

# Research on the Application of Landscape Signage in Quanzhou Chengnan Historical and Cultural District Based on Urban Catalyst Theory

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## ABSTRACT

Based on the theory of urban catalyst, this paper summarizes the problems and causes of landscape signs in the development of Chengnan Historical and Cultural District in Quanzhou City, Fujian Province, China, and constructs a systematic catalyst framework and overall design ideas through a combination of field research and SD method. The design and application of landscape signs are standardized to form a stage-by-stage catalyst response process to promote the sustainable development of the historic and cultural district. The study shows that at present, Quanzhou Chengnan historical and cultural district still exists problems such as incomplete system identification, vague artistic characteristics, and insufficient innovation in design forms, etc. By introducing the theory of urban catalyst, it helps to form a theoretical research system combining urban catalyst and landscape signage design, and at the same time, it also provides a new research idea for the updating and development of the landscape signage of historical and cultural districts.

**Keywords:** *Historical and cultural district, Landscape signage, Catalyst theory, Preservation and renewal.*

## 1. INTRODUCTION

Historical and cultural district, as a sustainable built environment space, has a positive role in promoting the diversity of its social functions [1]. Landscape signage is a micro landscape with significant meaning that remains after the development and evolution of the times, and it is an extremely important material carrier of urban history and culture. It has the inheritance of culture, thought, life style and interactive communication, and at the same time has certain historical, scientific, artistic and cultural value [2]. As a visual identification system of communication content, landscape signage is the most intuitive and easy to feel urban information communication media in the information society, and through a variety of ways to show the landscape characteristics of the material space and regional culture [3]. However, due to the influence of objective conditions and the lack of in-depth research on the theoretical system of urban landscape marking, landscape marking has not been emphasized in the process of urban development. It

not only destroys the integrity of the traditional landscape style of the historical and cultural districts, but also affects the cultural identity of the local society.

Urban catalytic theory, as a relatively mature urban design theory system, is to activate other existing spatial elements without changing its own nature, so that the elements interact with each other to promote the development of the region, and then cause a wider range of urban changes [4]. The theory of urban catalyst and its concept originated from the American architectural field, and with the development of the times, it has been applied to urban design, urban planning and other related disciplines since the end of the last century. In 1994, Wayne Otto and Don Logan summarized and analyzed the principles and objectives of urban catalyst theory applied to urban design in American Urban Architecture - Catalysts of Urban Design, and Urban Catalyst” is defined as a new element strategically introduced [5], which refers to the positive promotion of the overall environment and chain reaction by effectively activating the original

catalyst factors or introducing new catalyst factors without changing the original catalyst's essential properties(see “Figure 1”). Since then, the theory of urban catalysts has also gradually entered the stage of guiding strategies from the summarized theoretical stage.

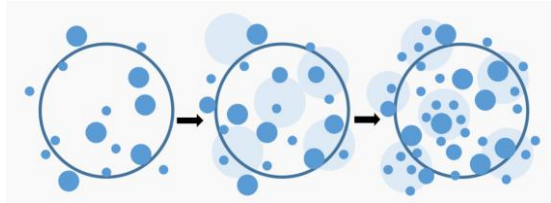


Figure 1 Urban catalyst reaction process.

## 2. LITERATURE REVIEW

Urban renewal has increasingly utilized urban catalyst theory, with significant contributions from various researchers. Carl Grodach(2008) demonstrated how art and culture centers can stimulate urban vitality[6], while Kasmuri et al. (2017) analyzed dynamic catalysts that revitalized Georgetown [7]. Ana et al. (2018) highlighted the role of industrial heritage in promoting sustainability [8], and Kassens (2010) explored the Olympic Games' impact on urban development [9]. Krishna (2016) examined the combined effects of politics, economics, culture, and public participation on urban conservation in Lucknow[10]. Successful examples include Hacker's Courtyard in Germany and Soho in New York, which have employed both material and immaterial catalysts for sustainable urban development.

