

Nonlinear Analysis of Core Competence for Real Estate Enterprise Using Evolutionary Fuzzy Neural Inference Model

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Abstract: The real estate development trade is a pillar industry of our national economy. The real estate companies must focus on core competence in order to succeed in the fierce competition. This paper presents a probabilistic model for core competence estimation of real estate firms. According to the nonlinear feature of real estate core competence, this paper establishes the fuzzy and neural network model to core competence assessment of real estate. We analyze the features of core competence, thus define the core competence in real estate industry. The main competition factors of real estate industry include R&D ability, innovation capability, strategic management capacity, marketing capacity and management capacity. We confirmed the weight of each index quantitatively by means of Analytical Hierarchy Process(AHP) according to an established index system. Then analyze the ability of artificial neural network to real estate core competence assessment, and lays the theoretical foundation of artificial neural network using in the systematic optimization of real estate core competence assessment and getting reasonable accurate core competence assessment result.

Key words: Analytical Hierarchy Process (AHP), artificial neural network, core competence assessment, fuzzy method, real estate

INTRODUCTION

At present, the real estate industry in China as a new economic growth point and the mainstay industries of the national economy will be facing in this century of unprecedented development opportunities, at the same time, in China's WTO accession, the real estate development enterprises not only faces the main consumer markets, market supply and demand, consumer demand, the changing and the influx of foreign enterprises will face competition in the domestic market forced the state-owned enterprises in international markets as well as the enormous challenges of survival. Current real estate development in the management of enterprises still exist many problems, to fundamentally solve these problems, seize opportunities, meet challenges, the fundamental method is only market-oriented and practical, establish core competencies strategic concepts, and, establish real estate enterprises core competencies management system. How to obtain the long-term existence and keep on the development in the competition has become the problem that the real estate management authorities just consider in the bitter and search for. Since the core competence principle have put forward by the C Paul and G Hammer in the lead, the enterprise core competence concept realm to become popular in the business development theories and strategy management world quickly (Xie, 2005). So it is especially important to build a scientific core

competence evaluation system for the real estate development enterprises through which to know clearly about their advantages and disadvantages, so to guide their future development better.

This study is on the basis of systematic and dynamic appraisal principle, build a systematic and dynamic core competence evaluation system for the real estate development enterprise through drawing lessons from the systematic and dynamic core competence evaluation system for the general technology-based enterprise first and then analyzing the characteristics and the value chain of the real estate development trade in detail to find the particularities. And then design the second and the following thinning evaluation indexes at all levels by drawing lessons from the evaluation system for the general technology-based companies and the practices of the real estate development.

Liu (2008-01) applied Supply Chain Management (SCM) to the project of real estate enterprises and sets up the mode of supply chain on the project, and then based on the mode of supply chain, we build the mode of the SCM taking the real estate enterprise as the center and discuss the operational flows of the supply chain of the project. It comes to a conclusion that using the SCM can improve the efficiency of the project of real estate, optimize the value chain of real estate enterprises and enhance the core competence of the real estate enterprises.

Kai (2007-03) start with connotative analysis of the core competence for real estate enterprises, which analyzes its comprising essentials and puts forward the main ways to promote the core competence for real estate enterprises.

Sun *et al.* (2007) analyze the features of core competence, thus define the core competence in real estate Industry. The main competition factors of real estate industry include land resources, capital scale and market management. Accordingly, we put forward the solution to establish the core competence of real estate industry.

At present there are a number of integration assessment methods (Zadeh, 1965; Cox, 1999), for example, AHP, grey evaluation, fuzzy comprehensive judgment, AHP-fuzzy comprehensive judgment, etc. We should review all the assessment methods in order to find the most suitable method for assessing the quality level of a construction project. Some experts have studied these. We carried out a comprehensive evaluation of a construction project using a fuzzy analysis. First, we confirmed the weight of each index quantitatively by means of AHP according to an established index system. Then, we defined the elements of an assessment matrix using fuzzy and a quality assessment model for construction project is set up. The advantage of this approach is that it does not rely on the experience of experts and it can improve the validity and the precision of evaluation. Consequently, it can reflect the quality status of construction project.

