

Optimization Strategy of Commercial Space in Xianyukou Hutong Based on Kernel Density and Space Syntax

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Abstract: Beijing Xianyukou Hutong (*hutong* refers to historical and cultural block in Chinese) occupies an important geographical location with unique urban fabric, and after years of renewal and protection, the commercial space of Xianyukou Street and has gained some recognition. This article Xianyukou takes commercial *hutong* in Beijing as an example, spatial analysis was carried out using methods like GIS kernel density method, space syntax after site investigation and research. Based on the street space problems found, this paper then puts forward strategies to improve and upgrade Xianyukou Street's commercial space and improve businesses in Xianyukou Street and other similar *hutong*.

Keywords: *Hutong*; Xianyukou Street; Commercial space; Space syntax; Kernel density estimation

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1. Introduction

In 1999, Beijing designated a historical protection area of the old city, and the plan clearly mentioned that the complete historical scene should be preserved or built. The 25 areas under control include Dashilan, East Liulichang Street, West Liulichang Street and Xianyukou area^[1]. The traditional *hutong* in Beijing is an embodiment of the urban humanistic spirit of Beijing, while the *hutong* in the Xianyukou area mostly retains the historical traces and styles. After the protection and renovation, the Xianyukou area has developed into a traditional commercial food street.

By studying the relevant information about the renewal of commercial space in the historical district, this paper analyzes the spatial changes and development of Xianyukou Hutong and the commercial characteristics inside the *hutong*. Secondly, a survey is carried out in Xianyukou area to understand the current situation and analyze its commercial spatial form. Through field investigation, combined with point of interest (POI) data, the kernel density estimation method was used to study the degree of commercial industry clustering in Xianyukou and its surrounding areas, and Depthmap software was used to establish a space syntactics axis model to describe the regional spatial pattern, so as to obtain the characteristics of human flow^[2]. Finally, a comparative analysis of the spatial vitality and commercial attraction to people flow between the Xianyukou area and the surrounding traditional *hutong*, as well as the exploration of more influential factors to activate commercial space.

2. An overview of Xianyukou Hutong

In the planning of the historical and cultural Reserve of Beijing, the Xianyukou area extends to the

Damochang Street in the north, to the north of Dongzhu Shikou Road in the south, to the west of Qianmen Street, and to the east of Caochang Shi Hutong^[3], as shown in **Figure 1**. Among them, the Xianyukou Hutong with Beijing urban characteristics starts from Qianmen Street in Dongcheng District in the west and ends at Qianmen East Road in the east, facing Dashilan across the street. Xianyukou Street and Dashilan Street intersect Qianmen Street, forming the core street space node of Qianmen Street.

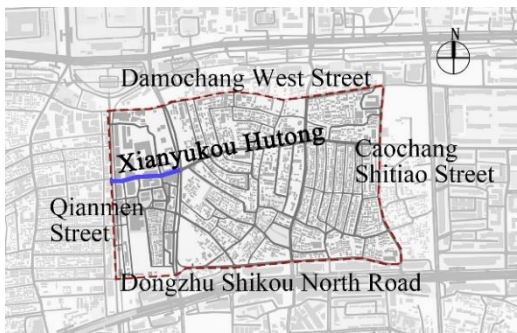


Figure 1. Range of historical and cultural blocks in Xianyukou

After rearranging the block texture, Xianyukou Street has sorted out the street pattern in three levels of historical texture, namely *hutong*, street, and courtyard, and renovated the surrounding environment and architectural features to further make Xianyukou Street more attractive. By taking advantage of its western location on Qianmen Street, it reintroduces Beijing’s time-honored brand shops, unifies the commercial shops on both sides of the *hutong* for the overall appearance style, and focuses on creating the street’s commercial label based on food and snacks. However, there are a series of problems in the renovation of Xianyukou Street. The value of the original building is ignored in the construction renovation, and a large scale of reconstruction and demolition are carried out^[4]. Most of the streets are restored to the appearance of a certain prosperity period but fail in portraying the evolution of architectural style throughout the period, resulting in the lack of urban historical and cultural characteristics, and tend fall into the same “Internet famous antique streets” category^[5]. At the same time, it overbuilds its food label and ignores the organic combination of the life mode of the people in the Xianyukou with the history and culture, and the hustle and bustle of the local people’s life gradually fades.