Urban landscape signage research evolved from an initial focus on urban signs to a more refined understanding of landscape-specific signage as theories and ideas advanced. In 2001, Yukio Ota et al. defined landscape marking as a spatial construct with a marking function[11]. Phil Baines later emphasized its role in guiding and enhancing public spaces[12]. By the 1980s, research on landscape signage design matured, yielding significant theoretical insights. Tanaka Naoto et al. (2006) highlighted the positive impact of signage on urban development[13], while Selatz (2007) systematically analyzed various urban landscape signs in “Public Signage and Guide Design” [14]. Katie Campbell (2012) explored classic design cases in “20th Century Landscape Design Signs,” offering innovative design concepts[15]. Collectively, these studies have fostered the development of landscape signage.

This paper takes landscape marking as the main research object, and introduces urban catalyst theory to guide it on the basis of combining historical and cultural district. By introducing the urban catalyst theory into the landscape identity design of Chengnan Historical and Cultural District, the potential and vitality of the landscape identity catalyst factors are introduced without destroying the properties of the space itself. And through the reshaping and activation of the catalyst elements, a positive catalyst effect is produced, which realizes the chain reaction and forms a systematic image of the urban landscape. This affects the development of historical and cultural district and urban space, making the study more relevant and referential.

## 3. MATERIALS AND METHODS

### 3.1 Research Objects

The Chengnan Historical and Cultural District of Quanzhou City, Fujian Province, China, is located in the southern part of the old city of Quanzhou, and is one of the “Three Pieces and One Line” protection areas, with a protection area of 22.3 hectares. The core protection area is 13.7 hectares [16]. As an important part of the ancient city space, the Chengnan Historical and Cultural District embodies the cultural characteristics of Quanzhou's fusion of multiple features, and has an important historical preservation value. It also reflects the urban planning concept and construction level of a specific period, and shows the humanistic features of the neighborhood, which has continuity and organic growth, and becomes an important clue to deeply understand the cultural lineage of the historical district (see “Figure 2”).

As an important seaport of Quanzhou, Chengnan neighborhood used to be an important commodity trading market and a lot of foreign merchants [17]. Besides, the traditional material and intangible carriers in the neighborhood are prominent, with social, artistic, original and unique characteristics. The district has preserved a large number of traditional streets and alleys that continue to this day, most of which are characterized by a single road network system and alley names that contain historical information. The streets and alleys are organized and provide good access to the outside environment. The road planning of the historical and cultural district skillfully combines the topography, making the streets and alleys connected to each other and forming a distinct pedestrian flow line. Except for

the main lanes that can be used by cars, the other streets and alleys are mainly living roads with pleasant spatial scales, and the street texture formed by the newly built residential and commercial

buildings and the street texture formed by the original residential buildings show a relatively separate state (see “Figure 3”).

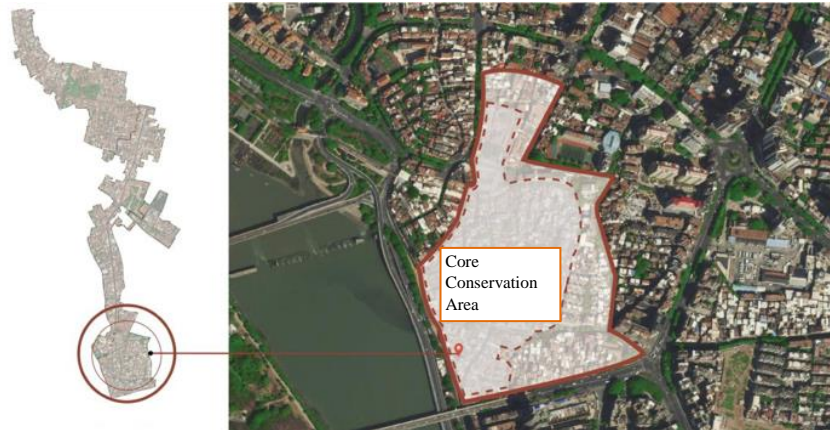


Figure 2 Location analysis of Chengnan Historical and Cultural District, Quanzhou City, Fujian Province, China.