ANN is basically as implied model of the biological neuron and uses an approach similar to human brain to make decisions and to arrive at conclusions. At present, the BP neural network is one of the most matures, wide spread artificial neural network. Its basic network is three-layers feed-forward neural network such as input layer, hidden layer, and output layer. The input signals must firstly disseminate forward into the hidden node. The output information of the concealment node transmits into output node Via-function action. Finally, the output variable result is obtained. The BP network can realize complex non-linear mapping relations will fully from input to output and has good exuding ability, which can complete the duty of complex pattern recognition.

The core competence is a magic weapon to vanquish the enemy in the market competition for real estate enterprises. This article will start with connotative analysis of the core competence for real estate enterprises, which analyzes its comprising essentials and puts forward the main ways to promote the core competence for real estate enterprises (Kai, 2007-03). To seek the purpose that gets reasonable accurate assessment result, this paper attempts to analyze reliability and the stability of fuzzy method and neural network model in the course of core competence assessment of the real estate enterprise, and

discusses its suitable ability for core competence assessment of the real estate firms and its guidance meaning in network optimization design.

Core competence of real estate enterprise description: Notations for EJSSP: C.K.Prahalad and Gary.Hamel (Xie, 2005; Kai, 2007-03) firstly brought the core competence forward in 1990. They argue that core competence is the collective learning in the organization, especially the capacity to coordinate diverse production skills and integrate streams of technologies. We think that core competence is the ability beyond the rival in essence which has three characteristics: difference--clearly competitive advantage, sustainability-potential expandability and inevitability--difficult for competitors to imitate. Core competitiveness, also known as "core (competition) capacity," "the core of competitive advantage", referring to the organization have to deal with external change and intense competition and the ability of competitors to win the set.

Core competence (Bomba Building, 2000-2001) is the competitiveness of enterprises which will enable the most basic long-term stability of the entire enterprise to maintain competitive advantage, access to the competitiveness of the stability of excess profits, assets and skills is the organic integration of the operating mechanism of their own organizational capacity, is the implementation of internal management strategy and external strategic transaction results. The residence real estate industry is the new economy growth point in the world, facing the unprecedented development opportunity. Meanwhile, the real estate industry not only faces the change of market consumer, the market supply relation, the consumer need etc. continuously, but also faces the foreign real estate enterprise flowing into the local market to make the competition increasing. Therefore, combining the actual circumstance of the real estate profession with the finance innovation development, to set up the core competence and to acquire the competitive advantage are the demands of existence and development of the real estate industry. In this study, we argue that core competence of real estate corporations is made up of R&D ability, innovation capability, strategic management capacity, marketing capacity and management capacity. The R&D ability is subdivided into proportion of research and development expenses, The success rate of research and development, The ratio of the number of patent owners (quantitative indicators), and Information collection capabilities (qualitative indicators). The innovation capability is including Production rate of new products, the technology leader in products and the degree of scientific and technological level and Product replacement rate (qualitative indicators). The strategic management capacity can be described as ability to integrate the environment, Market control ability, and strategic planning capacity. These three indicators are qualitative

Table 1: Evaluating results of core competence

Enterprise		Evaluation results				
		1	2	3	4	5
E ₁	Expect	0.05	0.01	0.92	0.02	0.00
	Actual	0.00	0.00	1.00	0.00	0.00
E ₂	Expect	0.00	0.02	0.00	0.85	0.13
	Actual	0.00	0.00	0.00	1.00	0.00
E ₃	Expect	0.01	0.01	0.00	0.10	0.88
	Actual	0.05	0.01	0.00	0.02	0.92
E ₄	Expect	1.00	0.00	0.00	0.00	0.00
	Actual	0.95	0.00	0.01	0.04	0.00
E ₅	Expect	0.00	1.00	0.00	0.00	0.00
	Actual	0.01	0.92	0.01	0.05	0.01

indicators. The marketing capacity consists of market share, sales margin (quantitative indicators), and product reputation (qualitative indicators). And organization and coordination capacity, human resources management capacity, financial management capacity is all in management capacity. These three are all qualitative indicators management capacity. The core competence factors of the real estate enterprise were shown in Table 1.

