constructed the index system of how to choose the leading industry of the characteristic town. Many scholars studied the characteristics towns' planning in different regions. Zhang Ting conducted a field survey in Northwest Hebei part, and she put forward town planning and design that suit local condition from the aspects of resources and environment, industry characteristics and space form etc. based on their traffic and location, history and culture, natural environment and economic policy. Some scholars pay attention to the development of the characteristic town, such as Wu et al. (2016) setting up the index system at development level of the characteristic towns and the evaluation method of the polygon diagram.

The purpose of this paper is to establish an evaluation system for the selection of the characteristic town, and to determine the weight of the evaluation index.

The characteristic town selection system used in this paper makes it quicker and more efficient to select characteristic towns, and bring long-term, comprehensive and institutional benefits to the local.

THE SETTING OF THE SYSTEM OF EVALUATION INDICES

The significance of evaluation: Considering the differences of regional characteristics, the level of development and exploration of reforming across the country, each town should avoid blindly following and exert plans based on one's own condition instead. In order to find a guiding system at national level, this paper uses the data from some characteristic towns of the first-branch characteristic towns and researches further with national indices of quantitative standard. Finally, we get the evaluation indices in the selecting of characteristic towns to ensure scientific evaluation (Zhang 2017).

The principles of setting evaluation indices: This paper uses the rationale of the subjects of Urban and Rural Planning, Industrial Economics, Environmental Science and System Theory comprehensively, and gets the principles of evaluation of selecting characteristic towns, referring to the article on indices system and evaluation method of characteristic town development, which is written by Yizhou Wu and other two scholars.

A. Principle of comprehension. Factors in many aspects like function, industry, form and mechanism should be taken into account.
B. Principle of practice. The indices should be less but more essential. When meeting the demands of evaluating, it is better to bring convenience to having access to data and the comments of experts.
C. Principle of combination of common indices and characteristic indices. Common indices contribute to comparing different small towns, and characteristic indices show the characters and achievements of each town. Therefore, we'd better combine these two kinds of indices together to evaluate.
D. Principle of foreseeability. Based on the selection of characteristic towns, the indices should be set in the long run, considering the development and cultivation of small towns.
E. Principle of science. The indices normally reflect the theoretical requirements of the national government and policies. On the other hand, the situations of small towns should not be negligible.
F. Principle of systematicness. The relations and logic structure of indices should be showed clearly in the system. Focusing on integrity, the system has to clarify the hierarchy structure of indices at all levels and avoid overlap between indices.

The system of evaluation indices: According to the principles above, this paper sets up the evaluation system. To meet the requirements of the governments and policies, this paper refers to

the recommended information Table 1, which is delivered by MOHURD (Ministry of Housing and Urban-Rural Development of the Peoples of Republic of China).

Table 1. Evaluation Indices System.

First-class index	Second-class index	Third-class index
A. Basic information	A1 Population	A11 Resident population
	A2 Economy	A21 GDP of the town
		A22 Annual net income per capita
		A23 Investment in fixed assets and real estate
	A3 Title	A31 Honorary title
B. Characteristics of the town	B1 Industrial development	B11 Layout of industries
		B12 Leading industry
	B2 Environmental construction	B21 Land utilization
		B23 Measures in environmental governance
	B3 Protection of traditional culture	B31 Intangible cultural heritage
		B32 Regional culture
		B33 Cultural activities
	B4 Service facilities	B41 Road traffic
		B42 Infrastructure
		B43 Public service facilities
C. Mechanism	C1 Plan	C11 Overall planning
		C12 Detailed planning
	C2 Innovative measures and achievements	C21 Planning and Construction Management
		C22 Social management service
		C23 Integration of the town and its villages

FUZZY COMPREHENSIVE EVALUATION MODEL

Based on fuzzy mathematics, fuzzy comprehensive evaluation (Chao et al. 2016) transfers qualitative evaluation to quantitative evaluation according to the membership function. This method evaluates the object comprehensively which is constrained by many factors and it can be used in the research of many fields, like for instance, the evaluation of credit risk of commercial banks, green building, water environment quality and value judgment. The evaluation of characteristic towns is a typical fuzzy concept, and it is hard to clarify what kind of towns can be selected as characteristic towns on most cases. In the process of evaluation, many indices cannot simply be quantified and there exits subjectivity to some degree. Therefore, the evaluation of characteristic towns is usually fuzzy (Wen 2010). This paper uses fuzzy comprehensive evaluation method to evaluate characteristic towns and the indices system is constructed. We quantify the qualitative indices combined with its corresponding weight and better deal with fuzzy and subjective problems.