Figure 3 Road map of Chengnan Historical and Cultural District, Quanzhou, Fujian Province, China.

### 3.2 Urban Catalyst

By introducing the urban catalyst theory into the landscape identity design of the historic and cultural district in the south of the city, the potential and vitality of the landscape identity catalyst factors are introduced without destroying the properties of the space itself. And through the reshaping and activation of the catalytic elements, a positive catalytic effect is produced, which realizes the chain reaction and forms a systematic image of the urban landscape. This affects the development of historical and cultural neighborhoods and urban space, making the study more targeted and referential (See “Table 1”).

Table 1. Characterization of the catalytic effect

| Characterization | Details  |
|------------------|--|
| Adjacency        | Newly introduced catalytic elements can influence surrounding elements to interact with each other without changing their original properties, resulting in a wider catalytic effect.  |
| Positivity       | The new catalyst element will not negatively affect the value of the original element, but can instead achieve favorable conversion through the activation of the newly introduced element, thus enhancing the value of the original element.                  |
| Controllability  | The catalytic effect can be well controlled and guided by certain means to ensure that the catalytic effect develops in a positive direction and enhances the cultural connotation of the overall space.   |
| Comprehensive    | In order to ensure the scientific validity of the catalytic effect, it is necessary to analyze and consider it rationally, and select potential catalytic elements with a full understanding of their background.  |
| Predictability   | The effect of the catalytic reaction is predictable and can be guided in advance by appropriate catalytic control measures in its favorable direction.   |
| Integral         | The effect of the catalytic reaction is that the whole is greater than the synthesis of the reactions of the elements. The ultimate goal of the catalytic reaction is the development of regional wholeness through the interaction of the catalytic elements. |
| Recognizability  | The catalyst element itself remains recognizable. The properties of the catalyst itself do not change as a result of the reaction process, but remain recognizable and do not assimilate their own properties during the catalyst reaction process.            |

### 3.3 SD (Semantic Analysis Method)

Semantic analysis is a psychological research method created by Osgood in 1957 [18]., the research process involves the use of relevant vocabulary for hierarchical categorization, rating several concepts in a set of bipolar adjective scales, and rating a sample of sub-subjects in order to assess the psychology of the respondents. The identified hierarchical scales and research subjects are then analyzed and the data quantified for further calculations, which are more commonly used in related professions such as architecture, landscape, and planning [19]. The study shows that semantic analysis has a high degree of reliability, can measure the respondents' attitudes towards the research object from different dimensions, and standardize the research procedure and rating procedure, thus improving the degree of consistency of the test.

### 3.4 Field Research

Through field photography and visiting research on the specific research object, the relevant landscape signage elements in the landscape space are organized, and at the same time, the development, background, and characteristics of landscape signage design in the neighborhood are

grasped in a holistic way and a deep knowledge is generated, and the current problems of landscape signage design in the environment are summarized.

## 4. ANALYSIS OF LANDSCAPE SIGNAGE IN HISTORICAL AND CULTURAL DISTRICT BASED ON THE SD METHOD

### 4.1 Adjective Pairs and the Choice of Evaluation Scales

In the previous period, after the field research and visit to the Chengnan Historical and Cultural District combined with the collation of the basic data of this historical and cultural neighborhood, the object content of the evaluation of the landscape marking of the historical and cultural neighborhood was proposed, and 23 adjective pairs were selected to visually evaluate the landscape marking of the historical and cultural district. At the same time, the Delphi method was adopted, that is, the data related to the personal experience and knowledge of participants and professionals were collected through certain means to form collective wisdom, which facilitated the proper analysis and evaluation of key factors [20]. And finally, corrected adjective pairs were obtained to form a questionnaire for the semantic differential method (See "Table 2").

