Analysis of Urban Informal from Multi Angle of Non Provincial Capital Cities in Mainland China

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Abstract: In order to establish and improve decision-making evaluation level of informal governance in non-capital cities in the mainland to guide the urban informal governance better, a decision-making evaluation method of urban informal governance of game compromise weight gray Euclid-TOPSIS hierarchy model is proposed. Firstly, evaluation index system of urban informal governance is established to provide informal governance model of urban-village with consultation of multiple subjects to gradually improve the status and value of urban-village in the power relations and resource allocation coordinated mutually by multiple subjects; secondly, comprehensive weight of index evaluation is obtained with method of game compromise and the index importance of urban informal governance decision-making is sorted with the decision-making method of TOPSIS; finally, it is indicated after example analysis that the proposed decision-making scheme of urban informal governance can realize the renovation with higher satisfaction.

1. Introduction

With gradual reformation of socialist economy from planned economy to market economy, the progress of urbanization in China constantly accelerated and urban was transformed and restructured dramatically under influence of globalization, marketization and decentralization and other factors since the reform and opening-up policy has been realized, especially the market reform of urban housing started from 1982 and the market reform of land system in 1987. With development of urban economy and gradual flexibility of household registration system, a large number of rural surplus labors swarms into cities, the urban-village, as the special product of urban development in China, become the key research object of rapid urbanization. On the one hand, villages with higher cost in development have been given up since the real estate developers had selected sections at superior location and with lower cost in demolition for the purpose of "interest pursuit" in urban development so that those "old villages" became the "island" in the urban development. On the other hand, vast external populations live in low-rent regions intensively due to difficult in affording the high cost of living in city so that urban-village is formed.

As a special product of rapid industrialization and urbanization development in China, urban-village occupies special urban social space in the structure of urban-rural dual land system. Especially, there are more external populations and urban-villages in megalopolis and metropolis. Relevant statistics shows that half of 120 million of rural-urban laborers in China live in 5 urban-villages. Urban-village, as the low-rent region where not only external populations are received but also economic production and social interaction are operated in the special mechanism, often shows the "informal" attributes, such as informal economy, informal sector or informal governance, and valued by government administrative departments and academic world. However, the urban-village problem caused by urban-rural dual structure becomes the important factor restricting the improvement of urbanization quality. Especially in the macro background of "new urbanization" and promotion of rural land system reform, solution to urban-village problem and balance urban and rural development become the important issue. Therefore, it is of great significance on promoting urban-village renovation, rural land system reform and improving urbanization quality to understand the nature and core of urban-village from the perspective of the informal nature of urban-village.

In order to improve the effectiveness of urban informal research, an urban informal model from multiple perspectives is proposed based on game compromise weight grey Euclid evaluation in this paper. Informal governance model of urban-village with consultation of multiple subjects is provided and comprehensive weight of index evaluation is obtained with method of game compromise. Index importance of urban informal governance decision-making is sorted with decision-making method of TOPSIS to obtain a better scheme for urban informal governance.

2. Informal governance model of urban-village

With the rapid development of urbanization and industrialization, the western countries have been exploring various problems in urban development to try to solve them in the way of urban governance. Governance refers to more flexible and wider distribution of internal and external political and economic powers, which is a process and mode of coordinating conflicts. From three perspectives including system theory, politics and administration, Leftwich parsed the connotation of governance: relevant rules in governance and power distribution are emphasized in system theory; freedom, formal vote, power supervision, equality, rights and obligations structure and pluralism are emphasized in politics; efficient public services with clear responsibilities and transparent public administration system are emphasized to be provided in administration. Ray·Gailor believes that there are three regulating methods for idealized allocation and coordinating resource, namely government rules (also known as bureaucracy or political rules), market rules and cooperation / reciprocity rules (namely network mode). As small administrative unit, the urban-village has the fundamental problems of land system and property rights which involve the managements and distribution interests pattern of government departments, real estate developers, urban-village collective economic organizations, villagers, external population and other subjects. At the same time, as a kind of cultural phenomenon, it also reflects the process of mutual conflict and mutual adaptation between the mainstream culture and the weak culture, which is embodied in stratum, social relations and space power relations. Informal governance of urban-village is the administrative attitude based on urban-village attribute and the spatial expression of bureaucratic mode, decentralized market mode and self-organization management mode. Completely negated attitude and measures are not allowed but it shall be guided from informal nature to semi-normalization and normalization with development to improve social production, spatial form and control mechanism of urban-village to gradually promote the status and value (Fig. 2) of urban-village in the power relations and resource allocation mutually coordinated by multiple subjects.

