Abstract

The researchers explore the current urban redevelopment problems in Taiwan old urban centers. Based on an indicator system framework, this study proposes a regeneration model—a performance evaluation method for a livable urban district, composed of four constructs, and 21 general indicators and 62 policy-making indicators. The four constructs are land use sustainability; transit oriented development (TOD) pattern, district composition, and architectural typology and estate. Considering this framework feasibility, the researchers recruited a panel of experts for judgment of priority for the indicator system in two phases of questionnaires. The first phase uses the fuzzy Delphi method (FDM) for experts to decide each policy-making indicator and the degree of importance of that indicator. The second phase uses the analytic hierarchy process (AHP) to determine the priority of the four constructs and that of each general indicator. Since panel experts from various disciplines and regions evaluate this indicator system with priorities, the current study discusses the variance of priorities caused by different panel experts. This AHP framework serves as a guideline for local government to proceed with regeneration plans toward livable districts, or a framework to evaluate the performance of regenerated old urban districts.

Keywords: urban village; a livable urban district; a framework of indicator system; analytic hierarchy process

1. Introduction

Taiwanese old urban centers have experienced deterioration under the effect of urban sprawl and suburbanization since the 1980's (Tsai, 2001). Serious urban core development problems are obvious. For instance, outdated conventional mixed-use patterns, weak business competitiveness, the traffic burden of small blocks, insufficient open space, and poor living standards undermine livability. Local governments have proposed some small scale redevelopment plans to renovate part of the built environment and keep urban deterioration in check, yet, these efforts do not reverse the general declining situation of old urban centers. American economist Richard U. Ratcliff pointed out the urban redevelopment concept in his publication, "Urban Land Economics" (1949):

"The redevelopment of cities is an ancient and basic process by which the urban structure, painfully and imperfectly, but continuously, moves to adjust itself to the ever-changing needs of the community."

Taiwanese old urban centers for example, developed for almost a century after urban renovation plans during the Japanese colonial period (Huang, 2000). The deterioration in these areas has caused serious socio-economic problems such as population loss, the increase of vacant buildings, and drop in land value in the past twenty years. This research builds an indicator system framework to evaluate the performance of deteriorated districts, and suggests a regeneration plan toward livability.

2. Urban Village and a Livable Urban District

2.1 Literature Review

What does a livable urban district mean? This study begins with the concept of an urban village, which Herbert J. Gans delineated as the spatial and socio-economic characteristics of an Italian west end neighborhood in his publication, "The Urban Villagers" (1962). Prince Charles (HRH the Prince of Wales) also mentioned rebuilding Britain's inner cities by applying the urban village concept in the book, "A Vision of Britain" (1989). He founded the Urban Village Group in 1992 and published "The Urban Villages Report," which presented the concept of urban codes and estate management in the conceptual plan called Greenville (Neal, 2003). In the early 1990's, Seattle Mayor Norm Rice proposed a prospective plan of urban networks composed of urban village units with a compact mixed-
use pattern, close to a shopping mall and public transit. From a regional perspective, the urban village concept was selected as a prior national planning policy during 1997–1999 in the UK (DOE, 1997).

British scholar John Punter concluded that, "The Death and Life of Great American Cities" (Jacobs, 1961), and "Good City Form" (Lynch, 1987) are the direct or indirect resource of design principles for livable cities (Schurch, 1999). Jacobs believed that diversity can keep an urban living environment from deterioration, and she proposed four conditions to generate urban diversity: mixtures of use, short blocks, mingling buildings varying in age, and dense concentration of people. Lynch described certain qualities as requisite for good urban form such as vitality, access, control, sense, fitness, and justice. The design principles of Jacobs and Lynch are similar to the planning doctrines of a sustainable community, new urbanism, and smart growth (Neal, 2003), although not as comprehensive. Allen Jacobs and Donald Appleyard also defined the five characteristics of a built environment as the goal and values of a livable city (Jacobs & Appleyard, 1987). They are: 1) livable streets and neighborhood, 2) minimum density and land use intensity of a residential district, 3) integrating living, working, and shopping activities, 4) public space in the built environment, 5) and diversified and identifiable buildings.

2.2 Characteristics of a Taiwanese Livable Urban District

Taiwanese old urban centers are distinct from western livable cities in that their mixed-use pattern and compact development brings diversity and daily convenience. The main archetype includes shops and arcades (Lee, 2004), typical in subtropical countries; also due to pedestrian behaviors, these shops typically aggregate on a retailing street, as Fig. 1. shows. These spatial characteristics produce a different streetscape from that in western livable cities.

