Exploring the Assessment and Strategies of Street Inclusivity in Suzhou, China

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ABSTRACT

Nowadays, the concept and significant value of inclusive development are widely recognized globally, making it a fundamental principle in urban planning. Simultaneously, urban spatial development has transitioned from incremental expansion to stock renewal. From strict separation between market blocks to integrated, there is a trend of diversity and inclusion in the spatial form and functionality of streets. Guided by this principle, street design aims to accommodate people of different genders and age groups, thereby promoting more profound face-to-face communication and social activities. In the context of advocating for a fair, diverse, and inclusive urban spatial renewal, it is essential to exploring how to better accommodate various social activities, functional layouts, and the experiences of stakeholder. Creating a friendly and integrated street environment is crucial to further enhance urban inclusivity and social openness. This effort holds significant practical importance.

As one of Chinese pilot cities for urban renewal, the city of Suzhou boasts a rich array of distinctive characteristics and historical streets. This paper selected four representative types of streets in Suzhou, using multiple sources of data such as street scenes,Point of Interest(POI) and Location-Based Services (LBS). A street inclusiveness assessment system was constructed to interpret street factors from three dimensions: spatial comfort, functional convenience, and human activities.This study analyzed the correlation between indicators, and uses the Analytic Hierarchy Process (AHP) to determine indicator weights and standardized values. The assessment of inclusive scores for the four streets were calculated. For the measurement of certain indicators, the study adopted the GSAM (Grounded Segment Anything Model) to segment and recognize objects. This model has the capability to automatically segment objects in images or videos, generate high-quality labels, and produce measurement results for the factors with a single click. The total score for inclusivity assessment of the four streets is ultimately determined through a combination weighting method.

The results of street inclusive assessment indicated that: (1) "Historical Character Streets" presented good performance across various indicators.This marked them suitable for creating highly inclusive and vibrant gathering spaces. (2) The high street penetration rate and density of store facilities demonstrated the potential for inclusive vitality of "Lifestyle and Culture Streets". (3) "Modern Distinctive Streets" performed better in terms of sky openness and pedestrian friendliness,but have a lower greenery ratio. (4) "Lifestyle Landscape Streets" had a higher quality of greenery and accessibility to other parks, but they showed lower inclusion attributes towards functional formats and human activities. Correlation analysis founded that as street building enclosure increases, the proportion of cultural facilities distribution also increases accordingly, providing a wider range of cultural activities. The indicators of accessibility to park and greenery spaces revealed a positive correlation with the proportion of business facilities, indicating a preference for environmentally superior areas among commercial establishments. In terms of inclusion assessment scores, "Historical Character Streets" and "Lifestyle and Culture Streets" received higher evaluation scores , while "Modern Distinctive Streets" and "Lifestyle Landscape Streets" exhibited lower values in this regard. Accordingly, based on the specific presentation of

indicators for these four types of streets, the study proposed corresponding renewal strategies, aiming to assist the relevant authorities in improving the inclusion and vitality of streets. It will enhance the quality and happiness of community residents.

KEYWORDS: Street Inclusion ; urban space; Streets classification; Assessment of Inclusivity; scenario strategies

1. Introduction

Currently, urban development in China has shifted its focus from expanding the quantity of cities to updating existing areas[1]. Streets, as a crucial component of urban space, play an indispensable role in city renewal and have garnered widespread attention. The transformation from strictly separated market districts to integrated street life reflects a diverse and inclusive trend in the form and function of street spaces. Enhancing inclusivity from all aspects has gradually become a focal point for evaluating streets' ability to better meet various social activities, functional formats, and people's experiences while creating a friendly and harmonious environment. This is also one of the critical directions for street renewal work. However, during recent years' urban renewal processes, there has been homogenization in street space design with insufficient consideration for inclusivity resulting in inadequate attractiveness of streets. Based on this issue, this paper establishes an inclusive evaluation system for streets and selects four distinctive streets in Suzhou City as empirical case studies to explore ways to enhance vitality and inclusivity during urban street renewal work.

The concept and value of inclusive development are widely recognized globally at present[2]. The inclusiveness of urban streets is reflected in their capacity to accommodate buildings and facilities on both sides, as well as in their design concepts that promote equilibrium in areas such as economy and culture[3]. Guided by this principle, street design aims to cater to individuals of diverse genders and age groups, thereby fostering more profound and varied face-to-face communication and activities[4]. In the field of urban planning, streets refer to roads within urban areas primarily utilized for daily life services and social activities for residents, encompassing elements such as ground-level shops, open spaces, and service facilities connected to the streets; all these elements can impact street inclusiveness[5]. Simultaneously, inclusive development necessitates comprehensive consideration of the needs of vulnerable groups while seeking consensus through negotiation to resolve potential conflicts between different group demands and avoid excessive polarization. Currently advocating for harmonious livable modern cities entails not only meeting basic functional requirements in urban street facilities but also adhering to a "people-oriented" value perspective[6].

