Multi-level Fuzzy Comprehensive Evaluation Model For Social Management Innovation

Liu Chengshui
Research Department
Beijing City University
Beijing ,China
lcs@bcu.edu.cn

Ji Wenyan
Research Department
Beijing City University
Beijing,China
jiwenyan@bcu.edu.cn; jiwenyan2007@126.com

***Abstract*—Social management innovation is of great importance for maintaining social order, promoting social harmony, safeguarding people and creating a good social environment for the development of the party and the state. This paper presents a comprehensive evaluation method for the social management innovation effect. Firstly, an index system consisting of 5 comprehensive indicators and 12 secondary indicators are established; secondly, AHP method is used to determine the index weight at all levels; then, the social management innovation effect are classified into five level as "excellent, good, fair, normal and poor", and indicators fuzzy membership function is developed; Finally, a multi-level fuzzy comprehensive evaluation model is established. The case study shows that the evaluation method can objectively reflect the operating results of the social management innovation.**

Keywords-multi-level fuzzy comprehensive evaluation; AHP; social management innovation;evaluation index system

I. INTRODUCTION

Social management innovation is an inevitable phenomenon when Chinese society developed to a certain stage after a 30 years fruitful economic reform; it is also an inevitable choice in a situation of social differentiation, structural imbalances and social transformation. Its practical significance is to resolve social contradiction, to ease social conflicts, to resolve social disputes, maintain social stability and promote social harmony.

At present, there are a lot of theoretical research on social management innovation, Xiao Jinming [1] focus on the significance of social management innovation, its characteristics and key points. Liu Yu, Ma Shuyan [2] studied external reasons for social management innovation. They pointed out that Chinese government faces many challenges in social management, such as the further development of economy, the adjustment of social structure, the equalization of interest distribution, the maintenance of social justice and the treatment of social crisis, and all these challenges call for the social management innovation. Zhu Sibei, Li Zuoren [3] discussed the reorientation and path in social management innovation. Deng Jitang [4], Liu Ping [5] studied the importance of law construction in social management innovation. For the transformation and development of Chinese society, it is necessary to constantly improve the level of democratization and the rule of law. The legal system should be perfected under the guide of protection of human rights, fairness and justice, democratic participation and power controlling. More measures should be taken to enhance administration under legal mode and a better public participation mechanism, to promote grass-root democratic autonomy for a socialistic civil society, to perfect the diversification of civil rights relief mechanism and to broaden the judicial functions of courts. Liu Xinyu [6] points out those social management innovations create unprecedented institutional environment for promoting NGOs' participation in environmental governance. Ji Zemin [7] presents that social regulation is an important government means in social management innovation. A social management mechanism led by the government and with all sectors of society participating should be established. Zhu Jun [8] points out that management of virtual society has become an integral part of the social management, the innovation of virtual society affects the social management.

By studying the reference, it can be learned that there are few article on evaluation models for social management innovation effect. This paper establishes evaluation indicators and evaluation system for social management innovation, analytic hierarchy process (AHP) and multi-level fuzzy evaluation are combined as a basic evaluation method; all these make the social management innovation evaluation more scientific and operability.

II. THE INDEX SYSTEM FOR SOCIAL MANAGEMENT INNOVATION

The index system is interconnected by a series of scientific mutual restraint indicators [1]. The indicator is the basic unit of the index system. The evaluation index system and evaluation methods should subject to the guiding principles [2] such as systematic, completeness and relevance principles [3].

General Secretary Hu Jintao has made profound interpretation of "social management", "social management innovation" connotation. On February 19, 2011, he delivered an important speech in the opening ceremony of the social management and innovation symposium of the principal leaders of the provincial and ministerial level cadres: "down-to-earth manner to improve the scientific level of social management, building socialism social management system with Chinese characteristics". He pointed out that social management is an indispensable activity of human society; the fundamental purpose of social management innovation is to maintain social order, promote social harmony, safeguard

its people and create a good social environment for the development of the party and the state. Speech made it clear that the satisfaction of the people is the foothold and starting point of the social management innovation; the goal of social management innovation is to build a harmonious social order and a moderately prosperous society. He pointed out that the basic task of social management includes social relations coordination, social behavior standardization, solving social problems, resolving social conflicts, promoting social justice, dealing with social risks, maintaining social stability. This is an important discovery of social management theory. The coordination of social relations, standardization of social behavior, solving social problems, resolving social conflicts, dealing with social risks are the main tasks of social management; Social justice is the criterion of value, while maintaining social stability is the purpose of social management.

