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Title	MULTI-PERIOD EVALUATION MODEL FOR THE SATISFACTION DEGREE IN PROPERTY MANAGEMENT
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Description	The Thirteenth East Asia-Pacific Conference on Structural Engineering and Construction (EASEC-13), September 11-13, 2013, Sapporo, Japan.
Relation	Proceedings of the Thirteenth East Asia-Pacific Conference on Structural Engineering and Construction (EASEC-13), September 11-13, 2013, Sapporo, Japan, C-3-4.
Citation	Proceedings of the Thirteenth East Asia-Pacific Conference on Structural Engineering and Construction (EASEC-13), C-3-4
Issue Date	2013-09-11
Doc URL	https://hdl.handle.net/2115/54279
Type	conference paper
File Information	easec13-C-3-4.pdf

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MULTI-PERIOD EVALUATION MODEL FOR THE SATISFACTION DEGREE IN PROPERTY MANAGEMENT

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ABSTRACT

The investigation of the residents' satisfaction degree is important for the property management company to measure the performance of site, to evaluate and rank the sites, and to trace the main indices resulting in worse performance. Therefore, this study proposes a multi-period evaluation model for the residents' satisfaction degree. An investigation scale with six constructs and nineteen indicators is developed to measure the residents' satisfaction degree. The investigation data can be transformed to be comparable by the proposed linear preprocessing method with specification limits. The priority is ranked by the integrated method with the technique for order preference by similarity to ideal solution and the signal-to-noise ratio. Finally, the main indicators resulting in worse performance can be identified by the proposed tracing method. An illustrative example of real case is adopted to demonstrate the feasibility and practicability of the proposed model. Results show the proposed model can obtain a more reliable result and can be easily used in similar problems.

Keywords: Property management, residents' satisfaction degree, signal-to-noise, TOPSIS.

1. INTRODUCTION

Owning to the limited land resource, the proportion of new building construction is decreasing in the city, but the market of property management is growing. Besides, people now have more and more requirements in living quality. Therefore, the evaluation of the residents' satisfaction degree is important for the sustainable development of the property management company.

Hence, this study collects the residents' satisfaction evaluation indicators in property management via literature review and expert investigation, and identifies the key evaluation indicators (KPIs) by the fuzzy Delphi method. After that, the analytic network process (ANP) is adopted to define the weights of the key evaluation indicators. In the performance comparison, the technique for order of preference by similarity to ideal solution (TOPSIS) is used. Besides, a specification limit based (SLB) linear pre-processing method is proposed to consider the interested scope in the transformation

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function. This study also uses the signal-to-noise (SN) ratio of the Taguchi method to consider the residents' satisfaction degrees of multi periods to enhance the decision reliability of priority.

Finally, a real case of a property management company in Taiwan is used as an illustrative example to demonstrate the operation of the proposed model and validate its applicability.

2. RESIDENTS' SATISFACTION DEGREE

In the related researches of the residents' satisfaction degree, the American Customer Satisfaction Index (ACSI) is the most critical reference. Many studies adopted the ASCI as the basis to develop their residents' satisfaction degree constructs and indicators. The developed constructs mainly contain the security and fire, clean and green, traffic safety, maintenance and repair, resident service, and community culture.

The weights of indicators and the decision making model are the two main research direction in the studies of the residents' satisfaction degree. In the determination of indicators' weights, the analytic hierarchy process and the entropy technique are the commonly used methods. However, the entropy technique is based on the deviation of data and might not really reflect the importance of indicators. Besides, most indicators are dependent. This situation will disobey the assumption of AHP. In the aspect of decision making model, the weighted sum method, the neural network, the fuzzy clustering method, and the TOPSIS have been used in the related studies. Among the methods, the TOPSIS is the most commonly used method and has been widely employed in various fields (Chen and Tzeng 2004; Milani et al., 2005; Srdjevic et al., 2004; Yang and Chou, 2005) for its well applicability (Kim et al. 1997).