In theoretical terms, the concepts of 'inclusive design' and 'universal design' were proposed in the 1990s[7]. By studying the changes in elderly people's perception of outdoor environments, the book 'Inclusive Urban Design - Living Streets' puts forward six design principles and provides detailed discussions[8]. At the level of urban public space design, starting with inclusive design for families with children, creative transformations are made to public spaces such as streets to meet

different population characteristics and regional requirements[9]. Inclusive design for older people needs to adhere to principles of hierarchy, accessibility, safety, and psychological well-being[10]. Additionally, vibrant spaces can better integrate multiple functions, purposes, and choices[11].

In terms of quantitative analysis, previous studies have primarily focused on examining the impact of inclusive pedestrian facilities and proposed a novel model (PLOS) for evaluating and enhancing the influence of street infrastructure on pedestrian service levels[12]. In order to realize an all-encompassing vision for streets, a comprehensive questionnaire survey and logistic regression analysis were conducted in Singapore to assess six dimensions of urban street design: accessibility, connectivity, streetscape, safety, vibrancy, and greenery[13]. The evaluation of sociality in commercial streets revealed that spatial accessibility significantly influences user participation in street activities[14]; mixed-use formats and favorable pedestrian experiences positively contribute to the creation of inclusive social spaces[15]. Furthermore, it was found that the urban street vitality and inclusivity is closely intertwined with their external representation as well as constituent elements.

The external representation primarily encompass crowd gathering intensity and commercial activity frequency. For instance, mobile signaling data is utilized to investigate the spatiotemporal distribution of crowds, aiming to explore the correlation between waterfront spaces and vitality[16]. Simultaneously, it delves into the deficiency of vitality in commercial pedestrian areas to comprehend users' evaluations of nodal spaces, buildings, and crowd activities[17]. In terms of constituent elements, diverse research methods are employed including establishing a vitality system for historical block public spaces based on dimensions such as spatial accessibility, spatial quality, and attributes[18]. Factors like sidewalk width and ground floor interface transparency exert influence on staying behavior within commercial pedestrian areas[19]. The examination of factors like social functional density and functional mix enables an exploration of the relationship between environment and citizen activities while enhancing street space quality. Furthermore, the study highlights that ground-level commercial facilities impact attractiveness while transportation convenience relies on spatial structure accessibility[20].

Currently, research on the assessment of street inclusivity primarily focuses on theoretical foundations, design strategies, and evaluations of vitality composition. However, there is a lack of analysis that combines urban street vitality and inclusivity assessment with quantitative indicators. Existing studies on specific types of streets are still too general and require more detailed classification to reflect their characteristics and diversity. In this study, we conducted feature analysis on pedestrian-oriented streets in Suzhou City and identified outstanding historical value, strong sense of life, and distinctive architectural styles from different eras as the basis for classifying these streets. The streets under investigation are categorized as follows: firstly, "Historical Comprehensive Streets" (Pingjiang Road) which possess significant historical and cultural heritage, serve as tourist attractions with intellectual property functions, offer comprehensive commercial services, and attract a substantial number of tourists; secondly, "Historical Life Service Streets" (Fengmen Hengjie) primarily focusing on life service functions while exhibiting a strong local atmosphere influenced by market trading activities; thirdly, "Modern Comprehensive Streets" (Huaihai Street) characterized by high commercial density and closely arranged shops with a modern style and distinctive ambiance; fourthly, "Modern Life Service Streets" (Xietang Old Street) featuring beautiful landscape environments while predominantly serving life service functions. By assessing the inclusiveness level of these four

types of urban streets, our aim is to effectively harness their inherent potential in order to enhance residents' quality of life.

2. Study area and Methodology

2.1 Research scope

As one of the pilot cities for urban regeneration, Suzhou has diverse historical and cultural districts with distinctive characteristics, forming streets that exhibit diverse historical and modern styles. This study primarily relies on high-frequency street vocabulary from social platforms such as Xiaohongshu and Dianping, along with popular check-in streets from hotlists, for the purpose of identifying 44 frequently mentioned "internet-famous" streets in the urban area of Suzhou. Based on their main features, these streets were manually reviewed and classified into four types: "Historical Comprehensive Streets", "Modern Comprehensive Streets", "Historical Life Service Streets", and "Modern Life Service Streets" (refer to Table 1). Among these, "Historical Comprehensive Streets" encompass historically significant cultural streets in Suzhou, characterized by high cultural value, diverse functions, and strong tourist attraction. "Modern Comprehensive Streets" are distinguished by high levels of commercial development, spaciousness , and well-equipped facilities. "Historical Life Service Streets" are often influenced by market trading hours and emanate a strong local atmosphere of bustling life. "Modern Life Service Streets" boast beautiful landscapes and a serene atmosphere, with unique street styles. Based on the results of classification, our study ultimately selected Pingjiang Road, Huaihai Street, Fengmen Heng Street, and Xietang Old Street as four representative examples of streets (as shown in Figure 1), and evaluated their inclusiveness from specified perspectives and data indicators

