Analysis of the Urban Renewal Strategies with Fuzzy Delphi Approach

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Abstract. Currently, the old houses more than 30 years are exceed 4.5 million in Taiwan. If it does not accelerate urban renewal and reconstruction, it will reach 6.4 million in ten years. "Urban renewal is not a goal, it is a tool". J. Q. Wilson mentioned it by his book named Urban Renewal in 1996. Since 2007, government promote renewal works energetically by the means of additional building bulk and tax reduce to achieve the following goal: promote a well-planned urban land redevelopment, revitalize urban functions, improve urban living environments, and to increase public interest. In addition, the inability to implement various supporting measures have made urban renewal very difficult. In particular, urban renewal adopt the "Joint Construction Agreement". Consequently, this study proceeds to explore the main factors that affect urban renewal for joint construction agreement. Through the evaluation model and expert groups giving fuzzy values, access the relative importance of each factors by using Fuzzy Delphi method. The study found the critical factor and propose strategies for urban renewal development in the future to improve the quality and quantity of urban renewal.

1. Introduction

In many developed cities, urban recession has been a long-standing problem. The old houses more than 30 years are exceed 4.5 million in Taiwan. If it does not accelerate urban renewal and reconstruction, it will reach 6.4 million in ten years. According to the Ministry of the Interior indicated that urban renewal case approved from 2006 to 2016 were 40 cases per year. From 2017 to 2018, 77 cases were approved per year, and 24 cases were approved in 2019. J. Q. Wilson mentioned that "Urban renewal is not a goal, it is a tool" [1]. However, the joint construction agreement method is a way to implement urban renewal. The systems of the Rights Transformation Method has be established formally after the regulations of right transfer of Urban Renewal be legislated in 1999 be concerned, its included majority election, raising the willingness of private enterprise to participate in the renewal business, solving the vertical-distribution issue in the process of urban renewal, defining clearly the participation rules, not only including the land owners and legal building owners, but also the ownership's of other legal rights and squatters occupying the land owned by others, and so on [2].

It has been going through nearly 20 years, since the urban renewal area of Taipei City has been demarcated in 2000. In chronological order, the objectives and strategies employed by Taipei’s urban renewal process can be categorized into three distinct phases-the addition of "Old Urban District Special Chapter" to the Urban Planning Law in 1973; the addition of "Encouraging Private Sector Investment on Urban Renewal Ventures Special Chapter" to the Taipei Urban Renewal Implementation Guidelines
in 1983; and the establishment of Urban Renewal Ordinance in 1988. Some of the areas have been rebuilt through urban renewal. However, more than half of the areas have not been rebuilt. The living environment and the areas surrounding major construction have not been able to develop in a balanced with the urban development. In addition to relying on the government's public power, the policy content of the urban renewal policy should be taking into account resident opinions and regional culture in the recent years. The concept of public-private partnership has arisen and use civil power to implement relevant policies to achieve policy objectives [3].

After their rapid economic development, many urban areas around the world have less developable space, and the notion of urban renewal has been developed to address urban issues. In view of the fact that urban renewal has not really played the role of improving urban function in the past, and the relevant incentive measures have lost the incentives and motivation for urban renewal, the Taipei City government has re-examined the urban renewal area and related building volume incentives to promote the urban renewal for urban development. In summary, this study results will provide as a reference for subsequent related urban renewal policies and implementation strategy urban renewal in the future.

2. Methodology

2.1 Establish research framework and methods

The research process adopted methodologies and phased achievements obtained as follows.

- **The first stage: Literature survey and analysis.**
  Systematic analysis of urban renewal status, trends and challenges in Taiwan proceed to classification of important influence indicators of variable sets.

- **The second stage: Systems engineering analysis.**
  According to the Taiwan's sustainable development policy, this research proceeds to establish an evaluation model.

- **The third stage: Fuzzy Delphi method (FDM).**
  This research using expert questionnaires proceeds with screening assessment factors to find important strategy factors.

