Mediterranean Archaeology and Archaeometry
2025, 25(1), 1499
ISSN:2241-8121
https://www.maajournal.com/

Research Article

Assessment of Vitality and Influencing Factors in the Production Space of Art and Culture: A Case Study of Shanghai

Mengqiu Zhao[1]*, Sun Meng[2], Zewen Chen[3]

[1] Department of Global Fine Art, Kyonggi University, Suwon, 100027, Korea.
[2] Department of Global Fine Art, Kyonggi University, Suwon, 100027, Korea.
[3] Department of Global Fine Art, Kyonggi University, Suwon, 100027, Korea.
*** Corresponding Author:** zmqzmqzmq97@gmail.com

Citation: Zhao, M. Meng, S. & Chen, Z (2025). Assessment of Vitality and Influencing Factors in the Production Space of Art and Culture: A Case Study of Shanghai. *Mediterranean Archaeology and Archaeometry, 25*(1), 493-513.

ARTICLE INFO

Received: 28 May 2024
Accepted: 06 June 2024

ABSTRACT

Enhancing the vitality of art and culture production spaces is crucial for revitalizing urban culture. Clarifying the influencing factors forms the foundation for this enhancement. Using Shanghai's art production spaces as a case study, we analyze the factors influencing vitality on both weekdays and holidays, elucidating their modes of action and general patterns.Firstly, we construct an evaluation system for the vitality of art and culture production spaces based on Baidu heat maps and Points of Interest (POI) data. Secondly, we quantify the vitality characterization and potential influencing factors of art production spaces. Lastly, we establish a coupled coordination degree model to measure these influencing factors.The findings reveal that daytime vitality surpasses nighttime vitality, with weekend and holiday populations exhibiting higher vitality compared to weekdays. Daytime vitality is concentrated in X1, while nighttime vitality shows a more balanced spatial distribution. The coupling and coordination between population vitality and service facilities are stronger during the day than at night, and higher on weekends and holidays compared to weekdays.Regarding the influencing factors of art and culture production space vitality, factors such as location, day and night economies, holiday economies, and accessibility can be combined comprehensively to enhance vitality. This study's outcomes will be instrumental in enhancing and developing art and cultural production spaces in Shanghai and beyond. They will also provide clarity on future development and renewal directions.

Keywords: Art and cultural production; Spatial vitality; Baidu heat map; POI data; Evaluation system; Coupling coordination degree

1 INTRODUCTION

In the past three decades, there has been significant attention given to the relationship between art, culture, and urban development[1][2][3]. Urban spaces are increasingly viewed as dynamic "laboratories" for artistic and cultural expression[4], where the lines between production and consumption of art and culture are constantly being redefined[5][6][7]. This ongoing process creates fertile ground for the overall prosperity of cities[8].The significance of spaces dedicated to artistic and cultural production has been underscored in spatial planning policies worldwide[9]. These policies aim to address challenges arising from urbanization while also seeking to revitalize culture and drive economic growth in cities[10]. Many countries have initiated large-scale, culture-led urban regeneration programs[11][12][13], encompassing cultural festivals, art exhibitions, and transnational collaboration projects. Governments worldwide have implemented these initiatives to foster the development of culture and the arts.Consequently, art and cultural production spaces have emerged as key catalysts for urban renewal and regeneration[14][15]. They play a pivotal role in enriching the urban cultural landscape[16], boosting community vitality[17], driving regional economic growth[18], and fostering the clustering of cultural and creative industries[19]. For instance, in Milan, Italy, the art and culture industry has effectively utilized urban spaces for promoting fashion brands and directing cultural narratives[20].

As times evolve, the essence of art and cultural production spaces continues to deepen[21][22] influenced by a blend of cultural and economic factors. These spaces have transformed into multifaceted hubs, encompassing social, academic, consumption, entertainment, and service functions[23][24]. The integration of art, culture, and cityscape entails harmonizing art venues, urban culture, and spatial design[25]. At its core lies the art production space[26], a distinct urban feature with essential functional divisions: exhibition areas, public services, administrative and logistical zones, and storage facilities. Often, these spaces intertwine with commercial outlets, cafes, multipurpose halls, restoration workshops, and VIP lounges. Central to this integration

are cultural service amenities, pivotal for sustaining residents' daily cultural engagement[27][28]. These encompass art galleries, museums, theaters, performance venues, concert halls, libraries, art studios, cinemas, heritage preservation centers, and art parks. Furthermore, the expansion of artistic and cultural spaces extends beyond conventional boundaries, encompassing diverse urban locales such as public squares, streets, and community hubs. This extension manifests through public art installations[29], street performances, mobile exhibitions, and other initiatives,[30] thereby weaving art and culture into the fabric of citizens' daily lives.It has been underscored that fostering social practices and interactions within existing urban spaces holds greater significance than the creation of novel urban landscapes. This unconventional approach to city policy synthesis wields a profound and enduring influence on the socio-spatial dynamics unfolding within urban environments[31]. Moreover, it can catalyze transformative effects in overlooked and derelict urban areas, offering a more impactful tool for urban revitalization compared to traditional regeneration strategies centered on physical cultural infrastructure, large-scale events, and support for creative industries[32].Certain scholars accentuate the intrinsic value of small-scale venues for social and cultural production spaces[33]. Despite the evolving landscapes and methods of artistic practice, production, and expression[34], Sjöholm[35]argues that the studio remains a vital tool and foundation in contemporary art's cultural production process.Furthermore, the mobile, ephemeral, and fluid nature of art flash shows exhibits a high degree of allure and interactivity. This approach fosters the creation of a chic and prominent artistic brand image, amplifying art's visibility and facilitating broader art promotion efforts[36][37].With the advent of novel art and cultural production spaces like art fairs[38], cultural festivals[39], and art forums, individuals engage not merely as spectators or consumers but as active participants. This evolving social interaction model fosters collective engagement and more sustainable collaborative development, increasingly vital in contemporary social dynamics[40].Art and cultural production spaces serve as primary conduits for interactions among art, urban settings, and inhabitants in modern cities. They represent focal points of vibrancy, making it imperative to elucidate the factors influencing their vitality for nurturing urban cultural revival. Furthermore, the significance of the diurnal economy, encompassing both weekday and holiday economic activities, should not be underestimated.

As the global trend towards increased fragmentation of urban landscapes continues, achieving a balanced distribution of arts and cultural services within cities remains a pressing need[41]. City administrators, planners, and relevant authorities must strive for equilibrium in urban spatial structures by implementing targeted measures for the advancement of arts and culture.Optimizing the layout of arts and cultural production spaces is paramount for enhancing urban residents' quality of life and ensuring equitable access to cultural services. However, the current imbalance in the distribution of these spaces within cities necessitates adjustment due to rapid population growth and urbanization-related challenges. Urban development, characterized by high density, mixed functions, and above all, diversity, underscores the need for a multifaceted approach[42].Therefore, the crux of structuring art and cultural production spaces lies in fostering their composite functions[43]. This involves establishing art and cultural zones of significant scale to both cultivate the cultural industry and act as focal points for economic development[44]. Building upon this foundation, increasing the visibility of art and cultural production spaces and enhancing their vitality are essential. This entails imbuing these spaces with broader public functions to bolster interaction between art, culture, urban spaces, and residents, thereby enriching the urban experience.

In urban planning policy documents, urban spatial vitality is depicted as the fundamental force driving activity within the city, reflecting human endeavors across different temporal and spatial dimensions. It is recognized as a cornerstone in fostering a high quality of life within urban environments, emanating from well-designed urban layouts, efficient functioning, and vibrant urban activities.The essence of urban vitality lies in the pulse of life coursing through city streets, squares, and green spaces, where pedestrian activity thrives. It is intricately intertwined with public life, encompassing social interactions, economic dynamics, and the amenities provided by the urban environment. Scholars investigating the clarification and preservation of urban spatial vitality have scrutinized various factors, including land use mix, population density, street layout, architectural diversity, accessibility, and urban boundaries. However, many of these findings have remained primarily qualitative and somewhat inconclusive.In response to this, some scholars have turned to big data analytics to dissect urban vitality into measurable components such as density, livability, accessibility, and diversity[45][46][47]. This data-driven approach offers promising avenues for more precise and comprehensive research into understanding and enhancing urban vitality[48].Zhenhua Li[49] et al. delved into the spatial and temporal dynamics of urban underground spaces' vitality, analyzing factors such as functionality, spatial configuration, traffic conditions, and pedestrian design. Yan Gu[50]et al. examined the multilayered transformation and spatial evolution of three post-industrial sites in Beijing, leveraging big data analysis. Beniamino Murgante [51]et al. investigated urban revitalization strategies within the framework of a 15-minute city, focusing on density, proximity, diversity, and digitalization. Qingsong He[52]et al. utilized geo-big data, including Points of Interest (POI) data, function mixing levels, location density, housing prices, and demographic shifts, to gauge urban vitality. De Koe and Hva[53]proposed a model utilizing parameters such as population density, land-use intensity, mixed land-use, and public/private ratios to assess urban vitality.From this perspective, spatial vitality flourishes with enhanced connectivity to infrastructure networks, diversified land-use functions, accessible amenities, and a mix of socio-economic activities.

Our study aims to investigate the alignment between the spatial and temporal distribution of population density and the presence of arts and cultural production spaces, offering insights for urban planners to optimize their development and layout. The vitality of these spaces is intricately intertwined with the liveliness and diversity of urban life. Serving as hubs of creativity, innovation, and community engagement, they play a pivotal role in shaping the cultural fabric of a city. Shanghai, renowned for its rich cultural heritage and dynamic contemporary art scene, serves as an ideal setting to explore the dynamics of such spaces.Despite their significance, arts and cultural production spaces encounter various challenges that impact their vitality. Understanding these challenges and the underlying factors influencing them is imperative for formulating effective strategies to support and bolster these spaces. Our study seeks to bridge this gap by conducting a comprehensive assessment of the vitality of arts and cultural production spaces in Shanghai, pinpointing key factors that shape their functionality and sustainability.Given that people are the primary participants in activities within these spaces, evaluating the spatial congruence between population

distribution and service facilities offers a nuanced approach to enhancing the configuration of arts and cultural production spaces[54].Previous research on arts and cultural service facilities has primarily concentrated on aspects such as site selection, land use structure[55][56], equity[57], accessibility[58], and resident satisfaction with cultural services[59][60]. These studies have unveiled the disparity between population distribution and the availability of cultural service facilities in cities[61]. However, there remains a dearth of literature employing a spatial vitality measurement system to scrutinize the vitality of arts and cultural production spaces and their interactions with urban environments. Consequently, there exists a lack of clarity regarding the future trajectory of these spaces.Moreover, few scholars have integrated the detailed spatial and temporal dynamics of human activities, particularly during holidays and weekdays, to explore the vitality characteristics of arts and cultural production spaces[62]. Previous evaluations of the spatial match between population distribution and cultural service facilities predominantly relied on surveys or statistical data, failing to capture the nuanced patterns of population activities in urban areas.Advancements in big data and mobile technologies have expanded the methodological toolkit for urban spatial research, enabling a more nuanced understanding of residents' spatio-temporal behaviors across various scales. With a focus on cost-effectiveness, convenience, and time optimization, techniques[63][64][65][66] such as Baidu heat map analysis[67]and Points of Interest (POI) data mining have gained traction in urban research fields. These methods have been employed for diverse purposes, including identifying urban functional zones[68] assessing urban environments[69], analyzing spatial patterns of urban facilities[70], and evaluating equity and accessibility[71].