Localized Taiwanese livable urban districts not only rely on western livable city values as previously mentioned, but also consider optimizing the performance of existing old urban districts. Hence, land use types, local traffic, street patterns, and building types are the four main factors to establish a regeneration model.

3. Regeneration Model

3.1 A Framework Performance Evaluation System for a Livable Urban District

Converging the four main factors into four constructs of an indicator system of performance evaluation requires detailed measuring techniques. Based on the literature review regarding livable cities and urban characteristics, this research proposes an indicator system framework for old urban districts, which examines the livability of Taiwanese old urban districts by top-down methods. A livable urban district is composed of four constructs as follows: 1) Land use sustainability, 2) TOD pattern, 3) District composition, and 4) Architectural typology and estate. Several general indicators follow each construct, shown in Fig. 2.

![Fig. 2. AHP Framework with Four Constructs and 21 General Indicators](image)

3.2 Four Constructs of a Livable Urban District

3.2.1 Land use sustainability (L)

Mixed use (Tsou, 2007) and high density are major socio-economic factors for land use sustainability (Burton, 2002). From a vernacular perspective, vertical mixed use is common in compact patterns of Taiwan old urban centers, while abused conditions of arcades are rampant. Hence, land use conditions necessitate comprehensive surveying.

To measure the performance of land use condition in a district, this research mainly focuses on residential and commercial density, and morphologically examines block composition. In a Taiwan old urban
Table 1. The Indicators Group in Construct L

| Policy-making indicators | Measure indicators |
|--------------------------|--------------------|
| L1.1 Land mixed use intensity (Horizontal mixed use) | Shannon Weaver H = -Σ [P_i × log_2 P_i]
| L1.2 Architectural mixed use intensity (Vertical mixed use) | Shannon Weaver H = -Σ [P_i × log_2 P_i]
| L1.3 Balance of job and housing (J/H) | \( J / H = 1 - \frac{\left( \frac{J_i \times \rho_i \times \omega_i}{H_i} \right)}{\left( \frac{J_i \times \rho_i \times \omega_i}{H_i} + (H_i) \right)} \)
| L1.4 Balance of retail and housing (R/H) | \( R = \frac{R_i}{H_i} \)
| L1.5 Balance of retail and job (R/J) | \( R/J = \frac{R_i}{J_i} \)
| L2.1 Population density | [Resident number/Total land area]
| L2.2 Graded density | [(Shop measurement in exterior layer/ per hectare)/(Housing units measurement in interior layer/ per hectare)]
| L2.3 Residential density | [Total residential floor area/ District area]
| L2.4 Commercial density | [Total commercial floor area/ District area]
| L3.1 Vacant building ratio | [Vacant buildings number/Total buildings numbers]
| L3.2 Derelict land ratio | [Number of derelict land parcels / Total number of land parcels]
| L4.1 Illegal addition ratio | [Number of illegal additions to buildings/ Total number of buildings]
| L4.2 Arcade occupancy ratio | [Arcades occupancy number/All arcades number]

center, graded density carries a different meaning from that in western livable cities, and refers to the density difference between the exterior layer and the interior layer of a block. Consequently, four indicators should evaluate the overall performance of land use sustainability of a district: L1 Degree of mixed use (Cervero, 2006), L2 Density of a district, L3 Low efficient use, and L4 Abused condition. Each indicator depends on several policy-making indicators. Please refer to Table 1. for the measure of each policy-making indicator.

3.2.2 TOD Pattern (T)

Considering the common characteristics of small blocks and the historic fabric in Taiwan old urban centers, the best way to conquer traffic is to develop TOD (Transit Oriented Development), which combines light rail transit (LRT) and bus rail transit (BRT). This traffic pattern works well in a typical Taiwan street, which is around 20–30 meters wide. Since people walk in local streets with frequent transit stations, this traffic pattern could reduce the use of personal vehicles. Consequently, TOD pattern performance of a district evaluates four general indicators: T1 Transportation mode, T2 Parking supply, T3 Pedestrian village, and T4 Location factor. Each indicator depends on several policy-making indicators. Please refer to Table 2. for the measure of each policy-making indicator.