2.2 Application of Fuzzy Theory and Fuzzy Delphi method

The Fuzzy Delphi method was proposed by Ishikawa et al., and it was derived from the traditional Delphi technique and fuzzy set theory [4]. This research application steps and operational process were as follows:

- **Step 1: Establish the hierarchical structure for the evaluation system:**
  The hierarchical structure contains three levels. The first level indicates the main goal. The second levels consist of three aspects. The third levels consists of twenty-nine criteria (C01-C29) (shown in Fig. 1).

- **Step 2: Gather fuzzy values of the expert groups:**
  The objective of the expert questionnaire was architecture, urban planning, and urban renewal field. Fuzzy Delphi Expert questionnaires were given to thirty experts in industry, government, and research.

- **Step 3: Establish each strategies factor of the triangular fuzzy function:**
  Ishikawa et al. proposed the Max-Min Method to establish the triangular fuzzy function values in this study [5]. The triangular fuzzy function of each strategies factor of the calculation formulae (1-3) follow.

\[
N_A = (L_A , M_A , U_A)
\]

\[
L_A = \text{Min} (X_{A1}, i = 1,2,3,...,n)
\]

\[
M_A = (X_{A1} \times X_{A2} \times ...X_{An})^{1/n}
\]

\[
U_A = \text{Max} (X_{Ai}), i = 1,2,3,...,n
\]

A is the influencing factor; i denotes the expert; N_A is each influencing factors of the triangular fuzzy function; X_{Ai} is the evaluation value of the i-th experts decision-makers for the A-th items of
influencing factors; \( L_A \) is the lower limit of evaluation value of the experts decision-makers for the A-th items of influencing factors; \( M_A \) is the geometric mean number of evaluation value of the experts decision-makers for the A-th items of influencing factors; and \( U_A \) is the upper limit of evaluation value of the experts decision-makers for the A-th items of influencing factors.

Fig. 1. The urban renewal strategies of joint construction agreement evaluation model. (Gray double line expressed removed factors after the screening and decision-making)

- **Step 4: Screen the strategy factors:**
  
The calculation formulae (4, 5) were follow.

\[
X_A \geq S, \text{ Accept assessment items of the } A \text{ strategy factor; } \\
X_A < S, \text{ Delete assessment items of the } A \text{ strategy factor.} \\
X_A \text{ is the geometric mean; } \\
S \text{ is the threshold value; } \\
A \text{ is the influencing factor.}
\]

3. Research content and methodologies

3.1 Establish assessment models of the framework and hierarchy

In 2008, Taiwan declarations of the principles of sustainable development policies stated that development of national sustainable environment policies should achieve the goals of social development, economy development and environmental development [6]. Through systems engineering
analysis method screening the key strategy factors that affect urban renewal development was compiled. Finally, we established a systematic evaluation model (shown in Fig. 1).

3.2 Screen and establish evaluation system
Fuzzy evaluation values were given by expert groups. This study found that after the comprehensive fuzzy operation, each strategy item had an importance approval degree of more than 66%.

In order to achieve the threshold value, this study adopted the calculation of the geometric mean and the discussions of the expert meeting. Therefore, the threshold value of $G_i$ was established as 7.0000. Finally, the original twenty-nine factors, after screening were reduced to twenty-three factors, accounted for 79% of the original evaluation system, shown in Fig. 1.

3.3 Comprehensive fuzzy computing and analysis
In this study, through the comprehensive fuzzy computing that each strategy factor $Z_i$ (test value) had a value greater than 0 ($Z_i > 0$). This shows that the opinions of the expert groups reached consensus, and each factor had convergence. Strategy factors screening results showed that the evaluation system produced a total of six evaluation factors with a $G_i$ value lower than the threshold value, so these were deleted (shown in Table 1).

The $G_i$ values showed that each factor obtained the experts received a score higher than 7.1855 on the recognition degree of importance. The geometric mean of the "Maximum value", "Optimum value" and "Minimum value" show that the maximum values go up to 9.5257; the optimum value is 7.7883, and the minimum value is 4.5028. These represent evaluation value of the experts for strategy factors where the majority showed a high degree of consensus.