METHODOLOGY

FUZZY, AHP and ANN:

Fuzzy method: Zadeh (1965) first proposed Fuzzy Logic as a tool with which to describe uncertainty and imprecision. Because FL imitates the high-order mode in which the human brain makes decisions in the face of uncertainty or vagueness, it provides an effective way for automated systems to describe highly complex, ill-defined, or difficult-to-analyze subjects. In general, Fuzzy Logic is composed of a fuzzer, rule base, inference engine and defuzzier (Zadeh, 1965; Cox, 1999; Stavrovski, 2005).

- Suppose $U = \{u_1, u_2, \dots, u_n\}$ is composed of evaluation index, $V = \{v_1, v_2, \dots, v_n\}$ represent the evaluation factors.
- Suppose $A = (a_1, a_2, \dots, a_m)$ is the weight of the evaluation index

$$\text{where } 0 < a_i \leq 1, \sum_1^m a_i = 1$$

- Suppose comment set is $V = (v_1, v_2, v_3, v_4)$, and v_1 represent the grade is best, v_2 represent the grade is better, v_3 represent the grade is average, v_4 represent the grade is bad.

Fuzzy relation from to can be description as follow:

$$R_i = \begin{bmatrix} r_{i1} \\ r_{i2} \\ \vdots \\ r_{ni} \end{bmatrix} = \begin{bmatrix} r_{i11} & r_{i12} & r_{i13} & r_{i14} \\ r_{i21} & r_{i22} & r_{i23} & r_{i24} \\ \vdots & \vdots & \vdots & \vdots \\ r_{in1} & r_{in2} & r_{in3} & r_{in4} \end{bmatrix} \tag{1}$$

where $r_{ij} = (i = 1, 2, \dots, m; j = 1, 2, \dots, n)$

The fuzzy comprehensive evaluation can be got as follow:

$$B = A \bullet R \tag{2}$$

In this study, the quality and grade of construction works are divided into four grades, namely: "best", "good", "qualified", "unqualified", and each grade score is 0.8, 0.6, 0.4, 0.1, respectively. So vector $C = [0.8, 0.6, 0.4, 0.1]^T$ is got. An evaluation of a quality rating score S_i was set up, so:

$$S_i = B_i \times C \tag{3}$$

Overview of AHP: The Analytic Hierarchy Process (AHP) is a structured technique for helping people deal with complex decisions. Rather than prescribing a "correct" decision, the AHP helps people to determine one that suits their needs and wants. Based on mathematics and psychology, it was developed by Thomas L. Saaty (Cox, 1999) in the 1970s and has been extensively studied and refined since then.

The procedure for using the AHP can be summarized as (Stavrovski, 2005). Model the problem as a hierarchy containing the decision goal, the alternatives for reaching it, and the criteria for evaluating the alternatives.

- Establish priorities among the elements of the hierarchy by making a series of judgments based on pair wise comparisons of the elements. For example, when comparing potential real-estate purchases, the investors might say they prefer location over price and price over timing.
- Synthesize these judgments to yield a set of overall priorities for the hierarchy. This would combine the investors' judgments about location, price and timing for properties A, B, C, and D into overall priorities for each property.
- Check the consistency of the judgments.

Come to a final decision based on the results of this process.

Overview of ANN: An Artificial Neural Network (ANN) Prahalad and Hamal (1990); Meng and Taozhu (2005) and Zadeh (1965) is an information processing paradigm that is inspired by the way biological nervous systems, such as the brain, process information. The key element of this paradigm is the novel structure of the information processing system. It is composed of a large number of highly interconnected processing elements (neurons) working in unison to solve specific problems. ANNs, like people, learn by example. The first artificial neuron was produced in 1943 by the neuron physiologist Warren McCulloch and the logician Walter Pitts. But the technology available at that time did not allow them to do too much.