3.2.3 District Composition (D)

The hybrid characteristics of Taiwan old urban centers combine coarse grain (geometric street pattern of the Japanese colonial government) and fine grain (historic fabric built in the Koxinga and Ching Dynasty). Hence, this research evaluates such hybrid districts not only based on the techniques of formal analysis, but also on historic conservation principles. Consequently, the performance of a district composition should consider the synergy effect of four general indicators: D1 Neighborhood pattern, D2 Subdivision, D3 Thoroughfare hierarchy, and D5
### Table 3. The Indicators Group in Construct D

| Policy-making indicators | Measure indicators |
|--------------------------|--------------------|
| D1.1 Street pattern      | Is the historic fabric well preserved in the geometric street pattern? |
| D1.2 Block size          | Investigate the distribution of large blocks and small blocks; evaluate the potential of small blocks. |
| D1.3 Housing diversity   | Investigate the location and quantity of various housing types. |
| D2.1 Accessibility of parcels | Investigate how many parcels are difficult to reach; difficult means that one needs to make three turns to reach a parcel from the main street of a block. |
| D2.2 Adjacent conditions of parcels | Investigate the parcels' adjacent condition. Is a parcel adjacent to the road? |
| D3.1 Boulevards          | Evaluate urban traffic condition, signal, streetscape, and crowds. |
| D3.2 Local streets       | Evaluate lane use condition, and whether a street collects local lanes. |
| D3.3 Lanes and alleys    | Evaluate whether the local traffic condition is unimpeded. |
| D3.4 Bicycle network     | Are there bicycle trails, bicycle routes and bicycle lanes in a district? |
| D3.5 Transportation node | Evaluate traffic circles or major road intersections, such as traffic condition, identification, and surroundings. |
| D3.6 Crossroads          | Evaluate crossroads by the following elements: turning radius, pedestrian crossing, curbs, left turn signal, and pedestrian waiting area. |
| D4.1 Buildings adjacent to historic lanes | [Number of buildings adjacent to historic lanes/Total buildings number in a district] (Unit: %) |
| D4.2 Parcels adjacent to historic lanes | [Area of parcels adjacent to historic lanes/Total land area of a district] (Unit: %) |
| D5.1 Open Space          | [Open space area/Population in a district] (Unit: m²/person) |
| D5.2 Green               | [Green area/Area of a district] (Unit: %) |
| D5.3 Eco-landscape       | Are there any natural landscapes or water systems in a district? Evaluate the potential to develop an eco-network. |
| D6.1 Residual space      | Investigate the distribution of low efficient, left over spaces |
| D6.2 Ill defined space   | Investigate distribution of the public space with ambiguous spatial hierarchy. |

### Table 4. The Indicators Group in Construct A

| Policy-making indicators | Measure indicators |
|--------------------------|--------------------|
| A1.1 Continuity between the old and the new buildings | Evaluate the continuity between the old context and new development. |
| A1.2 Useless old buildings | The number of old buildings, which need demolition and reconstruction. |
| A1.3 Reusable old buildings | The number of old buildings, which can be reused after renovation. |
| A2.1 Private land ownership ratio | [Total land area of private land parcels/Total land area of all land parcels] (Unit: %) |
| A3.1 Adjacent conditions of buildings | [Number of buildings adjacent to the road/Number of all the buildings] (Unit: %) |
| A3.2 Fire Fighting | Investigate the conditions of all the lanes and alleys, whether they can be accessed by firefighting trucks. |
| A3.3 Openings of building | Number of buildings with at least two elevations for lighting and ventilation / Number of all the buildings] (Unit: %) |
| A3.4 Front, rear, and side yard setback | [Number of buildings with front, rear, or side yards/Number of all the buildings] (Unit: %) |
| A4.1 Building heights | Investigate all the buildings' heights in a district, and examine whether they meet building code requirements. |
| A4.2 Skylines | Investigate the quantity and distribution of various roof types as follow: |
| | a. Sloped roofs |
| | b. Stylish roofs |
| | c. Roofs with large span |
| A4.3 Exterior wall continuity | Is there any regulation regarding exterior wall continuity for streetscape? |
| A4.4 Lot coverage ratio | Lot coverage ratio of exterior layer of a block/Lot coverage ratio of interior layer of a block |
| A4.5 Floor area ratio (FAR) | FAR of exterior layer of a block/FAR of interior layer of a block |
| A5.1 Front width of a shop house | Evaluate the minimum requirement for the front width of a shop plan based on its functional needs. |
| A5.2 Length of a shop house | Evaluate the maximum length of a shop, and whether circulation is too long. |
| A6.1 Diversity of elevation | Investigate whether the facades of buildings have rich vocabulary, are well preserved, and make a good streetscape. |
| A7.1 Diversity of construction methods | Investigate the quantity and distribution of different construction types as follows: |
| | a. Wood structure buildings, |
| | b. Brick and masonry buildings, |
| | c. RC buildings, |
| | d. Other construction methods |
| A7.2 Climatic characteristics | Investigate the quantity and distribution of buildings with climatic characteristics as follows: |
| | a. Arcade with shading device, |
| | b. Colonial style |

Sustainable recreational amenities. The indicator D4 historic fabric measures the impact zone of historic alley preservation; while the indicator D6 lost space surveys defective spatial composition (Talen, 2003). Each indicator depends on several policy-making indicators. Please refer to Table 3. for the measure of each policy-making indicator.