Hence, the article adopts the framework of urban vitality assessment, integrating the unique characteristics of art and cultural production spaces. It establishes an evaluation system for the vitality of these spaces by leveraging Baidu heat map and Points of Interest (POI) data, and quantifies relevant indicators. Through this approach, a methodological framework is proposed, along with a novel indicator for visually analyzing the spatial alignment between the distribution of art and cultural production spaces and the dynamic population pattern.By focusing on selected art and cultural spaces within Shanghai, the article delves into the objective laws and operational modes of the influencing factors shaping the vitality of these spaces. Through meticulous analysis, it seeks to uncover insights into the dynamics of art and culture spaces, facilitating a deeper understanding of their functioning and impact within the urban landscape.

2 STUDY AREA AND DATA

2.1 Study area

The rapid urbanization sweeping across China is projected to elevate the urbanization rate to 75.8 percent by 2050, as forecasted by the World Urbanisation Prospects. This transformative trend has reshaped the internal fabric of cities, fueling a heightened demand for arts and cultural service facilities and triggering significant shifts in their supply and demand dynamics.The study area encompasses Shanghai, a national central city, mega-city, core city of the Shanghai Metropolitan Area, and a nationally recognized historical and cultural hub. It encompasses 16 municipal districts under Shanghai's jurisdiction, namely Huangpu, Xuhui, Changning, Jing'an, Putuo, Hongkou, Yangpu, Baoshan, Jiading, Pudong New Area, Jinshan, Songjiang, Qingpu, Fengxian, Chongming, and the water-bound Jinshan Island, spanning a total area of 6340.5 square kilometers (see Figure 1). Shanghai boasts favorable conditions for the development of urban art and cultural production spaces.Selecting Shanghai as the study area allows for the initial identification and elucidation of the alignment between art and cultural production spaces and urban population distribution across different temporal contexts within developed regions. This endeavor serves as a foundational step, laying the groundwork for further in-depth research in this domain.The vitality of art and culture production spaces is integral to the vibrancy and diversity of urban life. These spaces serve as incubators for creativity, innovation, and community interaction, contributing significantly to the cultural landscape of a city. Shanghai, as a global metropolis renowned for its rich cultural heritage and dynamic contemporary arts scene, provides an ideal context for examining the dynamics of such spaces. However, despite their importance, art and culture production spaces face various challenges that can impact their vitality. Understanding these challenges and their influencing factors is essential for devising effective strategies to support and enhance these spaces. This research aims to fill this gap by conducting a comprehensive assessment of the vitality of art and culture production spaces in Shanghai and identifying the key factors that shape their functioning and sustainability.

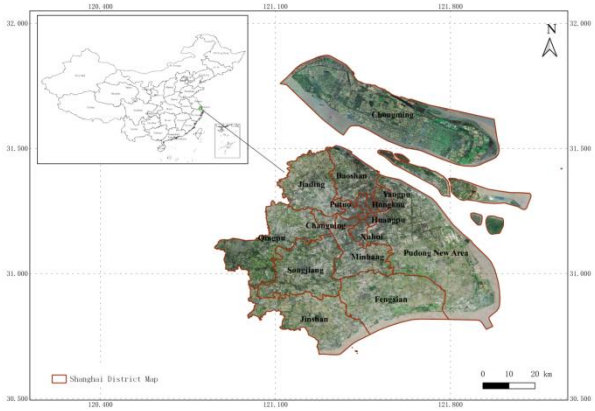

Figure 1. Location of study area

The research scope of the article encompasses arts and cultural production spaces within Shanghai, encompassing both core spaces and extension spaces (refer to Table 1). Within this framework, the core space primarily comprises cultural service facilities, while the extension space comprises four distinct types of spaces: transportation service facilities, educational service facilities, social welfare facilities, and social service facilities.

Table 1. Types of spaces for artistic and cultural production

Type of Spaces	Type of Service	Service Facilities
Core Spaces	Cultural Services Facilities	Art galleries, museums, theatres, performing arts centres, concert halls, cinemas, cultural heritage preservation institutions, etc.
Extended Spaces	Transport service facilities	Urban roads, footpaths, cycle paths, etc.
	Educational Services Facilities	Art colleges, art training organisations, libraries, art studios, etc.
	Social welfare facilities	Community centres, youth centres, nursing homes, etc.
	Social Service Facilities	Fitness centres, art parks, green centres, public squares, cafes, bookshops, etc.

2.2 Data Sources

2.2.1 Urban POI Data

The research data in this paper primarily originates from Baidu POI and Gaode POI datasets. These datasets encompass various attributes, including the name, address, type, latitude, and longitude information of each Point of Interest (POI). The POI data acquired from Baidu Map and Gaode Map are categorized into seven distinct categories, with each category comprising multiple subcategories. The collected POI data were classified into these seven categories based on the criteria outlined in the National Economic Industry Classification and Specification (GBT4754-2017) ,refer to Table 2.Following screening, deduplication, spatial matching, and other pertinent operations, the final dataset consists of 59,860 POIs representing active service facilities within the study area.

Table 2. Statistical data of POI service facilities in Shanghai's art and culture production space

Type of Spaces	Type	Acronyms	POI data contents	Number
Core Spaces（X1）	Culture,Sports and Entertainment Industries	CS	Art galleries, museums, theatres, performing arts venues, concert halls, cinemas, cultural heritage preservation institutions, martyrs' cemeteries, memorials, cultural event services, etc.	4255
Extended Spaces（X2）	Transportation,Storage and Postal Services	TS	Urban roads, urban distribution, courier services, etc.	10794
	Education Services	ES	Art colleges, art training organisations, libraries, art studios, etc.	23866
	Mass organizations, social organizations, and other member organizations	MS	Community centres, youth centres, nursing homes, etc.	1186
	Ecological environmental protection and Management services	EM	Fitness centres, art parks, green centres, public squares, etc.	4844
	Accommodation and Catering Services	AC	Art restaurants, cold drink shops, dessert shops, hotels, cafes, bookshops, etc.	14144
	Leasing and Business Services	LB	Cultural and exhibition services, conferences, conventions and related services, packaging services, etc.	771

2.2.2 Baidu Heat Map

The Baidu Heat Map is a significant big data visualization tool introduced by Baidu in 2011. It leverages user location information gathered from various Baidu products such as Baidu Map, Baidu Search Engine, Baidu Music, and Baidu Translate to compute crowd heat values across different times and areas. Subsequently, it visualizes these values on Baidu Map through density analysis and processing, enabling the depiction of crowd heat levels in precise locations[72][73]. The Baidu Heat Map has found widespread application in studying the dynamic distribution of crowds[74][75]and assessing the accessibility of urban service facilities[76].

The Baidu heat map data utilized in this study is sourced from Baidu Map (https://map.baidu.com/@14150759,4458924,13z). We utilized the Baidu API to retrieve Baidu heat map data for Shanghai in

2024, encompassing weekdays (7th May), weekends (21st April), and holidays (1st May), during the time frames of 14:00-16:00 and 20:00-22:00.

2.3 Research Methods

Drawing on previous literature, we developed an indicator system to externally assess the vitality of art and cultural production spaces and the factors influencing their vitality. The external characterization of the vitality of these spaces can be gauged by the population density surrounding each Point of Interest (POI). Meanwhile, factors influencing the vitality of art and cultural production spaces may encompass four key aspects: location, time period, accessibility, and commercial attractiveness.

Figure 2 illustrates the flowchart outlining the proposed spatial matching method. The methodology comprises three primary processes: data preparation and processing, analysis of the spatial distribution of population and facilities, and evaluation of the degree of coordinated interaction between facilities and population.

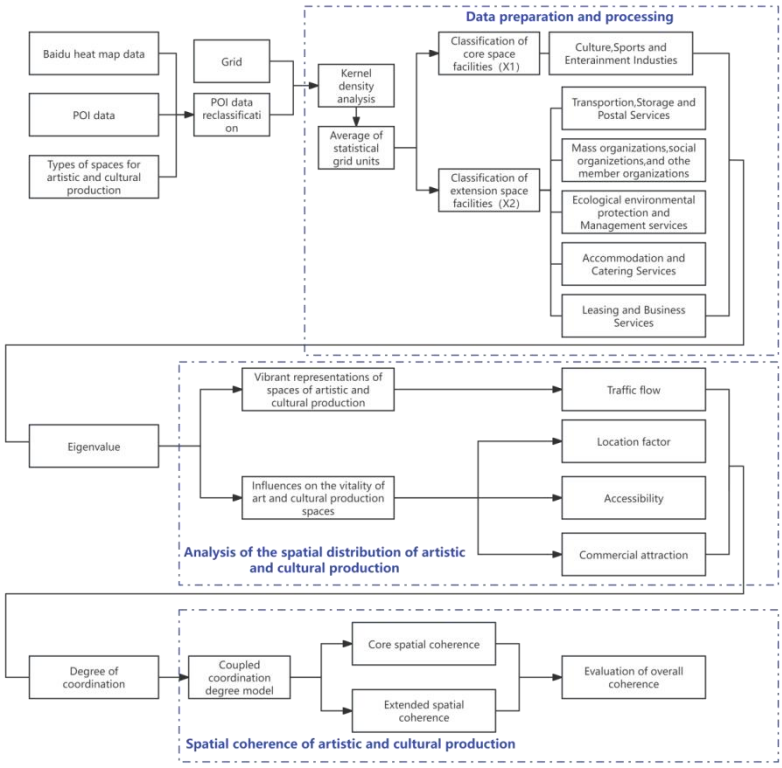

Figure 2. Technical framework of the study

2.3.1 Location factors

Location factors play a crucial role in shaping the vitality of art and cultural production spaces, particularly concerning landmarks in their vicinity. Landmarks such as large commercial complexes, world heritage sites, and nationally significant cultural relics protection units exert a significant influence on the vitality of these spaces. These prominent resources attract substantial foot traffic and exposure to the art and cultural production space. Consequently, the density of landmarks or resource points surrounding the art and cultural production space serves as an indicator of its location conditions.

The article employs kernel density analysis (KDE) to examine the overall spatial characteristics of POI points. Kernel density analysis, initially proposed by Rosenblatt and Emanuel Patzen, is a method for estimating the density of unknown points based on a non-fixed function of known points. By considering sample points x1, x2, ..., xn, kernel estimation allows for modeling the detailed distribution of variable attribute data. This analysis calculates the density values of point and line features in community spaces, simulating the continuity of density distribution, as shown in Equation (1):

$$f(s) = \sum_{i=1}^{n} \frac{1}{h^2} k\left(\frac{s-c_i}{h}\right) \quad (1)$$

Where f(s) represents the kernel density calculation function at spatial location s , h denotes the distance decay threshold, n signifies the number of feature points whose distance from location s is less than or equal to h , and k represents the spatial weight function.

2.3.2 Time Periods

In this study, a 200m x 200m grid was chosen as the statistical unit. The spatial grid was delineated based on heat map data and POI kernel density analysis. Subsequently, the spatial aggregation patterns of the population during different time periods were utilized to analyze the distribution of population within art and cultural production spaces in Shanghai.