3. Analysis on the global spatial distribution pattern of Xianyukou Street and its surrounding areas

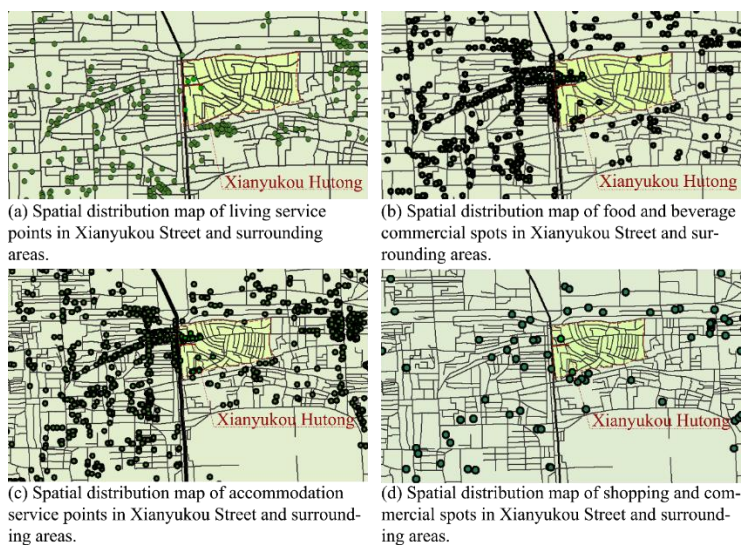


Figure 2. Spatial distribution of commercial spots in Xianyukou Street

By combining POI data analysis with kernel density estimation method, the degree of industrial agglomeration in a targeted area can be visually demonstrated by graphical representation. This method is used to calculate the density of the points around the grid pixels and obtain the degree of industrial agglomeration in a certain area [5]. Then the field survey of Xianyukou Street and its surrounding areas to verify the authenticity of the information provided by the map. According to the AmAP commercial types POI classification code, the numbers of POI in the four commercial types of catering, shopping, life service, and accommodation service are 3599, 260, 1903, and 3600, respectively. In terms of the four commercial formats, although the Xianyukou area does not belong to the core area of the total density distribution of commercial POI in Dongcheng District, the locations of Xianyukou Street and Dongzhu North Road are in the core area of the total density distribution of commercial POI in Qianmen District. Based on **Figure 2**, in terms of the commercial types of catering and accommodation service points, Xianyukou Street is the same as the adjacent Qianmen Street and Dashilan Street, which have a large and dense number of POI. In particular, Xianyukou Street faces Dashilan across the street, so the positioning of Xianyukou Street needs to be more detailed and accurate, so as to highlight its *hutong* characteristics.