### 3.2.4 Architectural Typology and Estate (A)

To transform deteriorated old urban centers into livable districts, it is essential to assess the impact of architectural typology and estate on the built environment. This means considering regeneration from the scale of individual buildings and parcels. Hence, this indicators group mainly derives from the planning and design regulations of Taiwan building code and urban design principles; the criteria of urban renewal and historic conservation should also be included. Seven general indicators should evaluate the performance of architectural typology and estate of a district: A1 Old buildings, A2 Land ownership,
Site planning, A4 Architectural massing (Barton, 2003), A5 Plan modules, A6 Elevation styles, and A7 Construction methods. Each indicator depends on several policy-making indicators. Please refer to Table 4. for the measure of each policy-making indicator.

4. Experts' Evaluation of the Indicator System

4.1 Fuzzy Delphi Method

The American control expert Lotfi A. Zadeh introduced the fuzzy set concept in 1965 to initiate research of human-made systems. In the field of fuzzy set theory (Ishikawa, 1993), researchers apply the centroid method (Klir, 1995) to calculate fuzzy value. The fuzzy operation is as follows:

1. Researchers first collect the fuzzy value (1~10) of each indicator from Panel experts' judgment of the degree of importance; then FDM is used to integrate m experts' fuzzy value to calculate the degree of membership function of each original indicator. Assuming that the p expert evaluates the degree of importance of the k original indicator as \( w_k = (a_{pk}, b_{pk}, c_{pk}) \), k=1,2,...m, then the fuzzy value of the k original indicator is \( \tilde{w}_k \), as shown in formula 1.

\[
\tilde{w}_k = (a_k, b_k, c_k) \quad k=1,2,...,m \quad \text{(1)}
\]

2. Using the centroid method, the fuzzy value of each original indicator is calculated as shown in formula 2.

\[
S_k = (a_k+b_k+c_k)/3 \quad \text{(2)}
\]

3. The researchers then set up the minimum value t for selecting from the indicators group. Using the centroid method, t is calculated as shown in formula 3.

\[
t = (S_k + S_{kh} + S_{wk})/3 \quad \text{(3)}
\]

\[
S_k = \min \{S_k \} , \quad S_{kh} = 1/m \sum_{i=1}^{m} S_i , \quad S_{wk} = \max \{S_k \}
\]

From the indicators group, the appropriate indicator is selected based on the following principles:

(A) If \( S_k \geq t \), then select the k original indicator as an indicator.

(B) If \( S_k < t \), then delete the k original indicator.

4.2 Analytic Hierarchy Process

AHP is a multi-attribute decision analysis method (MDAM) created by Professor Saaty in 1971. In this regeneration model, researchers use a similar concept to build the AHP framework. The application of AHP mainly involves the following four steps (Ramanathan, 2001).

Step 1: Structuring the decision problem into a hierarchical model

The current study lists four constructs, 21 general indicators, and 62 policy-making indicators for a livable urban district according to urban development criteria. The topmost level focuses on the problem of a livable urban district. The intermediate levels correspond to criteria - four constructs and sub criteria - 21 general indicators, while the lowest level contains methods to measure - 62 policy-making indicators. Fig.3. illustrates a complicated problem for evaluating a better performing district.

Step 2: Making pairwise comparisons and obtaining the judgment matrix

Concerning the final goal - a livable urban district, the questionnaire is designed based on hierarchical problems to ask panel experts, to make pairwise comparisons between two constructs under the goal, and between two general indicators under the same construct. A judgment matrix, denoted as A, forms using the comparisons. Each entry \( a_{ij} \) of the judgment matrix forms by comparing the row element \( a_i \) with the column element \( a_j \).

\[
A= a_{ij} (i, j=1, 2, ..., \text{the number of criteria}).
\]

The research suggests using a 9-point scale to transform verbal judgments into numerical quantities representing the values of \( a_{ij} \) (Saaty, 2000). The entries \( a_{ij} \) are governed by the following rules:

\[
a_{ij} > 0; \quad a_{ij} = 1/a_{ji}; \quad a_{ii} = 1 \quad \text{for all } i.
\]

Because of the above rules, the judgment matrix A is a positive reciprocal pairwise comparison matrix.