3. THE MULTI-PERIOD EVALUATION MODEL

3.1. Establishment procedure

The investigation and evaluation of the residents' satisfaction degree can be regarded as an application of the multi-attribute decision making model. Therefore, this study collects the indicators from the literature review and the expert interview. Then, the fuzzy Delphi method and the ANP are used to determine the key indicators and their weights, respectively. Finally, the TOPSOS is used to develop the multi-period evaluation model.

Although the TOPSIS has been widely used, two practical problems are still encountered. The first problem is the data preprocessing. The unit vector preprocessing method is used in TOPSIS, but this preprocessing method might change the linear relationship in the raw data and further influence the priority of alternatives. Besides, no matter the unit vector preprocessing method or other linear preprocessing methods can not consider the interested region of decision makers, i.e., the specification limits of indicators, in the transformation functions. The second problem is the number of evaluation periods. Single period is commonly used in the decision making problems, but only one period might be not enough to obtain a reliable result. Besides, the multi-period evaluation results

can provide information not only for decision-making but also for tracing the indicators resulting in worse performance.

Hence, this study proposes a multi-period evaluation model for the residents' satisfaction degree. The measured values are preprocessed by the proposed linear transformation with specification limits, and the determination of specification limit is defined by the fuzzy Delphi questionnaires of experts. Then, the closeness to ideal solution is calculated by the TOPSIS. The closeness of multi periods can be used to rank the performance and trace the indicators resulting in worse performance. In integrating the multi-period closeness, although the arithmetic mean or the geometric mean can be used, the variance of multi-period closeness ought to be concerned. Therefore, this study uses the signal-to-noise ratio (SN ratio) to both consider the mean and the variance of multi period closeness. The research procedure of this study is shown as Figure 1.

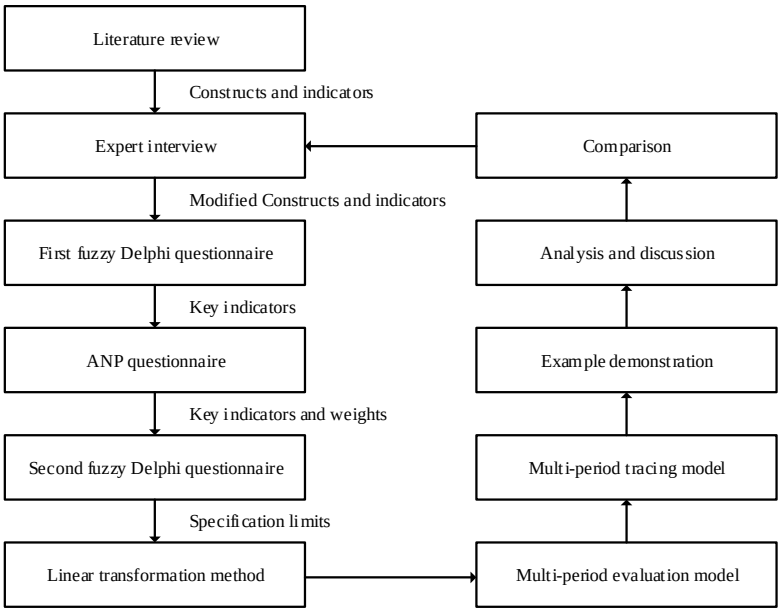


Figure 1: Research procedure.

3.2 Methods

The proposed methods, including the linear transformation method with specification limits, the multi-period evaluation method, and the multi-period tracing method, are stated as follows.

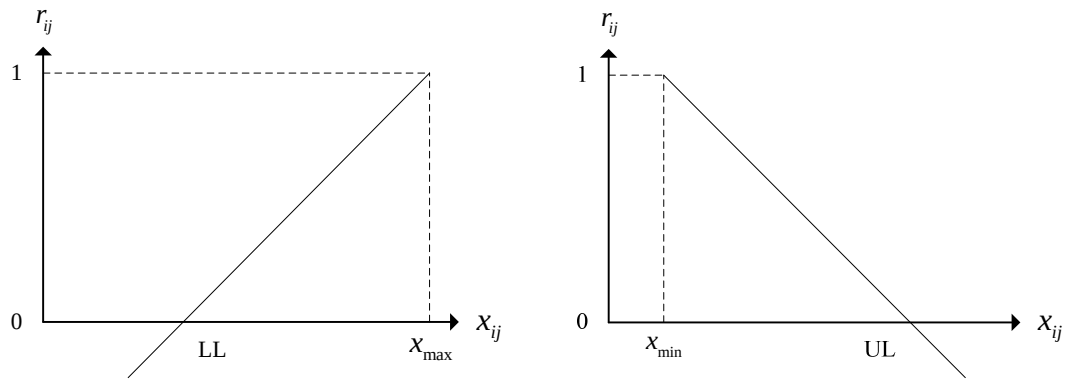
1. The linear transformation method with specification limits