Table 1 The classification and screening of Suzhou city streets

Classification	Street
Historical Comprehensive Street	Pingjiang Road, Shantang Street, Wusha Road, Taohuawu Street,etc
Modern Comprehensive Street	Huaihai Street, Gongyuan Road, Zhongjie Road, Jinfan Road, etc
Historical Life Service Street	Fengmen Heng Street, Daoqian Street, Pishi Street, Dongzhong Market, etc
Modern Life Service Street	Xietang Old Street, Dashitou Alley, Ximei Alley, Yangyu Alley, etc

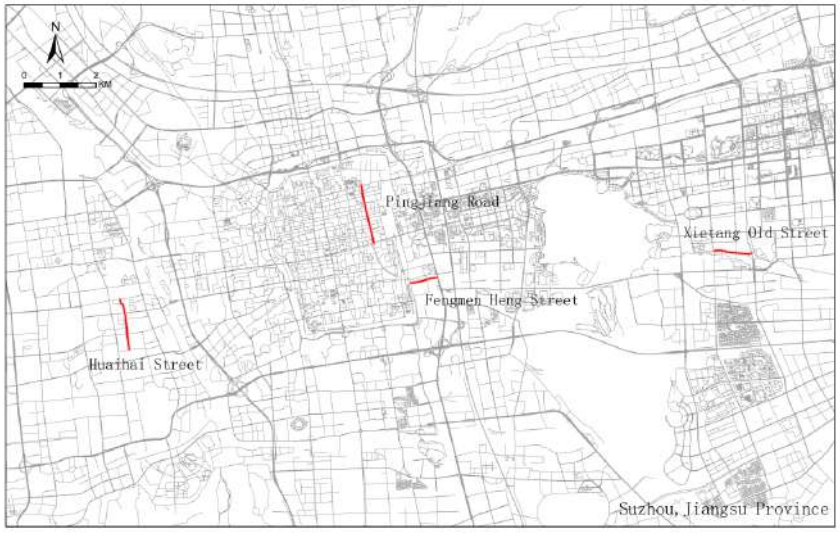

Figure 1 Street location map of this study

Pingjiang Road, recognized as one of the first historical and cultural streets in Suzhou, spans approximately 1606 meters. It exhibits a delicate texture and a street pattern resembling fish bones. Adorned with grey tiles and the style of a water town, Pingjiang Road displays its unique charm and rich cultural heritages. While the natural landscape along the street is commendable. It serves as an important tourist attraction and a prominent symbol of Suzhou. Huaihai Street, known for its Japanese-style charm, is designated as a "national-level famous and characteristic commercial street." The present architectural texture is relatively orderly, with clean street interfaces and spacious pedestrian areas. However, it suffers from a lack of greenery and a sense of hierarchy.

Fengmen Heng Street, with its quaint and humanistic appeal, attracts many visitors with its traditional style and local market culture. The present architectural texture of Fengmen Heng Street exhibits relative fragmentation. It is essential to improve street cleanliness as well as greenery. Xietang Old Street creates a kind of antique leisurely life atmosphere, and the good natural environment provides a good place for local people to walk and relax.

Figure 2 Investigation on plane texture and present statuses of four streets

2.2 Construction of an inclusive assessment

This study involved manual selection of objects and on-site inspections, utilizing handheld cameras to capture street view images aligned with the line of sight, along with points of interest (POI) data and LBS data etc, for analysis and review. The study examined streets from three dimensions: spatial inclusivity, functional inclusivity, and social inclusivity. Sixteen indicators were selected.

Spatial inclusivity primarily reflects the pursuit of high standards of comfort. The space permeability reflects the street's capacity and friendliness. Street greenery emphasizes the perceived environmental quality. Sky openness contributes to improving urban microclimates and alleviating the pressure of individual living and working. Enclosure indicates the degree to which buildings, walls, and other structures enclose public spaces. A good enclosure degree provides a comfortable and shaded feeling. Street width-to-building height ratio and building width-to- street width ratio have significant effects on spatial behavioral cognition, especially when the street width-to-building height ratio is less than 1[21]. In narrow spaces, the sense of enclosure is strong, leading to feelings of oppression and affecting the walking experience.

In the dimension of social inclusivity., our study concentrates on the diversity of street businesses, considering living and public service facilities (such as telecommunication services and public toilets), catering facilities (such as restaurants and tea houses), and cultural facilities (such as art galleries and museums) within the street space. These functional venues not only meet people's basic needs but also stimulate consumer behaviors, thereby positively impacting the inclusiveness of the street. Commercial density reflects the intensity of urban development and the convenience of daily life. A higher degree of street business aggregation indicates a higher level of mixed-use, which is beneficial for shortening distances to destinations.