Step 3: Local priorities and comparison consistency

Once the judgment matrix of criteria comparisons with respect to the goal is available, the local priorities of criteria are obtained and the consistency of the judgments is determined. Research generally agrees (Saaty, 2000) that criteria priorities can be estimated by finding the principal eigenvector \( w \) of the matrix A. That is: \( Aw = \lambda_{max}w \). \( W \) represents the local priority of a criterion, as formula 4 shows.

\[
W_i = \frac{\prod_{j=1}^{n} a_{ij}}{\sum_{i=1}^{n} \prod_{j=1}^{n} a_{ij}} \quad i, j = 1, 2, 3...n \quad \text{(4)}
\]
Collecting experts' judgment of the 0.1). Then the pairwise comparison

\[
W_i = A \times W_i = \begin{bmatrix}
    a_{11} & a_{12} & \ldots & a_{1n} \\
    a_{21} & a_{22} & \ldots & a_{2n} \\
    \vdots & \vdots & \ddots & \vdots \\
    a_{m1} & a_{m2} & \ldots & a_{mn}
\end{bmatrix}
\begin{bmatrix}
    W_i'
\end{bmatrix}
\end{array}
\]

Then solve for \( W_i' \) and \( W_i \) respectively.

\[
\lambda_{\text{max}} = \frac{1}{n} \times \left( W_i/W_i' + W_2/W_2' + \ldots + W_n/W_n' \right)
\]  

\( \lambda_{\text{max}} \) is the largest eigenvalue of matrix A as formula 6 shows.

\[
\lambda_{\text{max}} = \frac{1}{n} \times (W_i/W_i' + W_2/W_2' + \ldots + W_n/W_n')
\]  

C.I. is the Consistency Index to decide whether the input judgments by interviewees are consistent. The measurement of C.I. is obtained as formula 7 shows.

\[
\text{C.I.} = \frac{\lambda_{\text{max}} - n}{n - 1}
\]  

If C.I. \( \leq 0.1 \), then the pairwise comparison matrix has better consistency. If C.I. > 0.1, then the interviewees' input judgments are not consistent, and hence are not reliable.

**Step 4: Final priorities**

Once the local priorities of elements of different levels are available as outlined in the previous step, final priorities can be obtained by obeying the principle of hierarchic composition as follows:

The final priority of Sub criterion I = Local priority of Sub criterion I with respect to Criterion I × Local priority of Criterion I with respect to the goal.

### 4.3 Two Phases of Questionnaires

The first questionnaire phase is processed through FDM after collecting experts' judgment of the indicators. The study then sets up a fuzzy value and maximum disagreement numbers to select the appropriate policy-making indicators. The second questionnaire phase, which depends on the FDM result, is processed through AHP. The software "Experts' Choice 2000" is used to calculate the priorities of indicators. However, panel experts have their own evaluations for each indicator, related to three attributes: 1) industrial, governmental or academic fields, 2) disciplines, and 3) work regions. The following disciplines include experts' professions: a) Arch- architects and developers, b) Up- urban planning, urban design, landscape c) Cons - urban conservation, d) Mrt- mass rapid transit and transportation, e) Sus- Sustainable development, and f) Est- Real estate management. Experts' work locations include four metropolitan areas in the north, middle, and south parts of the Taiwan western urban region.

The period for panel experts to fill out two phases of questionnaires were from July to October 2008. In the first phase, 35 questionnaires were distributed, 27 experts replied, and 25 were valid questionnaires.

**4.4 Selection of Indicators by FDM**

This study selected 62 policy-making indicators for a livable urban district. The selection principles are as follows:

(A) If \( S_k < t \), then delete the k original indicator.

(B) If 10% of panel experts disagree with a policy-making indicator, this indicator is rejected.

The degree of importance for each indicator uses the scale 1~10. Calculation in the first phase questionnaire reveals a minimum fuzzy value of 4.59, a maximum fuzzy value of 7.28, and a geometric mean of all fuzzy values of 6.13. Hence, by the centroid method, the critical fuzzy value = \((4.590+7.280+6.213)/3=6.027\).