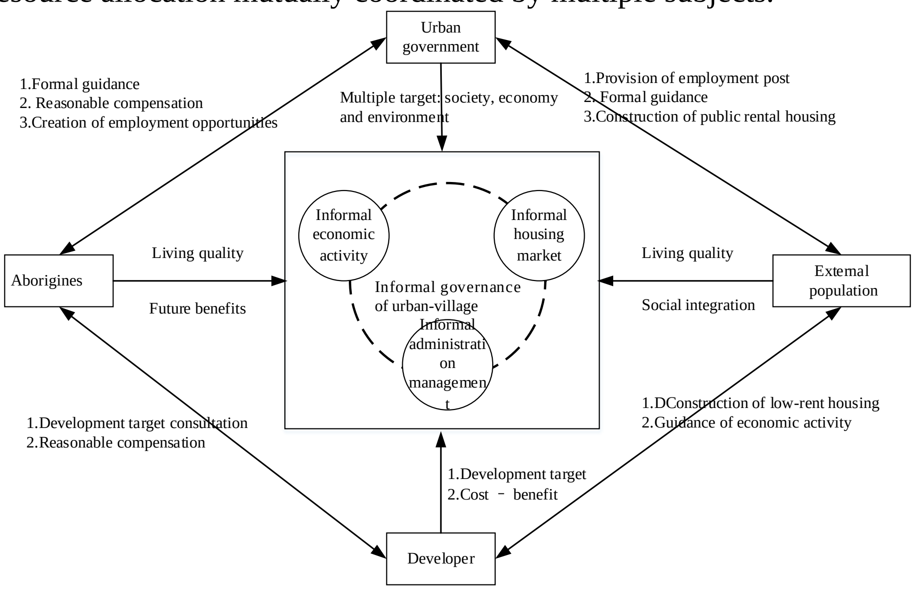

Figure 1. Informal governance model of urban-village with consultation of multiple subjects

3. Game compromise weight

3.1 Weight determination

Firstly, weight ω_1 of subjective evaluation index is determined based on AHP method with determination of weight ω_2 of objective evaluation index by combining entropy method. Finally, comprehensive evaluation index weight ω is constructed with reference of game compromise model. Calculation process of AHP weight is shown as follows [11]: ① Construction of judgment matrix; ② One-time check for single sort; ③ One-time check for general sorting hierarchy. Entropy can characterize the degree of disorder represented by information and the more the entropy is small, the more available amount of information is large so that it plays more obvious role in green building assessment and has larger weight index, indicating its larger importance. The specific process is shown as follows:

Step1: $R=\left(r_{ij}\right)_{m\times n}$ can be obtained after normalization of relation matrix $D=\left(d_{ij}\right)_{m\times n}$ of fuzzy evaluation as mentioned above. If d_{ij} is the evaluation index of emphasizing benefit, then the follows can be obtained: $r_{ij}=\left(d_{ij}-\min d_j\right)/\left(\max d_j-\min d_j\right)$. If d_{ij} is the evaluation index of emphasizing cost, then the follows can be obtained: $r_{ij}=\left(\max d_j-d_{ij}\right)/\left(\max d_j-\min d_j\right)$. In above formulas, d_{ij} is the index j of scheme i, $i=1,2,\cdots,m$, $j=1,2,\cdots,n$. n is the total evaluation indexes and m is the total evaluation schemes.

Step2: Proportion index p_{ij} is calculated to obtain $p_{ij}=r_{ij}\Big/\sum_{i=1}^{m}r_{ij}$, then entropy of such index is $E_j=\sum_{i=1}^{m}p_{ij}\cdot I\cdot n\cdot p_{ij}\Big/I\cdot n\cdot m$. If $p_{ij}=0$, then $p_{ij}\cdot I\cdot n\cdot p_{ij}$ =0 and then $0\le E_j\le 1$ can be obtained.

Step3: According to relevant definition of entropy, index j can be calculated as $w_j=(1-E_j)/\sum_{j=1}^{n}(1-E_j)$, then form of objective index weight is shown as $\omega_2=(w_1,w_2,\cdots,w_n)$.