According to the above theory and policy, the evaluation index system of social management innovation consists of 5 comprehensive indicators and 12 secondary indicators as the following:

The first comprehensive indicator is A, the ability for social relations coordination, its secondary indicator is itself.

The second comprehensive indicator is B, the ability to resolve social conflicts. It has three secondary indicators as b_1 information disclosure mechanism, b_2 social protection mechanisms and b_3 interests' coordination and dialogue mechanisms.

The third comprehensive indicator is C the ability to regulate social behavior. It has four secondary indicators as c_1 system regulations completeness, c_2 legal consciousness of the masses, c_3 legal consciousness of the party committee, and c_4 the level of administration according to law.

The fourth comprehensive indicator is D: the ability to solve social problems. Its secondary indicator is itself.

The fifth is E, the ability to cope with social risks. It has three secondary indicators as e_1 Risk warning mechanism, e_2 the risk of treatment effect and e_3 social management efficiency.

The score of these twelve secondary indicators can be derived according to the experts scoring criteria. All scores are between 1 to100.

III. DETERMINE THE INDICATOR WEIGHT

The index weight is an objective measure of the relative importance of the indicators in comprehensive evaluation process; its accuracy determines that of the evaluation results. There are dozens of methods for determining weights, which can be divided into two categories: one is the subjective weighting method based on the experience of experts such as Delphi, Analytic Hierarchy Process (AHP), fuzzy subset method (FSM), comparison matrix method (CMM); the other is the objective weighting method, such as entropy value method (EVM), principal component analysis, correlation method and so on. In this paper, Analytic Hierarchy Process (AHP) is used to determine the indicator weight of each level. The AHP method has the advantage that it can quantify the qualitative factors, test and reduce the subjective factors to some extent, and make the evaluation more scientific.

A. *Brief introduction of AHP*

Analytic Hierarchy Process (AHP) [4-6] is presented by A.L.Saaty in 1970s and introduced into China in 1980s. AHP can compare factors on the same level pair by pair, divide them into several importance levels, and give each a quantitative value. AHP is based primarily on the relative importance of various factors judged by people. Through the introduction of appropriate scale, these judgments may turn out to be quantitative description by judgment matrix. The process of AHP is as the follows:

The first step is to establish the hierarchy model. The hierarchical model is a system with delivery order structure of H layers. The first layer only has one element, for example, the evaluation result of social management innovation in this paper. Elements of each level belong to only one level, and each element must has at least one dominance relationship with a certain element on the upper or lower level. There is no direct relationship among the elements of the same layer, or two layers which are not adjacent to each other.

The second step is to set the judgment matrix. Compare elements u_i, u_j according to their importance to indicator c, and establish a judgment matrix $A = \left(a_{ij}\right)_{n\times n}$ according to the 1-9 scale method. a_{ij} is the importance value of u_i to u_j for indicator c, n denote the number of pairwise comparisons factors.

The third step is to calculate the indictors' weights and check its consistency. The largest eigenvalue and its corresponding eigenvector of judgment matrix A are calculated. The normalized eigenvector will be the weights of each indicator. Its consistency will be tested. Depending on the nature of the consistency matrix, we use the square root method to calculate eigenvectors of a single judgment matrix in this paper.

B. *Indicator Weight by AHP*

In accordance with the methods and principles of the previous section, we invited a number of experts and professors on social management innovation to compare the importance of each indicator through the Delphi method, and construct judgment matrix of all levels. The judgment matrix for the first level indicators (comprehensive indicator) is as follows:

$$H_{11}=\begin{vmatrix} 1 & 1/2 & 1/3 & 1/2 & 1/3 \\ 2 & 1 & 1/2 & 1 & 1/2 \\ 3 & 2 & 1 & 1 & 1 \\ 2 & 1 & 1 & 1 & 2 \\ 3 & 2 & 1 & 1/2 & 1 \end{vmatrix} \tag{1}$$

The judgment matrixes of secondary indicators to the first level indicators are as follows:

$$H_{21}=H_{24}=[0] \tag{2}$$

$$H_{22}=H_{25}=\begin{bmatrix} 1 & 3 & 2 \\ 1/3 & 1 & 1/2 \\ 1/2 & 2 & 1 \end{bmatrix} \tag{3}$$

$$H_{23}=\begin{bmatrix} 1 & 1 & 1/2 & 3 \\ 1 & 1 & 1/2 & 2 \\ 2 & 2 & 1 & 5 \\ 1/3 & 1/2 & 1/5 & 1 \end{bmatrix} \tag{4}$$

According to the calculation principles of the AHP, The index weights calculation results are shown in Table Ⅰ. All levels of index weight value shown in Table Ⅰ.

