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 work flow 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.

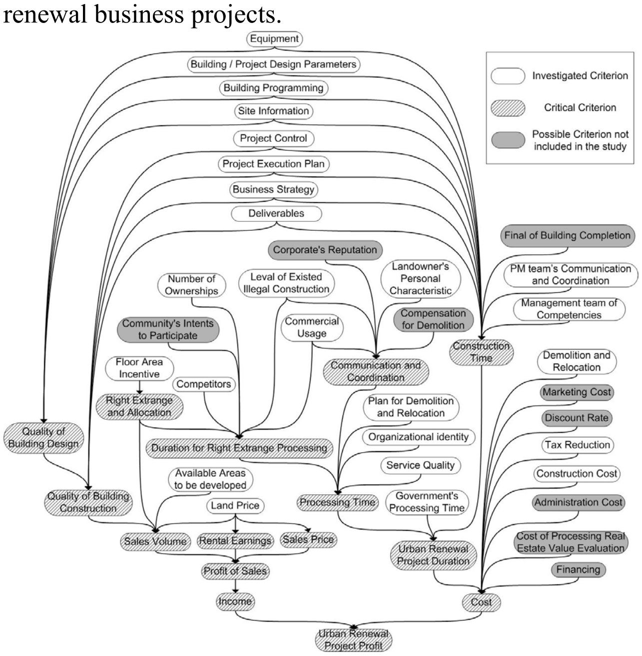

Fig. 1 Influence Diagram for the project risk factors in an urban renewal business project

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

Corporate Management Risk	PM team's Communication and Coordination, Organizational identity, Management team of Competencies	Mats Alvesson & Laura Empson (2008) [4] Lise Backer (2008) [5] Laura Empson (2004) [6] James C. McElroy et al (2001) [7]
Customer-Stakeholder Management Risk	Service Quality, Plan for Demolition and Relocation, Demolition and Relocation, Landowner's Personal Characteristic, Number of Ownerships	Linda C. Ueltschy et al (2009) [8] Andreas C. Soteriou & Richard B. Chase (1998) [9]
Laws and Regulations Risk	Government's Processing Time, Floor Area Incentive, Tax Reduction	McGreal, S. et al (2002) [10] Alastair Adair et al (2000) [11]
Economic Risk	Available Areas to be developed, Land Price, Construction Cost, Commercial Usage, Leval of Existed Illegal Construction, Competitors	Alastair Adair et al (2000) [11]
Building Technology Risk	Business Strategy, Deliverables, Project Control, Project Execution Plan, Site Information, Building Programming, Building / Project Design Parameters, Equipment	Injazz J. Chen et al (2004) [12] Saad H. Al-Jibouri (2003) [13] Robert R. van der Velde & Dirk Pieter van Donk (2002) [14] Project Definition Rating Index (1999) [3]

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).

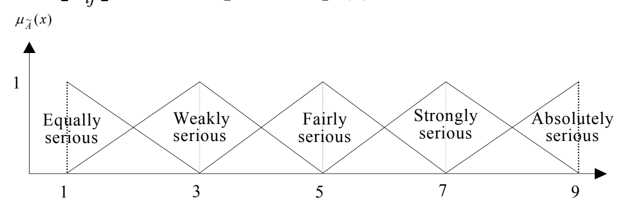

Fig. 2 Linguistic variables employed to evaluate the relative effects on project success between pairwise risk dimensions and pairwise risk factors.

$$\tilde{A}=\begin{bmatrix} 1 & \tilde{a}_{12} & & \\ & 1 & \tilde{a}_{23} & \\ & & \ddots & \tilde{a}_{(n-1)n} \\ & & & 1 \end{bmatrix} \qquad (1)$$

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.

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

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 mth 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 α-cut approach is employed to transform the obtained fuzzy values into their optimal nonfuzzy assessed crisp values in this study.

A matrix $\boldsymbol{A}\subset\boldsymbol{X}\times\boldsymbol{X}$, $\boldsymbol{A}=[a_{ij}]$, 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.