The Baidu heat maps from different time periods were overlaid and aggregated to illustrate the population distribution characteristics within Shanghai's art and cultural production spaces during various time frames.

The calculation formula is depicted in Equation (2):

$$H = \sum \frac{H_n}{N} \quad (2)$$

Where H is the average value during a certain period;H_n is the value during the nth period of the day;and N is the number of heat maps for this period.

2.3.3 Accessibility

The accessibility of art and cultural production spaces is assessed by considering the density of bus lines and the coverage of metro services in the vicinity, serving as key evaluation criteria. In Arc GIS, the travel cost is computed using the Cost Distance Model (CDM)[77][78]. This involves overlaying the kernel density analysis map of the art and cultural production space with the point distribution map of bus and metro facilities. This process reflects the actual accessibility of specific pathways within the area[79].

2.3.4 Commercial attractiveness

Commercial attractiveness refers to the allure or appeal of an area for commercial activities, including the presence of businesses, shops, restaurants, entertainment venues, and other commercial establishments. It encompasses factors such as foot traffic, consumer spending power, and the variety and quality of commercial offerings. In the context of art and cultural production spaces, commercial attractiveness may also be influenced by the presence of art galleries, studios, artisan workshops, cultural events, and other related enterprises. Assessing commercial attractiveness involves analyzing factors such as the density and diversity of commercial establishments, consumer behavior patterns, and the overall economic vitality of the area.The more robust the surrounding commercial services supporting the arts and cultural production space, the higher the influx of people and population density in the area[80][81]. Hence, the density map depicting the distribution of commercial service facilities surrounding the art and culture production space serves as a reflection of the attractiveness of commercial resources within the area[82].

2.3.5 Coupling Coherence Model

The Coupled Coordination Degree Model (CDM) offers a reliable means of assessing the correlation between systems[83]. It is utilized to depict the coordinated relationship between urban population agglomeration and the density distribution of service facilities[84][85][86][87]. Drawing inspiration from the capacity coupling coefficient model in physics, the coupling degree model is formulated, with the calculation formula presented as equations (3) through (5):

$$C = n\left[\frac{U_1 U_2 \ldots U_N}{(U_1+U_2+\ldots+U_N)}\right]^{\frac{1}{n}} \quad (3)$$

$$T = aU_1 + bU_2 + \ldots + nU_n \quad (4)$$

$$D = \sqrt{C \times T} \quad (5)$$

In equation (3), C represents the coupling degree function, with values ranging from 0 to 1. A higher value indicates a stronger coupling between population aggregation and the space allocated for artistic and cultural production. Here, u1 denotes the normalized degree of population aggregation, while u2 represents the normalized density of facilities within the space designated for artistic and cultural production.

Equation (4) introduces T as the comprehensive coordination degree between population aggregation and the facilities within the art and cultural production space.

Equation (5) defines D as the coupling coordination degree between urban population aggregation and the distribution of art and cultural production space facilities. The value of D falls within the range of 0 to 1. A value closer to 0 signifies a lower level of coordinated development between urban population aggregation and the distribution of spatial facilities for artistic and cultural production, whereas a value closer to 1 indicates a higher level of coordination between the two.

3 RESULTS

3.1 Spatial distribution pattern

Based on the service contents of various service facilities, two types of distribution spaces were identified. Kernel density distributions of service facilities in the core space (X1) and extension space (X2) within the study area were obtained, respectively (refer to Figure 3 and Figure 4).

X1 comprises Culture, Sports, and Entertainment Industries (CS), while X2 encompasses Transportation, Storage, and Postal Services (TS); Education Services (ES); Mass organizations, social organizations, and other member organizations (MS); Ecological environmental protection and management services (EM); Accommodation and Catering Services (AC); as well as Leasing and Business Services (LB).

Kernel density analysis reveals that the spatial pattern of X1 is characterized by large-scale aggregation in clusters, with intermittent discontinuous aggregation at the periphery. The density is higher in the north and lower in the south. Overall, the pattern is centered on Jing'an, Putuo, Huangpu, Hongkou, Yangpu, and Xuhui districts, with density decreasing from the center

to the periphery. Songjiang, Minhang, Jiading, and Jinshan districts all exhibit small aggregation centers, forming a tightly packed internal structure and a sparsely packed external structure.

On the other hand, the aggregation centers in X2 are more extensive compared to those in X1. The core and core-periphery districts present continuous and large-scale aggregation centers, except for periphery districts such as Chongming Island, Pudong District, Fengxian District, Jinshan District, and Qingpu District, which display intermittent and non-continuous aggregation centers.

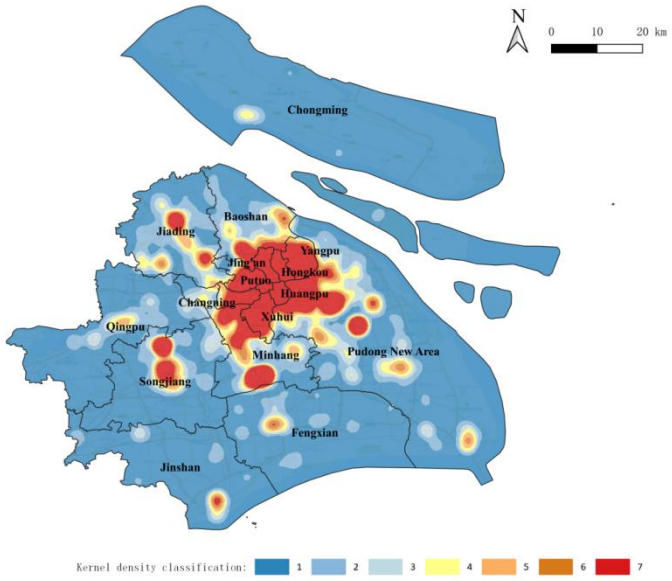

Figure 3. Heat map of nuclear density in core space (X1)

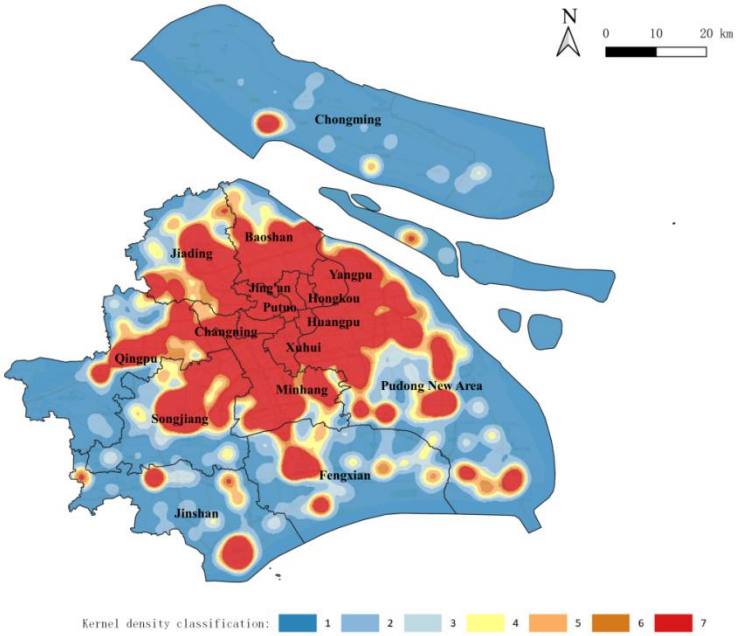

Figure 4. Heat map of nuclear density in extended space (X2)

3.2 Location

The numbered locations (1-39) on the map denote areas of high population density within the study area, identified using heat maps obtained from Baidu. It was assumed that their level of aggregation is associated with local iconic landmarks. These ten points exhibit varying characteristics and levels of importance in terms of location, agglomeration, and economic significance.

As depicted in Figures 5 and 6, X1 is more significantly influenced by landmarks compared to X2, displaying stronger central aggregation. The four areas most profoundly impacted by landmarks are Jing'an District, Huangpu District, Putuo District, and Xuhui District.

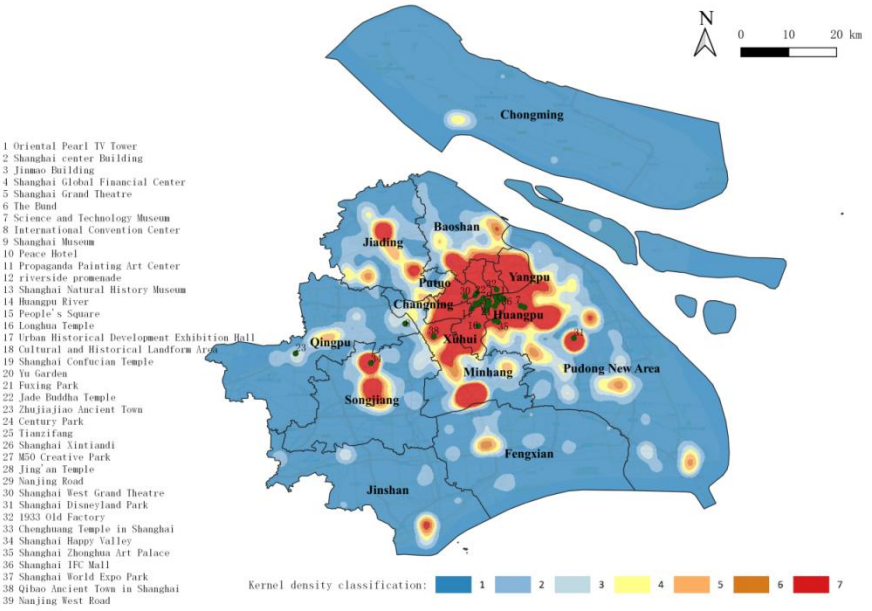

Figure. 5 Kernel Density Analysis of Locational Factors in Core Space (X1)

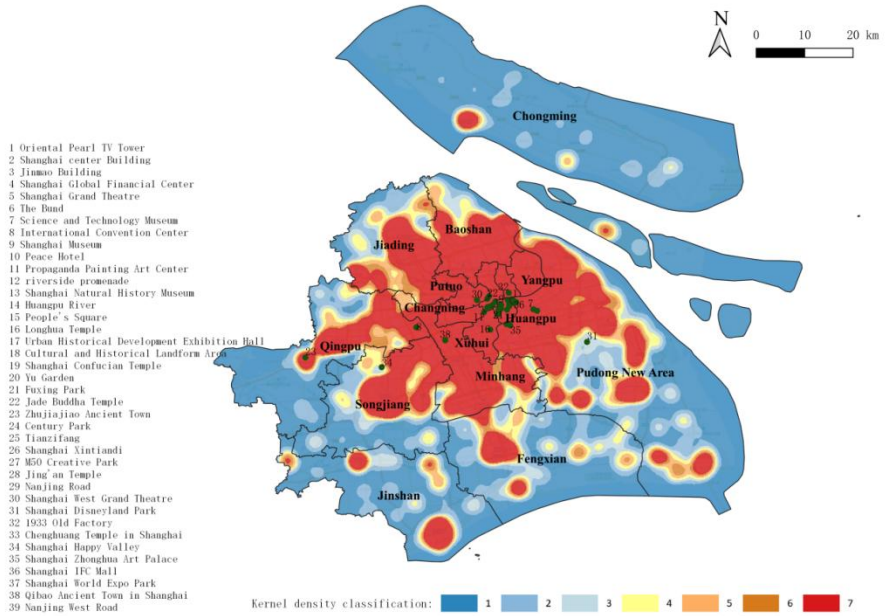

Figure. 6 Kernel Density Analysis of Locational Factors in Extended Space (X2)

3.3 Accessibility

As illustrated in Figures 7 and 8, accessibility appears to be high and evenly distributed in X1, while in X2, accessibility follows a circular structure gradually declining from the main city center to the periphery. Moreover, the accessibility of several smaller centers also exhibits a diminishing trend from the center to the outskirts. The transportation network plays a significant role in shaping accessibility, resulting in an accessibility distribution pattern characterized by "point-like distribution and radial diffusion" for art and cultural production spaces.