In terms of social inclusivity, the study indicators cover the accessibility of green spaces, public transit, pedestrian-friendliness, and the average density of crowds on weekdays and holidays. Accessibility to green spaces is related to the well-being of residents around the street, as these green areas serve as primary recreational spaces for daily activities, thereby attracting more foot traffic to nearby streets. The accessibility of public transit reflects the friendliness of people reaching the street, with well-developed public transportation providing more efficient and convenient commuting options for street stakeholders. Pedestrian-friendliness reflects the connectivity of the pedestrian traffic network, which can promote commercial and social activities. Crowd density reflects the real-time concentration of people and their activities on the street.The assessment of inclusive street is shown in Table 2.

Target Layer	Criterion Layer	Factor Layer	Data Collection
Assessment of Street Inclusivity	Spatial Inclusivity	Space permeability	$I_{sp}=\frac{S_{\text{ground window}}+S_{\text{ground door}}}{S_{\text{all}}}$ [22]
		Street greenery	$I_{green}=\frac{S_{green}}{S_{\text{all}}}$
		Sky openness	$I_{sky}=\frac{S_{\text{sky}}}{S_{\text{all}}}$
		Enclosure	$I_{en}=\frac{S_{\text{building}}+S_{\text{wall}}+S_{\text{fence}}+S_{\text{pole}}}{S_{\text{all}}}$
		Street width-to-building height ratio	$A_r=\frac{Sw}{Bh}$
		Building width-to- street width ratio	$A_r=\frac{Bw}{Sw}$
	Functional Inclusivity	Degree of business aggregation	$H=-\sum_{i=1}^{S}(P_i \ln P_i)$
		Proportions of living and public services	
		Proportion of catering facilities	$f_n(x)=\frac{1}{n\pi h^2}\sum_{n=1}^{n} K\left(1-\frac{(x-x_i)^2-(y-y_i)^2}{h^2}\right)$
		Proportion of cultural facilities	

	Commercial density	$D_{poi} = \frac{N_p}{L_r}$
Social Inclusivity	**Green space accessibility**	$D_{green} = \min d_{\text{green}}$
	Public transit accessibility	$D_{pt} = \min d_{\text{pt}}$
	Pedestrian friendliness	$I_{pf} = \frac{S_{\text{sidewalk}}}{S_{\text{all}}}$
	Average Crowded density on weekdays	$Density = \frac{1}{(radius)^2}\sum_{i=1}^{n}\left[\frac{3}{\pi}\cdot opp_i\left(1-\left(\frac{dist_i}{radius}\right)^2\right)^2\right]$, For dist_i <radius [23]
	Average Crowded density on holidays	

Table 2 The assessment of inclusive streets

2.3Methods

After specifying the research objects, this paper utilizes the deep learning technique: Fully Convolutional Network (FCN) model along with relevant methods to perform semantic segmentation recognition on the street image data in scenery surveys[24]. It extracts relevant elements and calculates the area proportions of each element in images. Simultaneously, the Grounded Segment Anything Model (GSAM) is employed to detect and extract target elements required for calculating the space permeability on the street[25]. This model can automatically segment object types in images or videos, generate high-quality labels, and derive element calculation results. The model employs street images of our study for calculation and analysis to ensure accurary and quality of data sources. In additional, the research quantifies relevant indicators through the Argis analysis and represents the crowd density level with heatmaps illustrating the population distribution.

In the process of weighting statistical indicators, this study initially employs the Analytic Hierarchy Process (AHP) to allow professionals to score the relative importance of indicators and calculate subjective weights through consistency tests.[26] Subsequently, the entropy weight method is utilized to determine objective weights by assessing indicators' relative degree of change in order to establish their weights within the overall system. Indicators with a greater degree of relative change are given greater weights to accurately reflect their importance in the overall system. Finally, a combination weighting method based on game theory is employed to calculate optimal weights for comprehensive subjective and objective indicators, thereby obtaining an inclusiveness score for the street. Due to data sources encompass multiple dimensions such as street view images, LBS and POI data with inherent differences in nature and measurement units, standardized processing of data becomes necessary. Additionally, descriptive analysis and correlation matrices are conducted on these indicators while revising and optimizing detection methods to enhance the efficiency and accuracy of results. This facilitates the credibility and correction of problems.

3. Assessment Result of Street Inclusivity

3.1 The determination of weight value

According to the evaluation system framework, this paper first employs the Analytic Hierarchy Process (AHP) to categorize the elements associated with evaluation decision-making into three levels: target, criteria, and factor layer. This includes one target layer, three criteria layers, and sixteen factor layers. Qualitative and quantitative analysis are conducted based on this framework. In this process, our study invited nine experts in architecture and urban planning as well as eleven relevant professionals to score the relative importance of indicators and calculate the results of subjective AHP weight values (Table 3), confirming that the judgment matrix meets consistency requirements.