3.2 Game compromise model

Research in literature [8] shows that game compromise model is able to realize the minimum differences among various weights and improve reasonability of weight setting. The game compromise model can be calculated according to the following steps herein based on above basic weight:

Step1: If there are L kinds of strategies to determine index weight, then weight set vector form is $\omega(k)=(\omega_{k1},\omega_{k2},\cdots,\omega_{kn})$, $k=1,2,\cdots,L$. Then combination form of vector weights of L groups above is $\omega=\sum_{k=1}^{L}\alpha_k\omega_k^T$. In the formula, ω is the possible vector set of index weight and α_k is the one-dimension coefficient in liner combination operation to it.

Step2: ω and ω_k are selected, with the coefficient α_k of minimum dispersion as the above liner combination coefficient.

$$\min\left|\sum_{j=1}^{L}\alpha_j\omega_j^T-\omega_j^T\right|,i=1,2,\cdots,L \tag{1}$$

Above process is equivalent to the solution to optimal derivative of liner equation system:

$$\sum_{j=1}^{L}\alpha_j\omega_i\omega_j^T=\omega_i\omega_i^T,i=1,2,\cdots,L \tag{2}$$

After the solution to equation system, the liner coefficient can be expressed as $(\alpha_1,\alpha_2,\cdots,\alpha_L)$ and $\alpha^*=\alpha_k/\sum_{k=1}^{L}\alpha_k$ can be obtained after normalization operation, then the above comprehensive weight is:

$$\omega^*=\sum_{k=1}^{L}\alpha^*\omega_k^T,k=1,2,\cdots,L \tag{3}$$

4. Gray Euclid assessment model

4.1 Construction of reference and comparison sequences

Basic principle of grey Euclid is to analyze the correlation degrees among the factors in the grey system with similarity between geometrical shapes of the sample sequence and the reference sequence. Firstly, the reference sequence $x_0 = \{x_0(k) | k = 1, 2, \cdots, n\}$ is constructed, then the corresponding comparison sequence is $x_i = \{x_i(k) \mid k = 1, 2, \cdots, n\}$, $i = 1, 2, \cdots, m$. Therefore it can be calculated as follows:

$$x_j = \frac{x_i(k)}{x_0(k)} (i = 1, 2, \cdots, m; k = 1, 2, \cdots, n) \tag{4}$$

In formula (5), informal governance of urban-village is included in comparison sequence and the costs in renovation, energy saving, waste recovery and environmental protection and other relevant indexes can be obtained after normalization operation.

4.2 Calculation of grey weighted correlation degree

Calculation of all the correlation coefficients in the reference and comparison sequences can be obtained as follows:

$$\xi_{0i}(k) = \frac{\min_i \min_k |x_0(k) - x_i(k)| + \rho \max_i \max_k |x_0(k) - x_i(k)|}{|x_0(k) - x_i(k)| + \rho \max_i \max_k |x_0(k) - x_i(k)|} \tag{5}$$

In formula (5), since the overall correlation degree has a great influence on value of ρ and determines the error in the correlation space, the resolution coefficient ρ shall be calculated and updated dynamically according to index assessment:

$$\overline{\Delta} = \frac{1}{nm} \sum_{i=1}^{m} \sum_{k=1}^{n} |x_0(k) - x_i(k)| \tag{6}$$

It is assumed than $\mu_\Delta = \overline{\Delta} / \Delta_{\max}$ and $\Delta_{\max}$ is the maximum value of $|x_0(k) - x_i(k)|$, then the value interval of P is $\mu_\Delta \le \rho \le 2\mu_\Delta$ and when condition $\Delta_{\max} > 3\overline{\Delta}$ is met, there will be $\mu_\Delta \le \rho \le 1.5\mu_\Delta$; if condition $\Delta_{\max} \le 3\overline{\Delta}$ is met, there will be $1.5\mu_\Delta < \rho \le 2\mu_\Delta$.

r_{0i}, the evaluation weights and measures of weighted grey correlation degree, can be calculated:

$$r_{0i} = \sum_{i=1}^{n} [\omega_i(k) \cdot \xi_{0i}(k)] \tag{7}$$

In formula (7), comprehensive weight corresponding to coefficient $\xi_{0i}(k)$ is $\omega_i(k)$.