Furthermore, urban-rural divisions also impact the accessibility of art and cultural production spaces. Lower accessibility is observed at the outskirts of Shanghai, including Chongming, Pudong, Fengxian, Jinshan, Songjiang, and Qingpu districts, whereas higher accessibility is noted in the primary urban area and along the city's main thoroughfares.

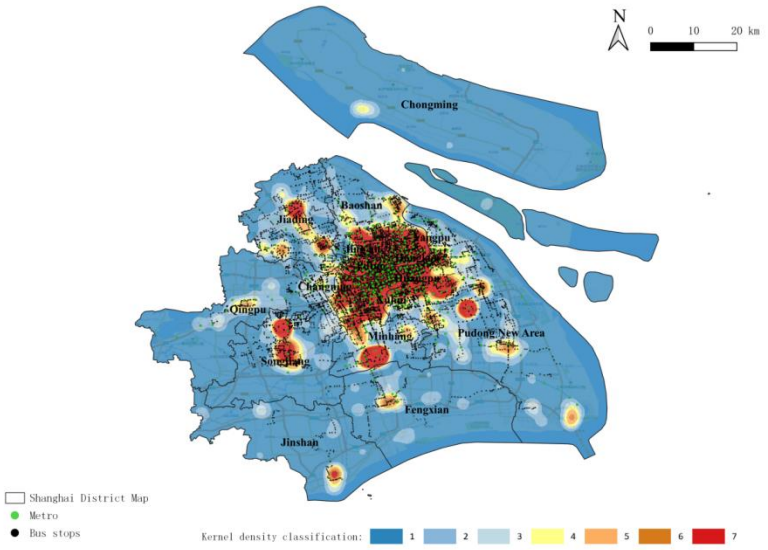

Figure. 7 Kernel Density Analysis Map of Accessibility Factors for Core Space (X1)

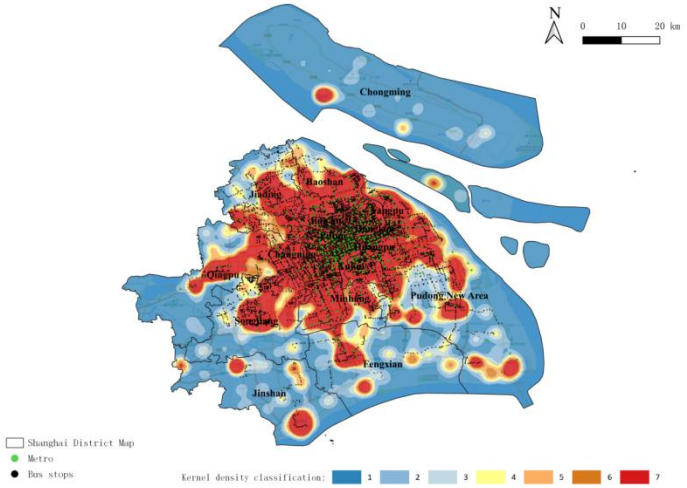

Figure. 8 Kernel Density Analysis Map of Accessibility Factors for Extended Space (X2)

3.4 Commercial attractiveness

As depicted in Figures 9 and 10, the regions exhibiting the highest commercial attractiveness for art and cultural production spaces in Shanghai are primarily concentrated in the seven central urban areas: Jing'an, Hongkou, Changning, Xuhui, Huangpu, Yangpu, and Putuo. These areas display a circular structure, with commercial attractiveness gradually diminishing from the center to the periphery. Among them, X1 demonstrates a more pronounced centrality in terms of the area covered by aggregation centers compared to X2.

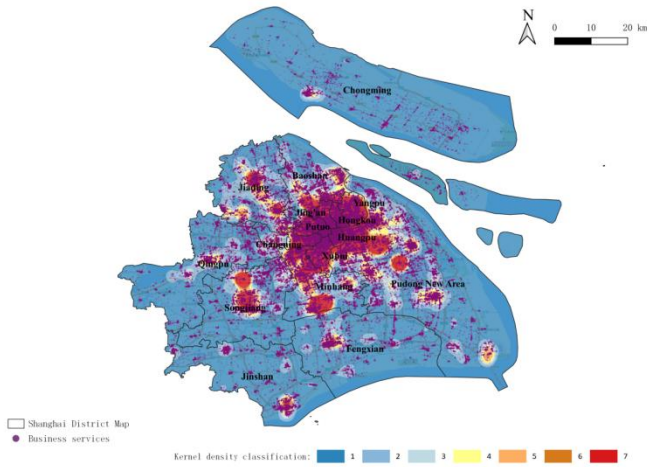

Figure. 9 Kernel density analysis map of commercial attractiveness factors for core space (X1)

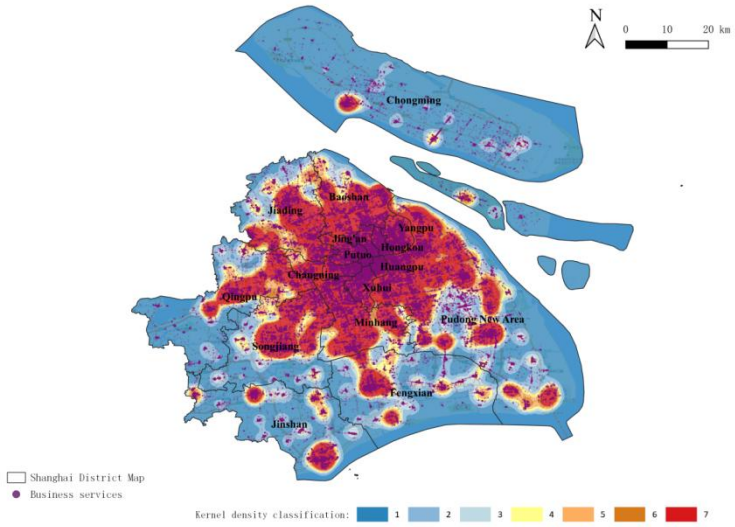

Figure. 10 Kernel density analysis map of commercial attractiveness factors for Extended space (X2)

3.5 Analysis of the Components of Population Vitality

To analyze the temporal evolution characteristics of population density in art and cultural production spaces, this study employs natural breakpoint classification to delineate the intensity of population aggregation. High aggregation zones are defined by heat map values of 6 and 7, subaggregation zones by values of 4 and 5, and weak aggregation zones by values of 1-3. The proportion of population activity during the time periods of 14:00-16:00 and 20:00-22:00 on weekdays, weekends, and festivals was calculated, revealing significant temporal variations (refer to Figure 11 to Figure supplement 16).

On weekdays, population activity intensity peaks during the daytime period of 14:00-16:00, with larger and more continuous high concentration areas. Conversely, during the 20:00-22:00 interval on weekdays, there is a decrease in the proportion and continuity of high aggregation areas and sub-aggregation areas of population activities. This decline in high intensity may be attributed to urban residents being engaged in work and study during daytime hours, preparing for the following day's responsibilities. As a result, they tend to adhere to a more regular work routine and reduce their activities and aggregation at night. Additionally, factors such as traffic congestion and socialization patterns contribute to the reduced proportion of areas with high concentrations of population activity during weekday nights.

Compared to weekdays, during weekends, there is an increase in the proportion of high agglomeration areas where population vitality is clustered during the daytime. This trend is likely due to longer breaks on weekends, prompting urban residents to engage in various recreational activities such as shopping and dining out, leading to increased population vitality in commercial areas and tourist attractions. It's noteworthy that discontinuous points of weak agglomerations are observed in the central city, with an increased proportion of sub-aggregations in peripheral areas such as Jiading District, Baoshan District, Pudong New District, Fengxian District, Jinshan District, Songjiang District, Qingpu District, and Chongming District. This phenomenon may result from dense crowds and traffic congestion in the city center, prompting people to seek recreational activities in suburban or outdoor settings like outings, walks, or picnics, thereby increasing population vitality in fringe urban areas.The continuity of high population concentration areas and the proportion of sub-concentration areas at night on weekends exhibit a decreasing trend, with an increase in the proportion of weak concentration areas in the central urban area. This trend

may be attributed to dispersed social activities at night on weekends, with people opting for nighttime entertainment venues such as pubs, nightclubs, and cinemas, in addition to leisure gatherings at home. Moreover, while the central urban area usually serves as the hub of commercial and office activities on weekdays, commercial activities decrease at night on weekends, resulting in a higher proportion of weakly congregated areas among the central city population.During daytime festivals, the proportion of areas with high population vitality is broader, radiating from the center to the surrounding areas along the city's arterial roads. This pattern is likely because people participate in various celebrations, parades, and rallies held along the city's arterial roads during daytime festivals, thereby broadening the proportion of areas with high population vitality.Conversely, the proportion of high-aggregation areas decreases at night on festival days, with a significant reduction in the proportion of high-aggregation and subaggregation areas of population along urban arterial roads. This nighttime trend exhibits a stronger group-like structure and reduced dispersion compared to daytime. This decline in aggregation may be due to fewer nighttime festivals and people preferring to gather and celebrate at home or in specific venues.