The set of factors: The set of factors is composed of evaluation indices, usually expressed as $U=\{U_1,U_2,U_3,\cdots,U_m\}$. According to the Table 1,

$$U=\{U_1,U_2,U_3\}$$
$$=\{Basic\ \inf ormation, Characteristics\ of\ the\ town, Mechanism\}$$
$$U=\{U_{11},U_{12},U_{13}\}=\{\mathrm{Re}sident\ population, Economy, Title\}$$

Others can be derived in the same way.

The set of comments: $V=\{V_1,V_2,V_3,\cdots,V_n\}$. In this paper, we choose five grades to comment every index of the town (Yu 2011).

$V=\{V_1,V_2,V_3,V_4,V_5\}=\{excellent, very\ good, good, qualified, bad\}$

The weights of evaluating factors: In this paper, we choose some of the first-branch characteristic towns and use principal component analysis to determine the weights, so as, to avoid some subjective factors. The steps are as follows:

(1) Standardize the data: When we evaluate Characteristic Towns, suppose that there are n samples and p indices, then we have Formula 1.

$$X=\begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1p} \\ x_{21} & x_{22} & \cdots & x_{2p} \\ \vdots & \vdots & \vdots & \vdots \\ x_{n1} & x_{n2} & \cdots & x_{np} \end{bmatrix}=(X_1,X_2,\cdots,X_P) \tag{1}$$

Afterwards, standardize the data, then we have Formula 2 and Formula 3.

$$x_{ij}^{*}=\frac{x_{ij}-\bar{X}_j}{s_j}(i=1,2,\cdots,n;j=1,2,\cdots,p) \tag{2}$$

$$\bar{X}_j=\frac{1}{n}\sum_{i=1}^{n}X_{ij},s_j^2=\frac{1}{n-1}\sum_{i=1}^{n}(X_{ij}-\bar{X}_j)^2(j=1,2,\cdots,p) \tag{3}$$

(2) Solve the correlation coefficient matrix, then we have Formula 4.

$$R=(r_{ij})_{pxp}=\begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1p} \\ r_{21} & r_{22} & \cdots & r_{2p} \\ \vdots & \vdots & \vdots & \vdots \\ r_{p1} & r_{p2} & \cdots & r_{pp} \end{bmatrix} \tag{4}$$

R is a symmetric matrix, so we can get the correlation coefficient of the data after standardization and it is expressed as Formula 5.

$$R=\frac{1}{n-1}X^{*T}X^{*} \tag{5}$$

(3) Solve the characteristic root $\lambda_K(k=1,2,\cdots,p)$ and its corresponding characteristic matrix $l_k(k=1,2,\cdots,p)$, then we have Formula 6.

$$\left|R-\lambda I\right|=0 \tag{6}$$

We can make the sequence of characteristic roots that we get from the equation above, then we get $\lambda_1>\lambda_2>\cdots>\lambda_p$ and its corresponding characteristic matrix $l_1,l_2,\cdots,l_p$.

(4) Select principal components.

We can get p principal components from principal component analysis. But we do not select p principal components in real cases, because the variance of every principal component and the amount of information it contains both decrease progressively. Instead, we select m principal components according to the rank of the contribution rate of every principal component. In this paper, the contribution rate means the proportion of certain principal component's variance in total variance, that is to say, it is the proportion of certain characteristic value in total values.

The contribution rate of the variance of the k^{th} principal component is Formula7.

$$\beta_k = \lambda \Big/ \sum_{i=1}^{p} \lambda_i \tag{7}$$

The accumulative contribution rate of the top k principal components can be expressed as Formula 8.

$$\sum_{i=1}^{k} \lambda_i \Big/ \sum_{i=1}^{p} \lambda_i \tag{8}$$

Higher contribution rate reflects larger amount of information of original variables. In normal cases, we postulate that the accumulative contribution rate should surpass 85%. Only in this way can we ensure that comprehensive variables contain most of the information of original variables as Formula 9.

$$\sum_{i=1}^{m} \lambda_i \Big/ \sum_{i=1}^{p} \lambda_i \geq 85\% \tag{9}$$

(5) Calculate the scores of principal components, then we have Formula 10.

