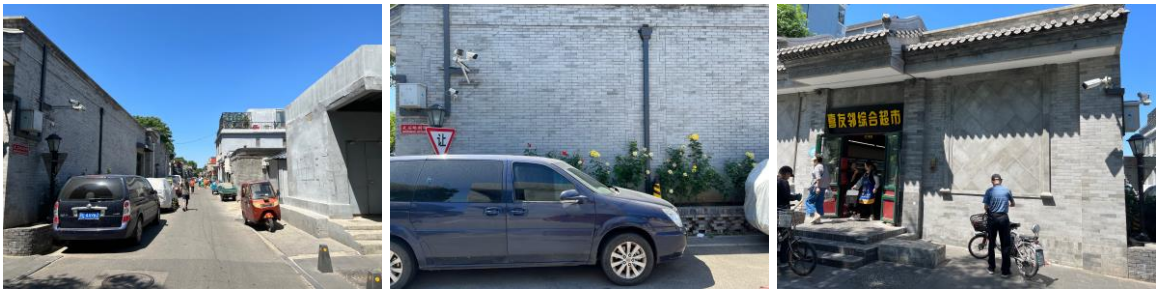
Figure 5: The entrance area of the Dashiqiao Hutong in 2023.

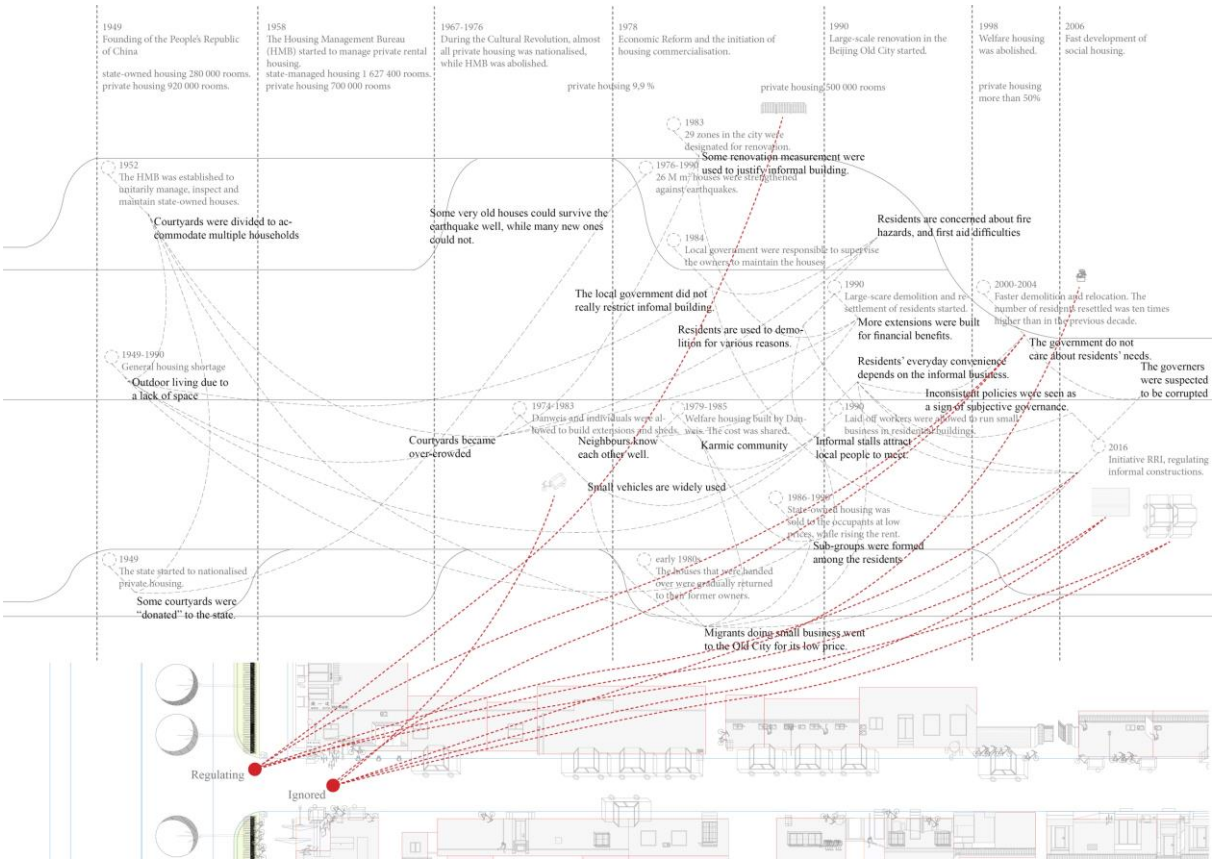

Figure 6: The map of the boundary space at the entrance to Dashiqiao Hutong, after the RRI initiative.