TABLE I. INDEX WEIGHT S OF INDICATORS OF ALL LEVELS

First-level indicators	**Weight**s	Secondary indicators	**Weight**s
A	0.089	a_1	1
B	0.163	b_1	0.539
		b_2	0.164
		b_3	0. 297
C	0.259	c_1	0.238
		c_2	0.216
		c_3	0.454
		c_4	0.092
D	0. 255	d_1	1
E	0. 234	e_1	0.539
		e_2	0.164
		e_3	0. 297

IV. MULTI-LEVEL FUZZY COMPREHENSIVE EVALUATION

When the evaluation work involves multi-index, requirements of all aspects should be consolidated to make a more realistic evaluation. In such cases, the fuzzy set theory can be used to draw a comprehensive evaluations based on each indicators according to a given criteria.

A. *The main steps of fuzzy comprehensive evaluation*

Define abbreviations and acronyms the first time they are.

- Establish the index set $U=\{u_1,u_2,\cdots,u_n\}$, which is the evaluation index system.
- Determine the weight set $\alpha=\{\alpha_1,\alpha_2,\cdots,\alpha_n\}$, it will make the relative importance of the different indicators clear.
- Establish the evaluation set $V=\{v_1,v_2,\cdots,v_m\}$, which are involved in the evaluation program set.
- Single index evaluation is made first and the membership vector $R_i=(r_{i1},r_{i2},\cdots,r_{im})$ can be acquired.
- Create a fuzzy membership matrix that combined each single factor membership vector.

$$R=\begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1j} & \cdots & r_{1m} \\ r_{21} & r_{22} & \cdots & r_{2j} & \cdots & r_{2m} \\ & & \vdots & & \cdots & \\ r_{i1} & r_{i2} & \cdots & r_{ij} & \cdots & r_{im} \\ & & \vdots & & \cdots & \\ r_{n1} & r_{n2} & \cdots & r_{nj} & \cdots & r_{nm} \end{bmatrix} \tag{5}$$

- Make the final comprehensive evaluation by :

$$B=\alpha\circ R \tag{6}$$

α is the weight vector; $\circ$ is the fuzzy operator; R is the fuzzy membership matrix, B is the result of a comprehensive assessment.

B. *Social management innovation evaluation model based on AHP and Fuzzy Comprehensive Evaluation*

- Determines the reviews set

Social management innovation effect is divided into five levels. They are R^1 excellent, R^2 good, R^3 fair, R^4 normal, and R^5 poor. Reviews set as follows:

$$\begin{aligned} V&=\{v_1,v_2,v_3,v_4,v_5\} \\ &=\{\text{Excellent},\text{Good},\text{Fair},\text{Normal},\text{Poor}\} \end{aligned} \tag{7}$$

- Determines the index membership

All these secondary indexes have a score by experts based on the evaluation based on scoring quantization. These indicators are designed in accordance with the characteristics of effective indicators, the greater the indicator, better indicators described. According to the quantitative evaluation, we define the membership function.

$$R_i^1=\begin{cases} 1 & u_i\ge 95 \\ (u_i-85)/10 & 85\le u_i\le 95 \end{cases} \tag{8}$$

$$R_i^2=\begin{cases} (95-u_i)/10 & 85\le u_i\le 95 \\ (u_i-75)/10 & 75\le u_i\le 85 \end{cases} \tag{9}$$

$$R_i^3 = \begin{cases} (85-u_i)/10 & 75 \le u_i \le 85 \\ (u_i-65)/10 & 65 \le u_i \le 75 \end{cases} \quad (10)$$

$$R_i^4 = \begin{cases} (75-u_i)/10 & 65 \le u_i \le 75 \\ (u_i-55)/10 & 55 \le u_i \le 65 \end{cases} \quad (11)$$

$$R_i^5 = \begin{cases} 1 & u_i \le 55 \\ (65-u_i)/10 & 55 \le u_i \le 65 \end{cases} \quad (12)$$

C. *Multistage Fuzzy Evaluation*

In accordance with the level relations of the evaluation system, the evaluation process starts from the feature layer, step by step up, until the overall layer. The evaluation result of each layer is judged according to formula (6).

