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Renewal strategies for historical and cultural neighborhoods from the perspective of catalysts—the case of Shantang street in Suzhou city

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Abstract: The theory of urban catalyst is to promote the maturity of the objective conditions of urban construction, through the intervention of new catalyst elements, triggering a certain "chain reaction", so as to promote the sustainable and progressive development of the city according to the will of the inhabitants. By means of actual research and questionnaire survey, we integrate and sort out the current situation of historical and cultural neighborhoods, existing historical sites, traditional culture, *etc.*, and explore the applicability of its operational characteristics under the special environment of historical and cultural neighborhoods by combining with the "urban catalyst theory", through repairing and renewing the historical buildings, old residences, cultural heritage, *etc.* of Shantang Street of Suzhou. By repairing and renewing the historical buildings, old houses and cultural heritage of Shantang Street in Suzhou City, it protects and develops the traditional culture of Shantang Street in the form of point leading to line and line leading to surface in the backdrop of the historical and cultural district as well as the needs of the old community, and drives the development of the whole district in a small-scale and gradual way to provide a new way of thinking for the renewal of historical and cultural districts.

Keywords: urban catalyst; progressive regeneration; historical and cultural neighborhoods; spatial perception

1. Introduction

With the acceleration of urbanization process, people put forward higher requirements for the construction of public service facilities, municipal infrastructure construction, cultural



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activity space construction, *etc.*, and the former prosperous historical and cultural districts also show different degrees of decline due to the development of the times and complex changes. Historic and cultural districts in cities not only retain a large amount of tangible and intangible cultural heritage, but also witness the development of the city, but nowadays there are problems such as chaotic spatial functions, insufficient public facilities, and a lack of measures to protect and renew the tangible heritage. In this context, the "urban catalyst theory" is introduced to provide a new path for the conservation and renewal of historical and cultural districts by improving the local physical environment, strategically introducing catalyst elements and continuing the historical and cultural lineage, *etc.*, and aiming at awakening the vitality of the local traffic and road system and spatial functional structure, so as to achieve the integrity of the functional structure of the districts and enhance the environment [1].

2. Introduction of the concept of "urban catalyst theory"

2.1. Urban catalysts theory (urban catalysts)

Catalyst: refers to a catalyst – a small amount of a substance that facilitates a significant chemical reaction that operates efficiently with little or no loss of the substance's original mass properties [1]. When a catalyst reacts, the thing or environment catalyzed by the catalyst is the "catalytic effect".

In 1989, Otto and Logan first systematically articulated the "urban catalyst theory" in their co-authored book, *American Urban Architecture: Catalysts of Urban Design*. This theory views "urban catalysts" as specific material elements that produce a series of localized but effective impacts that stimulate and synergize with each other to promote positive change in the city. Urban Catalyst Theory emphasizes the gradual and strategic incorporation of new design elements to update existing urban elements without making major, fundamental changes to them [2]. The theory not only criticizes the "fetishistic" approach of past American urbanism, but also advocates respecting and optimizing the living environment of residents when considering neighborhood renewal, and innovatively proposes a planning concept of "mutual stimulation of elements".

The "urban catalyst" is a representative implementation theory of the small-scale, incremental concept, starting from a small scale and gradually spreading its influence of renewal, eventually leading to the development of the whole area.

2.2. Operational characteristics of the "urban catalyst"

According to Vai-Otto's concept, the "urban catalyst" operates with the following characteristics [2];

(1) Gradual development. The process of operation of the catalyst is adjusted and improved in a gradual manner, not overnight.

(2) Systematic hierarchy. The material elements in the region are graded in terms of location and influence in terms of the level of vitality, and the catalytic renewal is carried out

successively according to the level of hierarchy and is complementary to each other, so as to finally form a hierarchical and systematic protection system (Figure 1).

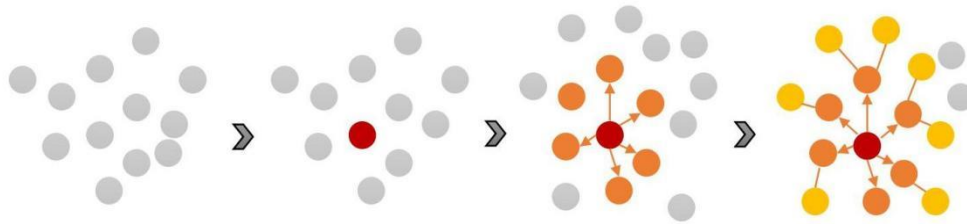


Figure 1. Characteristics of urban catalyst operation. Author's own drawing

(3) Overall relevance. At the macro level to regulate the effect of the catalyst, dynamically adjust the development strategy of the surrounding environment, to ensure that the catalyst and the environment have a close relationship, in order to guide the overall positive evolution of the situation.