$$U = R \bullet X^* = \begin{pmatrix} u_{11} & u_{12} & \cdots & u_{1m} \\ u_{21} & u_{22} & \cdots & u_{2m} \\ \vdots & \vdots & \vdots & \vdots \\ u_{p1} & u_{p2} & \cdots & u_{pm} \end{pmatrix} \tag{10}$$

Then, we get the weight of every index (Han et al. 2012), then we have Formula 11.

$$\omega_i = \sum_{j=1}^{m} \frac{u_{ij} \cdot \lambda_j}{\sum_{j=1}^{m} \lambda_j} \tag{11}$$

This paper chooses some of the first-branch Characteristic Towns in China, after standardization and several steps of solution(which are mentioned above), we get the variance of the components. We select eight principal components to make sure that the accumulative contribution rate meets the requirement (>85%).Then we solute the matrix show in Table 2 and Formula 12.

$$U = \begin{pmatrix} u_{11} & u_{12} & \cdots & u_{18} \\ u_{21} & u_{22} & \cdots & u_{28} \\ \vdots & \vdots & \vdots & \vdots \\ u_{21,1} & u_{21,2} & \cdots & u_{21,8} \end{pmatrix} \tag{12}$$

Finally, we get the weight of 21 indices (show in Table 3).

Regional culture makes up the most among the twenty-one indices, which reflects its importance in the selecting of characteristic towns. At present, the characteristic towns that have been selected are almost traditionally organic towns, with deep-rooted cultural background and long history. These exactly show cultural characteristics in different regions.

Besides, annual net income per capita, measures in environmental governance and integration of town and its villages outweigh over other indices. Annual net income per capita is a mirror of the economic condition and quality of life of the residents. So as to be selected as a characteristic town, the local government should endeavor to improve the level of living of residents, encouraging people to engage in the development of the town. Ecosystem is also needed to be focused in the process of being a characteristic town and ecologically sound measures should be taken by the local government as well as the enterprises in the town. Lucid

waters and lush mountains are invaluable assets. Sustainable development need to be considered when promoting industrial development.

Table 2. Total Variance Explained.

Principal component	Extraction Sums of Squared Loadings		
	Total	% of variance	Cumulative %
1	8.903	42.397	42.397
2	2.584	12.304	54.701
3	1.675	7.977	62.678
4	1.434	6.828	69.506
5	1.121	5.338	74.844
6	1.061	5.053	79.897
7	0.873	4.156	84.054
8	0.758	3.608	87.662

Table 3. The Weight of Each Index.

Third-class index	Weight (%)	Third-class index	Weight (%)
A11 Resident population	4.75	B32 Regional culture	8.38
A21 GDP of the town	6.81	B33 Cultural activities	4.87
A22 Annual net income per capita	8.01	B41 Road traffic	0.50
A23 Investment in fixed assets and real estate	5.76	B42 Infrastructure	1.80
A31 Honorary title	5.89	B43 Public service facilities	2.02
B11 Layout of industries	0.48	C11 Overall planning	3.73
B12 Leading industry	5.09	C12 Detailed planning	4.56
B21 Land utilization	0.61	C21 Planning and Construction Management	5.25
B22 Construction of housing and commercial projects	6.04	C22 Social management service	4.18
B23 Measures in environmental governance	7.27	C23 Integration of the town and its villages	7.34
B31 Intangible cultural heritage	6.66		

Urban-rural gap has been one of the main problems hindering development in China. As a result, the integration of town and its villages is not negligible in the selecting of characteristic towns. The characteristic towns should narrow the gap of living standard between residents in the town and in its villages, leading the process of urbanization.