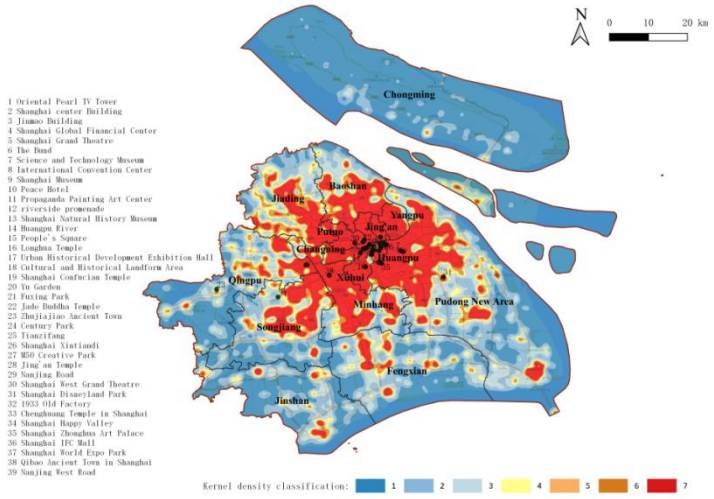

Figure. 11 Intensity of population concentration on weekdays (14:00-16:00)

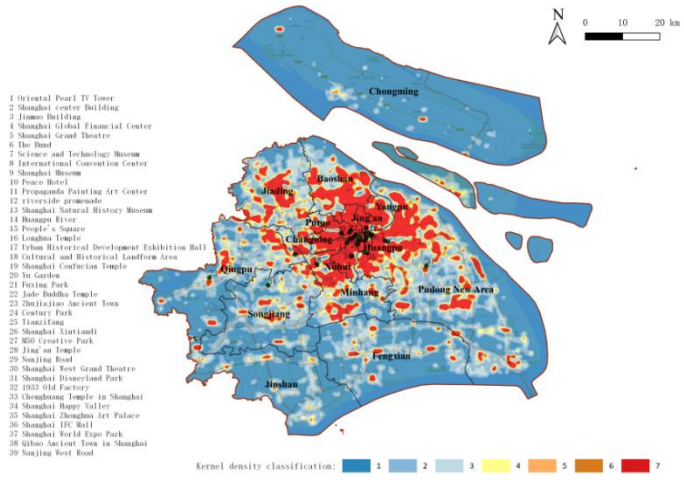

Figure. 12 Intensity of population concentration on weekdays (20:00-22:00)

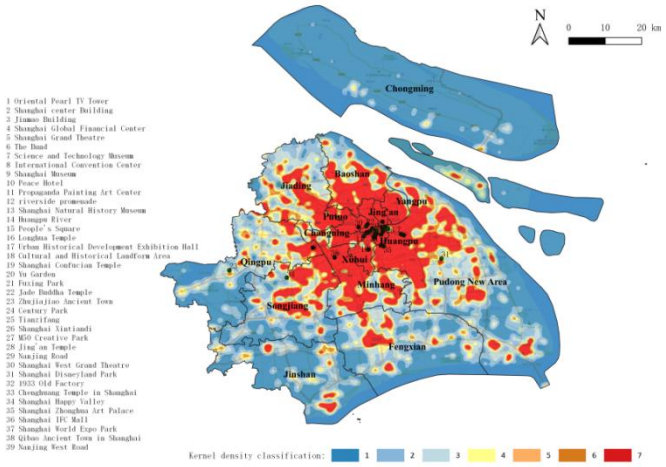

Figure. 13 Intensity of population gathering on weekends (14:00-16:00)

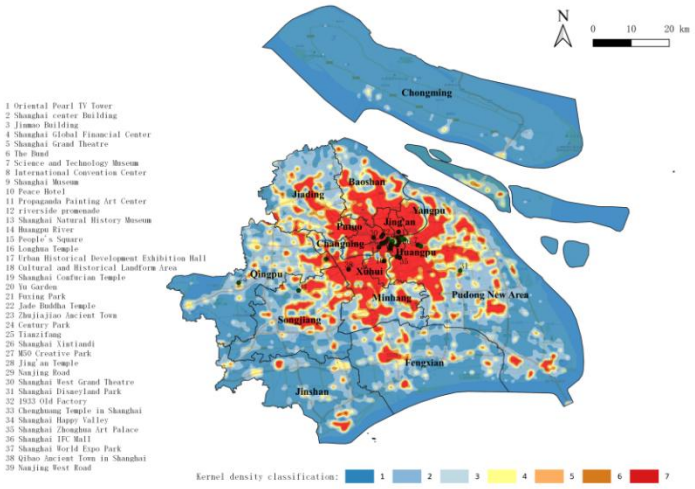

Figure. 14 Intensity of population gathering on weekends (20:00-22:00)

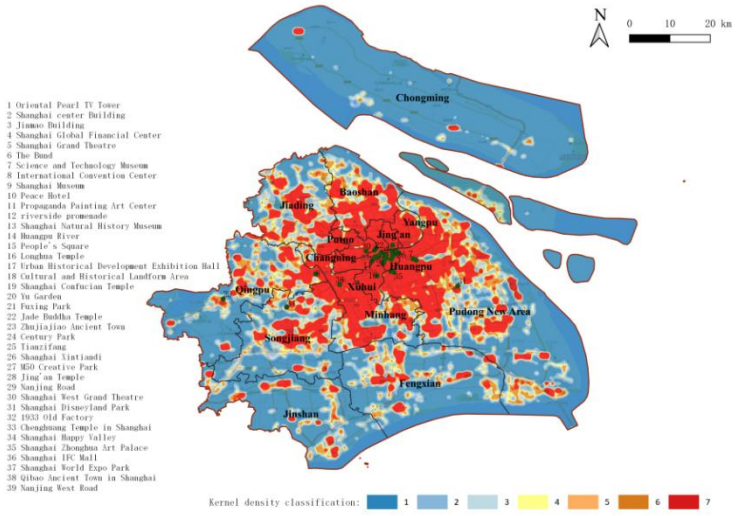

Figure. 15 Degree of population concentration on festive days (14:00-16:00)

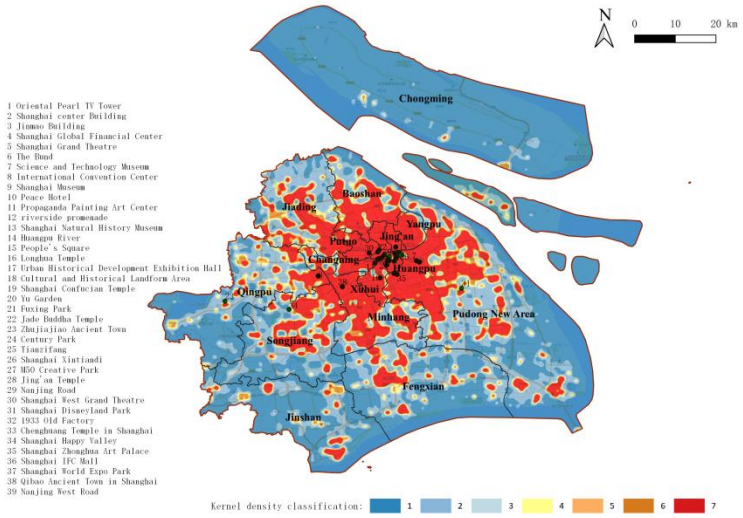

Figure. 16 Degree of population concentration on festive days (20:00-22:00)

From Figures 11 to 16, it is evident that the high concentration areas of population vitality throughout the day on weekdays exhibit significant variability compared to holidays, with the most notable feature being the substantial reduction in the proportion, pattern, and continuity of high concentration areas at night. This phenomenon may be attributed to factors such as the daily life patterns of urban residents, traffic constraints, socialization patterns, and variations in business activities.Moreover, the high concentration areas of population dynamics are more widespread and dispersed during holidays, with numerous small high concentration areas emerging in marginal urban areas. This trend occurs because holidays typically broaden the range of activities for city residents and visitors, including outdoor activities and festive celebrations, thereby providing marginal urban areas with opportunities to experience high-intensity activity as well.

3.6 Coupling between demographic vitality and services in arts and cultural production spaces

Equations (3) to (5) were employed to compute the degree of coupled coordination (DCPS) between population vitality and service facilities in the arts and cultural production space. Table 3 below presents the DC evaluation criteria. The results derived from the model can indicate the overall coordination between the development levels of different systems. A DCPS value approaching 1 signifies a strong coordination between the development levels of the systems, while a value nearing 0 indicates a weak degree of mutual influence.

Table 3. Classification of coupled coordination degree types

Range of Coupling Coordination Degrees	Type
$D \in [0,0.2]$	Serious disorder
$D \in [0.2,0.4]$	Moderate disorder
$D \in [0.4,0.5]$	General coordination
$D \in [0.5,0.8]$	Moderate coordination
$D \in [0.8,1]$	High degree of coordination

From Tables 4 and 5, it becomes evident that the overall degree of coordination (DC) of X1 is low, while the overall degree of coupled coordination (DCPS) of X2 is relatively high. Examining the spatial and temporal distribution of DC of population vitality and service facilities in art and cultural production spaces (Table 6), it can be observed that X1 as a whole demonstrates more coordination during weekday daytime. The distribution of DCPS within X2 internally is unbalanced, with high DCPS observed for TS, ES, and AC, and low DCPS for MS and LB. This imbalance may stem from the fact that urban residents tend to follow more regular activity patterns during weekday daytime, allowing art and cultural production space planners to better predict and organize relevant cultural activities and facility services to meet the diverse needs of visitors. Additionally, daytime hours typically witness a combination of cultural activities and work, such as gallery visits, museum tours, and library usage, alongside art studio

sessions and production. Consequently, the coordination between overall population vitality and service facilities is higher during weekday daytime, primarily due to the regularity of population activity on weekdays.The elevated levels of DCPS for TS, ES, and AC in X2 during weekday daytime may be attributed to the intensified art-related business activities during weekdays, including art exhibitions, sales, transportation, training, and associated services. Consequently, the spaces associated with TS, ES, and AC experience higher demand and are equipped with more staff and resources to accommodate this demand, resulting in better DCPS between population vitality and service facilities in these areas.Conversely, the lower DCPS levels observed for MS and LB during weekday daytime may result from conflicts between the daily work and study schedules of city residents and the opening hours of MS and LB spaces. Additionally, the lack of evident demand for cultural services during weekday daytime further reduces population vitality in MS and LB spaces.

Furthermore, the coordination between X1 and X2 during weekday nights is relatively lower. This can be attributed to various factors including the basic daily work and study schedules of urban residents, safety concerns, traffic constraints, and business hours. These factors restrict the extent of nighttime activities for people. Moreover, nighttime arts and cultural activities often require more publicity and promotion efforts, which not only increase the planning costs but also may result in a segment of the population being unaware of nighttime arts and cultural events.

During weekends, the DCPS for daytime X1 is poorer. Several factors contribute to this phenomenon. Firstly, there are differences in preferences and behaviors between tourists and local residents. While local residents may seek relaxation and leisure activities, tourists are more inclined towards experiencing local arts and cultural offerings and visiting iconic attractions. Consequently, weekends witness a surge in footfall in the core areas of arts and cultural production spaces, placing significant pressure on related service facilities. This increased demand can lead to issues such as insufficient guided tour services and long queues, affecting the overall experience. Additionally, weekends are highly competitive for arts and cultural activities and entertainment, leading to a potential imbalance in resource allocation and attractiveness of offerings, thus resulting in a lower DCPS.

The overall DCPS level of X2 during weekend daytime is higher, although the coupling coordination between MS and LB is poor. There are several factors contributing to the higher DCPS level of X2 during weekend daytime. Firstly, weekends typically see an increase in art and cultural activities and social gatherings, attracting various cultural events, art performances, and art bazaars in the extended spaces around the art and cultural production spaces. This diversity of recreational activities enhances the attractiveness and vitality of X1, fostering interaction and drawing more urban residents. Secondly, weekend daytime serves as the primary time for social activities among urban residents, and the extended spaces for art and culture production provide suitable environments for socializing, such as cafes and open-air water bars, meeting the activity needs of urban residents. Thirdly, most extended spaces for art and culture production are clustered in art and culture neighborhoods and agglomeration areas, which usually feature complete art and culture ecosystems with numerous cultural facilities, art shops, and art bars. This clustering effect elevates visibility and attraction to X2.

However, the lower level of coupling between MS and LB population vitality and spatial facilities in X2 may stem from the lack of attractive recreational activities and art projects, as well as the fact that urban residents have more leisure time on weekends and may opt to move away from the city center to engage in recreational and leisure activities in the suburban fringe areas. The overall DCPS of arts and cultural production spaces during weekend nighttime is at a low to medium level, influenced by factors such as security concerns, transportation inconveniences, lack of attractive activities, insufficient facilities and services, and cultural habits and lifestyles.