On the other hand, the entropy weight method is an objective weighting approach used for determining indicator weights by evaluating their relative degree of change[27]. Sixteen factor-layers (X_1~X_{16}) are standardized, and within each indicator category, we calculate the proportion of each standardized value to all standardized values for that specific indicator (p_{ij}).

$$p_{ij} = \frac{X_{ij}^*}{\sum_{j=1}^{n} X_{ij}^*} \quad (1)$$

Subsequently, the entropy value(e_i) for each indicator is calculated.

$$e_i = -\ln(n)^{-1} \sum_{j=1}^{n} p_{ij} * lnp_{ij} \ \ (\text{if} \ \ p_{ij} = 0 \ , \ \ e_i = 0 \ ) \quad (2)$$

Finally, based on the entropy value(e_i) , the study determined the weights w_i(Table 3). for each indicator using a formula.(w_i)

$$w_i = \frac{d_i}{\sum_{i=1}^{17} d_i} \ (d_i = 1 - e_i) \quad (3)$$

The combination weighting model based on game theory aims to minimize the discrepancy between the optimal weight and the various weights of each indicator, ultimately obtaining the optimal evaluation weights for both. Thus, following the calculation of the subjective weight (AHP) value and objective weight (Entropy) value, a more reasonable weight value is obtained through the game theory combination weighting method. The specific calculation steps are outlined as follows[28]:

The basic weight vector, denoted as w_k, represents the set of weights determined by the weight calculation method. $w_k = \{w_{k1}, w_{k2}, \dots, w_{km}\}$ k=1，2...L. Here, m represent the number of indicators. Since this study selects 2 weighting methods and 16 indicators, we have L=2 and m=16.

If $a = \{a_1, a_2\}$ is considered as the linear combination coefficient, then any linear combination of two vectors determines the comprehensive weight vector w for assessment:

$$w = \sum_{k=1}^{L} a_k \cdot w_k^T \ \ (a_k>0) \quad (4)$$

The weight vector a_k was optimized according to the minimization of the range between w and w_k, resulting in the optimal weight value w^*. The optimization objective function is as follows:

$$\min_{a_k>0} \left\| \sum_{k=1}^{2} a_k \cdot w_k^T - w_k \right\|_2 \tag{5}$$

In this formula: K=1 or 2.

The corresponding linear equations are derived from the differential properties of the matrix.

$$\begin{bmatrix} w_1 \cdot w_1^T & w_1 \cdot w_2^T \\ w_2 \cdot w_1^T & w_2 \cdot w_2^T \end{bmatrix} \begin{bmatrix} a_1 \\ a_2 \end{bmatrix} = \begin{bmatrix} w_1 \cdot w_1^T \\ w_2 \cdot w_2^T \end{bmatrix} \tag{6}$$

Finally, the values of the combination coefficient a_1, a_2 can be determined through mathematical calculation of the determinant. Standardization processing is necessary in order to ensure that sum of weights equals 1. After standardization, the final combination weight based on game theory can be calculated using the following formula.

$$w = a_1^* w_1^T + a_2^* w_2^T \tag{7}$$

Table 3 The weighted value of three methods

Target Layer	Criterion Layer	Factor Layer	AHP Weighted value	Entropy weight method	Final Combination weight
Urban Street Inclusivity	**Spatial Inclusivity**(0.382)	Space permeability	0.038	0.037	0.037
		Street greenery	0.062	0.069	0.065
		Sky openness	0.078	0.074	0.077
		Enclosure	0.054	0.039	0.048
		Street width to building height ratio	0.085	0.040	0.069
		Building width to street width ratio	0.112	0.038	0.086
	Functional Inclusivity(0.234)	Degree of business aggregation	0.010	0.036	0.019
		Proportions of living and public services	0.033	0.082	0.050
		Proportion of catering facilities	0.040	0.083	0.055
		Proportion of cultural facilities	0.037	0.055	0.043

	Commercial density	0.046	0.106	0.067
Social Inclusivity(0.384)	Green space accessibility	0.075	0.103	0.086
	Public transit accessibility	0.139	0.046	0.107
	Pedestrian friendliness	0.081	0.067	0.076
	Average Crowd density on weekdays	0.019	0.051	0.030
	Average Crowd density on holidays	0.091	0.075	0.085

From the perspective of the criterion layer, social inclusivity, representing the street's service target intuitively, carries the most prominent weight, while spatial inclusivity is considered a fundamental micro-perception of the street, significantly affecting its inclusiveness. The impact of functional inclusivity is relatively insignificant. From the perspective of factor layer, effective public transit ensures the arrival of diverse social groups to the street, making accessibility of public transit occupy a dominant position in terms of weight. The accessibility of green spaces, with significant weight proportion, is measured by the average distance from the center of the street to the surrounding parks and green spaces. As the primary venues for residents' daily recreational activities, green spaces attract more residents and other stakeholders, fulfilling their basic living needs. The average crowded density on holidays also carries significant weight, as bustling streets often attract more people, reflecting diverse inclusiveness.

