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AN ALTERNATIVE APPROACH OF COMPETITIVENESS EVALUATION FOR REAL ESTATE DEVELOPERS

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ABSTRACT. This paper presents a fuzzy competitiveness rating (FCR) method for measuring the competitiveness of real estate developers with referring to the Chinese real estate industry. Research data used for analysis were collected from a case study in Green Town Company. Research into the assessment of real estate developers' competitiveness has been limited. The fuzzy competitiveness rating method is proposed as an alternative effective approach in assessing the competitiveness of real estate developers. The FCR method furnishes real estate developers with innovative solution to assess their competitiveness. By understanding properly organizational competitiveness, real estate developers can adopt appropriate actions and strategies to utilize organization resources more effectively to enhance their competitiveness, thus improve their business performance in the real estate market.

KEYWORDS: Real estate developers' competitiveness; Fuzzy sets theory; Linguistic term; Fuzzy competitiveness rating method

1. INTRODUCTION

Business in real estate industry is generally subject to more uncertainties when general business environment changes in turbulent times. Business performance in such uncertain environment and turbulent economic times depends on organizational competitiveness: the ability to compete. Business competitiveness has been addressed by various researchers from the perspectives of national, industry and firm level (for example, Porter, 1990; Momaya and Selby, 1998; Flanagan et al., 2005; Shen et al., 2006). Porter (1990) pointed out that competitiveness is at the core of the success or failure of firms in a market economy. Oral (1993) presented a competitiveness model, called industrial competitiveness model (ICM), to measure a manufacture's competitiveness at industry level. The Institute for Management

Development (IMD) and the World Economic Forum adopted "World Competitiveness Scorecard" in ranking the top 22 countries as best Organization for Economic Cooperation and Development (OECD) (IMD, 2004). Shen et al. (2006) presented the Key Competitiveness Indicators (KCIs) model for examining contractor's key competitiveness in construction industry through establishing relative significance between various indicators.

Referring to real estate industry, previous studies have also addressed various topics on business competitiveness. For example, Porter (1989) established various factors affecting real estate business' competitive advantage, including two critical factors: lower cost and differentiation. It is suggested that the real estate company with low cost strategy can achieve lower costs across many processes, including finance and delivering a project. Development with lower costs allows developers to get a higher margin at prevailing price. On the other hand, with adopting 'differentiation strategy', a business will develop the ability to have some unique skills or resources that allow an organization to command a premium price. A recent study by Li et al. (2009) presents other factors affecting real estate business and suggests that the real estate developer's unique financial competency, market coverage and management competencies are vital to its competitiveness.

Nevertheless, it appears that little study has been undertaken on the assessment of competitiveness of real estate developers with particular reference to the Chinese context where economic system has been under reform. The proper evaluation on the competitiveness will help a firm (both domestic and overseas) know whether it has competitive advantage over its competitors within the business environment, and identify its strength and weakness. The competitiveness assessment results can therefore be valuable information for real estate organizations to make decisions and apply adequate methods to improve their competitiveness where necessary. By using a questionnaire survey, Li et al. (2009) developed a competitiveness indicators checklist for helping assess real estate developers' competitiveness. However, the checklist can not be used to identify relative advantages that a specific firm has. It is considered important to introduce a mechanism to help real estate firms to understand their relative competitiveness, which is the major aim of this study.

As pointed out in previous studies that organizational competitiveness is a complicated system. Such system is characterized by complex mechanism, ill-defined system boundary and layers, multiple variables and fuzziness (Feng and Xu, 1996; Nijkamp, 1986; Feng and Xu, 1999). Particularly, fuzziness exists when organizational competitiveness is described. Therefore, this study intends to apply fuzzy set theory and introduce an alternative approach for assisting real estate developers in assessing their competitiveness through establishing a fuzzy synthetic rating model. Two major procedures are introduced in order to build up the model. The first step is to formulate a set of competitiveness indicators and establish the membership functions of fuzzy competitiveness indicators (Zadeh, 1965). A membership function represents the fuzziness degree of linguistic variables. Secondly, by using the indicators, the fuzzy competitiveness rating (FCR) model is built up to evaluate the competitiveness of real estate developers. A case study will be conducted as a demo to illustrate the application of the FCR model.