To sum up with the indicators selection result, the 62 policy-making indicators were reduced to 33 policy-indicators, and 21 general indicators were reduced to 15 general indicators. Among the failed 29 policy-making indicators, 23 of them disagreed with the panel experts, and 23 of them were lower than the fuzzy value of all indicators.

### 4.5 The Performance Evaluation System with priorities

In the second phase questionnaire, researchers distributed 27 questionnaires; 21 experts replied, and only 18 questionnaires were valid (C.I. \( \leq 0.1 \)). Applying the eigenvalue method obtained the local priorities of the four constructs and 15 general indicators. From the eigenvalue result, in the first level, construct L (0.344) and construct D (0.330) are the first and second important criteria for a livable urban district. In the second level, the top five prior considered general indicators are respectively: L1 - degree of mixed use (0.1569), L2 - density of a district (0.1176), D3 - thoroughfare hierarchy (0.096), D5 - sustainable recreational amenities (0.0891), and T1 - transportation mode (0.0855). These five sub criteria are mainly concerned with urban life options and livable environment standard. The five medium prior considered general indicators are respectively: D2 - subdivision (0.0746), D1 - neighborhood pattern (0.0706), L3 - low efficient use (0.0695), T3 - pedestrian village (0.0566), and T2 - parking supply (0.0459). These five sub criteria are crucial in the detailed design phase of planning and design doctrines for a livable district. The five last considered general indicators all belong to construct A, their priorities are respectively: A3 - site planning (0.0417), A4 - architectural massing (0.0352), A1 - old buildings.
Due to the low priorities value (below 0.05), this study concludes that the sub criteria concerning individual sites and buildings, should be considered after the other ten sub-criteria.

4.6 Analysis of Variance of the Indicator’s Priorities

Fig. 4 shows a paradigm that illustrates the priority values of the four constructs and 15 general indicators by six experts’ disciplines. The highest priority value is the TOD pattern (0.554), evaluated by sustainable development experts. The second highest priority value is district composition (0.459), evaluated by real estate experts and the third highest value is land use sustainability (0.437), evaluated by urban planning experts.

Since Figs. 4 and 5 clarify the priorities of the performance evaluation system determined by panel experts from diverse disciplines and work regions, the researchers make ANOVA analysis based on experts’ disciplines and regions. ANOVA of priorities of the four constructs by experts’ regions shows that only architectural typology and estate (p=0.006) are significant. This means that experts’ regions have significant impact on their judgment for construct A. ANOVA of priorities of the four constructs by experts’ disciplines demonstrates that only the TOD pattern (p=0.002) is significant. This means that experts’ disciplines have significant impact on their judgment for construct T.

5. Conclusion

The first proclamation of the Taiwan Urban Renewal Act occurred in November 1998. Yet, many small-scale regeneration plans have not significantly reformed socio-economic factors and the built environment of old urban centers. Consequently, this research builds a framework for a performance evaluation system to assess local old urban centers. This framework not only consults performance evaluation methods for a livable urban district (Burton, 2002; Hemphill et al., 2004; Hoppenbrouwer et al., 2005), but also refers to many Taiwan local urban planning and building code requirements. Hence, this indicator system offers the local municipal government a comprehensive and technical tool to reexamine the performance of regeneration plans in old urban centers.

According to the survey result of the phase two questionnaires, the priority values illustrate panel experts’ judgment concerning the factors of pairwise comparisons of general indicators and policy-making indicators based on the livability issue. In the second level of the AHP framework, the top five prior general indicators focus on initial planning issues of a district; the middle five prior general indicators focus on detailed planning and design issues, and the last five prior general indicators concentrate on individual sites and building design requirements. The priority order of these 15 sub criteria determined by panel experts is not necessarily consistent with practical regeneration work required by the Urban Renewal Act, and the urban design review process and building code. However, this statistical result concretizes the top-down logic, which means a livable urban district should follow a process from urban master planning, detailed planning, urban design, to building and site design.

ANOVA analysis proves the researchers’ hypothesis of the effect of experts’ attributes on priority variance of the indicators. Panel experts’ work regions have a significant impact on their priority judgment only in terms of architectural typology and estate, while their disciplines have an effect on their priority judgment only concerning the TOD pattern. Hence, panel experts’
attributes do not necessarily influence their evaluation in terms of the whole indicator system.

The researchers use FDM and AHP to process panel experts' judgment on urban regeneration indicators. Since experts' attributes are diverse, this indicator priority framework is an open system, which could include regeneration guidelines, or performance evaluation methods of old urban districts for the local municipal government. Recruiting different panel experts could change the priority order and value of the indicators under the same framework.

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