Regarding spatial inclusivity, the building width to street width ratio significantly has a greater impact on people's visual perception of the street and holds the highest weight in terms of comfortable inclusiveness in public space. Additionally, sky openness, street greenery, and the street width to building height ratio also carry relatively high weights. Open skies and green views have a soothing effect on pedestrians. In contrast, the degree of business aggregation, concerning functional inclusivity, is deemed to have a relatively low impact on inclusiveness among factors. Predominantly, various customer groups on the street prioritize catering, residential, and cultural facilities, relegating other functions to a lesser role in enhancing inclusiveness.

3.2Descriptive statistics of indicators

The calculation results of indicator data in the study reveals significant differences in spatial, functional, and social inclusivity among four representative types of streets: Pingjiang Road performs excellently in all three dimensions. Fengmen Heng Street, representing grassroots cultural streets, excels in functional inclusivity. Huaihai Street, in its endeavor to establish a model of modern-style streets, exhibits relatively weak consideration for social inclusivity. Xietang Old Street, a newly constructed commercial street with a New Chinese style in recent years, requires further development in terms of social inclusivity.

In the dimension of spatial inclusivity, Fengmen Heng Street performs the best in space permeability owing to its open ground floor storefronts. Xietang Old Street has a much higher

street greenery compared to the other three streets, indicating effective landscaping and greening efforts. Given that the greenery of streets in ancient cities is constrained by narrow layouts, often limited to decorative interstitial spaces between buildings, this constraint may contribute to the lower street greenery observed on Pingjiang Road and Fengmen Heng Street. Meanwhile, Huaihai Street, a modern commercial street frequently employs billboards and neon lights on store facades to attract merchants and customers, potentially impacting street greenery. Pingjiang Road, Fengmen Heng Street, and Xietang Old Street demonstrate comparable levels of sky openness, suggesting similar degrees of openness in their vistas. In terms of the building width to street width ratio and street width to building height ratio, Pingjiang Road performs satisfactorily in both aspects, not only ensuring visual aesthetics but also efficiently utilizing limited space to accommodate more commercial stores, cultural venues, and community service facilities. Simultaneously the building width to street width ratio of Huaihai Street provides a comfortable spatial scale, contributing to the attraction of pedestrian flow. Pingjiang Road and Xietang Old Street feature relatively low enclosure, promoting a sense of spaciousness and enhancing positive psychological experiences.

In terms of functional inclusivity, the higher Commercial density in Fengmen Heng Street reflects the frequent commercial activities in the area, affirming its potential for future development. Higher degrees of business aggregation lead to greater convenience for citizens. The relatively low degree of business aggregation on Huaihai Street indicates a weaker diversity of functions and a lower degree of service concentration in the area. The remaining three streets display similar degrees of business aggregation. The proportions of living and public services, catering facilities, and cultural facilities reflects the quantity of services provided in a particular function within the street. A higher proportion indicates greater service opportunities for diverse people. Pingjiang Road, representing historical streets, features a relatively high proportions of living and public services, as well as catering facilities, reflecting a coexistence of lively and commercial atmosphere. On the other hand, the higher proportion of cultural facilities in Fengmen Heng Street reflects its unique vibrant grassroots cultural atmosphere.

Regarding social inclusivity, Baidu's heat map provides real-time information on crowd gathering and street space utilization, displaying the spatiotemporal intensity of different locations. This study collected heat map data for October 2nd, 3rd, 6th, and 14th, as well as October 7th, 10th, 11th, and 13th, 2023, calculating the average heat value representing the average crowd density during holidays and workdays respectively. The results show that regardless of whether it is workdays or holidays, Pingjiang Road exhibits a high density of crowd distribution, reflecting its high tourism value and attractiveness to people. Conversely, Xietang Old Street ranks at the bottom of the four streets in terms of average crowd density on both holidays and workdays, indicating its limited appeal to crowds and its current state of relative inactivity. In terms of pedestrian friendliness, Huaihai Street provides great convenience for pedestrians and non-motorized vehicles owing to its systematic, rational, and spacious road layout, creating a pedestrian-friendly environment conducive to promoting activities and enhancing social inclusiveness. Pingjiang Road is surrounded by abundant ancient city parks and verdant areas. Moreover, its central location enables it to offer high levels of accessibility to green spaces and public transit, thereby attracting a diverse range of customers.