An ANN is conured for a specific application, such as pattern recognition or data classification, through a learning process. Learning in biological systems involves adjustments to the synaptic connections that exist between the neurons. This is true of ANNs as well. A trained neural network can be thought of as an “expert” in the category of information it has been given to analyze. This expert can then be used to provide projections given new situations of interest and answer “what if” questions. Other advantages include (Cox, 1999):

- **Adaptive learning:** An ability to learn how to do tasks based on the data given for training or initial experience.
- **Self-organization:** An ANN can create its own organization or representation of the information it receives during learning time.
- **Real time operation:** ANN computations may be carried out in parallel, and special hardware devices are being designed and manufactured which take advantage of this capability.
- **Fault tolerance via redundant information coding:** Partial destruction of a network leads to the corresponding degradation of performance. However, some network capabilities may be retained even with major network damage.

Core competence analysis based on ANN:

The establishment of fuzzy matrix: According to the above unascertained measure synthetic appraisal model, we take one hundred typical enterprises in one certain region (supposed to object1) for example to evaluate synthetically. The number of the appraisal experts is ten. The appraisal index system is shown in Table 1.

The index set is {best, good, qualified, unqualified} and it is divided into five appraisal scales and by all appearances, it is positive sequence. The each factor is total ten score. Then, each appraisal object is ten score and the distinguishment is that the degrees are different. The scoring principle is fit the measurement criterion. Based on the statistical data of the appraisal objects, the single measurement matrix can be got by Eq. (1).

The determination of weights: Weight set of indices can be got through group-decision AHP. The proportion of the scale of project’s entity quality is determined by export analysis combining the analytic hierarchy process, as shown the following matrix:

$$E = \begin{bmatrix} 1 & 2 & 3 & 3 & 3 & 3 & 3 & 3 & 3 & 3 \\ 0.5 & 1 & 2 & 2 & 2 & 2 & 2 & 2 & 2 & 2 \\ 0.33 & 0.5 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 0.33 & 0.5 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 0.33 & 0.5 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 0.33 & 0.5 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 0.33 & 0.5 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 0.33 & 0.5 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 0.33 & 0.5 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 0.33 & 0.5 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{bmatrix}$$

Solving Matrix Eigenvalue problems, $EA = \lambda_{\max}A$, got as follow:

$$\lambda_{\max} = 10.014$$

$$C_I = \frac{n-\lambda_{\max}}{n-1} = \frac{|10-10.01|}{9} = 0.001$$

$$C_R = \frac{C_I}{R_I} = \frac{0.001}{1.49} = 0.0075 < 0.1$$

Therefore, the matrix meets the consistency requirements. The weight set of project’s entity quality can be got as: A[0.24,0.15,0.08, 0.08, 0.08, 0.08, 0.08, 0.08, 0.08, 0.08].

Comprehensive evaluation: By Eq.(1), the evaluating matrix of fuzzy measure of single index is obtained as follows:

$$R = \begin{bmatrix} 9/10 & 1/10 & 0 & 0 \\ 8/10 & 2/10 & 0 & 0 \\ 7/10 & 3/10 & 0 & 0 \\ 8/10 & 2/10 & 0 & 0 \\ 9/10 & 1/10 & 0 & 0 \\ 9/10 & 1/10 & 0 & 0 \\ 9/10 & 1/10 & 0 & 0 \\ 8/10 & 2/10 & 0 & 0 \\ 9/10 & 1/10 & 0 & 0 \\ 9/10 & 1/10 & 0 & 0 \end{bmatrix}$$

Using (2), the comprehensive evaluating matrix of fuzzy measure of entity quality is obtained as follows:

$$B = A \cdot R = [0.85, 0.015, 0, 0]$$

By (3), the comprehensive evaluating score is got as follows:

$$S = B \times C = [0.85, 0.15, 0, 0] \times [0.8, 0.6, 0.4, 0.1] = 0.77$$

Similarly, the appraisal of Quality assurance material, Impression quality, Design quality and Influence on environment are calculated as: 0.766, 0.77, 0.772, 0.766. According to the similar method, obtain the result of fuzzy synthetic evaluation in other projects.

