EXPLORING RISKS FOR URBAN RENEWAL PROJECTS

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ABSTRACT: Urban renewal requirements have been important issues for local governments in Taiwan and therefore many urban renewal projects were initiated in the past few years and such demands will be increased in the future. According to past performance of urban renewal projects, projects suffered tons of problems, such as project delay due to evaluating existed property value, value allocations for future property, and relocating residents for temporary living, were encountered in urban renewal projects and then negatively influenced the benefit of urban renewal business to participated private firms. The purpose of this study is to explore the framework of risks frequently encountered when performing urban renewal business projects in Taiwan, and further used the risk framework to assess the relative effects of the identified risk factors on urban renewal business project success. The risk breakdown structure for generic projects is employed and simultaneously the workflow of performing urban renewal business projects was discussed and reviewed to identify the associated risk factors in urban renewal business projects. A hierarchical risk structure of urban renewal business projects was established in this study and then was used to measure and assess the relative effects of the risk factors with Consistent Fuzzy Preferred Relations.

Keywords: Risk Management, Urban Renewal, Project Management, Consistent Fuzzy Preference

1. INTRODUCTION

Limited land development, poor urban land use design with large amount of immigrations to urban areas and poor maintenance on aged buildings lead to dim and messy on city configuration and cause some safety issues to city’s residential environment, which impeded city development. To resolve the highly chained and important issue to enhance the city development in the future, central government and many local governments in Taiwan deployed urban renewal incentives policies to enhance the public-private partnerships on urban renewal business of redecorating, maintaining and rebuilding aged and poor planned residential community, which can be divided into several levels. The most complex level is to dismantle aged community and then regenerate a well planned community with sufficient infrastructures to support community livings. The simplest level only repairs and redecorates aged buildings. However, renewing residential community improves utilization of urban city land, improves city configuration, and enhances the public services to improve community’s living environment and further raise city’s competence level on economics development and living environment.

In Taiwan, urban renewal projects are divided into two types which are respectively called as urban renewal program and urban renewal business project. Urban renewal programs are proposed and implemented by city government, and their scales are usually large. The objectives of the renewal program include enhancing the quality of regional environment, improving the living environment while conserving the regional culture and history. Urban renewal business projects are proposed by private parties such as construction companies, real estate development firms, or urban planning companies. Implementers propose the community renewal projects with corresponding to the published urban plans to acquire the permit from city government. Once city’s urban renewal committee authorized the permit, implementers
could kick off the project with partial supports specified in
the proposed plan from government.
Although urban renewal projects could bring high benefits
and profits to private implementers, projects with the
characteristic of long duration usually spanning a long
period, huge investment, requiring the agreement from
threshold amount of ownership residents, and complicated
acquisition process make the urban renewal business
projects more complicated and full of uncertainty. Project
risks in these projects therefore are much complicated and
difficult to be acknowledged, predicted, controlled and
managed. Without sufficient information on the risks and
uncertainties encountered by urban renewal business
projects, these projects are extremely vulnerable to suffer
project delay, increased cost, and even are terminated
before project completion.
The purpose of this study is to investigate the risk
configurations for a general urban renewal business project.
Urban renewal business project risks will be systematically
identified, and then assessed to explore the relative effects
of identified risk factor on project success. Explored
project risk configurations can be used by urban renewal
business project stakeholders to raise their risk knowledge
and conscious to conduct urban renewal business projects.
Project managers and project team can use the results to
enhance the performance of risk management for better
chance to success.
2. LITERATURE REVIEWS
2.1 Reviewing flow process of an urban renewal
business project
Government usually lead when large scale of urban
renewal projects were promoted such as renewal projects
of the train station area in a city, port area, transportation
hub area, airport community, local commercial area or
national administration area. [3] Urban renewal business
projects with smaller scale such as the renewal projects of
residential communities can be led by private parties.
These types of projects may focus on the repair and rebuild
of aged residential communities and the enhancement of
public facilities to improve residents' living environment.
The detailed flow processes of an urban renewal business
project were created to facilitate the risk identification in
this study.
2.2 Establishing the risk assessment model
During the risk identification process, the risk breakdown
structure (abbreviated as RBS) proposed by PMI (Project
Management Institute) for generic project [1] was
employed as the basic risk framework to identify the risk
factors for urban renewal business projects. Because an
urban renewal business project usually included building
construction, the project definition rating index (PDRI) for
building projects [2,3] was also adapted in this study to
integrate with the employed PMI’s risk framework to
enhance the development of the risk framework for urban
renewal business projects. In addition, potential risk factors
in each risk sub-category were explored based on the
suggested elements in PMI’s framework, defined elements
in the PDRI, exploring potential risks in each of the
required flow process in an urban renewal business project
and from literature reviews. Total of fifty three risk factors
were initially identified for urban renewal business projects.
Moreover, a causal-effect influence diagram, shown as
Figure 2, was developed to enhance the selections of
significant risk factors for further effect assessments
because identified risk factors are too many. The identified
risk factors were further reviewed and screened by
discussing the causal-effects with associated experts. Risk
factors with darken color in Figure 2 were considered as
having obvious effects to the project benefits and costs
which are main drivers of the project success defined in
this study. The hierarchical risk breakdown structure of
urban renewal business projects was finalized as the first
three columns in Table 1.
The explored hierarchical risk breakdown structure with
five risk categories and twenty four risk factors further can
be used to assess the occurrence probability of identified
risk factors and their potential relative effects on project
success. Risk evaluation includes two parts of assessments
which are for occurrence probability and effects on risk
consequences. When risk assessment is conducted, the
assessment of potential effects of risk factors on
consequence is much more difficult to be performed rather
than evaluating occurrence probability since the effects
should be evaluated based on two dimensions-vulnerability
and risk exposure. The scope of this study is limited to the assessment of risk effects of explored risk factors on project consequences. Consistent fuzzy preference relation (CFPR) was employed to evaluate the relative effects for further establishment of risk checklist used for urban renewal business projects.