(4) Functional integration. On the basis of ensuring that the original urban structure is not destroyed, the spatial functions in the region are reintegrated by using point-like updating, screening out locally inappropriate functions and supplementing new architectural functions, so as to make the regional distribution of functions balanced and perfect.

(5) Morphological diversity. Selection of catalysts when the advantages and disadvantages of its location, the size of the impact is a more important criterion, but not confined to the form, its form can be small or large, can be virtual or real, can be changed with the neighborhood environment.

2.3. Analysis of the applicability of "urban catalysts" and the preservation and renewal of historic and cultural districts

2.3.1. Characteristics of historic and cultural neighborhood conservation renewal

According to the experience of protection and renewal at home and abroad and the Interpretation of Regulations for the Protection of Famous Historical and Cultural Cities, Towns and Villages, the main objectives of the protection and renewal of historical and cultural neighborhoods are expressed as follows: overall protection of the intact historical style, comprehensive protection of historical and cultural values, strict protection of historical and cultural relics [3], and small-scale, progressive renewal of the environment.

(1) Protecting the cultural value of neighborhoods. Historical and cultural neighborhoods have accumulated excellent regional cultural heritage, the value of which is not only embodied in material relics and monuments, but also in the rich intangible culture, such as traditional crafts passed down from generation to generation, folk customs and celebrities and famous events. These historical cultures throughout the past and present constitute the core value of the neighborhood.

(2) Protect the cultural heritage of the neighborhood. Historical and cultural heritage is not a renewable resource, so in the renovation, the protection of tangible cultural heritage must be put in the first place, and in the laws and regulations as well as government supervision

to control, historical neighborhoods renovation should be carried out without destroying the cultural heritage of the streets and alleys, and strive to achieve sustainable development.

(3) The small-scale progressive renewal of historical and cultural neighborhoods has certain research value in itself. Historical and cultural districts that have gone through the changes of the times have shown signs of decay and are in urgent need of a certain degree of protection and renewal in order to adapt to the needs of the modern society, but due to their uniqueness, the operable space for renovation is limited, so choosing the catalyst theory as a renewal method is not only an effective protection of the original texture of the district, but also an important way of stimulating the vitality of the local space [4].

2.3.2. Adaptation of urban catalyst theory to the conservation and renewal of historic and cultural neighborhoods

The operational characteristics of the "urban catalyst" are highly compatible with the methods and tools selected for the conservation and renewal of historic and cultural districts, as shown in the following:

(1) Intervening forms. "Urban catalysts can be small or large, virtual or real, and their forms are varied and unrestricted; they can be applied at the material level, or in non-material form, or even in a combination of material and non-material forms. In historical and cultural districts, conscious control of the form, scale and rhythm of the catalyst can better adapt to the complex environment.

(2) Renewal approach. A gradual, small-scale approach should be adopted in the regeneration, which is determined by the complexity of the current situation of the historic and cultural district and the diversity of the environment, while the "urban catalyst" effect of the subtle approach will lead to a continuous regeneration of the district, which is in line with the characteristics of the historic and cultural district.

(3) Linkage effect. Renewal of historical and cultural districts is a continuous and gradual process, which needs to be adjusted according to the actual situation in order to control the pace and direction of renewal [5]. The catalytic effect is also a process of gradual renewal and continuous correction. Urban catalysts can enhance the vitality of existing elements and catalyze the development of a stronger and larger catalytic effect.

To summarize, the concept of "urban catalyst" is complementary to the preservation and renewal of historic and cultural districts. However, due to the strict legal constraints and limited space for regeneration in the core protection zone, this approach is more suitable to be applied to the construction control zone, which has more space for operation and higher feasibility for implementation, and through the regeneration practice of the construction control zone, it can effectively promote the good protection of the core protection zone [6], so as to achieve the goal of the overall protection and regeneration of the whole neighborhood landscape.

3. Spatial characteristics of Shantang street historical and cultural neighborhood in Suzhou city

3.1. Spatial pattern of streets

Shantang Street Historical and Cultural Neighborhood has a total length of about 580 m, starting from Shantang Bridge in the east and ending at Baim Bridge in the west, and at the same time, it extends from Tonggui Bridge to the south-west, showing a "D" shape pattern. Nowadays, the Shantang Historic District still maintains the landscape pattern of "a street and a river", "an ancient street in a water city", and the historical style of "small bridges and flowing water", "whitewashed walls and tiles". The historical style of "small bridges and flowing water" and "whitewashed walls and tiles" [7]. Most of the streets in Shantang Historical and Cultural Neighborhood have a width of about 5–9 m, with commercial buildings on both sides, followed by residential buildings, and some of the streets have one-sided commercial buildings and the Shantang River on the other side, with most of the buildings 1–2 storeys in height, with sparse and dense street spaces, and multiple enlarged spaces appearing rhythmically in the linear street spaces with appropriate scales (Figure 2).