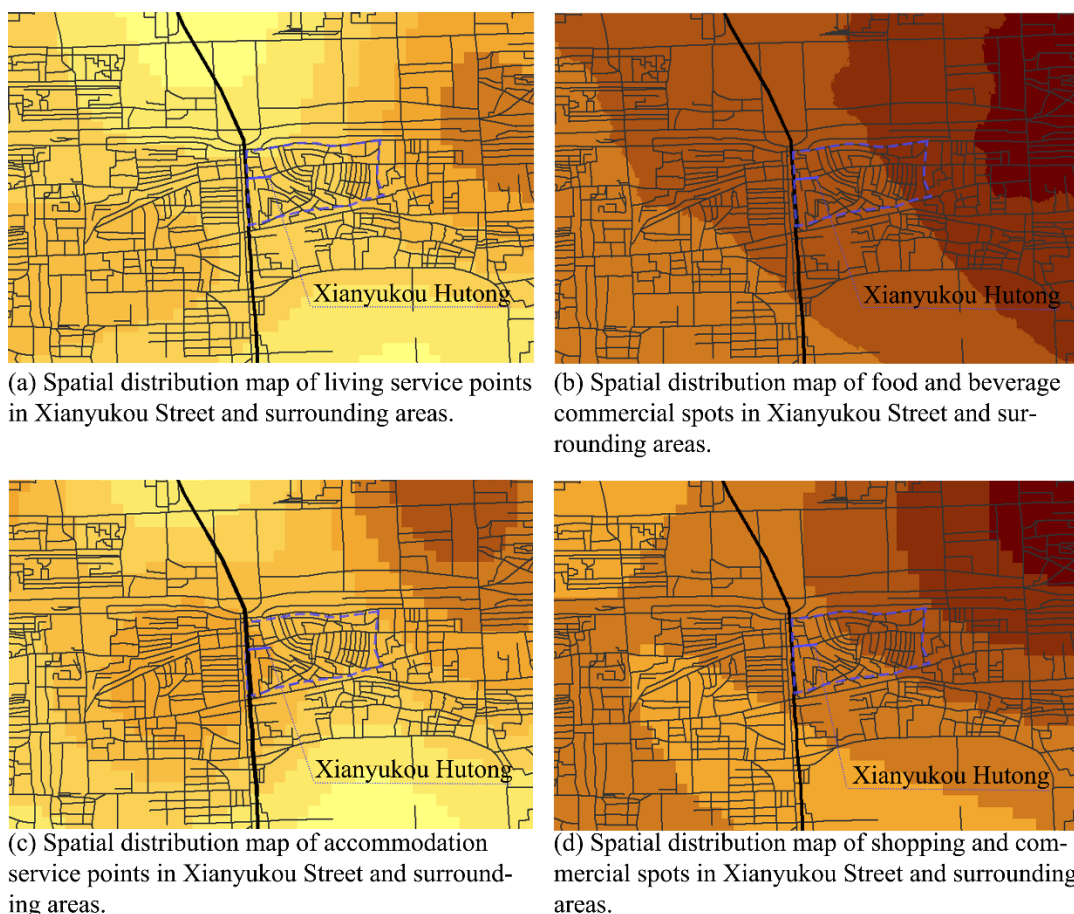


Figure 3. Spatial distribution of nuclear density in commercial spots of Xianyukou Street

Through the analysis of the research results by the kernel density estimation method, the four different commercial forms above have formed different spatial distribution patterns. In **Figure 3(a)**, in terms of life service commercial formats, the density of life service commercial formats in Xianyukou Street and its surrounding areas presents a spatial form of small discrete agglomeration, and the life service commercial points are relatively scattered. The northeast direction of the Xianyukou area shows a small range of hot spots, while the Xianyukou Street is located in the sparse periphery of the two small range of hot spots, and

the density of life service points is low. As shown in **Figure 3(b)**, in terms of catering commercial formats, the density characteristics of commercial formats in this area show that Beijing Workers' Stadium in the northeast direction of Xianyukou Street is located in the central area, while Xianyukou Street is located in the peripheral area of the commercial core. **Figure 3(c)** shows that in terms of commercial forms of accommodation services, the density of commercial forms of accommodation services in this region also presents a spatial form of small discrete clusters, and the commercial points of accommodation services are mainly scattered around small hot spots in the Forbidden City and Tian'anmen Square. Xianyukou Street is located around the core of accommodation services centered on Meishi Street and Dashilan Street. It is in the transition area between the commercial activity intensive area and the residential area. In Figure 3 (d), in terms of commercial forms of shopping, this area shows a spatial form spreading outward from the central area. The core of commercial forms of shopping is still the core of Beijing Workers' Stadium in the northeast direction, and Xianyukou Street is in the central area, which is in the transitional zone of the integration of the eastern and western commercial cores.

Among them, the distribution characteristics of food and beverage commercial spots in Xianyukou Street and its surrounding areas are consistent with the overall distribution of shopping commercial spots, and the distribution mode is regional intensive distribution, mainly concentrated in Beijing Workers' Stadium. The distribution density of Xianyukou Street is very similar to that of Qianmen Street and Dashilan Street. The distribution characteristics of living service commercial points are unified with the overall distribution of accommodation service commercial points, showing a small range of hot spots, and the distribution of commercial service points in Meishi Street and Dashilan street is more dense than that in Xianyukou Street, especially the distribution of residential service commercial points with Meishi Street as the center of the small range of hot spots. Based on the distribution characteristics of the four commercial service points, Xianyukou Street has not formed a self-centered service radiation hotspot and competitive strength.