4. Discussion and strategy proposals

4.1 Discussion
In response to the gradually aging society in Taiwan, the changes in the living style and living environment, as well as the outdated functions of old environment that are unable to meet the living demand of the modern society, it is significantly urgent to effectively promote urban renewal since the old urban buildings have been decaying, the building structure have failed to meet the requirements of earthquake resistance, and essential public facilities have also been under-serviced [7]. However, due to the differences in the roles and objectives of the public and private sectors, the promotion of urban renewal has been poorly implemented. The public sector is unable to formulate appropriate policies and promote urban renewal with effective measures, while the private sector is also ineffective in promoting urban renewal because of the lengthy implementation process and the high uncertainty during the process [8].

According to the research data analysis, there are seven items key problems caused by the implementation of urban renewal in Taiwan through "Joint Construction Agreement", which are illustrated below in detail:

- **Design Planning.** The design of planning pattern and size according to requirements cannot achieve zero error, and builders often have to increase costs in order to meet requirements. In addition, due to the influence of the economic environment, the product may deviate from the market, resulting in price reduction and unmarketability.
- **Allocation techniques and proportion.** The imparting to the success of urban renewal through "Joint Construction Agreement" is the allocation techniques and proportions. Consequently, builders must give them more subsidies in building area and amount.
- **The expenses of non-publicity.** The condition of non-publicity is that they cannot recognize the cost, and builders often have to absorb the cost, which will become profits and taxes.
- **Public land treatment.** Because of the need for use, the urban renewal public land administrator often chooses a house with better location, and the builder should strive to obtain more favourable housing location through negotiation and fair mechanism to facilitate sales and value preservation.
Table 1. The results of factors screening by Fuzzy Delphi method.

| Aspect of second level | Objective of third level | Geometric mean | Expert decision-making consensus values | Test value | Screening results |
|-----------------------|--------------------------|----------------|----------------------------------------|------------|------------------|
|                       |                          | Geometric mean | Expert decision-making consensus values | Test value | Screening results |
|                       |                          | Oi  | Ai  | Ci  | Gi  | Zi  |
| Social Strategies     | C01                      | 8.8424 | 6.3783 | 4.6458 | 7.3873 | 2.7932 | – |
|                       | C02                      | 9.1157 | 7.7883 | 6.5217 | 9.3527 | 0.9013 | – |
|                       | C03                      | 8.8699 | 6.7952 | 4.7872 | 7.8572 | 0.7104 | – |
|                       | C04                      | 7.3489 | 6.5433 | 4.5028 | 6.9514 | 3.5695 | deleted |
|                       | C05                      | 8.9012 | 7.3102 | 5.5012 | 7.3873 | 2.7932 | – |
|                       | C06                      | 8.6832 | 7.3573 | 5.4549 | 7.8032 | 1.9563 | – |
|                       | C07                      | 8.4629 | 6.6780 | 4.8967 | 7.4020 | 1.9184 | – |
|                       | C08                      | 9.0246 | 7.5215 | 6.2879 | 9.2008 | 1.8630 | – |
|                       | C09                      | 7.9911 | 6.5298 | 4.9454 | 6.7526 | 0.3684 | – |
|                       | C10                      | 8.5792 | 6.9807 | 5.0314 | 7.4020 | 1.9184 | – |
|                       | C11                      | 8.5681 | 7.1678 | 5.2548 | 8.4969 | 1.7359 | – |
|                       | C12                      | 8.9331 | 7.5773 | 5.6680 | 8.3861 | 0.3222 | – |
|                       | C13                      | 8.5681 | 7.1678 | 5.2548 | 8.4969 | 1.7359 | – |
|                       | C14                      | 8.5681 | 7.1678 | 5.2548 | 8.4969 | 1.7359 | – |
|                       | C15                      | 8.9331 | 7.5773 | 5.6680 | 8.3861 | 0.3222 | – |
|                       | C16                      | 8.5681 | 7.1678 | 5.2548 | 8.4969 | 1.7359 | – |
|                       | C17                      | 8.6378 | 7.1025 | 5.2170 | 7.4535 | 2.1527 | – |
|                       | C18                      | 7.9723 | 6.5896 | 4.7345 | 6.7232 | 0.6621 | deleted |
|                       | C19                      | 8.3891 | 7.3753 | 5.3590 | 8.0861 | 0.7673 | – |
|                       | C20                      | 8.4378 | 6.8921 | 4.5876 | 7.5438 | 1.8961 | – |
|                       | C21                      | 8.5371 | 7.0225 | 5.0128 | 7.4401 | 1.5695 | – |
|                       | C22                      | 8.8424 | 6.3783 | 4.6458 | 7.3873 | 2.7932 | – |
|                       | C23                      | 9.1157 | 7.7883 | 6.5217 | 9.3527 | 0.9013 | – |
|                       | C24                      | 8.8699 | 6.7952 | 4.7872 | 7.8572 | 0.7104 | – |
|                       | C25                      | 7.3489 | 6.5433 | 4.5028 | 6.9514 | 3.5695 | deleted |
|                       | C26                      | 8.9012 | 7.3102 | 5.5012 | 7.3873 | 2.7932 | – |
|                       | C27                      | 8.6832 | 7.3573 | 5.4549 | 7.8032 | 1.9563 | – |
|                       | C28                      | 8.4629 | 6.6780 | 4.8967 | 7.4020 | 1.9184 | – |
|                       | C29                      | 9.0246 | 7.5215 | 6.2879 | 9.2008 | 1.8630 | – |