The process of evaluation: (1) Determine the membership: This paper chooses elliptic membership functions to determine the membership. Values with 60, 70, 80, 90, 100 are responding to the grades bad, qualified, good, very good and excellent. The membership functions are as follows:

$$\mu_1(x)=\begin{cases}1 & x\le 60\\ \frac{1}{2}+\left[\frac{1}{4}-\left(\frac{x-60}{10}\right)^2\right]^{\frac{1}{2}} & 60<x\le 65\\ \frac{1}{2}-\left[\frac{1}{4}-\left(\frac{x-70}{10}\right)^2\right]^{\frac{1}{2}} & 65<x\le 70\\ 0 & x\ge 70\end{cases}$$

$$\mu_2(x)=\begin{cases}0 & x\le 60\\ \frac{1}{2}-\left[\frac{1}{4}-\left(\frac{x-60}{10}\right)^2\right]^{\frac{1}{2}} & 60<x\le 65\\ \frac{1}{2}+\left[\frac{1}{4}-\left(\frac{x-70}{10}\right)^2\right]^{\frac{1}{2}} & 65<x\le 75\\ \frac{1}{2}-\left[\frac{1}{4}-\left(\frac{x-80}{10}\right)^2\right]^{\frac{1}{2}} & 75<x\le 80\\ 0 & x\ge 80\end{cases}$$

$$\mu_3(x)=\begin{cases}0 & x\le 70\\ \frac{1}{2}-\left[\frac{1}{4}-\left(\frac{x-70}{10}\right)^2\right]^{\frac{1}{2}} & 70<x\le 75\\ \frac{1}{2}+\left[\frac{1}{4}-\left(\frac{x-80}{10}\right)^2\right]^{\frac{1}{2}} & 75<x\le 85\\ \frac{1}{2}-\left[\frac{1}{4}-\left(\frac{x-90}{10}\right)^2\right]^{\frac{1}{2}} & 85<x\le 90\\ 0 & x\ge 90\end{cases}$$

$$\mu_4(x)=\begin{cases}0 & x\le 80\\ \frac{1}{2}-\left[\frac{1}{4}-\left(\frac{x-80}{10}\right)^2\right]^{\frac{1}{2}} & 80<x\le 85\\ \frac{1}{2}+\left[\frac{1}{4}-\left(\frac{x-90}{10}\right)^2\right]^{\frac{1}{2}} & 85<x\le 95\\ \frac{1}{2}-\left[\frac{1}{4}-\left(\frac{x-100}{10}\right)^2\right]^{\frac{1}{2}} & 95<x\le 100\\ 0 & x\ge 100\end{cases}$$

$$\mu_5(x)=\begin{cases}0 & x\le 90\\ \frac{1}{2}-\left[\frac{1}{4}-\left(\frac{x-90}{10}\right)^2\right]^{\frac{1}{2}} & 90<x\le 95\\ \frac{1}{2}+\left[\frac{1}{4}-\left(\frac{x-100}{10}\right)^2\right]^{\frac{1}{2}} & 95<x\le 100\end{cases}$$

(2) Comprehensive evaluation: The fuzzy relation from U to V is expressed as fuzzy matrix R. r_{ij} denotes the membership of the i[th] index in the j[th] comment grade. Comprehensive evaluation can be expressed as Formula 13.

$$B=W\circ R=(w_1,w_2,\cdots w_m)\circ\begin{pmatrix}r_{11} & r_{12} & \cdots & r_{1n}\\ r_{21} & r_{22} & \cdots & r_{2n}\\ \vdots & \vdots & \vdots & \vdots\\ r_{m1} & r_{m2} & \cdots & r_{mn}\end{pmatrix}=(b_1,b_2,\cdots,b_n) \quad (13)$$

where "$\circ$" is the signal of certain kind of calculation and B denotes the set of fuzzy comprehensive evaluation.

In this paper, we choose fuzzy operator M(*,+) since it not only takes the influence of all indices into account but also reserves all information of single-factor evaluation, which is suitable to the principles of evaluation of Characteristic Towns.

APPLICATION AND CONCLUSION

This paper choose one small town of the second-branch of the Characteristic Towns in China. After calculation, the membership of every index can be seen in the Table 4 below.

The numbers in the table can be regarded as matrix R, which is the relation from factors set to comments set.

Then we get the set of fuzzy comprehensive evaluation B=(0.09, 0.33, 0.49, 0.09, 0). Since 0.49 is the largest, we claim that the comprehensive evaluation of this small town is good.

In real cases of selecting characteristic towns, we can compare different towns through this approach or by calculating the comprehensive scores using the corresponding score of each comment grade.

Based on the data of the first batch of Characteristic Towns, this paper uses principal component analysis to transform the existing indices of Characteristic Towns to a few principal indices, and gets the weight of each index. Five sets of comments are set up to determine the membership of each index to each evaluation grade, and to make a fuzzy comprehensive evaluation of the indices of the small towns.