This study integrates the specification limits into the linear transformation method. Figure 2 shown the structure of the linear transformation method with specification limits. In Figure 2, UL and LL are the specification upper limit and the specification lower limit, respectively. The transformation functions of the larger the better type and the smaller the better type are denoted as Eq. (1) and Eq. (2), respectively.

$$r_{ij} = \frac{x_{ij} - LL}{x_{\max} - LL}. \tag{1}$$

$$r_{ij} = \frac{UL - x_{ij}}{UL - x_{\min}}. \tag{2}$$

In Eqs. (2) and (3), x_{ij} and r_{ij} are the original value and the transformed value, respectively. $x_{\max}$ and $x_{\min}$ are the maximum value and the minimum value of the original values.



(a) The larger the better type (b) The smaller the better type

Figure 2: The structure of the linear transformation method.

2. The multi-period evaluation method

The TOPSIS is first used to calculate the closeness (C_i^{t+}) at the *t-th* period. After that, the larger the better type SN ratio can be used to define the comprehensive evaluation. Therefore, the value of multi-period evaluation (p_i) is denoted as

$$p_i = -10\log_{10}\left[\frac{\sum_{t=1}^{T}\frac{1}{\left(C_i^{t+}\right)^2}}{T}\right], \tag{3}$$

where T is the number of the multi periods. Eq. (3) can both consider the mean and the variance of the performance of the residents' satisfaction degree to obtain a reliable priority. In Eq. (3), the larger p_i means the better performance.

3. The multi-period tracing method

In the worse performance sites, the main indicators resulting in the worse residents' satisfaction degree can be identified by the proposed multi-period tracing method. First, the transformed values of indicators at the periods are collected as

$$r_{jt} = \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1T} \\ r_{21} & r_{22} & \cdots & r_{2T} \\ \vdots & \vdots & \ddots & \vdots \\ r_{m1} & r_{m2} & \cdots & r_{mT} \end{bmatrix}.$$

Then, by using the nominal the better SN ratio, the performance evaluations of indicators (p_j) can be defined as

$$p_j = -10\log_{10}\left[\left(\overline{r}_{jt} - m\right)^2 + s_{r_{jt}}^2\right], \tag{4}$$

where $m = 1$ (the transformation of the target value is equal to 1). $\overline{r}_{jt}$ and $s_{r_{jt}}$ are the mean and the standard deviation of r_{jt}, respectively. The same as p_i, the larger p_j means the better indicators. Therefore, the worse indicators with lower p_j ought to be noticed.

4. RESULTS AND DISCUSSIONS

A real case in Taiwan is used as the illustrative example. After the expert interviews and the first fuzzy Delphi questionnaire, the constructs and the indicators of the residents' satisfaction degree are collected, including six constructs and nineteen indicators. The ANP questionnaire is used to determine the construct weight (CW), the indicator weight (IW), and the final weight (FW). Then, the second fuzzy Delphi questionnaire is adopted to define the lower limit (LL) of the specification. The above mentioned data are shown in Table 1.

Table 1: The residents' satisfaction degree indicators and weights.