Preference relation matrix A is typically assumed to be a multiplicative reciprocal presented as Eq. (3).

$$a_{ij} \cdot a_{ji} = 1 \quad \forall i, j \in \{1, \cdots, n\} \tag{3}$$

The fuzzy preference relation $P \subset X \times X$ on a set of criteria X is a fuzzy set with membership function $\mu_p : X \times X \rightarrow [0,1]$. The preference relation is represented by the matrix $\boldsymbol{P} = [p_{ij}]$, where $p_{ij} = \mu_p(x_i, x_j)$. Herein, p_{ij} is interpreted as the level of preference of criterion x_i over x_j. If $p_{ij} = 1/2$, it means that x_i and x_j are equally important (i.e. $x_i \sim x_j$); $p_{ij} = 1$ indicates that x_i is absolutely important/preferred to x_j; $p_{ij} > 1/2$ shows that x_i is more important/preferred to x_j, i.e. $x_i \succ x_j$. In this case, the preference matrix, P, is usually assumed additive reciprocal as Eq. (4).

$$p_{ij} + p_{ji} = 1, \forall i, j \in \{1, \cdots, n\} \tag{4}$$

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

$$p_{ij} = g(a_{ij}) = \frac{1}{2}(1 + \log_9 a_{ij}) \tag{5}$$

Herein, $\log_9 a_{ij}$ is used to transfer $\boldsymbol{A} = [a_{ij}]$ to $\boldsymbol{P} = [p_{ij}]$ 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 $\boldsymbol{P} = [p_{ij}]$ is consistent (Herrera-Viedma et al., 2004).

$$p_{ij} + p_{jk} + p_{ki} = \frac{3}{2} \quad \forall i < j < k \tag{6}$$

$$p_{i(i+1)} + p_{(i+1)(i+2)} + \cdots + p_{(j-1)j} + p_{ji} = (j-i+1)/2, \quad \forall i < j \tag{7}$$

When we obtain the $n-1$ preference intensity ratio $\{a_{12}, a_{23}, \cdots, a_{n-1,n}\}$ of criteria/alternative $\boldsymbol{x} = \{x_1, \cdots, x_n \mid n \geq 2\}$ from experts' judgments, Eq. (5) can be used to construct a fuzzy preference relation for the set of n–1 values $\{p_{12}, p_{23}, \cdots, p_{n-1,n}\}$. Then the other preference relations values of the decision matrix, $\boldsymbol{B} = \{p_{ij} \mid \underset{i<j}{\wedge} p_{ij} \notin \{p_{12}, p_{23}, \cdots, p_{n-1,n}\}\}$, 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 $a = \left|\min\{\boldsymbol{B} \cup \{p_{12}, p_{23}, \cdots, p_{n-1n}\}\}\right|$. In this case, the transformation function $\boldsymbol{P'} = f(p)$ as Eq. (8) should be employed to develop the consistent reciprocal fuzzy preference relation matrix $\boldsymbol{P'}$. This transformation process can remain the decision matrix with reciprocity and additive consistency.

$$f : [-a, 1+a] \rightarrow [0,1], f(x) = (x+a)/(1+2a) \tag{8}$$

This study utilizes this method to assess the relative effects on project success of the risk factors. The obtained assessment decision matrix, $\boldsymbol{P'} = (p'_{ij})$, 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.

$$a'_{ij} = 9^{(2 \times p'_{ij} - 1)} \tag{9}$$

$$A' = [a'_{ij}] \tag{10}$$

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. 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 α-cut approach with 0.5 as the value of α and λ 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 relations matrix, as the A' matrix in Fig.3, is resolved by using the eigenvector approach to compute the relative effects of investigated risk factors.