- **Eliminate nail householders and occupiers.** Nail householders and occupiers are the biggest obstacles to urban renewal. In spite of the government can demolish the building by force according to law, but most builders will still try to settle through communication and give preferential co-construction conditions.

- **Co-Construction deposit.** It will take a long time to make urban renewal through joint construction agreement. The uncertainty of time makes it difficult to estimate the interest loss of builders. In addition, the construction quality and the delay of project duration are also the factors affecting the full return of the construction margin.

- **Construction completion and Housing transfer.** Apart from the improvement of construction defects, the biggest problem is that the relationship between rights and obligations must be clarified. The content of the margin refund must be stated in the co-construction contract and the housing purchase and sale contract. The future margin refund belongs to the builder.

4.2 Urban renewal of strategy proposals

In order to successfully implement urban renewal, the general public should have the basic consciousness of "replacing the old with the new", but there should also be a reasonable system that builders can follow. Most importantly, the government must actively intervene and play a leading role. Ultimate, the study proposes eight items of the urban renewal strategies as specific references for government to promote urban renewal (shown in Table 2).
5. Conclusions
It is a good intention for the government to implement urban renewal, but the results cannot meet the expected statistics. There are many limiting factors to urban renewal. For example, urban renewal is just an embellishment of the propaganda of government policies [8-9]. However, the most difficult way of promotion of urban renewal is to apply private "Joint Construction Agreement". The government did not implement effective and aggressive urban renewal policy, which caused the "Joint Construction Agreement" to encounter many problems when implementation of urban renewal [10-11]. This study shows that barriers will make builders feel urban renewal is a never-ending road. Therefore, "Joint Construction Agreement" will be the way that builders are reluctant to adopt.

Table 2. The urban renewal strategies.

| • Strengthen deep cultivation plan. | • Fair tax system and preferences. |
| • State-run and private-operation. | • Social housing policy. |
| • Broaden the preferential policy subsidy on floor area ratio. | • Solutions to nail households. |
| • Simplify urban renewal procedures. | • Supporting measure policies for the overflow of historic sites. |

Through the research resulting was found, the critical factors which affect the urban renewal implementation are twenty-three criteria in three major objectives. Finally, based on the evaluation values of expert groups and Fuzzy Delphi statistical results to provide an operable evaluation model. In addition, it also provides effective references for the implementation of "Joint Construction Agreement" to promote urban renewal strategy in the future. Ultimately, with the increasing trend of the old buildings and cities around the world, the research results are expected to provide important references for urban renewal promotion strategies.

Ultimately, With the yearly increasing trend of the proportion of old and obsolete buildings and cities around the world, the research results are expected to provide developing and developed countries with important references for specific urban renewal planning and promotion strategies.

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