3. METHODOLOGY

Consistent fuzzy preference relations (CFPR) were proposed for constructing the decision matrices of pairwise comparisons based on additive transitivity [22]. The concept and steps of using CFPR is presents as the following steps.

Table 1 Investigated Risk Factors and Dimensions

<table>
<thead>
<tr>
<th>Corporate Management Risk</th>
<th>Customer-Return Management Risk</th>
<th>Laws and Regulations Risk</th>
<th>Economic Risk</th>
<th>Building Technology Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>PID team’s Communication and Coordination, Organizational Identity, Management team of Competitiveness</td>
<td>Service Quality, Plan for Demolition and Relocation, Demolition and Relocation, Landowner’s Personal Characteristic, Number of Outbidders</td>
<td>Government’s Processing Time, Floor Area Incurred, Tax Reduction, Access to be developed, Land Price, Construction Cost, Commercial Usage, Level of Excess Illegal Construction, Competitors</td>
<td>Attractive Aesthetics, Deliverables, Project Control, Project Execution Plan, Site Information, Building Programming, Building/Project Design, Design Parameters, Equipment</td>
<td>Project Definition Rating Index, Strategy, Deliverables, Project Control, Project Execution Plan, Site Information, Building Programming, Building/Project Design, Design Parameters, Equipment</td>
</tr>
</tbody>
</table>

To construct pairwise comparison matrices for CFPR among five identified risk dimensions and their all risk factors in each dimension, participated experts were asked to evaluate levels, in linguistic scale shown as Fig 2, of relative effects of each pair risk dimensions and factors on project success. A fuzzy positive reciprocal matrix $\tilde{A} = [\tilde{a}_{ij}]$ is developed as Eq. (1).

$$\tilde{A} = \begin{bmatrix} \tilde{a}_{12} & \tilde{a}_{13} & \ldots & \tilde{a}_{1n} \\ \tilde{a}_{21} & \tilde{a}_{22} & \ldots & \tilde{a}_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \tilde{a}_{n1} & \tilde{a}_{n2} & \ldots & \tilde{a}_{nn} \end{bmatrix}$$