Verification and testing: The treated the 30 samples data were input into the neural network, the former 15 sample as the study group, and the next 5 groups as test samples. The network error was of 0.0001 expected. The use of neural network learning system to repeated training data, experimental results have been the best time, the parameters are as follows:

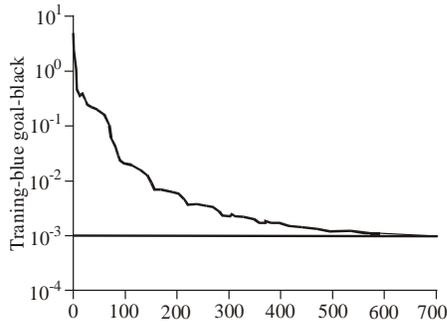


Fig. 1: The error curve of training

Momentum: $\phi = 0.3$
 Learning rate: $\eta = 0.4$
 Learning number: $n = 1000$
 Hidden layer nodes: $p = 6$
 The actual network error: $\zeta = 0.0035$

The final weights and node thresholds of each level are as follows:

$$W_1 = \begin{bmatrix} -9.7302 & 1.10221 \\ -1.70174 & 4.62636 \\ -1.71763 & -13.5603 \\ -6.19883 & -0.42276 \\ 6.52308 & -10.7620 \\ -1.46127 & -10.4351 \end{bmatrix}$$

$$b_1 = \begin{bmatrix} 2.9651 \\ 0.861066 \\ 4.56791 \\ -0.926566 \\ 3.61568 \end{bmatrix} \quad b_2 = \begin{bmatrix} -2.8839 \\ -0.0474151 \\ 8.48565 \\ -2.05588 \\ 1.82947 \\ 1.44887 \\ 1.68849 \end{bmatrix}$$

$$W_2 = \begin{bmatrix} -220442 & 4.09808 & -0.867928 & -1.3239 & -7.40429 & 410411 \\ -279807 & 0.03406 & 263186 & -0.66796 & -7.02526 & 249682 \\ 7.07528 & -6.2266 & 62.54334 & -261349 & -263847 & -100439 \\ -320715 & 1.0241 & 470205 & -0.09640 & 153448 & -0.25043 \\ -415472 & 1.94121 & 3.4298 & -438106 & -111613 & 3.93755 \\ 232461 & -1.64653 & -0.528233 & 0.93287 & 0.741542 & -0.2267 \\ -113642 & 0.660891 & 9.17254 & -3.7801 & -497152 & 6.03484 \end{bmatrix}$$

The training results of ANN and the error curve are shown in Fig. 1, and the evaluating results of core competence is shown in Table 1.

CONCLUSION

In the future only through core competence can the companies obtain competitive advantage and achieve the

industry integration, while the real estate companies pay no attention to the core competence will fail in the competition. This study establishes neural network in view of core competence assessment of real estate companies. It is a kind of nonlinear method. It only needs to be input managed datum into neural network, evaluating the result will be obtained through neural network toolbox in MATLAB (2001) software which can avoid subjectivity and simplicity. The results will be more effective and objective. Evaluating core competence degree of real estate firms effectively will provide the basis for decision-makers. The technology of core competence data collection and utilization requires further study to support various types of decision making, such as core competence assessment, feasibility analysis, etc.

Step 1: Understand what value you currently bring to your owners. Examine the value you provide to investors, your building occupants, any customers of theirs that you significantly impact, even for yourself and the other owners of your privately-held company. Examine and understand what your current core competencies are across the activities you perform to deliver that value.

Step 2: Determine what types of value your company should provide in the future. This involves researching and developing your ideas on future customer needs and competitive trends. Understand which types of value your company could potentially impact based on current core competencies as well as those you might acquire. Especially important: some creative thinking on new ways to deliver value, particularly if they can replace existing ways of doing things. Analysis on main competition factors of real estate industry such as land resources, capital scale and market management.

Step 3: Obtain the main factors of the core competence in real estate industry, integrate the important internal resources and cultivate the real estate industry culture based on the core competence. Absolutely, satisfying the market valid need is the life of the real estate industry; then the core ability is the life spring of the industry. To build up the core competence, the real estate industry must form the core competence that has the special features of this industry, based on the proper business, the proper person and the proper ground system, and taking the right measures.

Finally, apply this evaluation system to try to analyze and appraise the core competence of six typical real estate listed companies of our country. And the results indicate that this core competence evaluation system of the real estate development enterprise system has basically realized our original intention which for the enterprise's self-known and the future development guidance.

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