Constructs	CW	Indicators	IW	FW	LL
Security and fire	0.17	S1. Fire equipments	0.39	0.068	81.6
		S2. Security equipments	0.39	0.068	76.6
		S3. Entrance and exit management	0.12	0.020	76.4
		S4. Community patrol	0.09	0.016	79.0
Clean and green	0.11	G1. Garbage collection	0.42	0.046	80.3
		G2. Green conservation	0.46	0.051	80.3

		G3. Road clean	0.13	0.014	80.9
Traffic safety	0.07	T1. Parking	0.23	0.017	76.0
		T2. Pedestrian and vehicle separation	0.12	0.009	79.2
		T3. Entrance control	0.65	0.047	80.9
Maintenance and repair	0.22	M1. Maintenance quality	0.41	0.091	75.5
		M2. Repair immediacy	0.48	0.108	76.9
		M3. Equipments operation	0.11	0.026	79.3
Residents service	0.37	R1. Response convenient	0.12	0.044	79.3
		R2. Employee attitude	0.47	0.174	81.5
		R3. Communication	0.25	0.093	81.3
		R4. Problems resolving	0.16	0.058	77.8
Community culture	0.05	C1. Diversity of community activities	0.67	0.035	81.7
		C2. Frequency of community activities	0.33	0.017	82.6

Table 1 was introduced by seven sites (S1 to S7), which are belonged to a property management company in Taiwan during three quarters (Q1 to Q3). The results of the multi-period evaluation are shown in Table 2. As shown in Table 2, S3 is the best site and S7 is the worst site.

Table 2: The results of the multi-period evaluation.

	Q1			Q2			Q3			p_i	Rank
	d_1^+	d_1^-	C_1^+	d_2^+	d_2^-	C_2^+	d_3^+	d_3^-	C_3^+		
S1	0.146	0.322	0.689	0.186	0.330	0.640	0.320	0.255	0.444	-5.06	3
S2	0.170	0.303	0.641	0.345	0.250	0.420	0.164	0.350	0.681	-5.34	4
S3	0.212	0.224	0.514	0.244	0.318	0.566	0.176	0.348	0.664	-4.85	1
S4	0.268	0.263	0.495	0.295	0.211	0.417	0.207	0.272	0.568	-6.34	5
S5	0.218	0.244	0.528	0.336	0.226	0.402	0.267	0.267	0.500	-6.62	6
S6	0.173	0.265	0.606	0.205	0.262	0.561	0.216	0.254	0.541	-4.92	2
S7	0.306	0.203	0.399	0.329	0.220	0.400	0.182	0.321	0.638	-6.99	7

This study further traces the main indicators resulting in the worst performance of S7. Table 3 shows the results of multi-period tracing. The worst three indicators in S7 are sequentially G3 (Road clean), R2 (Employee attitude), and G2 (Green conservation). The correction actions can be first taken based on these indicators.

Table 3: The results of the multi-period tracing.

	Q1	Q2	Q3	p_j	Rank
S1	0.2	0.6	0.4	4.074	7
S2	1.0	0.5	0.8	8.696	1
S3	0.2	0.5	0.6	4.360	5
S4	-0.4	-0.2	0.8	-0.839	15

G1	0.0	0.5	1.0	2.997	9
G2	-0.1	-0.2	-0.4	-2.093	17
G3	0.0	-0.7	-0.5	-3.156	19
T1	-0.1	1.0	0.8	3.019	8
T2	-0.4	0.7	-0.1	-0.639	14
T3	1.0	0.9	-0.4	0.357	12
M1	-0.1	0.7	0.5	2.115	10
M2	1.0	0.9	0.2	5.045	4
M3	0.7	0.3	0.7	5.541	3
R1	0.7	0.4	1.0	8.172	2
R2	-0.5	-0.6	0.5	-2.499	18
R3	0.2	-0.4	0.6	0.165	13
R4	0.9	-0.1	0.2	1.545	11
C1	-0.1	-0.4	1.0	-0.892	16
C2	0.1	1.0	0.6	4.106	6

5. CONCLUSIONS

The residents' satisfaction degree will influence the competition of the property management company. A reliable and practicable evaluation model is necessary. Hence, this study integrates the TOPSIS and the SN ratio to develop a multi-period evaluation method and a multi-period tracing method. A real case is adopted as the illustrative example to demonstrate the proposed model. Results show the proposed model can obtain a reliable multi-period evaluation and can trace the main indicators resulting in the worse performance. This model can be also easily used in similar problems.

6. ACKNOWLEDGMENTS

This study was supported by the National Science Council in Taiwan (NSC 101-2218-E-228-003).

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