Where $\tilde{a}_{ij}$ is a fuzzy value for the comparative effect of risk factor $i$ and risk factor $j$ on project success. When $m$ experts participate in the evaluations, the geometric mean approach presented as Eq. (2) can be used to synthesize the evaluations of $m$ experts.

$$\tilde{a}_{ij} = (\tilde{a}_{ij}^1 \otimes \tilde{a}_{ij}^2 \otimes \tilde{a}_{ij}^3 \otimes \ldots \otimes \tilde{a}_{ij}^m)^{1/m}$$

Where $\tilde{a}_{ij}^m$ is the fuzzy value of the relative effect of risk factor $i$ and risk factor $j$ on project success according to the $m$th evaluator. Since $\tilde{a}_{ij}^m$ is a TFN, $\tilde{a}_{ij}$ is also a TFN and can be expressed by the following equation:

$$\tilde{a}_{ij} = (L_{ij}, M_{ij}, U_{ij})$$. The $\alpha$-cut approach is employed to transform the obtained fuzzy values into their optimal nonfuzzy assessed crisp values in this study.

A matrix $A \in X \times X$, $A = [a_{ij}]$, represents the multiplicative preference relations on a set of $X$ criterions, where $a_{ij}$ represented the ratio of preference intensity of criterion $x_i$ to criterion $x_j$. Herein, $a_{ij} = 1$ indicates equally important between criterion $x_i$ and $x_j$, $a_{ij} = 9$ manifests that $x_i$ is absolutely important compared to $x_j$. 

Fig. 1 Influence Diagram for the project risk factors in an urban renewal business project

Fig. 2 Linguistic variables employed to evaluate the relative effects on project success between pairwise risk dimensions and pairwise risk factors.
Preference relation matrix $A$ is typically assumed to be a multiplicative reciprocal presented as Eq. (3).

$$a_{ij} \cdot a_{ji} = 1 \quad \forall i, j \in \{1, \ldots, n\}$$

(3)

The fuzzy preference relation $P \subseteq X \times X$ on a set of criteria $X$ is a fuzzy set with membership function $\mu_{ij} : X \times X \rightarrow [0,1]$. The preference relation is represented by the matrix $P = [p_{ij}]$, where $p_{ij} = \mu_{ij}(x_i, x_j)$.

Equation (3) gives the consistency (Herrera-Viedma et al., 2004). The preference relation is presented as Eq. (4).

$$p_{ij} + p_{ji} = 1 \quad \forall i, j \in \{1, \ldots, n\}$$

(4)

A set of alternatives $x = \{x_1, \ldots, x_n\}$ and $x \in X$ is associated with a reciprocal multiplicative preference relations matrix $A = [a_{ij}]$ for $a_{ij} \in [1/9, 9]$. Then, $a_{ij}$ can use Eq. (5) to obtain the corresponding reciprocal fuzzy preference relation $P = [p_{ij}]$ for $p_{ij} \in [0,1]$ associated with $A$:

$$p_{ij} = g(a_{ij}) = \frac{1}{2} (1 + \log_9 a_{ij})$$

(5)

Herein, $\log_9 a_{ij}$ is used to transfer $A = [a_{ij}]$ to $P = [p_{ij}]$ because $a_{ij}$ is between 1/9 and 9.

Additive transitivity, with the relationships as Eq. (6) and Eq. (7), is one of the suggested properties when the reciprocal fuzzy preference relation $P = [p_{ij}]$ is consistent (Herrera-Viedma et al., 2004).

$$p_{ij} + p_{jk} + p_{ki} = \frac{3}{2} \quad \forall i < j < k$$

(6)

$$p_{ij} + p_{i(j+i)} + p_{i(j+i)} + p_{j} = (j - i + 1)/2 \quad \forall i < j$$

(7)