2. COMPETITIVENESS INDICATORS FOR REAL ESTATE DEVELOPERS

Content analysis is used for identifying a preliminary list of competitiveness indicators for real estate developers. The content analysis method has been widely utilized in social sciences (Rattleff, 2007). In a recent review on

previous works concerning competitiveness indicators for organizations, 91 relevant works are identified, which were published during the period from 1973 to 2007 (Zhang et al., 2009). Typical indicators include corporate brand image, uniqueness in product, market strategy and so on. There are few research works which address the competition between real estate developers and competitiveness factors in China. These include Blue book of China's enterprises competitiveness (2006), Research report on Chinese Top10 real estate listed developers (2005), and Research report on the most influential listed organizations in China (2006). In the reports Blue book of China's enterprises competitiveness (2006), a mathematical formula is used for the calculation of a competitiveness index value by incorporating various competitiveness indicators such as the sales' annual average growth rate in recent three years, overall labour productivity and others. The joint report by "Guanghua School of Management in Beijing University" and "Shanghai Security News" (Research report on the most influential …, 2006) has presented 8 indicators for identifying the important real estate developers in China, including return on equity, entrepreneurship, corporate structure, social responsibility and so on.

There are still other research works in examining firm competitiveness in other business fields such as manufacturing and construction (e.g. McKee and Robinson, 1989; Holt et al., 1994; Wheelen and Hunger, 2002; Kaplan and Norton, 1996; Tan et al., 2007; Li et al., 2009, etc.). These previous works provide valuable references to formulate a set of competitiveness indicators. By reviewing these literature works, organizational competitiveness indicators in real estate industry can be broadly classified into three groups; those from resource-based theory (Wernerfelt, 1984; Barney, 1991; Powell, 2001; Newbert, 2008), those from core competence mechanism theory (Prahalad and Hamel, 1990; Sanchez et al., 1996), those from dynamic capabilities theory (Teece et al., 1997) and those from Porter's competitive force theory (Porter, 1990). As the results, over 100 competitiveness indicators are listed from examining literatures. In order to ensure effective readability and proper relevance to real estate developers, these indicators were presented to 15 real estate practitioners and the academics in the discipline for comments and suggestions. The respondents were invited to advise whether the listed indicators are appropriate in capturing the competitiveness of real estate developers with reference to the Chinese context. Valuable comments were received and amendments were made accordingly, which led to the confirmed list of 42 competitiveness indicators, as shown in Table 1.

Table 1. A list of competitiveness indicators for the real estate developers in China

Group	Indicator	Code
Resources (R)	Corporate brand awareness	X_1
	Annual land reserves	X_2
	Access to a diverse range of capital	X_3
	Availability of consumer community resources	X_4
	Availability of rich human resources; effective staff promotion	X_5
	Availability of extensive real estate policy information; many information channels	X_6
	Favoring support from planning department	X_7
	Relationship with government	X_8
	Sound organizational culture	X_9
	Knowledge of market information channels and relevant market strategy	X_{10}
	Expert team organized for forecasting and analyzing consumer market	X_{11}
	Availability of long-term strategic partner (construction, design, supervision and property management, etc.)	X_{12}

(Continued)