4. Spatial syntax interpretation of Xianyukou Street and its surrounding areas

4.1. Space syntax

Space syntax is mainly used for analyzing the integration degree and selection degree of the target space. The degree of integration mainly represents the accessibility of a certain space in the city. The higher the degree of integration, the stronger the accessibility of the region. The degree of integration can be divided into the overall degree of integration and the local degree of integration ^[6]. The degree of choice represents the aggregation attraction of a certain space to the flow of people. In the research method of historical and cultural blocks, the most appropriate local integration degree is the topological radius distance of $R = 3$, because $R = 3$ is the closest scale value similar to human walking in the space ^[7].

4.2. Spatial syntax analysis of Xianyukou Street

Xianyukou Historical District is closely connected with Qianmen, Dashilan, and Caochang areas in many aspects, such as geographical location, culture, history, and economy, but there are also a series of differences ^[8]. Therefore, in the space syntax analysis of Xianyukou Street, Qianmen, Dashilan, and Caochang areas are also included in the research scope to explore the similarities and differences of the designated areas. DepthmapX software was used for this analysis, and the research object was first transformed into an identifiable axis map ^[9]. Then, the axis map of Xianyukou Street and its surrounding areas is studied and analyzed with relevant analytical means, and the spatial structure features presented are further interpreted.

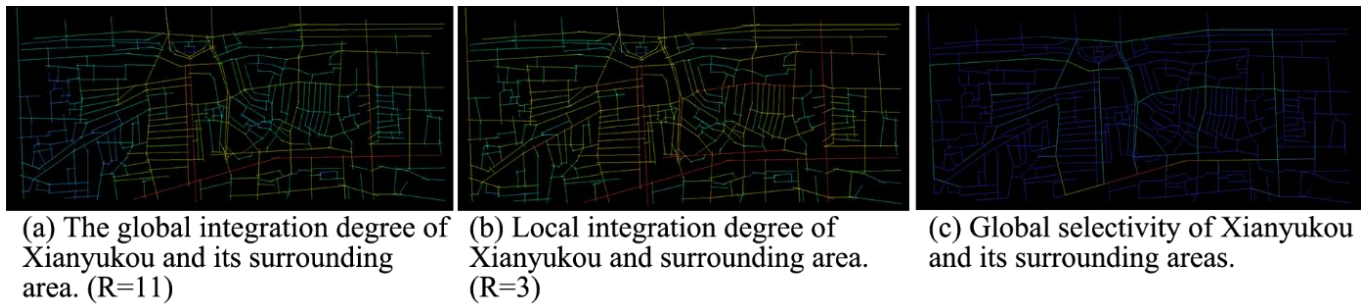


Figure 4. Spatial Syntax analysis of Xianyukou and surrounding areas

4.2.1. Analysis of block integration degree in Xianyukou District

DepthmapX software was used to analyze the global integration degree of this area and the local integration degree of the three topological distances ($R = 3$), as shown in **Figures 4(a)** and **(b)**. The axes with the highest global integration degree values of Xianyukou Street and its surrounding areas are Qianmen Street, Jewelshi Street, Dongzhu Shikou Street and Caochang 10 respectively. The local integration values of these four streets were 1.659, 1.611, 1.767 and 1.558, respectively^[10]. **Figure 4** shows that local integration of other streets was lower than 1.500. When the topological distance is equal to 3, the axes with the highest local integration value in the Xianyukou area are 3.076 in Qianmen Street, 3.009 in Caochang Shitiao Street, 2.922 in Xianyukou Street and 2.716 in Jewelshi Street. In addition, the local integration value of Xianyukou Street is 2.363, lower than that of Dashilan (2.520). Thus, we can judge that the main commercial centers of Xianyukou and its vicinity are located in Qianmen Street and Xianyukou Street. In the area of Xianyukou and its surrounding area, other streets showed low accessibility.