4.3 Weighted calculation of correlation degree

Weighted grey correlation is corrected with combination of the fluctuation of weighted mean r_{0i} relative to reference and comparison coefficient $\xi_{0i}(k)$, its influence on calculation of correlation degree and Euclid strategy to obtain the correlation degree $\overline{r}_{0i}$ as:

$$\overline{r}_{0i} = 1 - [(r_{0i} - 1)^2 + \sum_{k=1}^{n} \omega_j(k) \left(\xi_{0i}(k) - r_{0i}\right)^2]^{1/2} \tag{8}$$

Evaluators are sorted according to correlation degree based on relative correlation degree weighted by Euclid. The more the value is large, the more the influence on evaluation result is large. Acquisition of clid weighted correlation degree will be decided in the way of TOPSIS criterion integration in the next section.

5. Decision-making of TOPSIS criterion integration

5.1 Algorithm flow of multiple-criteria decision-making

At present, there are a lot of integration strategies [12~13] of multiple-criteria decision-making and the algorithm flow is shown in Fig. 2.

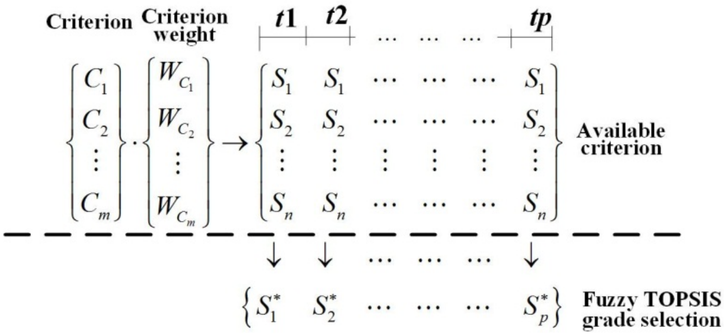

Figure 2. Decision-making flow

$C=\{C_1,C_2,\cdots,C_m\}$ as shown in Fig. 2 is the m-dimensional criterion and $W_C=\{W_{C_1},W_{C_2},\cdots,W_{C_m}\}$ is the weight corresponding to the said criterion which is mainly to distinguish the criterion importance. Flow of fuzzy TOPSIS decision-making as used in the figure includes: (1) extraction of the criterion information features; (2) extraction of the weight information feature; (3) determination of TOPSIS fuzzy grade.

5.2 Step of decision-making algorithm

In the classical decision-making process, the weight W_C of criteria decision-making includes: unknown information, incomplete information and uncertain information. These information weights are unable to be quantized in the traditional way. Therefore, the criterion decision-making algorithm is proposed based on fuzzy theory in this paper:

Step1: Construction of decision-making correlation matrix. If m groups of discriminant indexes $S_i\left(i=1,2,\cdots,m\right)$ are included and the corresponding criterions are $C_j\left(j=1,2,\cdots,n\right)$, then the decision-making matrix can be formed as follows:

$$X=\begin{array}{c c} & \begin{array}{cccc} C_1 & C_2 & \cdots & C_n \end{array} \\ \begin{array}{c} S_1 \\ S_2 \\ \vdots \\ S_m \end{array} & \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix} \end{array} \tag{9}$$

In formula (9), x_{ij} are the quantized values of discriminant indexes S_i relative to discriminant criterions C_j .

Step2: Assignment of weight entropy of discriminant index. In order to measure the weight entropy objectively, the matrix shall be normalized corresponding to criterions $C_j\left(j=1,2,\cdots,n\right)$ firstly to obtain criterion projection P_{ij} :

$$P_{ij}=x_{ij}\Big/\sum_{i=1}^{m}x_{ij} \tag{10}$$

Entropies can be obtained as follows:

$$e_j=-\left(\ln m\right)^{-1}\cdot\sum_{j=1}^{n}p_{ij}\ln p_{ij} \tag{11}$$

Weights corresponding to criterions are expressed as follows:

$$W_{C_j}=\left(1-e_j\right)\Big/\sum_{k=1}^{n}\left(1-e_k\right) \tag{12}$$

Step3: Fuzzy TOPSIS decision-making matrix is constructed as follows:

$$\tilde{R} = \left[\tilde{r}_{ij}\right]_{m\times n} \tag{13}$$

Fuzzy numbers $\left(a_{ij}, b_{ij}, c_{ij}\right)$ are constructed as follows according to fuzzy rule as shown in Fig. 2:

$$\begin{cases} \tilde{r}_{ij} = \left(\dfrac{a_{ij}}{c_j^+}, \dfrac{b_{ij}}{c_j^+}, \dfrac{c_{ij}}{c_j^+}\right), & if \quad j \in F \\ \tilde{r}_{ij} = \left(\dfrac{a_j^-}{c_{ij}}, \dfrac{a_j^-}{b_{ij}}, \dfrac{a_j^-}{a_{ij}},\right), & if \quad j \in C \end{cases} \tag{14}$$