Dimensions	A1	A2	A3	A4	Dimensions
D1	S	S	W	S	*D2*
D2	E	W	E	L F	*D3*
D3	F	S	W	S	*D4*
D4	E	E	L F	L S	*D5*
Criteria	A1	A2	A3	A4	Criteria
c1	S	F	L F	E	c2
c2	L S	L F	E	S	c3
c3	S	S	E	E	c4
c4	L F	L F	F	L W	c5
c5	LF	L F	W	L W	c6
c7	L F	L S	E	L F	c8
c8	L F	L F	W	S	c9
c9	E	E	L F	L W	c10
c10	L F	L F	L A	L S	c11
c12	L F	L F	L F	L W	c13
c13	F	S	S	W	c14
c15	W	F	S	W	c16
c16	L W	E	W	E	c17
c18	W	E	E	W	c19
c19	L W	L F	L F	L W	c20
c20	W	W	F	F	c21
c21	W	W	E	E	c22
c22	W	W	L W	L W	c23
c23	E	E	L W	E	c24
c24	E	E	E	F	c25

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

$$A=\begin{bmatrix} 1 & 5.610 & & & \\ & 1 & 1.086 & & \\ & & 1 & 3.215 & \\ & & & 1 & 0.514 \\ & & & & 1 \end{bmatrix} \quad P=\begin{bmatrix} 0.5 & 0.892 & 0.911 & 1.177 & 1.026 \\ 0.108 & 0.5 & 0.519 & 0.784 & 0.633 \\ 0.089 & 0.481 & 0.5 & 0.766 & 0.614 \\ -0.177 & 0.216 & 0.234 & 0.5 & 0.349 \\ -0.026 & 0.367 & 0.386 & 0.651 & 0.5 \end{bmatrix}$$

$$P'=\begin{bmatrix} 0.5 & 0.790 & 0.804 & 1 & 0.888 \\ 0.210 & 0.5 & 0.514 & 0.710 & 0.598 \\ 0.196 & 0.486 & 0.5 & 0.696 & 0.585 \\ 0 & 0.290 & 0.304 & 0.5 & 0.388 \\ 0.112 & 0.402 & 0.415 & 0.612 & 0.5 \end{bmatrix} \quad A'=\begin{bmatrix} 1 & 3.574 & 3.798 & 8.998 & 5.506 \\ 0.280 & 1 & 1.063 & 2.517 & 1.541 \\ 0.263 & 0.941 & 1 & 2.369 & 1.450 \\ 0.111 & 0.397 & 0.422 & 1 & 0.612 \\ 0.182 & 0.649 & 0.690 & 1.634 & 1 \end{bmatrix}$$

Fig. 3 Multiplicative preference relations matrix and CFPR matrix for risk dimensions

5. RESULTS AND DISCUSSIONS

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

Dimensions	Local Weight	Criteria	Local Weight	Global Weight	Ranking
Economic Risk	0.545	Available Areas to be developed	0.270	0.147	1
		Competitors	0.169	0.092	4
		Land Price	0.195	0.106	2
		Construction Cost	0.079	0.043	8
		Leval of Existed Illegal Construction	0.106	0.058	7
		Commercial Usage	0.181	0.099	3
Customer-Stakeholder Management Risk	0.152	Service Quality	0.059	0.009	21
		Number of Ownerships	0.131	0.02	15
		Landowner's Personal Characteristic	0.119	0.018	16
		Plan for Demolition and Relocation	0.158	0.024	13
		Demolition and Relocation	0.533	0.081	6
Law and Regulation Risk	0.143	Government's Processing Time	0.239	0.034	10
		Floor Area Incentive	0.6	0.086	5
		Tax Reduction	0.162	0.023	14
Corporate Management Risk	0.061	Management team of Competencies	0.641	0.039	9
		PM team's Communication and Coordination	0.2	0.012	18
		Organizational identity	0.16	0.01	20
Building Technology Risk	0.099	Project Control	0.247	0.024	12
		Building Programming	0.145	0.014	17
		Project Execution Plan	0.29	0.029	11
		Building / Project Design Parameters	0.11	0.011	19
		Site Information	0.065	0.006	22
		Business Strategy	0.058	0.006	23
		Deliverables	0.053	0.005	24
		Equipment	0.032	0.003	25
Sum =	1		5	1	

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 rene wal 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 f actors.

Table.4 Ranking order of investigated risk factors

The implementation of CFPR on the risk assessment f acilitates the assessment process. This approach resolve s the inconsistent issue of collected data when AHP p rocess was implemented. In addition, the application o f the fuzzy concept to collect relative risk effect data can be more realistic and easier for responses to refle ct their risk perception on project success.

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