Group	Indicator	Code
(Continued)		
Mechanism (M)	Effective corporate ownership	X_{13}
	The innovation and reform on organizational structure	X_{14}
	Reasonable equity structure, which promote the sustained development of organization	X_{15}
	Availability of mature decision-making mechanism	X_{16}
	Appropriate incentive mechanism	X_{17}
	Rational surveillance and restraint mechanisms on senior managers	X_{18}
	Effective coordination mechanism with the related upstream and downstream enterprises	X_{19}
	Autonomous and flexible market-oriented operation mechanism	X_{20}
Capability (C)	Good at expanding finance channels and cash liquidity	X_{21}
	Good at making investment analysis and orientation in the project feasibility stage	X_{22}
	No major investment mistakes in recent three years	X_{23}
	Entrepreneurship (e.g. top leaders with resolute determination and quick response to tell new market opportunity, superior strategic management capacity)	X_{24}
	Scientific and rational use of capital budgeting and planning capabilities	X_{25}
	Sensitive risk prediction, assessment and response capacity	X_{26}
	Good team collaboration capability	X_{27}
	Business marketing ideas, strategies and marketing schedule control can get maximum benefit	X_{28}
	Scientific market research before the real estate project	X_{29}
	The capability to grasp the latest market trends and characteristics of design concepts	X_{30}
	Good at promoting the selling point of real estate project timely and effectively	X_{31}
	Establishment of a specialized database of targeted consumers in time for effective communication and coordination	X_{32}
	Sound and efficient organizational management capacity	X_{33}
	Development of green corporate brand; conduct green strategy to gain social responsibility	X_{34}
	Knowledge of change in market environment and market trend in good time	X_{35}
	Efficient land pricing strategy and success rate of land bidding	X_{36}
	Excellent value chain integration capability	X_{37}
	The smoothly access to relevant government departments' real estate project approval	X_{38}
	Strict and efficient quality control and planning capability	X_{39}
	Rational and clear corporate business schedule control	X_{40}
	Good inter-departmental co-ordination capacity	X_{41}
	Effective cost control methods and capabilities	X_{42}

3. RESEARCH METHODS

Fuzzy set theory is used in this study to develop a fuzzy competitiveness rating (FCR) model for measuring real estate developer's competitiveness. Fuzzy sets were introduced by Zadeh (1965) as an extension of the classical notion of set. According to Zadeh (1965), if X is a collection of objects denoted generically by x, then a fuzzy set $\tilde{A}$ in X is a set of ordered pairs: $\tilde{A} = \{(x, \mu_{\tilde{A}}(x)) | x \in X\}$. $\mu_{\tilde{A}}(x)$ is a value assigned to represent the membership of x in $\tilde{A}$. If the value of $\mu_{\tilde{A}}(x)$ is nearer to 1, the grade of membership of x in $\tilde{A}$ will be higher. For example, if there are 3 fuzzy members in a fuzzy set $\tilde{A}$, namely, x_1, x_2, x_3 and their membership values are defined respectively as 0.4, 0.7, and 0.5 then, we can denote the fuzzy set as $\tilde{A} = \{(x_1, 0.4), (x_2, 0.7), (x_3, 0.5)\}$, where x_2 is most relevant to fuzzy set $\tilde{A}$, as it assumes the value of 0.7, mostly closing to the maximum

value 1 in the set. As discussed previously in this paper, organizational competitiveness is described with fuzziness. Individual competitiveness indicators can be considered as fuzzy indicators, which formulate a fuzzy set. The grade of membership of an individual indicator is considered as the relative significance of the indicator, based on which weighting values between indicators can be established.

The concept of fuzzy numbers, presented by Jain (1977) and Dubois and Prade (1988), can be applied to improve the representation of the fuzzily defined system. The decision makers assess the alternatives with fuzzy numbers and rank these fuzzy numbers, and then make their decisions (Mizumoto and Tanaka, 1976; Nahmias, 1977). And there are various established membership functions for describing fuzzy numbers, such as linear, non-linear, and exponential functions. Triangular linear fuzzy membership function is commonly used in researches for describing the fuzziness in factor analysis (Tah and Carr, 2000; Lin and Chen, 2004; Li et al., 2007; Chen and Zhao, 2010). And this method is used to describe the fuzzy parameters in this paper. A typical definition of triangular fuzzy number can be found in the study by (Zimmermann, 2001). Considering triangular fuzzy number with member p, denoted by $\tilde{P}(a, b, c)$, the membership function of p is defined as:

$$\mu_{\tilde{P}}(p) = \begin{cases} 0, & p \le a, \\ (p-a)/(b-a), & a \le p \le b, \\ (c-p)/(c-b), & b \le p \le c, \\ 0, & p \ge c. \end{cases} \quad (1)$$

In the formula (1), p represents the approximate value range between 0 and 1, a, b, c are parameters for describing fuzziness, where $0 \leqq a$; $0 \leqq b \leqq c \leqq 1$. These relations can be expressed graphically, as shown in Figure 1. b is the most possible value, and a and c are the lower and upper bounds respectively.