Figure 2. Spatial pattern of streets and lanes. Image source: Author's own photographs

3.2. Overall appearance of the neighborhood

The façade forms of commercial buildings in Shantang Street are mostly integrated with the overall style of the neighborhood, but different types of stores will be distinguished in terms of windows, signboards, door and window forms, and colors. According to the research, the store façade style of Shantang Street is divided into three forms: (1) relatively traditional façade form, in terms of color, material, form retains more traditional elements, part of the store has traces of antiquity; (2) part of the store according to the type of business, will be the traditional elements of the modern form of the combination of design, and in terms of color and so on, as far as possible to echo the block's overall style. (3) The block agrees that there are some stores with poor coordination with the overall appearance of the block. The specific situation is that in order to display their products to a greater extent, the merchants will design the windows as complete and large glass windows, which is not in line with the overall appearance of the block; or the design of the plaques, displays and signboards of the stores is

too colorful, bright and modern, which visually destroys the overall appearance of the historical and cultural block of Shantang Street.

3.3. Streetscape

Street landscape consists of three parts: (1) street originally existed in the old and famous trees and retained trees, some trees planted in the building wall or corner position, can increase the sense of hierarchy of the street, and the street space to play a secondary role in qualifying; (2) landscape potted plants part of the municipal construction, but also street merchants spontaneously placed landscape potted plants on the street to play a role in defining and decorating the role of the street, these embellishments for the street added a Life atmosphere, but some of them are placed haphazardly, the lack of unified management, the passage of tourists caused some obstacles; (3) Shantang River as a reflection of the Shantang Street Jiangnan water town characteristics of the important elements of the style, the quality of the river needs to be improved, and at the same time, in some of the streets can not be viewed in the Shantang River water view, the overall less open space, the streets as a whole is more confined.

3.4. Street vignette facilities

Lane sketches facilities are not enough, resulting in a slightly monotonous space, and only a small number of rest facilities are configured in the river and rest pavilion area, the number of rest facilities is difficult to meet the needs of visitors, so the walking comfort is not high. Along the side of the river, visitors often sit on the stone guardrail at the edge of the river to rest, which not only affects their own comfort and safety, but also affects the passage of others, and there are potential safety hazards. In addition, the efficiency of space utilization under the connecting points, corners and plaques between some of the buildings needs to be improved.

3.5. Existing problems in Shantang street

Shantang Street Historic District is a representative district of Suzhou. Although it has undergone a series of destruction, restoration and renovation, it still retains the spatial pattern of parallel rivers and streets, cultural relics and intangible cultural heritages, and it is an important carrier of Wu culture in Suzhou. Since 1978, under the guidance of the principle of maintaining the original appearance, Shantang Street has been undergoing large-scale restoration work, mainly retaining the pattern of the traditional stores along the street, and carrying out restoration and renovation works for the protection of the historical and cultural district from large to small. In this process, some residents of the key protection areas have been relocated, the residential buildings in the non-core protection areas have been preserved, the pattern of the water lanes has been protected and restored, and the buildings with the culture of Wuzhi have been restored and preserved, but Shantang Street is still facing the problem of the lack of local identity and authenticity, which is mainly manifested in the following aspects.

3.5.1. Destruction of texture and loss of scale

With the acceleration of urbanization, the function, structure and form of neighborhoods, as the basic unit of urban life, are often fractured due to urban development, resulting in a serious problem of fragmented texture and intermingling of old and new elements. At the same time, the withdrawal of traditional transportation modes and the transformation of modern means of transportation have made it difficult to adapt the original street scale to modern transportation needs, which has aggravated the sense of separation between the old and the new urban areas. Moreover, in the process of neighborhood renewal, large-scale addition and renovation projects have encroached on the original public space, ignoring the original scale, style and number of floors of the neighborhood, resulting in a mixed pattern of neighborhoods (Figure 3).



Figure 3. Status of the Shantang street neighborhood.

3.5.2. Impairment of the appearance of the city wells

Although the renovated neighborhood has retained most of its exterior features, it has encountered the problem of the decline of traditional culture in terms of cultural connotation - temples, pagodas, ancestral halls and other monuments carrying historical memories are getting cold, with little public attention and participation, the interactivity of the historical attractions is weak, and there is a lack of special activities that deeply display the charm of Wu culture, making the cultural heritage It is difficult to show the cultural heritage. In addition, the cityscape of the neighborhood has been eroded to a certain extent, and the commercial businesses in the streets and lanes are mixed and disorderly. The linear layout of the single business presented after the renewal and renovation of Shantang Street does not fully reflect the beauty of the spatial texture and pattern unique to the ancient city of Suzhou, and it is difficult to reproduce the prosperous atmosphere of the former Gusu and the culture of the city in its entirety (Figure 4).