V. CASE STUDY

For those index scores of social management innovation in Beijing 2012, we made the multi-level fuzzy comprehensive evaluation. All these scores of its secondary indicators are shown in Table 5. Accordingly, these memberships of the secondary indicator are calculated according to equation (8)-(12), the result is shown in Table II.

TABLE II. FUZZY COMPREHENSIVE EVALUATION RESULT

The first level indicator		The secondary indicator		
Name	Membership	Name	Membership	Score
A	(0.9,0.1,0,0,0)	a_1	(0.9,0.1,0,0,0)	94
B	(0.7327,0.2673, 0,0,0)	b_1	(1, 0, 0,0,0)	97
		b_2	(1, 0, 0,0,0)	96
		b_3	(0.1,0.9, 0,0,0)	86
C	(0.6328,0.2958, 0.0714,0,0)	c_1	(0, 0.7, 0.3,0,0)	82
		c_2	(0.7, 0.3, 0,0,0)	92
		c_3	(1, 0, 0,0,0)	95
		c_4	(0.3, 0.7, 0,0,0)	88
D	(0, 0, 0.8,0.2,0)	d_1	(0, 0, 0.8,0.2,0)	73
E	(0.3234, 0.2156, 0.3125,0.1485,0)	e_1	(0.6, 0.4, 0,0,0)	91
		e2	(0, 0, 1,0,0)	75
		e3	(0, 0, 0.5,0.5,0)	70

The final evaluation result is (0.4391, 0.1790, 0.2856, 0.0963, 0). The method of maximum membership degree is used to determine the rating results. The validity test result of maximum membership degree is as the follows

$$\alpha = \frac{n\beta - 1}{2\gamma(n-1)} = \frac{5 \times 0.4391 - 1}{2 \times 0.2856(5-1)} = 0.523241$$

Where α is the maximum membership degree; n is the number of reviews; β is the proportion of largest component; γ is the proportion of the second largest component.

Obviously $\alpha \ge 0.5$, the principle of maximum degree is valid, so the results of the evaluation is "Excellent"

VI. CONCLUSIONS

This paper established index system for social management innovation effect evaluation, which consists of 5 comprehensive indicators and 12 secondary indicators. This index system can fully reflect the operating results of the social management innovation. The social management innovation effect is evaluated in accordance with the "excellent, good, fair, normal and poor". AHP method is used to determine the index weight at all levels, indicators fuzzy membership function is developed and a multi-level fuzzy comprehensive evaluation model is established. The case study shows that this evaluation method is scientific and rigorous. Its evaluation result can objectively reflect the operating results of the social management innovation.

REFERENCES

[1] Xiao Jin-ming, "Significance, Characteristics and Focus of Social Governance Innovation",Journal of shandong university,Issue 4, 2012,pp.1-10.

[2] Liu Yu, Ma Shuyan, "external reasons for social management innovation", Journal of Henan Institute of Science and Technology Issue 9 , Sep.2012,pp.69-71.

[3] Zhu Si-bei, Li Zuo-ren, "Reorientation in Social Management Innovation", Journal of Shenzhen University Humanities & Social Vo1.29 ,Issue 4, 2012,pp.19-21.

[4] Deng Ji-tang, "Reference of the Western mode of the rule of law in the context of social management innovation", Journal of China Three Gorges University(Humanities & Social Sciences) Vo1.34, Issue 3, May 2012,pp.84-89.

[5] Liu Ping, "The Ideology of the Rule of Law and the Construction of Legal Mechanism in Social Management Innovation", Qilu Journal, Issue 5,Total issue 230, 2012,pp.100-106.

[6] Liu Xin-yu, "On Promoting NGOs'Participation in Environmental Governance in the Context of Social Management Innovation", Social science, Issue 8, 2012,pp.78-86.

[7] JI Ze-min, "The Study of Social Management Innovation Based on the Government Social Regulation", Journal of Tangshan College, VoI.25, Issue 5, Sep. 2012, pp.60-64.

[8] Zhu Jun, "Innovation Concept and M echanism Research on Virtual Social Management", Journal of Beihua University(Social Sciences),Vol.13, Issue 3, Jun. 2012 ,pp.131-134.