Table 2. Corrected SD factor adjective pair description map

| Serial number | SD Evaluation Factor                 | SD Evaluation Scale Description   |
|---------------|--------------------------------------|---|
| 1             | Orientation Recognition              | High directional recognition - low directional recognition                              |
| 2             | Design Functionality                 | Functionally rich - single function   |
| 3             | Color Harmony                        | Color coordinated - color cluttered   |
| 4             | Information Accessibility            | Intuitive information conveyance - ambiguous information conveyance                     |
| 5             | Visual impact                        | Strong visual impact - weak visual impact   |
| 6             | Experience profundity                | Deep experience - no experience   |
| 7             | Attractiveness                       | Strong attraction - weak attraction   |
| 8             | Introductory                         | Strong guidance - weak guidance   |
| 9             | Artistic aesthetics                  | Strong artistic aesthetics - weak artistic aesthetics                                   |
| 10            | Sign modeling complexity             | Complex modeling - simple modeling  |
| 11            | Scientific use of materials          | Scientific use of materials - unscientific use of materials                             |
| 12            | Visual image richness                | Rich and varied - uniform   |
| 13            | Design craftsmanship                 | Fine craftsmanship - Rough craftsmanship  |
| 14            | Durability                           | Long lasting - short lasting  |
| 15            | Sign form diversity                  | Variety of forms - single form  |
| 16            | Landscape harmonization              | Harmonized - disorganized   |
| 17            | Convenience                          | Convenient - inconvenient   |
| 18            | Sign design systematicity            | Highly systematic - Weakly systematic   |
| 19            | Recognition of local characteristics | Strongly recognizable local characteristics - Weakly recognizable local characteristics |

|    |                                   |   |
|----|-----------------------------------|---|
| 20 | Strong cultural atmosphere        | Strong cultural atmosphere - weak cultural atmosphere                     |
| 21 | Embodiment of urban spirit        | Clear urban spirit - weak urban spirit                                    |
| 22 | Uniqueness of traditional culture | Unique culture - universal culture  |
| 23 | Embodiment of Cultural Theme      | Strong embodiment of cultural themes - Weak embodiment of cultural themes |

After the above adjectives are determined, the evaluation scales need to be selected. After combing through the relevant literature on SD evaluation, it was found that 5-7 grades are generally chosen, and it is better not to have less than 5 grades, and if it is lower than 5 grades, it may result in a lack of accuracy in the evaluation results. Therefore, after comprehensive

consideration, the designated evaluation factor was set as 23 groups of positive and negative paired adjectives. Its evaluation is set to 5 levels, i.e., very, slightly, average, slightly, and very, using a 5-point scoring scale set symmetrically with 0 as the center axis, and the set scores are +2, +1, 0, -1, and -2 in that order ("Table 3").

Table 3. Comprehensive evaluation form

|                      | Very | Slightly | Average | Slightly | Very |                  |
|----------------------|------|----------|---------|----------|------|------------------|
| Adjective (Positive) | +2   | +1       | 0       | 1        | -2   | Adjective (Anti) |

#### 4.2 Selection of Subject Groups and Distribution of Questionnaires

The SD survey method usually uses 20-50 as the number of subject groups, and the number of subject groups is directly proportional to the precision of the data results. In SD questionnaire, different age, culture level, and familiarity with the environment will affect the visual evaluation. Therefore the gender, age, culture and source of the subject group need to be investigated. The questionnaires were distributed offline concentrating on the scope of the historical and cultural neighborhoods in the south of the city and the subjects were randomly selected to fill in the questionnaires. The basic information table of the

subject group is finally formed. Details are provided in "Figure 4", "Figure 5", "Figure 6", "Figure 7", and "Figure 8".

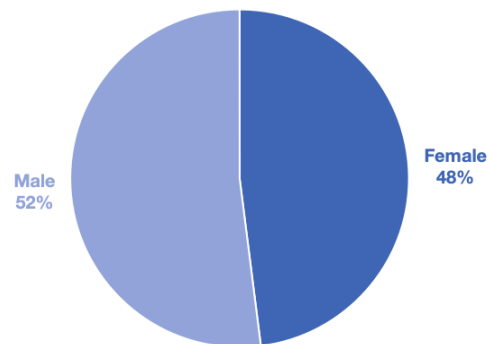


Figure 4 Ratio of subjects' gender structure.