Figure 4. Status of the Shantang street neighborhood.

3.5.3. Destruction of hydrophilicity of streets and alleys, destruction of pedestrian systems

Public activities in traditional neighborhoods usually revolve around rivers and streets, especially at the intersection of rivers and streets, and at the intersection of streets and alleys. However, modern road planning may encroach on the traditional public space on both sides of the river and streets, and destroy the original pedestrian system. Some of the streets and alleys lack systematic consideration in the early planning stage, resulting in irrational functional layout and empty cultural connotations (Figure 5).



Figure 5. Status of the Shantang street neighborhood. Image source: Author's own photographs

3.5.4. Disorganized flow of former residents and tourists and inadequate municipal facilities

Residential and commercial areas are intertwined with each other, lack of order and organization, easy city life and fast-paced business can not be adapted to the occasion, tourists travel will inevitably disturb the life and rest of the surrounding residents. The small scale of the street and the large flow of traffic will inevitably block the traffic. Some of the residents will directly discharge their sewage into the river, and the infrastructure is also incomplete.

4. The selection and positioning of catalyst carriers in Shantang street, Suzhou under the theory of "Urban Catalysts"

In order to establish the framework of the catalyst, the first step is to make the preliminary preparation of the catalyst, through the field investigation in the neighborhood, in-depth understanding of the cultural connotation of the historical and cultural neighborhoods and the current situation of the defects, and as a breakthrough point to solve the dilemma, but also the first premise to determine the operation of the catalyst; the second step is based on the characteristics of the catalyst elements and the adaptability of the catalyst elements, selecting

the vitality of the catalyst elements and carriers that can be developed; the third step is to take the appropriate The third step is to adopt appropriate design methods to revitalize and transform the catalytic points, so as to drive the vitality of the whole neighborhood by using the points as surfaces; the fourth step is to correctly guide and control the development direction of the catalytic elements, so as to realize the positive cycle [8].

4.1. Physical catalyst elements

Shantang Street in Suzhou has a long history, and a large number of traditional houses of different periods remain, which are rich in deep cultural and historical value. The structure and decoration of the ancient dwellings are distinctive, such as wall paintings, window carvings, *etc.*, all of which show the charm of folk art. Many of them are the former residences of celebrities and places where historical events took place, so these ancient buildings have significant historical connotations. Today, Shantang Street is a treasure trove of cultural relics, including dozens of celebrities' residences, guild halls, temples, ancestral halls, ancient playhouses, pagodas, ancient bridges and gardens, including 11 cultural relics protection units of all levels, 16 municipal buildings under control, 9 ancient pagodas, and more than 40 other monuments. Buildings, as carriers of national culture, bear the imprint of history, and it is imperative to pay attention to the protection of the historical value contained therein when promoting renewal and reconstruction.

4.1.1. General residential

Most of the functional types of buildings in Shantang Street are residential in nature, and the main components of the neighborhood's architectural complex are mostly residential buildings, where the residents' main activities are also concentrated. Residential buildings are the basic units of Shantang Street. Such units are simple in structure and single in function, but they can constitute the social network of Shantang and have the characteristic of continuous renewal, which enhances the sense of community identity of the residents through continuous renewal measures (Figure 6).



Figure 6. Residential texture of Shantang street. Image source: Author's own photographs

4.1.2. Religious buildings

Along Shantang Street, there are many buildings with religious characteristics, such as Jishi Temple, Dabeian Temple, Hulin Temple, Guanyin Pavilion, Yu Family Ancestral Hall (later converted into Shantang Central Elementary School), Ganlu Ruyun, *etc.* Most of these buildings have been protected and restored in the form of cultural heritage units. Most of these religious buildings hidden in residential buildings have been protected and repaired to some extent in the form of cultural heritage units, but unfortunately only a small part of them are still being used by residents and tourists, and more religious buildings have become blocked doorways, but these buildings are of great historical and research value .

4.1.3. Neighborhood views

Neighborhood landscape is mainly composed of node vignettes, ecological landscape, cultural landscape, *etc.*, which, as material catalysts, carry traces of local historical evolution and have unique regional cultural characteristics. Specifically manifested as architectural vignettes, water landscape and cultural features, such as the water scenery of Shantang River, coastal pavilions, water facilities and ancient trees and wells and other figurative objects, displaying the unique landscape of the historic district and regional characteristics, and become a material carrier to show the characteristics of the region (Figure 7).