During the daytime and nighttime of festivals, the DCPS of arts and cultural production spaces generally exhibit coordination, albeit with poorer DCPS for MS and LB spaces. Festivals typically feature a variety of cultural activities and celebrations, attracting people to arts and cultural production spaces; however, compared to other types of service spaces, MS and LB spaces may offer less attractive services in terms of cultural ambiance and visibility.

Table 4. The Coupled Coherence of the Core Space of Artistic and Cultural Production (X1)

Type	Times		C	T	D	Evaluation
X1	Workday	14:00-16:00	0.8239	0.3482	0.5356	Moderate coordination
		20:00-22:00	0.9688	0.1209	0.3422	Moderate disorder
	Weekend	14:00-16:00	0.0	0.0754	0.0	Serious disorder
		20:00-22:00	0.9688	0.1209	0.3422	Moderate disorder
	Holiday	14:00-16:00	0.675	0.5754	0.6232	Moderate coordination
		20:00-22:00	0.7544	0.4391	0.5755	Moderate coordination

Table 5. The Coupled Coherence of the Extended Space of Artistic and Cultural Production (X2)

Type		Times		C	T	D	Evaluation
X2	TS	Workday	14:00-16:00	0.9188	0.717	0.8117	High degree of coordination
			20:00-22:00	0.0	0.217	0.0	Serious disorder
		Weekend	14:00-16:00	0.9975	0.467	0.6825	Moderate coordination
			20:00-22:00	0.9294	0.317	0.5428	Moderate coordination
		Holiday	14:00-16:00	0.9832	0.367	0.6007	Moderate coordination
			20:00-22:00	0.9294	0.317	0.5428	Moderate coordination
	ES	Workday	14:00-16:00	1.0	1.0	1.0	High degree of coordination
			20:00-22:00	0.0	0.5	0.0	Serious disorder
		Weekend	14:00-16:00	0.9428	0.75	0.8409	High degree of coordination
			20:00-22:00	0.7454	0.6	0.6688	Moderate coordination
		Holiday	14:00-16:00	0.8427	0.65	0.7401	Moderate coordination
			20:00-22:00	0.7454	0.6	0.6688	Moderate coordination
	MS	Workday	14:00-16:00	0.2634	0.509	0.3662	Moderate disorder
			20:00-22:00	0.0	0.009	0.0	Serious disorder
		Weekend	14:00-16:00	0.366	0.259	0.3079	Moderate disorder
			20:00-22:00	0.5501	0.109	0.2449	Moderate disorder
		Holiday	14:00-16:00	0.4618	0.159	0.271	Moderate disorder
			20:00-22:00	0.5501	0.109	0.2449	Moderate disorder
	EM	Workday	14:00-16:00	0.714	0.5882	0.6481	Moderate coordination
			20:00-22:00	0.0	0.0882	0.0	Serious disorder
		Weekend	14:00-16:00	0.8781	0.3382	0.545	Moderate coordination
			20:00-22:00	0.998	0.1882	0.4334	General coordination
		Holiday	14:00-16:00	0.9657	0.2382	0.4796	General coordination
			20:00-22:00	0.998	0.1882	0.4334	General coordination
	AC	Workday	14:00-16:00	0.9638	0.7895	0.8723	High degree of coordination
			20:00-22:00	0.0	0.2895	0.0	Serious disorder
		Weekend	14:00-16:00	0.9973	0.5395	0.7335	Moderate coordination
			20:00-22:00	0.8737	0.3895	0.5834	Moderate coordination
		Holiday	14:00-16:00	0.9483	0.4395	0.6456	Moderate coordination
			20:00-22:00	0.8737	0.3895	0.5834	Moderate coordination
	LB	Workday	14:00-16:00	0.0	0.0	0.0	Serious disorder
			20:00-22:00	0.0	0.0	0.0	Serious disorder
		Weekend	14:00-16:00	0.0	0.0	0.0	Serious disorder
			20:00-22:00	0.0	0.0	0.0	Serious disorder
		Holiday	14:00-16:00	0.0	0.0	0.0	Serious disorder
			20:00-22:00	0.0	0.0	0.0	Serious disorder

Table 6. Characteristics of Spatial and Temporal Distribution of Spatial Coupling Coordination of Artistic and Cultural Production

Times	Level	Workday	Weekend	Holiday
14：00 - 16：00	High	X2(TS/ES/AC)	X2(ES)	-
	Moderate	X1/EM	X2(TS/EM/AC)	X1、X2(TS/ES/EM/AC)
	Low	X2(MS/LB)	X1、X2(MS/LB)	X2(MS/LB)
20：00 - 22：00	High	-	-	-
	Moderate	-	X2(TS/ES/EM/AC)	X1、X2(TS/ES/EM/AC)
	Low	X1、X2(ES/MS/EM/AC/LB)	X1、X2(MS/LB)	X2(MS/LB)

4 DISCUSSION

4.1 Utilising the locational advantages of landmark buildings to create a clustering effect of arts and cultural centres

From the analysis of the results, it's evident that locational elements exhibit strong central agglomeration. Concentration of resources supporting artistic and cultural production activities, such as capital and talent, in specific areas can lead to the formation of more active and prosperous artistic and cultural centers, thereby enhancing the vitality of the space. Consequently, local governments may consider incorporating landmark buildings into cultural facility construction projects as part of urban planning initiatives. By strategically positioning cultural facilities around landmark buildings, an artistic atmosphere and cultural ambiance can be cultivated to attract artists, cultural and creative talents, as well as visitors, thus fostering an art and culture clustering effect.

Moreover, enhancing the composite function of landmark building spaces and their surrounding public areas by creating multifunctional cultural and artistic venues can further attract a diverse range of cultural activities, including exhibitions, performances, lectures, workshops, and more. By increasing the social function of landmark building spaces, participation from different groups and for various purposes can be encouraged. Additionally, leveraging their prime locations, landmark buildings can bolster the status and appeal of arts and cultural centers by showcasing local cultural characteristics, historical heritage, and the works of local artists. Through these measures, landmark buildings can capitalize on their location advantages and serve as the focal point of a thriving arts and culture hub, attracting urban residents for gatherings, cultural exchanges, and artistic endeavors.

4.2 Improve the accessibility of art and cultural production spaces and promote the prosperity of the city's cultural industry

In this study, it's observed that transportation-related spaces (TS) associated with accessibility elements exhibit a medium-high level in the DCPS, indicating the significance of accessibility factors in attracting visitors. To optimize the spatial layout and location of arts and cultural production spaces, ensuring the presence of convenient public transport systems and pedestrian pathways around these spaces is essential for enhancing accessibility.

In terms of fostering public participation and increasing visibility, fostering collaborative partnerships with neighboring communities and institutions to co-host cultural activities and projects can attract a broader audience. Furthermore, promoting these events through diverse channels can enhance the visibility and accessibility of arts and cultural production spaces. Lowering the entry barriers and participation costs can also encourage a wider range of individuals to engage with these spaces.

Regarding the equity of social and cultural services, it's imperative to ensure the provision of facilities such as barrier-free access, wheelchair ramps, and tactile paths in and around art and cultural production spaces to enhance accessibility for individuals with disabilities. By implementing these measures, arts and cultural production spaces can become more inclusive and accessible to diverse segments of the population.

4.3 Flexible scheduling of arts and cultural activities and regular evaluation and adjustment of the content of arts and cultural production

In summary, the vitality of art and cultural production spaces in Shanghai tends to be higher during daytime than nighttime, with weekends and holidays exhibiting higher population vitality compared to weekdays. Daytime vitality is predominantly concentrated in X1, while nighttime vitality shows a more balanced spatial distribution. Coordination between population vitality and service facilities is stronger during daytime than nighttime, and weekdays show higher coordination levels compared to weekends and festive days.

Given these findings, it's advisable to flexibly schedule art and cultural activities based on urban residents' activity intensity during different time periods. Specific thematic exhibitions and art activities can be arranged during holidays, and collaborations with neighboring commercial districts, community organizations, and art colleges can facilitate joint publicity and promotion efforts across different time periods, thereby expanding the influence of art and cultural production spaces and attracting diverse social participation groups.

Moreover, relevant departments should continuously update and enhance art activity planning programs based on public feedback and demand to ensure the sustainability of art and cultural production spaces' vitality across various time periods.

4.4 Creating suitable business forms to improve the vitality of the whole region's art and cultural production space

In this study, ES and AC, which are related to commercial attractiveness, generally exhibit a medium-high level, except for the nighttime of weekdays when they are at a low level. This suggests that appropriate commercial formats play a crucial role in enhancing the vitality of art and cultural production spaces. The research on location factors indicates that the influence of location factors, such as landmark buildings, is limited to specific areas. Consequently, areas lacking significant historical resources may struggle to attract the necessary resources and opportunities to support art and culture production, leading to uneven development and widening gaps in the arts and culture sector.

To address this, placing businesses with suitable formats in areas lacking historical resources can be equally attractive and serve as an essential factor in attracting visitors to art and cultural production spaces, especially on weekends and festival nights. This underscores the importance of strategically planning the layout of commercial functions and selecting appropriate commercial formats to enhance the vitality of art and cultural production spaces.

5 CONCLUSION

In summary, this study establishes a methodological framework to quantitatively analyze the current level of DCPS in art and cultural production spaces in Shanghai using Baidu heat map data and service facility POI data. By integrating kernel density analysis, grid coverage, cost distance model (CDM), and coupled coordination degree model, a more comprehensive and accurate understanding of the distributional characteristics of the vibrancy of art and cultural production spaces and the factors influencing vibrancy can be obtained.

The main findings of this study indicate that in terms of the spatial and temporal distribution characteristics of art and culture production spaces, the daytime vitality in Shanghai is higher than nighttime vitality, with weekends and holidays showing higher population vitality compared to weekdays. Daytime vitality is concentrated in X1, while nighttime vitality exhibits a more balanced spatial distribution. The DCPS of Shanghai's art and culture production space is higher on weekdays than on weekends and holidays, with service facilities being unevenly distributed within the city, primarily concentrated in the central city.

The highest DCPS is found in TS, ES, and AC on weekdays and weekends, followed by X1 on weekday daytime, festival daytime and nighttime, as well as in X2, TS, EM, and AC on weekend daytime and nighttime, and ES on weekend nighttime. Conversely, X1 on weekday nighttime, weekend daytime, and nighttime exhibit the lowest DCPS, along with X2, MS on weekday daytime, and LB, weekday nighttime ES, MS, EM, AC, LB, weekend daytime and nighttime MS and LB, and festival daytime and nighttime MS and LB.

Regarding the influencing factors of the vitality of art and cultural production spaces, enhancing the vitality can be achieved by leveraging the location advantages of landmark buildings, improving accessibility, flexibly arranging the timing of art and cultural activities, regularly evaluating and adjusting production content, and creating suitable commercial formats.

.

REFERENCES

[1] Currid, Elizabeth. "How Art and Culture Happen in New York: Implications for Urban Economic Development." Journal of the American Planning Association 73, no. 4 (2007): 454–67. doi:10.1080/01944360708978526.

[2] Grodach, Carl, and Anastasia Loukaitou - Sideris. "CULTURAL DEVELOPMENT STRATEGIES AND URBAN REVITALIZATION: A Survey of US Cities." International Journal of Cultural Policy 13, no. 4 (2007): 349–70. doi:10.1080/10286630701683235.