When we obtain the $n-1$ preference intensity ratio $\{a_{12}, a_{23}, \ldots, a_{n-1,n}\}$ of criteria/alternative $x = \{x_1, \ldots, x_n\}$, from experts’ judgments, Eq. (5) can be used to construct a fuzzy preference relation for the set of n–1 values $\{p_{12}, p_{23}, \ldots, p_{n-1,n}\}$. Then the other preference relations values of the decision matrix, $B = \{p_{ij} \mid i < j \notin \{p_{12}, p_{23}, \ldots, p_{n-1,n}\}\}$, will be obtained by the applying to Equations (6) and (7). However, when Equations (6) and (7) were used to calculate preference relation values all the necessary elements in the decision matrix $P$ may not lie within $[0,1]$ and lie within $[-a, 1 + a]$, where $a = \min \{B \cup \{p_{12}, p_{23}, \ldots, p_{n-1,n}\}\}$. In this case, the transformation function $P' = f(p)$ as Eq. (8) should be employed to develop the consistent reciprocal fuzzy preference relation matrix $P'$. This transformation process can remain the decision matrix with reciprocity and additive consistency.

$$f : [-a, 1 + a] \rightarrow [0,1], f(x) = (x + a)/(1 + 2a)$$

(8)

This study utilizes this method to assess the relative effects on project success of the risk factors. The obtained assessment decision matrix, $P' = (p'_{ij})$, shows the consistent reciprocal relation. It can apply the Equations (9) and (10) to determine the multiplicative preference relations matrix associated with relative effects of risk factors on project success.

$$a'_{ij} = 9^{2s_{ij}}$$

(9)

$$A = [a'_{ij}]$$

(10)

### 4. CASE STUDY

Because CFPR was employed to assess the relative effects of risk factors, the perceived priority of the relative effects were first evaluated for investigated risk dimensions and factors in order to eliminate the measurement bias of relative effects. It’s believed that the measured relative effect for two factors with similar magnitude of effects have smaller bias than for two factors with larger magnitude e. The results collected for the preliminary priority of investigated risk dimensions and factors were used to develop pairwise effect comparison questionnaire between two risk dimensions and between two risk factors. The CFPR questionnaire applying to fuzzy set concept was...
further developed to collect pairwise effect comparison data that were presented in Table 2.

The synthesized fuzzy relative effects of pairwise risk dimensions and pairwise risk factors from four experts were computed by using Eq. (2). The synthesized TFNs were further defuzzified by using \( \alpha \)-cut approach with 0.5 as the value of \( \alpha \) and \( \lambda \) to a multiplicative preference relations matrix, parts of resulted matrix were displayed in Fig. 3.

The multiplicative preference relations matrix is further used to explore the CFPR matrix, displayed as P matrix in Fig. 3, by using Eq. (5)–Eq. (7). The fuzzy preference relation value should be between the range of 0 and 1, Eq. (8) was employed to refine the fuzzy preference relations matrix. The refined fuzzy preference matrix is displayed as the P’ matrix in Fig. 3. The refined fuzzy preference matrix is further transferred to multiplicative preference relations matrix by using Eq.(9). Finally, the multiplicative preference relation is matrix, the A’ matrix in Fig.3, is resolved by using the eigenvector approach to compute the relative effects of investigated risk factors.

![Fig. 3 Multiplicative preference relations matrix and CFPR matrix for risk dimensions](source)

### Table 3

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Table 3. Experts’ linguistic data for compared effects between pairwise risk dimensions and pairwise factors.

Local weights of investigated risk dimensions as well as local weights and global weights of investigated risk factors for urban renewal business projects were presented in Table 4. For urban renewal projects, economic risks should be noticed since the relative effects of economic risks on project success is much higher than other risks. For the twenty-five investigated risk factors, most factors included in economic risk dimension have higher priority on the relative effects comparing to the factors in other dimension. This study demonstrated the risk assessment for urban renewal business projects. A hierarchical risk breakdown structure was identified through a systematic approach. The relative effects of identified risk factors on project success were further assessed to provide important information for future use when
a risk checklist is going to be developed or a reliable risk analysis is going to be conducted for urban renewal projects. For the risk factors with higher priority, their occurrence probabilities can be further studied to investigate the relative level of risks for certain risk factors.

Table 4 Ranking order of investigated risk factors

The implementation of CFPR on the risk assessment facilitates the assessment process. This approach resolves the inconsistent issue of collected data when AHP process was implemented. In addition, the application of the fuzzy concept to collect relative risk effect data can be more realistic and easier for responses to reflect their risk perception on project success.

REFERENCES