Figure 7. Shantang street waterfront public space and landscape. Image source: Author's own photographs

4.1.4. Transportation road network

In the core conservation area, Shantang Street, which runs parallel to the Shantang River, serves as the main road, with Tonggui Bridge, Xinmin Bridge, Xingqiao Bridge, Baimqiao Bridge and other ancient bridges extending the road on both sides as the secondary road; the overall road network is intricate, with lanes and alleys interspersed on both sides of the main road, forming a unique street scene. These valuable qualities of the streets and lanes are a display of the great history and culture of Shantang Street. By improving the road network structure, it not only rationalizes the planning of Shantang Street and improves the convenience of residents' travel, but also connects important landscape nodes, which has a driving effect on the development of the tourism industry.

4.1.5. Public space

Historical and cultural districts play a central role in the regeneration strategy with their linear qualities and serve as an effective way of dividing space. The unique architectural layout and compact distance scale within such neighborhoods creates a walkable transportation network with a mix of residential, commercial, special structures and recreational functions, which are integrated through a coherent spatial design. For example, in Shantang Street, small recreational areas, such as the Royal Pavilion, the ancient theater and the river port, are cleverly integrated into the building complexes along both sides of the river, and these miniature spaces become places for neighbors to socialize and tourists to take a break, demonstrating a diversified functional carrying capacity.

In *Urban Imagery*, Kevin Lynch emphasizes the strategic significance of nodal spaces - a nodal space is a strategically important point from which an observer can enter, and a center from which people travel [9]. However, in historic districts, node spaces are not clearly defined because the infrastructure is not yet complete. Often, larger street intersections are used to construct nodes, such as squares and other open spaces. This is reflected in Shantang Street, where the key nodal spaces are mainly located at the intersection of two main streets, totaling five prominent public areas surrounded by landmarks such as guild halls, pagodas, and ancient bridges, which are situated in small plazas or adjacent to historical and cultural monuments, constituting key nodes for the display of the neighborhood's image. In the process of renewal, these node spaces can strongly emphasize the cultural heritage of Shantang Street and meet the diversified daily activity needs of the residents. Cultural activity centers, on the other hand, are a product of the modernization process, which are public spaces with high frequency of use based on the actual needs of the residents, closely connected to their daily lives, and have become the main venue for community leisure and entertainment. When selecting such spaces as the catalyst for activating the neighborhood, the importance of reflecting the emotional connotation of the local residents should be fully considered, so as to ensure that the renewal plan is closer to the people's emotional ties and spiritual support.

4.2. Immaterial catalytic elements

Intangible catalysts, such as traditional handicrafts, historical sites of the neighborhood, folk culture, *etc.*, focus on presenting the social customs, life style and spiritual core of Shantang Street. Most of these non-material elements rely on the material form, reflecting the unique historical and cultural heritage of the neighborhood through multiple forms [10]. Selecting the core spiritual content of Shantang Street and adopting innovative expression methods can effectively highlight its historical and cultural depth, and promote the lasting inheritance and development of regional culture.

(1) Traditional handicrafts. Shantang Street is a neighborhood with deep cultural connotations, and traditional handicrafts are even more unique, prominently represented by the non-legacy handmade Suzhou Peach Blossom Dock New Year's Paintings, Suzhou embroidery, and rosewood wood carvings. Calligraphy, painting, textile, carving, *etc.*, are

common cultural phenomena in Shantang Street, Suzhou Taohuayu New Year's Paintings originated from the engraving process in the Song Dynasty, evolved from the embroidered image map, and developed into a folk art genre in the Ming Dynasty. The paintings and inscriptions on the walls, the textile patterns of Suzhou embroidery, and the carved textures of the window panes are all deeply rooted in the daily lives of the residents of Shantang Street. The traditional culture of "benevolence, righteousness, propriety, wisdom, loyalty and filial piety" has become the pursuit and belief of the residents of the neighborhood, setting the overall cultural tone of Shantang Street, while preserving the handicrafts and folk customs inherited from the Wu culture.

(2) Historical development of the neighborhood. Among the many ancient streets in Suzhou, Shantang Street has the reputation of being the most famous street in Gusu and the most famous street in Suzhou in terms of history and culture. Shantang Street is located in the northwestern part of the ancient city of Suzhou, with a total length of 3600 meters, and its origin can be traced back to the time when Bai Juyi served as the assassin of Suzhou in 825 A.D. At that time, he presided over the excavation of the Shantang River that surrounded the Huqiu Mountain, and Shantang Street has been built up with a history of more than a thousand years since then. Starting from the east side of the Shantang River at the Dusheng Bridge, and ending at the west side at the Huqiu Wangshan Bridge, the famous Shantang Street is built along the riverbank and is about 3.6 kilometers in length, which is known as "Seven Miles of Shantang" in folklore. Historically, Cao Xueqin described it in his masterpiece *Dream of Red Mansions*: "When the earth fell to the southeast, there was a city of Gusu in the southeast, and outside the Gate of Heaven, there was a ten-mile street, which was the richest and most elegant place in the red world." The "Ten Mile Street" mentioned here actually points to the humanistic attraction of Shantang Street.