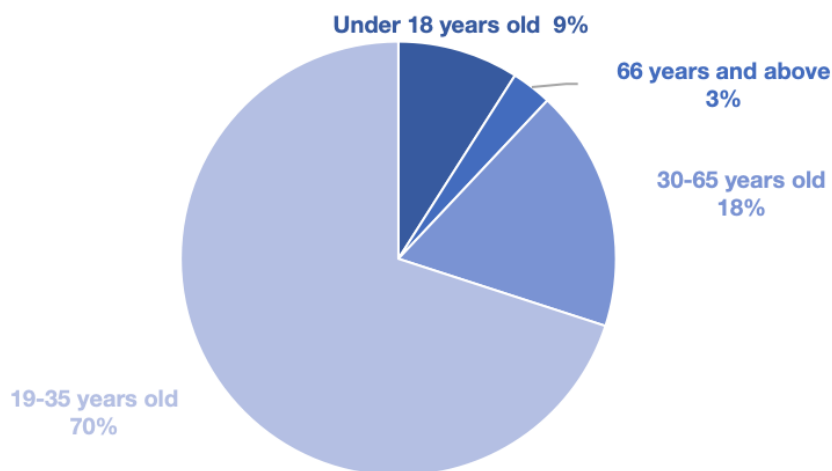


Figure 5 Age structure ratio of subjects.

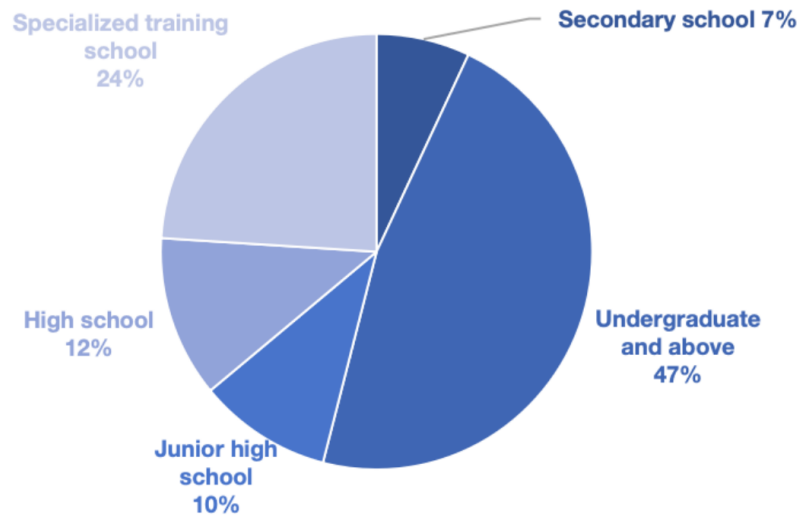


Figure 6 Proportion of subjects with educational level.

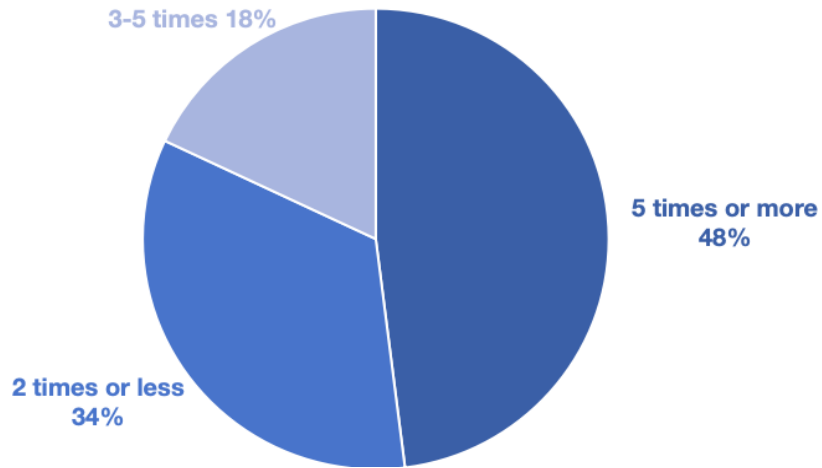


Figure 7 Proportion of visits by subjects.