Figure 7: The demolition of a restaurant in Huayuan Dongxiang. The restaurant was operating through the small window that had been renovated in a previous RRI action. Left: the restaurant in operation; right: the demolition the next day.

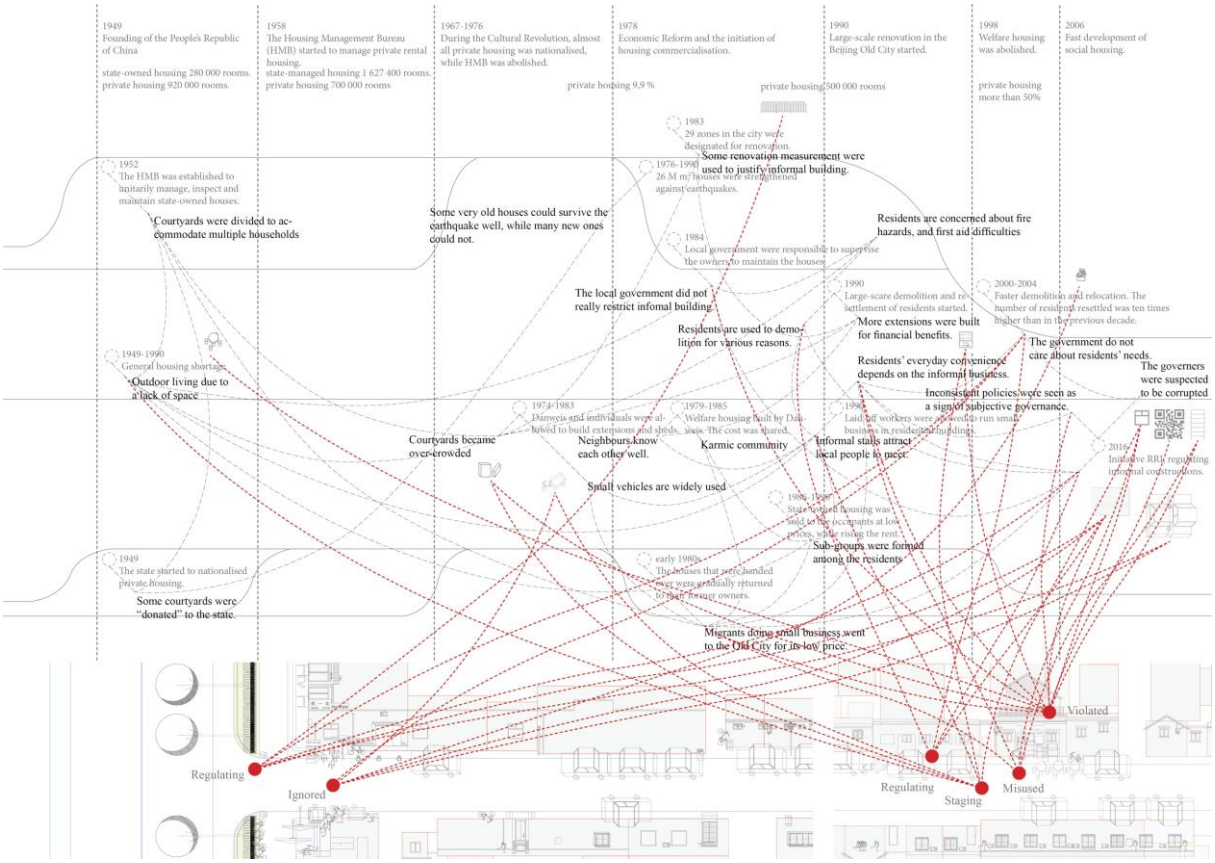

Figure 8: The map of the boundary space combining situations at the entrance to Dashiqiao Hutong, and the restaurant in Huanyuan Dongxiang after the RRI initiative.

Re-evaluating urban resilience with boundary space mapping

The case study shows that the multiple meanings of response measures stem not only from their evolving relationships with other historical strands of Beijing's urban development, but also from residents' interpretations in specific situations. If residents are seen as owners of urban space and active participants in its construction, then the free expression of their perspectives, which influence their interaction with the physical environment of the city, should be taken into account, if not the main reference, when evaluating the response measures. This is the only way to achieve equity in urban space.