(3) Folkways and customs. Shantang Street has a long history of Wu culture. Wu culture, *i.e.* the regional culture of Wu, encompasses the unique production and living customs formed by local residents in the process of interacting with the natural environment since ancient times, as well as the rich cultural innovations and achievements nurtured therefrom, which is undoubtedly the result of the people of Wu through a long period of historical evolution, constantly recognizing and transforming the natural environment, and uniting the collective wisdom of generations of people in Wu. Wu culture consists of four basic elements: the natural geographical conditions, the production and living styles of the people of the Wu region, the art of the Wu dialect that has been passed down for thousands of years, and the urban architectural forms that were nurtured in the early days of the Wu region. Shantang Street, on the other hand, is home to many precious historical relics of the Wu region, such as the Yuhuan Hall, Li Hongzhang Ancestral Hall, the Tomb of the Five Men, the Ancestral Hall of the Thirteenth Ajussshi, and the Tomb of Gexian, as well as a variety of guild halls, historic bridges, and elegant pagodas dotting the area. This place presents the typical features of the Jiangnan water town - winding water lanes, small bridges and rivers, white walls and black tiles - and the ubiquitous humanistic imprint of the Wu region has attracted generations of literati to stop and sing, creating countless moving poems.

For those intangible cultural elements, we must excavate their intrinsic value and display them in the form of popular carriers, and condense and express these profound cultural connotations through corresponding graphics and texts, so as to ensure that the spirit of Wu culture can be inherited through the material entities in a lasting way.

5. Urban catalyst conservation and renewal of Shantang street extension in Suzhou, China

In view of the actual situation of Shantang Street Historical and Cultural Neighborhood, the catalyst strategy is a two-step approach to guide the implementation of the renewal. The initial phase focuses on the selection and optimization of the catalyst, focusing on the six characteristics of the operation of the catalyst, focusing on the transformation of the block's open space, street system, architectural quality, public space and the overall quality of the streets and alleys, and visually demonstrating the catalyst's functioning mechanism, in order to enhance the quality of the community's living environment, and stimulate the vitality of the block [11]. In the second phase, the focus is shifted to the cultural heritage of the street, and the street renewal and injection of cultural connotations become the endogenous driving force of the second phase to continue the cultural lineage of the neighborhood.

5.1. Selection and optimization of catalyst carrier

5.1.1. Modular swimming spaces: progressive developmental guidance

The process of operating the catalyst is adjusted and improved in a gradual manner. Adjustment and improvement according to the development situation, rather than overnight. The modular construction just meets this operation characteristic, using the cubic module construction to reconstruct the swimming and living space of Shantang Street, using the splicing combination of multiple modules and the function given to make the single space become rich (Figure 8).



Figure 8. Modular construction. Image source: Author's own drawing.

The residential space and play space of Shantang Street are closely linked together, therefore, when transforming the public space, modular construction is placed in the open space where tourists and residents often stay, and at the same time, combined with the architecture and environment, the size of the module is reasonably adjusted and the combination of the form: it can be combined with the building to form a resting function area;

or combined with the ancient trees to form a real neighborhood interaction ding house; or along the river to form a drying rest area. When multiple modules are combined together to form a scale, they can form a node that develops continuously, thus forming a catalyst point that spreads outwards and affects the surrounding neighborhood. At the same time, the modular construction should also follow the historical and cultural neighborhood style to ensure the integration and adaptability between the catalyst and the surrounding environment.

5.1.2. Street system renovation: overall relevance is improved

Hierarchical differentiation of the material elements in the area is made according to their location advantages and disadvantages, influence size and other factors, and successive catalytic renewal is carried out according to the vitality level, so as to make them interact with each other and form a hierarchical and systematic protection system. Roads, alleys and parallel rivers are the important structure of the neighborhood. The historical streets and alleys of Shantang Street have Shantang Street parallel to Shantang River as the main road, and Tonggui Bridge, Xinmin Bridge, Xingqiao Bridge, Baimqiao Bridge and other ancient bridges extend the road on both sides as the secondary road, and the overall spatial pattern of the streets and alleys is formed by the series of twisting alleys and lanes, and preserves the complete neighborhood texture with a strong sense of authenticity.