The product line of characteristic towns in the future is to be more diverse. The towns which lack industrial resources and operational strategy will be canceled the title of characteristic town, considering the appraisal at national level and market choice. We believe that the indices system of characteristic towns is to be constructed in a more complete way. Borrowing indiscriminately from others' experience and related practices in the pursuit of short-term achievements will be eliminated.

Table 4. A Town's Membership of 21 Indices.

Indices	Excellent	Very good	Good	Qualified	Bad
A11 Resident population	0.00	0.99	0.01	0.0	0.00
A21 GDP of the town	0.00	0.50	0.50	0.00	0.00
A22 Annual net income per capita	0.00	0.00	1.00	0.00	0.00
A23 Investment in fixed assets and real estate	0.00	0.80	0.20	0.00	0.00
A31 Honorary title	0.50	0.50	0.00	0.00	0.00
B11 Layout of industries	0.01	0.99	0.00	0.00	0.00
B12 Leading industry	0.00	0.04	0.96	0.00	0.00
B21 Land utilization	0.10	0.90	0.00	0.00	0.00
B22 Construction of housing and commercial projects	0.00	0.90	0.10	0.00	0.00
B23 Measures in environmental governance	0.00	0.10	0.90	0.00	0.00
B31 Intangible cultural heritage	0.96	0.04	0.00	0.00	0.00
B32 Regional culture	0.00	0.80	0.20	0.00	0.00
B33 Cultural activities	0.00	0.00	1.00	0.00	0.00
B41 Road traffic	0.00	0.04	0.96	0.00	0.00
B42 Infrastructure	0.00	0.10	0.90	0.00	0.00
B43 Public service facilities	0.00	0.80	0.20	0.00	0.00
C11 Overall planning	0.00	0.00	0.80	0.20	0.00
C12 Detailed planning	0.00	0.00	1.00	0.00	0.00
C21 Planning and Construction Management	0.00	0.00	0.80	0.20	0.00
C22 Social management service	0.00	0.10	0.90	0.00	0.00
C23 Integration of the town and its villages	0.00	0.00	0.04	0.96	0.00

Under the circumstances of more diversified industrial layout in the future of characteristic towns, the systematic evaluational indices will be established, and the evaluational methods of all industrial indices will be more comprehensive. In order to plan the long-term industrial resource allocation and operational strategy management, we will transform the developmental needs of more characteristic towns into corresponding data indicators to create more and more industrial information.

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Evaluation System Design for Application of Innovative Teaching Methods in Major of Construction Management: Case Study in a University of Finance and Economics

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ABSTRACT

At present, the attention degree of Chinese higher education to students' comprehensive development ability is significantly raised. Cross-disciplinary and cross-scenario cross-education patterns have become a new development direction. As a typical interdisciplinary specialty, major of construction management is gradually introducing innovative teaching methods such as workshop, flipped classroom, peer instruction. However, the current domestic application of these teaching methods has not formed a systematic evaluation system. Based on the application of four innovative teaching methods in major of construction management, this research screens evaluation indicators of teaching effect which is in line with the major, and uses analytic hierarchy process (AHP) and Delphi expert scoring method to get a set of measurable, quantitative evaluation indicator system. Finally, taking major of construction management in a university as a case, the validity of the evaluation system is tested.

INTRODUCTION

Nowadays, the concept of higher education in China has started to shift from "knowledge education" to "education for people" (Educational Research Editorial Department 2016). This requires that university education should not only impart knowledge, but also guide students to develop actively, creatively and sustainably. To develop the system of cultivating students' core literacy in line with the local conditions, we must jump out of the limitations of a single specialty and a single scenario and carry out a cross-disciplinary and cross-scenario education model that adapts to society. The major of construction management is a typical interdisciplinary specialty. Its professional goal is to cultivate senior management talents who can achieve definite project objectives under certain circumstances and effectively plan, organize, lead and control the resources that the project can control. (Zhao 2010).

The traditional major of construction management is offered by comprehensive universities and universities of science and technology, but in recent years, a number of universities or colleges of finance and economics have also set up this specialty. Compared with traditional universities, major of construction management set up in universities of finance and economics is more inclined to cultivate the compound senior management talents rather than engineering and technical talents, therefore, the setting of its professional courses has their own distinct characteristics, and teaching methods also need to be more scientific, flexible and humanized (Li 2006).