In formula (14):

$$\begin{cases} c_j^+ = \max c_{ij}, & if \quad j \in F \\ a_j^- = \min a_{ij}, & if \quad j \in C \end{cases} \tag{15}$$

Step4: Weighted matrix can be evaluated as follows according to the criterion weight solved in Step2 and with combination of fuzzy matrix worked out in Step3:

$$\tilde{V} = \begin{bmatrix} \tilde{v}_{11} & \tilde{v}_{12} & \cdots & \tilde{v}_{1n} \\ \tilde{v}_{21} & \tilde{v}_{22} & \cdots & \tilde{v}_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ \tilde{v}_{n1} & \tilde{v}_{n2} & \cdots & \tilde{v}_{nn} \end{bmatrix} = \begin{bmatrix} \tilde{r}_{11} & \tilde{r}_{12} & \cdots & \tilde{r}_{1n} \\ \tilde{r}_{21} & \tilde{r}_{22} & \cdots & \tilde{r}_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ \tilde{r}_{m1} & \tilde{r}_{m2} & \cdots & \tilde{r}_{mn} \end{bmatrix} \cdot diag\left\{W_{C_1}, \cdots W_{C_n}\right\} \tag{16}$$

Step5: Assessment matrix of weighted criterion obtained from formula (16) is sorted to acquire positive ideal solution A^+ and negative ideal solution A^-:

$$\begin{cases} A^+ = \left(\tilde{v}_1^+, \tilde{v}_2^+, \cdots, \tilde{v}_n^+\right) \\ A^- = \left(\tilde{v}_1^-, \tilde{v}_2^-, \cdots, \tilde{v}_n^-\right) \end{cases} \tag{17}$$

Step6: Distance between positive and negative ideal solutions is solved as follows:

$$d\left(A_1, A_2\right) = \sqrt{\frac{1}{3}\left[\left(a_1 - a_2\right)^2 + \left(b_1 - b_2\right)^2 + \left(c_1 - c_2\right)^2\right]}$$

$$\begin{cases} d_i^+ = \sum_{j=1}^{k} d\left(\tilde{v}_{ij}, \tilde{v}_j^+\right), i = 1, 2, \cdots m \\ d_i^- = \sum_{j=1}^{k} d\left(\tilde{v}_{ij}, \tilde{v}_j^-\right), i = 1, 2, \cdots m \end{cases} \tag{18}$$

Key index factors of urban informal governance decision-making star levels can be sorted according to above steps:

6. Example analysis

6.1 Description of research area

This research is based on the continuous observation for urban space in Hanzheng Street area in Wuhan in the past two years. The conclusion is rather the record of interaction between school and people on the Hanzheng Street than the result of continuous research on human and space, architecture and city. Moreover, this process is just started and the “Hanzheng Street”, as mentioned hereof, does not refer to a street known as “Hanzheng Street” only but includes a large historical old city extended northward and southward at the confluence of Hanjiang River and the Yangtze River with this transmeridional street as the center, which is shown in Fig. 3. It consists of over 460 streets and lanes, covering an area of about 1.69km2, with temporary population of about 200 thousand. At present, the object of our research is only the transmeridional part of this old city. As described as its name, “Hanzheng Street” is the center street of Hankou District, which not only was once the center district of Hankou in history but also is the one of the cradles of urban culture in Wuhan.