Therefore, when transforming the street, more attention should be paid to preserving the unique spatial texture existing in the current situation, and realizing the continuation of the texture of Shantang Street through grasping the spatial structure of the street, nodes, and scale [12]. On this basis, it enhances the accessibility of the road, facilitates the daily life of the residents, and improves the quality of the environment. A number of small public activity areas can be set up in the internal space of the street to provide a place for residents to have daily rest and communication, which has a positive effect on neighborhood interaction (Figure 9).



Figure 9. Analysis of the public transportation system in the Xuejiawan area. Image source: Author's own drawing

5.1.3. Multi-level public landscape nodes: systematic hierarchical influences

Grasp the catalyst effect at the planning level, dynamically adjust the development strategy of the surrounding environment, always maintain a close connection between the catalyst and the environment, and guide the overall effect to evolve in a positive direction. Fieldwork on

Shantang Street reveals that the buildings are densely arranged, with limited public space, especially the lack of micro and small spaces for interaction, resulting in limited neighborhood interaction. Therefore, public space is considered as a key catalyst element for redesign, aiming to stimulate the environmental quality of the neighborhood, enhance the communication and interaction between neighbors, and strengthen the residents' sense of belonging to the community, so as to realize the deep integration of humanities and space.

Due to the relatively fragmented distribution of resources within Shantang Street and the lack of effective cultural links between the various regions, based on the characteristics of the resource layout of the area, the plan is to construct a series of linear landscape node spaces [13], with the aim of using these nodes to strengthen the radiance and influence of the core area on the surrounding regions, establish close spatial links, and thus expand the overall development space of the neighborhood (Figure 10).



Figure 10. Multi-level catalyst distribution in Shantang Street. Image source: Author's own drawing

5.1.4. Architectural restoration and functional replacement: functional integration of remodeling

The core area of Shantang Street has many monuments of cultural value from the Ming and Qing Dynasties and the Republic of China, as well as modern renovated and repaired residences, such as the Shantang Sculpture Building (Qing Dynasty), Rongyang Building, the Republic of China Market, the Republic of China Old Mansion, and the Shantang Activity Center, *etc.* Different types of architectural forms are subjected to different methods of improvement, and buildings are classified according to their historical value or degree of damage, and corresponding measures are taken to Optimization and improvement of functions.

For example, the private market and the Shantang Cultural Center, two buildings that are both commercial in nature and serve the residents, were selected, and after surveying their architectural quality, the market's exterior walls were repaired and renovated, the roof skeleton was retained, the interior facilities were improved, modern equipment was added to ensure indoor comfort, and the discarded bathrooms and storefronts inside the market were replaced with a centralized food market, and the other side of the market was transformed into a spacious plaza to increase the gathering of people and to provide an open plaza for the Shantang Cultural Center (Figure 8). The other side was transformed into an open plaza to

increase the gathering of people and provide an open plaza for the Shantang Cultural Center (Figure 11).

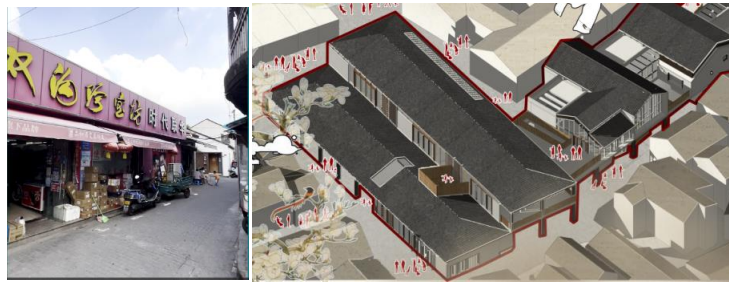


Figure 11. Private markets before and after renovation. Image source: Author's own drawing

On the basis of ensuring that the original urban structure is not destroyed, the spatial functions in the region are reintegrated using point-like renewal, screening out locally inappropriate functions and supplementing new architectural functions, so as to make the regional distribution of functions balanced and perfect.

5.1.5. Combination of multiple catalyst types: morphological diversity activation

There is no strong limitation on the form when selecting the catalyst, but it should pay attention to its location, influence and other factors, which can be real or virtual, large or small, with strong applicability. When using the catalyst factor to stimulate the vitality of Shantang Street, attention should also be paid to the diversity of the catalyst form, which can be used to select material and non-material, functional and ornamental, renovation and new catalyst points, and combined with different forms of catalysts to create a characteristic neighborhood, and to promote the Shantang Historical and Cultural Neighborhood from the tourism and residential function to a multifunctional historical and cultural neighborhood integrating residence, culture, tourism and commerce.

However, the selection of the catalyst location should be based on the actual situation of the neighborhood, focusing on its influence, influenceable range and feasibility, for example, choosing the better-preserved residential houses on the important nodes with the property rights of public rental housing, increasing its commercial type and replacing its internal function without changing its main pattern and appearance, so that it can be used as a catalyst to stimulate the commercial development of a specific area. For example, the residential house at the corner of Xuejiawan was transformed into a theater, which became a catalyst for the Xuejiawan area (Figures 12 and 13).