This is not to say that historical housing repair policies, economic strategies and construction efforts are unimportant in shaping concrete situations. On the contrary, they interact with each other, both as responses to environmental challenges and as reactions to those responses. They should all be integral to the study of urban resilience. Mapping the boundary space provides a method to synthetically analyse the broad context of resilience, including all material, immaterial and intangible contextual actors. The boundary spaces act as a bridge between the virtual network and the actual assemblages, serving as channels for the re-emergence of past actions, releasing their potential.

As the maps demonstrate, historical housing repair policies and their associated economic strategies gained less attention from the residents compared to the construction measures, especially after the 1978 economic reform. Furthermore, these official initiatives often received negative evaluations when the overall physical environment was less favourable. However, evaluating response measures, from the perspective of assemblage thinking, should remain impartial to different initiatives in urban development history. The focus is on the capacity to connect heterogeneous elements into diverse assemblages in specific situations, ultimately fostering social resilience. This is reflected in the boundary space map, where key

nodes of interconnected contextual actors constituting the virtual network have opportunities to be actualised, not solely those pertaining to ecological rationality. It ensures that urban resilience measures are evaluated not only based on their immediate effects but also in terms of the broader changes they bring to the physical-social space.

From this perspective, the 2016 RRI action aimed to impose the specific values of safety and environmental balance as the dominant channel for the actualisation of the diverse virtual networks. Such an action disrupts the boundary spaces, whose richness and balancing capacity allow the actualisation of heterogeneous elements in new assemblages. Spontaneous construction, which allows residents to express their vision of space use (Zhu, 2019), serves as a self-balancing mechanism for the boundary space. This flexible approach empowers residents to actively influence their surroundings, rendering the enforcement measure ineffective.

Today, we cannot revisit the past to evaluate historical measures such as public housing management in the 1950s or maintenance regulations in the 1980s. They have become contextual actors in virtual network, forming diverse assemblages and contributing to the overall resilience of social space. Based on technological and social responses, assessing urban resilience by mapping boundary spaces requires a shift in perspective to embrace the actualising potential of each contextual actor in the history of urban development.

Conclusion

Based on an empirical study in Beijing's Old City, this study employs assemblage thinking to reframe urban resilience, emphasising the need to move beyond technological responses to environmental change. Instead, through the lens of social resilience, it argues for considering a wider range of urban development history, both official and informal. Drawing on Deleuze's philosophy of difference, the study highlights how past urban construction strategies have contributed to the formation of actual assemblages as a virtual network potentially embedded in concrete situations.

A boundary space acts as a connection between virtual networks and actual assemblages. It includes past strategies as contextual actors and their interpretations by local residents as immaterial actors that influence the creation of actual assemblages. Contextual actors within this boundary space make connections and form networks that are capable of being actualised differently in specific situations. The richness of boundary spaces serves as an indicator of the city's social resilience, with an emphasis on the empowerment of individuals to respond through their individual interpretations of past strategies, thus signifying equality.

A mapping method was developed to effectively navigate the complexity and diversity of boundary spaces. The maps show that residents' interpretations of historical strategies differ from original intentions, may be contradictory and irrational, and may not be consistent with environmental rationality. In particular, not all contextual actors find expression in current situations. When subjected to minimal intervention, both the virtual network and the actual assemblages in the Old City demonstrate complexity and diversity, sharing a greater number of nodes. The richness of the boundary spaces facilitates the realisation of diverse elements, involving a multitude of actors in the formation of new assemblages. The RRI initiative, which displaced certain groups of residents in the name of resilience, has limited the realisation of the virtual network. The virtual network, however, tends to rebalance the boundary space by re-engaging other actors in the formation of new assemblages.

The mapping of boundary spaces in this case study implies that the assessment of response strategies from a socio-spatial perspective should not advocate rigid criteria. They have already acquired multiple meanings through their evolving relationships with other historical strands of urban development and residents' interpretations in specific situations. Instead, it should examine whether each actor and node, as perceived by residents, has the potential for

actualisation. I caution that measures that disrupt boundary spaces run the risk of reducing urban resilience and residents' equity in shaping their own urban environments. Ultimately, these measures may prove ineffective in the face of the self-balancing dynamics inherent in boundary spaces.

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