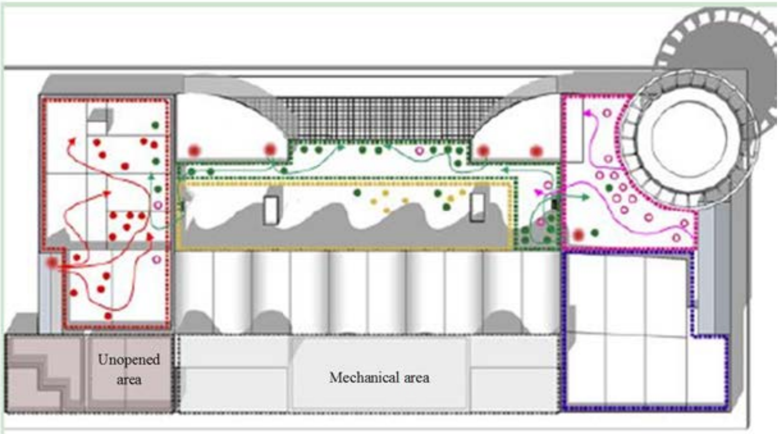

Figure 3. Track and range of people activities

Guqintai, the famous waterfront music building complex, is located in Wuchang District, Wuhan City, Hubei Province, which attracts various people. At the same time, benefited from multilevel design of site beyond the main building of Guqintai, many grey spaces and spatial sections with different altitudes and slopes promote Guqintai to become a public sports carrier with integration of flying kites, leisure and fitness (shown in Fig. 4a), assembly (shown in Fig. 4b), athletics and even skateboarding (Fig. 4c) and other sports. In order to avoid the interference and influence between each other, different people on the same activity site are distributed dispersedly in the time section. Coser’s location shooting is not the most special and representative in activities around Guqintai, but undeniably, it has made up the blank time on use of a part of the space.

(a) Leisure and Fitness (b) Assembly (c) Skateboarding

Figure 4. People with different activities at the venue

6.2 Comprehensive evaluation analysis

Factors of star levels are evaluated with combination the informal governance project of urban-village and values of converted with combination of discriminant fuzzy matrix in Table 1~2 for solution. In reference sequence, index values corresponding to discriminant grades from one star to three stars are 1, 2 and 3. Initial data is processed in the dimensionless way and parameter Δ_{ij} is calculated according to formula (5) to obtain $\Delta_{\min}=0$ and $\Delta_{\max}=1$. Correlation degrees and resolution coefficients of all the factors can be calculated according to formula (5~6) and the weighted grey correlation degree $r_{0i}=(0.679, 0.786, 0.672)$ can be calculated with combination of the comprehensive weight solved in Table 3. Weight of correlation degree of relative grey Euclid can be acquired as $r'_{0i}=(0.612, 0.733, 0.624)$ according to formula (9).

According to research results of grey Euclid, the maximum value of r'_{0i} is the star level of informal governance project of urban-village to be evaluated and it can be known that $r'_{03}>r'_{02}>r'_{01}$, $r_{\max}=r'_{03}$ based on the calculation result of r'_{0i}. This project is in the three start level of informal governance project of urban-village, consistent with actual assessment result. At the same time, according to formula (10), it can be calculated as follows: $c(j)=$ (0.012, 0.037, 0.031, 0.023, 0.116, 0.112, 0.163, 0.247, 0.081, 0.109, 0.068, 0.079, 0.132, 0.172, 0.024, 0.067, 0.113, 0.052, 0.049, 0.053, 0.066, 0.118, 0.068). These results are sorted to obtain $c(A_{24})>c(A_{42})>c(A_{23})>$

$c(A_{41}) > c(A_{62}) > c(A_{21})$. Then it can be known that factors affecting the star levels of the rural green building projects are sorted in order of importance as follows: overall image of informal governance of urban-village, inheritance of traditional custom, satisfaction on the renovation effect, integration with residents' living habits, electricity saving and diversification of rural investment.

7. Conclusion

In this paper, a decision-making evaluation method of urban informal governance of game compromise weight gray Euclid-TOPSIS hierarchy model is proposed. Informal governance evaluation index system of urban-village has been established from perspectives of 23 indexes such as land saving, energy saving, water saving, material saving and indoor environment aiming at characteristics of informal governance of urban-village and the standards to be achieved, and fuzzy relation matrix of urban informal governance decision-making evaluation is established with the fuzzy method. Then comprehensive weight of index evaluation is obtained with the method of game compromise and the index importance of urban informal governance decision-making is sorted with the decision-making method of TOPSIS. Such system structure can be used in comprehensive evaluation for level of informal governance and construction project of urban-village and has strong practicability, which can search the factors affecting the evaluation of informal governance of urban-village and establish the direction of rectification.

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