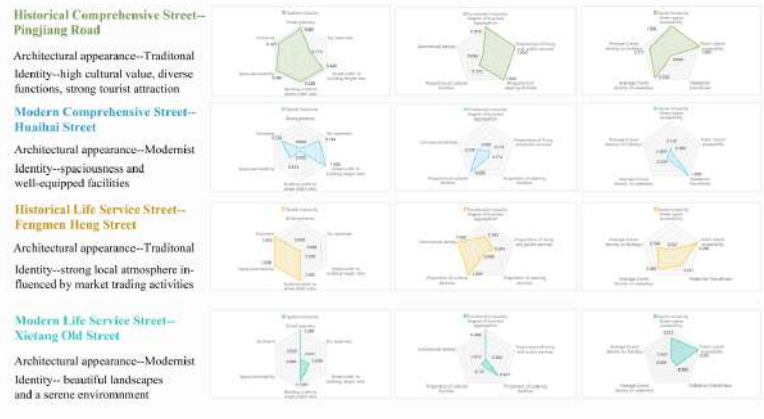

Figure 4 Four representative street inclusion indicators radar map

3.3Total assessment score of street inclusivity

The standardized numerical values obtained from the statistics of each indicator in the assessment are multiplied by their respective final combination weights. The inclusivity assessment scores for the four representative streets can be obtained by adding and summing these values for each item. The resulting scores (table 4) are as follows：

Table 4 Total assessment score of street inclusivity

Representative	Pingjiang Road	Huaihai Street	Fengmen Heng Street	Xietang Old Street
Assessment score	0.581	0.343	0.394	0.243

Pingjiang Road, representing the "Historical Comprehensive Streets", clearly outperforms in the inclusivity assessment. This is evident from high-weight indicators such as street greenery, average crowd density, public transit accessibility, and green space accessibility, aligning with its expected role as a significant protected street in Suzhou's cultural district and ancient city area. Fengmen Heng Street, representing the "Historical Life Services Streets", and Huaihai Street, representing the "Modern Comprehensive Streets", closely follow. These streets exhibit excellent indicators in space permeability, enclosure, and commercial density, indicating potential to achieve higher inclusivity quality. In comparison, Xietang Old Street, representing the "Modern Life Services Streets", displays a lower level of inclusiveness compared to the other representative streets. Thus, it is essential to update and optimize strategies to enhance its spatial, functional, and social inclusiveness

Based on a comprehensive analysis of various indicators, Pingjiang Road, as a representative old street in Suzhou, demonstrates diverse functionality and bustling popularity. Its assessment values in all dimensions are relatively high, and it attains the highest level of overall inclusiveness. Therefore, when updating its design, it requires only minor optimization without excessive

interference. However, in recent years, despite meeting contemporary demands in terms of architectural scale and accessibility, the newly renovated Huaihai Street and Xietang Old Street have lower indicator values for public transit accessibility, average crowd density, and the proportions of living and public services. As a result, their attractiveness to people is limited, leading to lower overall inclusiveness

4. Renaissance strategies

After considering the inclusivity assessment results of the four types of streets, it is evident that Pingjiang Road emerges as the most inclusive street. However, it still encounters challenges such as a low proportion of cultural facilities and pedestrian-friendliness. In order to address these issues without compromising the existing comfortable street greenery, it is recommended to appropriately increase the commercial density, enhance the proportion of cultural facilities, and enrich cultural experiences and historical heritage functions. For instance, establishing a Water Town Cultural Academy can effectively stimulate pedestrian flow and elevate inclusiveness quality on this street.

For the remaining three streets with low inclusivity assessment scores, namely Fengmen Hengjie representing traditional local culture, Huaihai Street showcasing modern fashion, and Xietang Old Street reflecting contemporary urban life, based on the data results of the evaluation system, corresponding update strategy suggestions are provided from the perspectives of specific population groups, functions, and spatial inclusivity dimensions. These strategies aim to be applied to streets with similar attributes in order to achieve inclusive and diverse characteristics.

The revitalization of Fengmen Hengjie, a representative market culture street, should address the evolving daily life needs of its inhabitants and overcome the current limitations resulting from an exclusive focus on catering to a single customer group. (1) In terms of social inclusivity, enhancements can be made to pedestrian walkways to improve their user-friendliness and facilitate access to surrounding park greenery, thereby addressing the issue of inadequate pedestrian amenities. Moreover, regular hosting of diverse events and festive temple fairs can attract visitors from various backgrounds and interests by showcasing historical intangible cultural heritage, culinary delights, shopping opportunities, etc. (2) With regards to spatial inclusivity, careful attention should be given to building layout and space design in order to ensure ample lighting conditions and incorporate natural landscapes. Given the limited street greenery, ecological challenges, and compact nature of the street's space constraints; garden-style designs could be implemented within microspaces at street corners or intersections. (3) In terms of functional inclusivity, it is imperative to enhance the proportion of living and public services and catering facilities in order to diversify people's options on the streets. By augmenting the street greenery, we can also elevate the design aesthetics of ground floors, thereby attracting a greater number of businesses to establish themselves and meeting diverse consumer needs through differentiated distribution of functions, thus fostering Fumen's inclusivity.