[3] Gibson, Lisanne, and Deborah Stevenson. "URBAN SPACE AND THE USES OF CULTURE." International Journal of Cultural Policy 10, no. 1 (2004): 1–4. doi:10.1080/1028663042000212292.

[4] Alves, Teresa. "Art, Light and Landscape New Agendas for Urban Development." European Planning Studies 15, no. 9 (2007): 1247–60. doi:10.1080/09654310701529243.

[5] Skrede, Joar. "What May Culture Contribute to Urban Sustainability? Critical Reflections on the Uses of Culture in Urban Development in Oslo and Beyond." Journal of Urbanism: International Research on Placemaking and Urban Sustainability 9, no. 4 (2016): 408–25. doi:10.1080/17549175.2015.1074603.

[6] Lysgård, Hans Kjetil. "The Definition of Culture in Culture-Based Urban Development Strategies: Antagonisms in the Construction of a Culture-Based Development Discourse." International Journal of Cultural Policy 19, no. 2 (2013): 182–200. doi:10.1080/10286632.2011.647005.

[7] Sheng Zhong,Artists and Shanghai's culture-led urban regeneration,Cities,Volume 56,2016,Pages 165-171,ISSN 0264-2751,https://doi.org/10.1016/j.cities.2015.09.002.

[8] Markusen, A. (2006). Urban Development and the Politics of a Creative Class: Evidence from a Study of Artists. Environment and Planning A: Economy and Space, 38(10), 1921-1940. https://doi.org/10.1068/a38179

[9] Flew, Terry. "Toward a Cultural Economic Geography of Creative Industries and Urban Development: Introduction to the Special Issue on Creative Industries and Urban Development." The Information Society 26, no. 2 (2010): 85–91. doi:10.1080/01972240903562704.

[10] Lysgård, Hans Kjetil. "Creativity, Culture and Urban Strategies: A Fallacy in Cultural Urban Strategies." European Planning Studies 20, no. 8 (2012): 1281–1300. doi:10.1080/09654313.2012.680581.

[11] Camarero,C.,Garrido,M.J.，&Vicente，E.Social and Financial Signaling to Increase Fundraising Revenue in Museums .Journal of Nonprofit&Public Sector Marketing,2023:35(2):144-164.

[12] Cerreta, M., & La Rocca, L. (2021). Urban regeneration processes and social impact: Aliterature review to explore the role of evaluation. In , 21. Computational Science andIts Applications-ICCSA 2021: 21st International Conference, Cagliari, Italy, September13-16,2021,Proceedings, Part V (pp.167-182).

[13] Lily Kong,Cultural icons and urban development in Asia: Economic imperative, national identity, and global city status,Political Geography,Volume 26, Issue 4,2007,Pages 383-404,ISSN 0962-6298,https://doi.org/10.1016/j.polgeo.2006.11.007.

[14] Carl Grodach,Urban cultural policy and creative city making,Cities,Volume 68,2017,Pages 82-91,ISSN 0264-2751,https://doi.org/10.1016/j.cities.2017.05.015.

[15] Tricarico, Luca, Zachary Mark Jones, and Gaia Daldanise. "Platform Spaces: When Culture and the Arts Intersect Territorial Development and Social Innovation, a View from the Italian Context." Journal of Urban Affairs 44, no. 4–5 (2022): 545–66. doi:10.1080/07352166.2020.1808007.

[16] SlachOndřej and BorutaTomáš. "What Can Cultural and Creative Industries Do for Urban Development? Three Stories from the Postsocialist Industrial City of Ostrava" Quaestiones Geographicae 31, no.4 (2013): 99-112. https://doi.org/10.2478/v10117-012-0039-z

[17] Shin Nakagawa,Socially inclusive cultural policy and arts-based urban community regeneration,Cities,Volume 27, Supplement 1,2010,Pages S16-S24,ISSN 0264-2751,

[18]https://doi.org/10.1016/j.cities.2010.03.003.

[19] Jun Wang,'Art in capital': Shaping distinctiveness in a culture-led urban regeneration project in Red Town, Shanghai,Cities,Volume 26, Issue 6,2009,Pages 318-330,ISSN 0264-2751,https://doi.org/10.1016/j.cities.2009.08.002.

[20] Huffschmid, Anne. "From the City to 'Lo Urbano': Exploring Cultural Production of Public Space in Latin America. " Iberoamericana (2001-) 12, no. 45 (2012): 119–36. http://www.jstor.org/stable/41677562.

[21] Valli, C. (2015). When Cultural Workers Become an Urban Social Movement: Political Subjectification and Alternative Cultural Production in the Macao Movement, Milan. Environment and Planning A: Economy and Space, 47(3),643-659. https://doi.org/10.1068/a140096p

[22] Sacha Kagan, Antoniya Hauerwaas, Verena Holz, Patricia Wedler,Culture in sustainable urban development: Practices and policies for spaces of possibility and institutional innovations,City, Culture and Society,Volume 13,2018,Pages 32-45,ISSN 1877-9166,https://doi.org/10.1016/j.ccs.2017.09.005.

[23] Pratt, A. C. (2009). Urban Regeneration: From the Arts `Feel Good' Factor to the Cultural Economy: A Case Study of Hoxton, London. Urban Studies, 46(5-6), 1041-1061. https://doi.org/10.1177/0042098009103854

[24] Rich, M. A., & Tsitsos, W. (2018). New Urban Regimes in Baltimore: Higher Education Anchor Institutions and Arts and Culture–Based Neighborhood Revitalization. Education and Urban Society, 50(6), 524-547. https://doi.org/10.1177/0013124517713607

[25] Rius-Ulldemolins, Joaquim, Gil-Manuel Hernàndez I Martí, and Francisco Torres. "Urban Development and Cultural Policy 'White Elephants': Barcelona and Valencia." European Planning Studies 24, no. 1 (2016): 61–75. doi:10.1080/09654313.2015.1075965.

[26] Liang, S., & Wang, Q. (2020). Cultural and Creative Industries and Urban (Re)Development in China. Journal of Planning Literature, 35(1), 54-70. https://doi.org/10.1177/0885412219898290

[27] Jakob, D. (2013). The eventification of place: Urban development and experience consumption in Berlin and New York City. European Urban and Regional Studies, 20(4), 447-459.

[28] Anna-Lisa Müller,Voices in the city. On the role of arts, artists and urban space for a just city,Cities,Volume 91,2019,Pages 49-57,ISSN 0264-2751,https://doi.org/10.1016/j.cities.2018.04.004.

[29] Crisman, Jonathan Jae-an. "Evaluating Values in Creative Placemaking: The Arts as Community Development in the NEA's Our Town Program." Journal of Urban Affairs 44, no. 4–5 (2022): 708–26. doi:10.1080/07352166.2021.1890607.

[30] Gibson, Lisanne, 2019, Histories of Cultural Participation, Values and Governance pp 153, 978-1-137-55027-9

[31] Belfiore, Eleonora and Gibson, Lisanne, 2019, Histories of Cultural Participation, Values and Governance pp 1, 978-1-137-55027-9

[32] Xueling, T., Yinhe, L., Yajuan, L., & Hu, Y. (2024). Production and reconstruction of food cultural spaces from a glocalization perspective: Evidence from Yanji City. Leisure Studies, 43(1), 89–105. https://doi.org/10.1080/02614367.2023.2191979

[33] Salone, Carlo, Sara Bonini Baraldi, and Giangavino Pazzola. "Cultural Production in Peripheral Urban Spaces: Lessons from Barriera, Turin (Italy)." European Planning Studies 25, no. 12 (2017): 2117–37. doi:10.1080/09654313.2017.1327033.

[34] Whiting, S. (2021). The Value of Small Live Music Venues: Alternative Forms of Capital and Niche Spaces of Cultural Production. Cultural Sociology, 15(4), 558-578. https://doi.org/10.1177/17499755211021307

[35] Polèse, M. (2012). The Arts and Local Economic Development: Can a Strong Arts Presence Uplift Local Economies? A Study of 135 Canadian Cities. Urban Studies, 49(8), 1811-1835. https://doi.org/10.1177/0042098011422574

Sjöholm, J. (2014). The art studio as archive: tracing the geography of artistic potentiality, progress and production. CulturalGeographies, 21(3),505-514. https://doi.org/10.1177/1474474012473060

[36] Zendel, A. (2021). "There are no days off, just days without shows": precarious mobilities in the touring music industry. Applied Mobilities, 6(2), 184–201. https://doi.org/10.1080/23800127.2020.1827516

[37] Hristova Desislava, Aiello Luca M., Quercia Daniele,The New Urban Success: How Culture Pays ,Frontiers in Physics ,VOLUME 6 ,2018, ISSN=2296-424X,DOI=10.3389/fphy.2018.00027 ,https://www.frontiersin.org/articles/10.3389/fphy.2018.00027

[38] Ron Griffiths,Cultural strategies and new modes of urban intervention,Cities,Volume 12, Issue 4,1995,Pages 253-265,ISSN 0264-2751,https://doi.org/10.1016/0264-2751(95)00042-K.

[39] García, Beatriz. "URBAN REGENERATION, ARTS PROGRAMMING AND MAJOR EVENTS: Glasgow 1990, Sydney 2000 and Barcelona 2004." International Journal of Cultural Policy 10, no. 1 (2004): 103–18. doi:10.1080/1028663042000212355.

[40] N D Dembich, A VStreltsov, M A Zyrina, A A Marchenko.Modular system-based urban equipment design.Siberian Industrial Days International Forum IOP Publishing.IOP Conf. Series: Materials Science and Engineering 944 (2020)012007 doi:10.1088/1757-899X/944/1/012007

[41] Ashley, Amanda J., Carolyn G. Loh, Karen Bubb, and Leslie Durham. "Diversity, Equity, and Inclusion Practices in Arts and Cultural Planning." Journal of Urban Affairs 44, no. 4–5 (2022): 727–47. doi:10.1080/07352166.2020.1834405.

[42] Montgomery, John. "Editorial Urban Vitality and the Culture of Cities." Planning Practice & Research 10, no. 2 (1995): 101–10. doi:10.1080/02697459550036649.

[43] Pierre Bourdieu,The field of cultural production, or: The economic world reversed,Poetics,Volume 12, Issues 4–5,1983,Pages 311-356,ISSN 0304-422X,https://doi.org/10.1016/0304-422X(83)90012-8.

[44] Vivian Yuan Yuan, Vivian Yuan Yuan, Correlated Concepts and Theory Developments, The Economic Logic of Chinese Cultural-Creative Industries Parks, 10.1007/978-981-15-3540-6_2, (11-48), (2020).

[45] Jacobs J. The Death and Life of Great American,Cities[M]. New York: Random House, 1961: 61-65.

[46] Gehl J. Life between Buildings: Using Public,Space[M]. Washington, D.C.: Island Press,2011: 24-27.

[47] Montgomery, John. "Making a City: Urbanity, Vitality and Urban Design." Journal of Urban Design 3, no. 1 (1998): 93–116. doi:10.1080/13574809808724418.

[48] Chen Zeng, Yan Song, Qingsong He, Feixue Shen,Spatially explicit assessment on urban vitality: Case studies in Chicago and Wuhan,Sustainable Cities and Society,Volume 40,2018,Pages 296-306,ISSN 2210-6707,https://doi.org/10.1016/j.scs.2018.04.021.