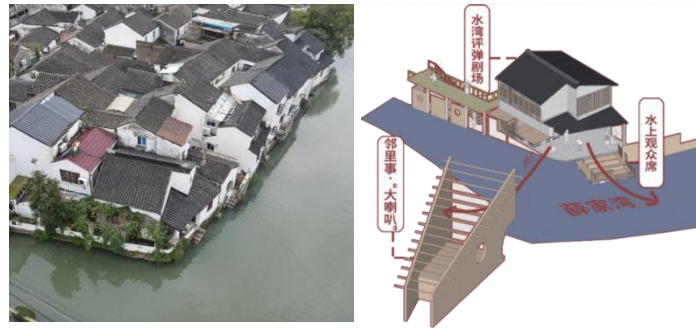


Figure 12. Critics Theater before and after renovation. Image source: Author's own drawing



Figure 13. Linear landscape node space. Image source: Author's own drawing

5.2. *Effective guidance by catalysts*

From the selection of catalysts in the early stage to the activation of factors in the later stage, a chain reaction is triggered to enhance the vitality of the neighborhood, but this is not the end of the catalyst reaction. The protection and renewal of historical and cultural neighborhoods is a gradual process, and the catalyst reaction must be guided continuously to ensure that the renewal work is carried out in an orderly manner, and that the development of the neighborhood is driven continuously to form a virtuous cycle. The guiding catalyst effect is mainly reflected in two dimensions.

5.2.1. Event guidance

Through the event-led catalyst strategy, such as: holding commentary, opera and other Wu culture folklore performances to attract tourists and local residents to watch, further promote the integration between traditional and modern culture, make the neighborhood vitality, and promote the revival of neighborhood functions and competitiveness; at the same time, develop the network of self-media, make promotional publicity for Shantang Street, through the media dissemination, it can not only enhance the neighborhood's popularity, but also can At the same time, the development of online self-media to make promotional propaganda for Shantang Street can not only enhance the popularity of the neighborhood, but also supervise the development of the neighborhood, thus expanding its market influence.

5.2.2. Upper guidance

As there are more random factors in the implementation of the catalyst strategy, it needs to be constantly guided and regulated in the course of practice. The government, as an important player in the construction of historical and cultural neighborhoods, should actively implement relevant policies to effectively promote the sustainable development of the neighborhoods. On the one hand, it should actively communicate and interact with residents, listen to their needs, and motivate them to actively participate in the renewal and development of the neighborhood; on the other hand, it should establish a corresponding management system according to the actual situation of the neighborhood, to ensure that the development behaviors are compliant and reasonable, and to avoid irrational means of renewal, so as to ensure that the catalytic strategy develops in an orderly and positive way.

6. Conclusion

Taking Shantang Street in Suzhou as an example, this study takes advantage of the original catalytic factors of the historical and cultural neighborhood to activate the vitality and renewal of the neighborhood by implanting new elements. Starting from the dimensions of material and cultural catalysts, the study aims to stimulate and guide the further development and construction of the neighboring area in a phased and orderly manner. Given that the catalyst theory advocates gradual renewal, it is less difficult to implement, and is conducive to better preservation of the regional landscape. As time progresses, a positive cycle is naturally formed, which helps to improve the level of economic development and the quality of living environment for the residents.

In general, the theory of "urban catalyst" is applied to the regeneration of historical and cultural districts in a series of regeneration creations such as material space renewal, functional adaptability adjustment, cultural inheritance, and enhancement of the vitality of the districts, *etc.*[14], and under the framework of strengthening the identity of traditional Chinese culture and the theory of urban catalyst, the theory is effectively applied to the protection and renewal of the historical and cultural districts of our country at present. The work of the neighborhoods will be carried out under the framework of traditional Chinese cultural identity reinforcement and urban catalyst theory.

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Conflicts of interests

The authors declare no conflict of interest.

Authors' contribution

Conceptualization, Ruijin Peng and Yao Wu; methodology, Ruijin Peng; validation, Yao Wu, Zirong Ding and linghua Hu; formal analysis, Ruijin Peng and Yao Wu; investigation, Ruijin Peng; resources, Yao Wu; data curation, Ruijin Peng and Zirong Ding; writing—original draft preparation, Ruijin Peng.; writing—review and editing, Yao Wu, Zirong Ding and linghua Hu; visualization, Ruijin Peng; supervision, Yao Wu and Zirong Ding ; project administration, Yao Wu; funding acquisition, Yao Wu. All authors have read and agreed to the published version of the manuscript.

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