The preservation and promotion of distinct cultural features and unique architectural styles should be prioritized in the renovation of modern streets like Huaihai Street, aiming to create an appealing place that is both inclusive and compatible with individuality for residents and tourists. (1) In terms of social inclusivity, artistic interactive devices could be installed on specific sections

of walls along the street to provide visitors with opportunities for interaction while showcasing its history. These artistic interactive devices can take various forms such as photo spots, as well as projection games or musical performances, attracting a more diverse clientele while addressing concerns regarding lower crowd density. (2) In terms of spatial inclusivity, Huaihai Street exhibits a high degree of sky openness and relatively tall building enclosure; however, the street greenery is low. During the renovation process, it is necessary to adjust the building width-to- street width ratio while transforming monotonous and dull walls into refreshing and comfortable vertical greenery. Considering sustainable development, diversity and hierarchy can be enhanced through combinations of different materials and colors in storefront designs. (3) In terms of functional inclusivity, based on the issues identified in the inclusivity assessment, it is necessary to further diversify the types of businesses on Huaihai Street. This can be achieved by adding more daily retail stores and organizing regular market activities to meet residents' purchasing needs for daily necessities. Enhancing openness in building facades will not only increase attractiveness but also infuse vitality into modern-style streets, creating a street space with rich experiential qualities.

The revitalization of modern urban streets, exemplified by Xietang Old Street, should prioritize enhancing and refining the functional layout while introducing a greater array of cultural amenities to infuse more vitality into the area. (1) In terms of functional inclusivity, Xietang's long-established street with its chessboard arrangement of streets and lanes is characterized by densely intertwined open courtyards and interlacing pathways. Building upon the issues identified in the comprehensive evaluation, efforts can be made to address relatively low commercial density, distribution ratio of living and public facilities, and proportion of cultural facilities in Xietang. For future development, support can be extended to small businesses and entrepreneurs to encourage them in opening new storefronts thereby increasing shop density and attracting more creative and small-scale retail enterprises. Simultaneously, methods such as hosting large-scale cultural themed festivals can also be employed to augment the distribution ratio of cultural facilities providing residents and tourists with an expanded range of choices. （2）In terms of spatial inclusivity, Xietang Old Street exhibits a notable disparity in street permeability compared to other streets. This discrepancy primarily stems from the prevalence of tea houses and small shops, resulting in a lower population density. To address this concern, it is imperative to adjust the street width-to-building height ratio and augment the incorporation of residential and cultural amenities while enhancing the diversity and hierarchical nature of storefront design. However, Xietang Old Street claims the top spot among the four streets in terms of Street greenery, signifying its immense potential for development.

4.5. Conclusion

The contemporary urban street research is gradually shifting its focus towards "diversity and inclusivity" and being more "people-oriented", while also emphasizing objectivity and precision. Drawing on multi-source data, this article constructs a comprehensive street inclusivity assessment system comprising 16 indicator factors such as street greenery and sky openness. Four typical streets, namely Pingjiang Road, Huaihai Street, Fengmen Hengjie, and Xietang Old Street are selected for inclusivity assessment. The evaluation results reveal the following: (1) Pingjiang Road excels in various indicators and is well-suited for creating a highly inclusive vitality gathering place. (2) Huaihai Street performs admirably in terms of sky openness and pedestrian friendliness but has a lower street greenery. (3) Fengmen Hengjie exhibits great potential for

inclusive development due to its high street permeability and commercial density. (4) Xietang Old Street retains its old-fashioned style with alley layout but falls slightly short in terms of commercial density, proportion of living and public facilities, cultural facilities, etc. In the correlation analysis of indicator factors, it was observed that higher enclosure degrees of street buildings corresponded to an increased proportion of cultural facilities distribution, thereby offering a more diverse range of cultural activities. In design, the street greenery is often compromised to accommodate commercial and cultural facility requirements. Regarding inclusivity assessment scores, Pingjiang Road representing "historical style streets" exhibits the highest inclusivity, while Huaihai Street representing "modern style streets" and Fengmen Hengjie representing "community culture streets" demonstrate lower levels of inclusivity. Xietang Old Street representing "modern life streets" ranks last in this regard. Consequently, corresponding strategies for inclusive updates are proposed for each category. For future urban street updates, it is crucial to comprehend the key elements influencing street inclusivity and consider them comprehensively from dimensions such as spatial layout, functionality, and user groups on the street.

In the process of quantifying relevant indicators, this paper introduces the GSAM model for calculating street permeability index. Compared to previous methods, the GSAM model is more efficient and convenient, capable of rapidly processing a large number of image elements. However, when applying it to calculate indicators, there are interferences that can affect measurement accuracy such as complex clipping of multi-story buildings, pedestrians on streets, distances between buildings, and window patterns. These interferences need to be eliminated in order to enhance result accuracy. Additionally, further explanation is needed regarding the integration and entry points of quantified research on street inclusivity and traditional street vitality. The construction of an inclusivity evaluation system lacks indicator innovation and requires breakthroughs in subsequent research to explore more quantitative assessments of micro-level inclusive qualities.

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