4.2.2. Analysis of block selection in Xianyukou district

From the global perspective of Xianyukou and its nearby areas, **Figure 4(c)** shows that the axes with the highest global selection degree R_n are Dongzhu shikou Street, Qianmen Street, Meishi Street, Qianmen East Road and Xianyukou Street, with the global selection degrees of 128112, 66044, 72593, 51798, and 52082 respectively. In addition to the above streets and alleys, the selection degree of regional streets and lanes is obviously lower (**Figure 4**). By comparing the choice degree of Dashilan Street and Xianyukou Street, the choice degree of Dashilan Street is 4512, while that of Xianyukou Street is 2427. The former is significantly higher than the latter, indicating that Dashilan Street is significantly more attractive to citizens and tourists than Xianyukou Street, which is consistent with the actual situation obtained from the field survey.

5. Summary of commercial space problems in Xianyukou Street

5.1. The degree of regional integration is low

The accessibility of Xianyukou Street is low, which fails to form a complete walking tour streamline system with the secondary streets in the surrounding area. In the investigation, it was found that the flow of people centered on Xianyukou Street radiated to the surrounding secondary *hutongs* in a fishbone shape, connecting the surrounding six *hutongs* in series, without forming a commercial walking circuit. Although Xianyukou Street and its surrounding areas have rich commercial forms, and the street scale has a hierarchical walking system, the utilization rate of shops in secondary *hutongs* such as the surrounding Dajiang Hutong is low, and some secondary *hutong* are impassable with fences, which further makes the walking system of Xianyukou block unable to be closed.

5.2. The selection of blocks is low



Xianyukou block lacks core attraction, it is difficult to attract more tourists continuously. On one hand, the characteristic commercial value of the traditional *hutong* is not reflected in the design and layout of its commercial space. Xianyukou Street and Dashilan Hutong have the same commercial positioning, and it is located at the opposite of Dashilan, while Dashilan already has a greater visibility. On the other hand, most of the new Xianyukou Street is transformed to introduce time-brand gourmet shops, and the translation of “old Beijing flavor” is superficial, and the buildings are mostly newly built, with low openness. As a representation Beijing cuisine, the symbol of “fish” has not been organically translated, such as on manhole covers, streetlamps, pavement, building walls and other details. Secondly, the entrance of Xianyukou Street lacks the reuse and creation of the historical and cultural characteristics of *hutong*, and fails to make full use of the intersection space between Qianmen Street and Xianyukou Street. Besides, the driving force of people flow are the Pianyifang, Tianleyun Theatre, which are at the easternmost exit. Moreover, there is a lack of resting places like seats for tourists. Most of the shops only set up the sales window, and tourists can only sit on the floor in front of the store or go into the store to have a rest. In addition, the commercial utilization rate of Xianyukou Street is high, only a few trees are planted, and there is little greenery in the courtyards of the surrounding secondary *hutong*, but these courtyards do not play the function of staying and resting.

5.3. Lack of linkage with the surrounding core area

Xianyukou Street is located in the transition zone between Dashilan and Beijing Workers’ Stadium. However, it failed to closely connect with Dashilan by using the surrounding stream of people to form its own competitiveness and commercial radiation. There are few shopping and commercial spots in Xianyukou Street, and the catering and accommodation commercial spots are not dense enough. Besides, the major theaters, the art galleries, the Taiwan Guild Hall, and other passenger flow driving forces are on the east side, and the secondary main stores in the middle are not closely related to the main commercial stores at both ends.


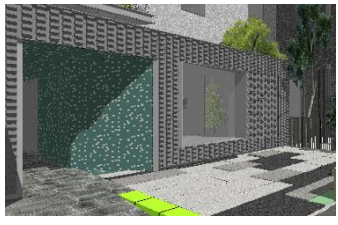

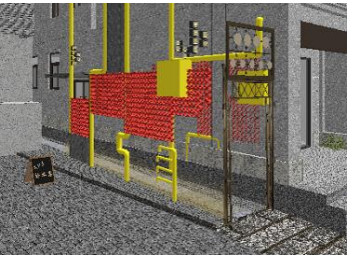


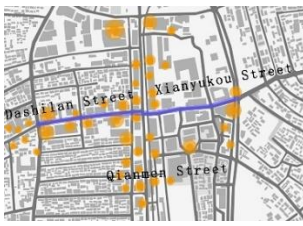

5.4. Xianyukou Street commercial space renewal and improvement strategy

Table 1. Current situation and renewal strategy of commercial space in Xianyu Street

| Status quo problem | Status quo node space | Status node space diagram | Upgrade and improvement strategy | Strategy schematic |
|---|--|---|--|---|
| The degree of regional integration is low | Flow of people (flow line is fishbone shape) |  | Set the main tour route to guide the flow of people. Set it as the circular streamline with the core of Xianyukou Street |  |