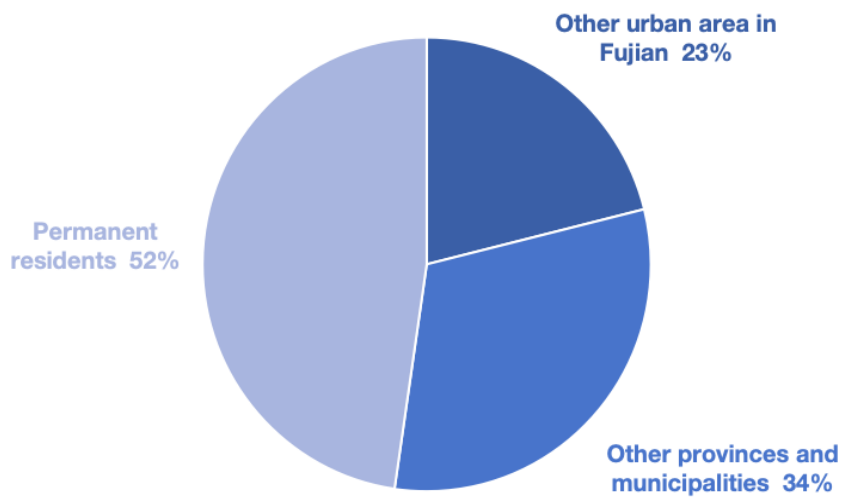


Figure 8 Proportion of subjects' clientele distribution.

### 4.3 Statistics and Analysis of Comprehensive Evaluation Averages

The final data of 265 questionnaires were counted and the average score of each evaluation factor was counted to finally get the SD composite

rating scale of questionnaires distributed at different nodes in the district (see “Table 4”), and the curve diagram of the district's comprehensive evaluation was plotted according to the composite rating scale (see “Figure 9”).