[49] Zhenhua Li, Yi Lu, Yu Zhuang, Linchuan Yang,Influencing factors of spatial vitality in underground space around railway stations: A case study in Shanghai,Tunnelling and Underground Space Technology,Volume147,2024,105730,ISSN0886-7798,https://doi.org/10.1016/j.tust.2024.105730.

[50] Yan Gu, Yanju Yao, Wei Yan, Juanjuan Zhao, Teng Fei, Shulin Ouyang,Examining the transformation of postindustrial land in reversing the lack of urban vitality: A paradigm spanning top-down and bottom-up approaches in urban planning studies,Heliyon,Volume 10, Issue 8,2024,e27667,ISSN 2405-8440,https://doi.org/10.1016/j.heliyon.2024.e27667.

[51] Beniamino Murgante, Lucia Patimisco, Alfonso Annunziata,Developing a 15-minute city: A comparative study of four Italian Cities-Cagliari, Perugia, Pisa, and Trieste,Cities,Volume 146,2024,104765,ISSN 0264-2751,https://doi.org/10.1016/j.cities.2023.104765.

[52] Qingsong He, Weishan He, Yan Song, Jiayu Wu, Chaohui Yin, Yanchuan Mou,The impact of urban growth patterns on urban vitality in newly built-up areas based on an association rules analysis using geographical 'big data',Land Use Policy,Volume 78,2018,Pages 726-738,ISSN 0264-8377,https://doi.org/10.1016/j.landusepol.2018.07.020.

[53] De Koe, D. M., and P. D. B. HvA. "Urban vitality through a mix of land-uses and functions: An addition to citymaker." Minor Thesis, Wageningen University and Research Centre, Wageningen, The Netherlands (2013).

[54] Chen, Y.; Hu, Y.; Lai, L. Demography-Oriented Urban Spatial Matching of Service Facilities: Case Study of Changchun, China.Land 2022, 11, 1660.

[55] Teitz, M.B. Toward a Theory of Urban Public Facility Location. Papers of the Regional Science Association; Springer: Berlin/Heidelberg,Germany, 1968; Volume 21, pp. 35–51.

[56] Niu, S.; Hu, A.; Shen, Z.; Lau, S.S.Y.; Gan, X. Study on Land Use Characteristics of Rail Transit TOD Sites in New Towns —Taking.Singapore as an Example. J. Asian Archit. Build. Eng. 2019, 18, 16–27.

[57] Berry, D.; Steiker, G. The Concept of Justice in Regional Planning: Justice as Fairness. J. Am. Inst. Plan. 1974, 40, 414–421

[58] Reyes, M.; Páez, A.; Morency, C. Walking Accessibility to Urban Parks by Children: A Case Study of Montreal. Landsc. Urban.Plan. 2014, 125, 38–47.

[59] Song, X.; Deng, W.; Liu, Y.; Zhao, C.; Wan, J. Residents' Satisfaction with Public Services in Mountainous Areas: An Empirical.Study of Southwestern Sichuan Province, China. Chin. Geogr. Sci. 2017, 27, 311–324.

[60] W˛eziak-Białowolska, D. Quality of Life in Cities–Empirical Evidence in Comparative European Perspective. Cities 2016, 58, 87–96.

[61] Yin, C.; He, Q.; Liu, Y.; Chen, W.; Gao, Y. Inequality of Public Health and Its Role in Spatial Accessibility to Medical Facilities in China. Appl. Geogr. 2018, 92, 50–62.

[62] Wang, D.; Dewancker, B.; Duan, Y.; Zhao, M. Exploring Spatial Features of Population Activities and Functional Facilities in Rail.Transit Station Realm Based on Real-Time Positioning Data: A Case of Xi'an Metro Line 2. ISPRS Int. J. Geo-Inf. 2022, 11, 485.

[63] Zhang, N.; Zhang, J.; Chen, W.; Su, J. Block-Based Variations in the Impact of Characteristics of Urban Functional Zones on the Urban Heat Island Effect: A Case Study of Beijing. Sustain. Cities Soc. 2022, 76, 103529.

[64] Hu, X.; Shen, P.; Shi, Y.; Zhang, Z. Using Wi-Fi Probe and Location Data to Analyze the Human Distribution Characteristics of Green Spaces: A Case Study of the Yanfu Greenland Park, China. Urban For. Urban Green. 2020, 54, 126733.

[65] Heikinheimo, V.; Tenkanen, H.; Bergroth, C.; Järv, O.; Hiippala, T.; Toivonen, T. Understanding the Use of Urban Green Spaces from User-Generated Geographic Information. Landsc. Urban Plan. 2020, 201, 103845.

[66] Fan, Z.; Duan, J.; Lu, Y.; Zou, W.; Lan, W. A Geographical Detector Study on Factors Influencing Urban Park Use in Nanjing,China. Urban For. Urban Green. 2021, 59, 126996.

[67] Bao, Wenxuan, Adu Gong, Tong Zhang, Yiran Zhao, Boyi Li, and Shuaiqiang Chen. 2023. "Mapping Population Distribution with High Spatiotemporal Resolution in Beijing Using Baidu Heat Map Data" Remote Sensing 15, no. 2: 458. https://doi.org/10.3390/rs15020458

[68] Niu, H.; Silva, E.A. Delineating Urban Functional Use from Points of Interest Data with Neural Network Embedding: A Case Study in Greater London. Comput. Environ. Urban Syst. 2021, 88, 101651.

[69] Wu, H.; Wang, L.; Zhang, Z.; Gao, J. Analysis and Optimization of 15-Minute Community Life Circle Based on Supply and Demand Matching: A Case Study of Shanghai. PLoS ONE 2021, 16, e0256904.

[70] Xu, D.; Huang, Z.; Lv, L.; Chen, X.; Cao, F. Research on Spatial Characteristic of Urban Leisure Tourism Based on POI Mining:A Case Study of Nanjing City. Geogr. Geo-Inf. Sci. 2018, 34, 59–64.

[71] Zhao, P.; Luo, J.; Hu, H. Spatial match between residents' daily life circle and public service facilities using big data analytics:A case of Beijing. Prog. Geogr. 2021, 40, 541–553.

[72] Li, J.; Li, J.; Yuan, Y.; Li, G. Spatiotemporal distribution characteristics and mechanism analysis of urban population density: A case of Xi'an, Shaanxi, China. Cities 2019, 86, 62–70.

[73] Fan, Z.; Duan, J.; Lu, Y.; Zou, W.; Lan, W. A geographical detector study on factors influencing urban park use in Nanjing, China. Urban For. Urban Green. 2021, 59, 126996.

[74] Zhang, S.; Zhang, W.; Wang, Y.; Zhao, X.; Song, P.; Tian, G.; Mayer, A. Comparing Human Activity Density and Green Space Supply Using the Baidu Heat Map in Zhengzhou, China. Sustainability 2020, 12, 7075.

[75] Qingli Shi, Li Zhuo, Haiyan Tao, Junying Yang,A fusion model of temporal graph attention network and machine learning for inferring commuting flow from human activity intensity dynamics,International Journal of Applied Earth Observation and Geoinformation,Volume 126,2024,103610,ISSN 1569-8432,https://doi.org/10.1016/j.jag.2023.103610.

[76] Zhao, Dan, Liu Shao, Jianwei Li, and Lina Shen. 2024. "Spatial-Performance Evaluation of Primary Health Care Facilities: Evidence from Xi'an, China" Sustainability 16, no. 7: 2838. https://doi.org/10.3390/su16072838

[77] Mika Siljander, Emilia Venäläinen, Floris Goerlandt, Petri Pellikka,GIS-based cost distance modelling to support strategic maritime search and rescue planning: A feasibility study,Applied Geography,Volume 57,2015,Pages 54-70,ISSN 0143-6228,https://doi.org/10.1016/j.apgeog.2014.12.013.

[78] Kunyuan Wanghe, Xile Guo, Meng Wang, Hongfei Zhuang, Shahid Ahmad, Tauheed Ullah Khan, Yanqing Xiao, Xiaofeng Luan, Kai Li,Gravity model toolbox: An automated and open-source ArcGIStool to build and prioritize ecological corridors in urban landscapes,Global Ecology and Conservation,Volume 22,2020,e01012,ISSN 2351-9894,https://doi.org/10.1016/j.gecco.2020.e01012.

[79] Becker, Daniel, María De Andrés-Herrero, Christian Willmes, Gerd-Christian Weniger, and Georg Bareth. 2017. "Investigating the Influence of Different DEMs on GIS-Based Cost Distance Modeling for Site Catchment Analysis of Prehistoric Sites in Andalusia" ISPRS International Journal of Geo-Information 6, no. 2: 36. https://doi.org/10.3390/ijgi6020036

[80] Teng Wang, Yandong Wang, Xiaoming Zhao, Xiaokang Fu,Spatial distribution pattern of the customer count and satisfaction of commercial facilities based on social network review data in Beijing, China,Computers, Environment and Urban Systems,Volume 71,2018,Pages 88-97,ISSN 0198-9715,https://doi.org/10.1016/j.compenvurbsys.2018.04.005.

[81] Yang, Jing, Jie Zhu, Yizhong Sun, and Jianhua Zhao. 2019. "Delimitating Urban Commercial Central Districts by Combining Kernel Density Estimation and Road Intersections: A Case Study in Nanjing City, China" ISPRS International Journal of Geo-Information 8, no. 2: 93. https://doi.org/10.3390/ijgi8020093

[82] Shi, Xiaochi, Daqian Liu, and Jing Gan. 2024. "A Study on the Relationship between Road Network Centrality and the Spatial Distribution of Commercial Facilities—A Case of Changchun, China" Sustainability 16, no. 10: 3920. https://doi.org/10.3390/su16103920

[83] Lu Xing, Minggao Xue, Mingsheng Hu,Dynamic simulation and assessment of the coupling coordination degree of the economy–resource–environment system: Case of Wuhan City in China,Journal of Environmental Management,Volume 230,2019,Pages 474-487,ISSN 0301-4797,https://doi.org/10.1016/j.jenvman.2018.09.065.

[84] Wang, Di, Dong Jiang, Jingying Fu, Gang Lin, and Jialun Zhang. 2020. "Comprehensive Assessment of Production–Living–Ecological Space Based on the Coupling Coordination Degree Model" Sustainability 12, no. 5: 2009. https://doi.org/10.3390/su12052009

[85] Wang, Chengsong, Qian Yang, and Shanhua Wu. 2022. "Coordinated Development Relationship between Port Cluster and Its Hinterland Economic System Based on Improved Coupling Coordination Degree Model: Empirical Study from China's Port Integration" Sustainability 14, no. 9: 4963. https://doi.org/10.3390/su14094963

[86] Pan Chen, Xiaoqing Shi,Dynamic evaluation of China's ecological civilization construction based on target correlation degree and coupling coordination degree,Environmental Impact Assessment Review,Volume 93,2022,106734,ISSN 0195-9255,https://doi.org/10.1016/j.eiar.2021.106734.

[87] Lu Gan, Huan Shi, Yuan Hu, Benjamin Lev, Hongxing Lan,Coupling coordination degree for urbanization city-industry integration level: Sichuan case,Sustainable