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| Status quo problem | Status quo node space | Status node space diagram | Upgrade and improvement strategy | Strategy schematic |
|--|--|---|---|---|
| The selection of blocks is low | Characteristic commercial space |  | Into the store culture |  |
| | Entrance (Intersection of Xianyukou Street and Qianmen Street) |  | <ol style="list-style-type: none"> (1) Multi-level display entrance space (2) Add an entrance signature |  |
| | Public facilities, greening |  | Increase greenery and rest areas |  |
| Lack of linkage with the surrounding core area | Layout of commercial points |  | Form commercial system with Dashilan and Qianmen Street |  |

First of all, through strengthening the commercial and green space inside the block, the single building shops, *hutongs* and blocks are connected to form a series. Based on the current commercial walking system, it will further integrate and activate the surrounding secondary *hutongs*, make the shops more accessible and welcoming and increase the attraction of Xianyukou Street and its surrounding areas. Moreover, strengthen the spatial permeability between streets will increase the connectivity between street areas in the line of sight, increase the tour route indication chart, make the surrounding secondary hutong and Xianyukou Street businesses into a “ring system”; tourists can return to Qianmen Street after visiting the Xianyukou area. Secondary *hutongs* should serve to enrich the tourists’ senses in various forms, they can be transformed into commercial space such as creating photography walk space, Virtual Reality (VR) experience hall, stages, and so on, or create an area for Beijing cuisine and cultural experience.

Secondly, core appeal needs to be built. Further emphasize on what Xianyukou street is known for, which is a place for Beijing cuisine. Besides, cultural and folk cultural activities of “old Beijing flavor”

food needs to be developed from multiple angles and avoid blindly building monotonous antique buildings. Instead, design commercial space combined with the unique food culture of shops, such as shop signs, exhibition area of the founding story of the time-brand, characteristic black brick wall, and so on. In this way, it makes rational use of the entrance space to enrich the facade display form and spatial level change of the entrance space, further open the west entrance interface, and increase the entrance interesting facilities with bright colors to activate its vitality. At the same time the overall cultural connotation of the block and the original street architectural characteristics should be considered, so as to ensure an authentic display of architectural characteristics of various shops and color coordination, to avoid the highly unified facade of street shops, single way of cultural display and monotonous commercial space. Green plants should be planted in the *hutong* to support commercial development and break the pattern of single function within the area. At the same time, some small-scale public cultural space or resting spots should be added in the street node space, and at the same time meet the needs of the market, food display and other activities in a specific season, to increase the sense of participation and identity of citizens.

The linkage with Dashilan Hutong should be strengthened and form its own commercial characteristics. Commercial anchor stores and secondary anchor stores for shopping and catering should be introduced to attract the flow of people from the two surrounding core business districts. At the entrance of Xianyukou Street, the central and eastern exits should be arranged to form a commercial gathering point with the surrounding retail merchants. At the central part of Dajiang Hutong and the intersection of Dajiang Hutong and Nan Xiaoshun Hutong, a commercial gathering point is formed with the art and culture center and the surrounding commercial points, so as to link with Dashilan in terms of distance and commercial points (Table 1.)

6. Conclusion

Xianyukou Historic District is closely related to the social life and historical style of Beijing, and also reflects the historical precipitation of the civilization in this area. Focusing on the commercial buildings and surrounding public space in Xianyukou Street, this study analyzed the shortage of commercial space in Xianyukou Street, and finally put forward the improvement strategy reflecting the cultural value of the old city. While continuing its precious historical context and regional connotation, this study adds new functions to activate the vitality of the region and make it integrate with modern life. Only through the reuse and creation of history and culture can people experience the real historical and cultural value of the city.

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Disclosure statement

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