Table 4. Composite score chart

| SD Evaluation Factor                 | Riverside North Road | Jubao Street | Qinglong Lane | Cross Street | Tian Hou Road | Gangzai Qian | Gongta Lane | Zhongshan South Road | Wanshou Road |
|--------------------------------------|----------------------|--------------|---------------|--------------|---------------|--------------|-------------|----------------------|--------------|
| Orientation Recognition              | 3.76                 | 3.09         | 3.69          | 3.50         | 3.86          | 4.09         | 3.63        | 3.56                 | 4.00         |
| Design Functionality                 | 3.82                 | 3.78         | 3.58          | 3.21         | 3.95          | 4.24         | 4.13        | 3.88                 | 3.90         |
| Color Harmony                        | 3.91                 | 3.61         | 3.65          | 3.61         | 4.18          | 4.26         | 4.20        | 3.68                 | 4.02         |
| Information Accessibility            | 3.64                 | 2.83         | 2.96          | 2.93         | 3.86          | 3.97         | 3.30        | 2.92                 | 4.07         |
| Visual impact                        | 3.67                 | 3.30         | 3.50          | 2.93         | 3.86          | 4.09         | 3.88        | 3.72                 | 4.17         |
| Experience profundity                | 3.91                 | 3.78         | 3.62          | 3.54         | 4.23          | 4.21         | 4.20        | 3.72                 | 4.24         |
| Attractiveness                       | 3.70                 | 3.52         | 3.50          | 3.29         | 4.18          | 4.12         | 3.63        | 4.04                 | 4.26         |
| Introductory                         | 3.73                 | 3.43         | 3.42          | 3.39         | 3.86          | 4.24         | 4.13        | 3.84                 | 3.69         |
| Artistic aesthetics                  | 3.85                 | 3.39         | 3.38          | 3.18         | 3.73          | 3.94         | 3.68        | 3.60                 | 3.60         |
| Sign modeling complexity             | 3.42                 | 2.96         | 3.35          | 3.18         | 4.09          | 4.06         | 4.03        | 3.56                 | 3.90         |
| Scientific use of materials          | 3.85                 | 3.57         | 3.27          | 3.50         | 3.73          | 3.79         | 3.88        | 3.40                 | 4.00         |
| Visual image richness                | 3.42                 | 3.52         | 3.38          | 3.50         | 3.27          | 3.79         | 3.65        | 3.44                 | 3.50         |
| Design craftsmanship                 | 3.79                 | 3.52         | 3.62          | 3.43         | 3.86          | 4.06         | 3.70        | 3.28                 | 3.81         |
| Durability                           | 3.18                 | 2.61         | 3.08          | 2.89         | 3.41          | 3.56         | 2.90        | 2.64                 | 2.81         |
| Sign form diversity                  | 3.15                 | 3.35         | 3.35          | 3.21         | 3.77          | 3.71         | 3.88        | 3.00                 | 3.67         |
| Landscape harmonization              | 3.76                 | 3.74         | 3.58          | 3.57         | 4.14          | 4.29         | 3.93        | 3.96                 | 3.76         |
| Convenience                          | 3.48                 | 3.65         | 3.23          | 3.14         | 4.09          | 4.06         | 3.43        | 4.08                 | 4.02         |
| Sign design systematicity            | 3.18                 | 2.83         | 2.88          | 2.86         | 3.00          | 3.35         | 2.75        | 2.68                 | 2.52         |
| Recognition of local characteristics | 3.21                 | 3.39         | 3.12          | 3.07         | 3.68          | 4.00         | 3.40        | 3.20                 | 3.69         |
| Strong cultural atmosphere           | 3.79                 | 3.96         | 3.54          | 3.14         | 4.18          | 4.44         | 4.08        | 3.92                 | 4.12         |
| Embodiment of urban spirit           | 3.45                 | 3.13         | 3.35          | 3.21         | 3.45          | 3.76         | 3.48        | 2.80                 | 3.10         |
| Uniqueness of traditional culture    | 4.00                 | 3.96         | 3.58          | 3.43         | 4.18          | 4.32         | 4.03        | 3.32                 | 4.19         |
| Embodiment of Cultural Theme         | 3.67                 | 3.70         | 3.50          | 3.21         | 4.00          | 4.29         | 3.98        | 3.72                 | 3.98         |



Figure 9 Comprehensive evaluation curve diagram.

The comprehensive evaluation curve indicates that the subject group's assessment of the historical district landscape is largely positive, reflecting overall satisfaction. The highest score is in experience profundity, suggesting a strong appreciation for the district, primarily due to its rich cultural atmosphere. Whereas only the signage design systematicity evaluation factor in the figure is below 3, which is a poor performance, indicating a lack of systematic landscape signage design within the district. At the same time, the landscape signage design is fragmented and does not form a harmonious and unified landscape signage design with integrity of the historical and cultural district.

## 5. THEORY AND DESIGN PRINCIPLES OF LANDSCAPE SIGNAGE CATALYST IN CHENGNAN HISTORICAL AND CULTURAL DISTRICT

The construction of the signage system, using the city's image and cultural background as the overall design concept, refining the systematic design of landscape signage as the design goal, and managing and incorporating the overall style during the design analysis process comprise the fundamentals of the systematic design of landscape signage [21]. Due to the different functional attributes of each signage element, its design focus

is also different, and should be considered comprehensively according to the city image and actual situation. With the progress and development of society, innovative modeling structures and design concepts give landscape signage design more possibilities. As an information entity structure that talks directly with people and provides them with spatial orientation and behavioral guidance, the objects to be conveyed by landscape signage are open and inclusive groups, emphasizing people's sense of intervention in the space and integrating scientific, technological, cultural, artistic, social and economic factors into the design. At the same time, urban landscape space is often a spiritual place representing thematic and regional characteristics, and landscape signage is to a large extent a design practice that combines its regional characteristics [22]. In this way, people can understand the local culture through the unique cultural characteristics of landscape signage design, and then produce a certain cognition and sense of identity for the development of urban regional culture.

Therefore, based on the above research and analysis, the theory and design principles of landscape signage catalyzing the historical and cultural neighborhoods in the southern part of the city are determined, and the details are shown in "Table 5".

Table 5. Corrected SD factor adjective pair description map

| Catalytic mode               | Design Principles     | Concrete Content   |
|------------------------------|-----------------------|--|
| Catalytic element activation | Systematic Principles | In the specific design process, the theme and direction of the renewal design are determined, and the design style and positioning of each signage element is homogeneous according to the same design goal. Through the intrinsic correlation between different functional signs to achieve the coordinated development with the environment, so as to realize the shaping and vitality stimulation of the catalytic factors. |
| Catalytic modality update    | Innovative Principles | A gradual renewal and development model is adopted in the choice of catalyst approach. Through a small-scale, progressive approach to renovation and design, and to realize a specific range of reshaping, actively use the various design elements to strengthen the infectious force and expressiveness of the space, and constantly innovate the expression   |



|                    |                                    |   |
|--------------------|------------------------------------|---|
|                    |                                    | techniques and strengthen the design concept. Thus, the organic renewal and sustainable development of the neighborhood is realized.  |
| Catalytic guidance | effect Principle of Territoriality | Summarize the unique historical and cultural connotations or folk cultural characteristics of the urban area and transform them into visual image symbols. At the same time, the catalytic effect is spread outward from the core area by means of phased regulation ("Figure. 10"), and guidance is provided through relevant policies, activities and events to attract public attention and maximize the benefits of the catalytic transformation. |



Figure 10 Linkage reactions to catalytic effects.

## 6. CONCLUSION

As a witness of Quanzhou's marine culture, Chengnan Historical and Cultural District is rich in historical monuments, traditional buildings and dwellings, foreign cultural resources and commercial functions, with deep cultural heritage and special humanistic environment, so it has high protection value. However, there is no overall landscape marking system in the neighborhood, and problems such as weak functional attributes, blurred artistic characteristics and regional culture have emerged, which requires a complete and scientific theoretical system to guide the research on the design of landscape marking in the district.

The urban catalyst as an urban design theory that strategically introduces catalytic elements, the operation of its catalytic mode and the generation of catalytic reactions is a sustainable and progressive development process, which coincides with the concept of updating the landscape marking of historical and cultural districts. The renewal and development of landscape marking is also a dialectical process of diversity and unity, with mobility and continuity, acting from point to point and from part to the whole, strengthening the sense of order in the space, thus guiding people's activities. Therefore, using urban catalyst as a theoretical guide to apply to the design of landscape signs in historical and cultural neighborhoods,

researchers can build up a strategic framework for the application of landscape signs in historical and cultural neighborhoods based on the theory of urban catalyst, promote the renewal and development of landscape signs, and at the same time feed back to the historical and cultural neighborhoods, expand the scope of influence, and establish a set of landscape signage system corresponding to the characteristics of the urban planning and spatial structure.

In summary, under the social background of cross-disciplinary development, the introduction of urban catalyst theory into the design of landscape marking in historical and cultural neighborhoods makes the landscape marking design more systematic and scientific through the construction of catalyst strategy and operation mechanism, which is suitable for solving the problems of landscape protection and renewal in historical and cultural neighborhoods. As a new strategy attempt and application, it not only expands the research boundary of the catalyst theory, but also makes the theoretical system of landscape marking more in-depth and holistic, enhances the social importance of landscape marking design, and at the same time, realizes the inheritance and development of traditional culture on the basis of the protection of regional culture, and provides reference for the development of other historical and cultural districts and the innovation of landscape marking.

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