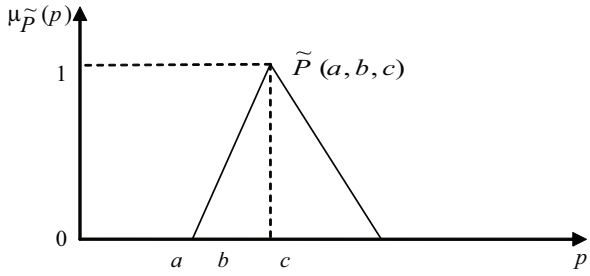

Figure 1. Distribution of a triangular fuzzy number $\tilde{P}$

Furthermore, when there are more than one fuzzy variables (such as competitiveness indicators), the average membership values can be calculated through the following formula (Heilpern, 1997):

Let $\tilde{x} = [x_l, x_m, x_u]$ and $\tilde{y} = [y_l, y_m, y_u]$ be two triangular fuzzy numbers, the distance between $\tilde{x}$ and $\tilde{y}$ is defined as:

$$d(\tilde{x}, y) = \begin{cases} \left(\frac{1}{3}(|x_l - y_l|^p + |x_m - y_m|^p + |x_u - y_u|^p\right), & 1 \le p < \infty \\ \max(|x_l - y_l|, |x_m - y_m|, |x_u - y_u|), & p = \infty \end{cases} \quad (2)$$

When p = 2, the formula (2) is similar to the Euclidean distance measurement and it is most commonly used, reasonable and practicable for distance measurement of fuzzy triangular numbers.

In application of fuzzy theory, common linguistic terms are used for improving effectiveness of the application. Linguistic terms have been found intuitively easy in expressing the fuzziness and imprecision of the decision maker's assessments (Zadeh, 1965; Deng and Yeh, 1998; Liang, 1999). Decision making problem such as evaluating the competitiveness of real estate developers is usually conducted under uncertainties, vagueness, fuzziness, and some information is incomplete or missing in the decision-making process. For example, it is

difficult for developers to give an exact value to express their opinion on company's competence. Instead, they are able to describe their feeling in the linguistic term of "good", "fair", or "poor" etc. In this way, subjective assessments are given in linguistic terms to determine the degree to which each competitiveness indicator contributes to organization competitiveness, represented by a fuzzy matrix. Similarly, decision makers can also use linguistic terms such as "very important", "important", "low", "very low" to express their opinion on each criterion involved, represented by a fuzzy vector. Each linguistic term is associated with a fuzzy set defined by a membership function. The triangular fuzzy number has been used effectively for expressing linguistic terms in research (Chen, 2000; Deng, 2006). In this study, two groups of linguistic terms are used (Juang and Lee, 1991; Chen, 2000; Li et al., 2007), one for decision rating, including the terms "very poor", "poor", "fairly poor", "fair", "fairly good", "good" and "very good", as shown in Table 2. Another group concerns with weighting values of indicators, including "very low", "low", "fairly low", "fair", "fairly high", "high", and "very high", as shown in Table 3.

Table 2. Linguistic terms used by the decision ratings

Linguistic terms	Very Poor (VP)	Poor (P)	Fairly Poor (FP)	Fair (F)	Fairly Good (FG)	Good (G)	Very Good (VG)
Membership function	(0,0,0.1)	(0,0.1,0.3)	(0.1,0.3,0.5)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.7,0.9,1.0)	(0.9,1.0,1.0)

Table 3. Linguistic terms used for describing weighting values

Linguistic terms	Very Low (VL)	Low (L)	Fairly Low (FL)	Fair (F)	Fairly High (FH)	High (H)	Very High (VH)
Membership function	(0,0,0.1)	(0,0.1,0.3)	(0.1,0.3,0.5)	(0.3,0.5,0.7)	(0.5,0.7,0.9)	(0.7,0.9,1.0)	(0.9,1.0,1.0)

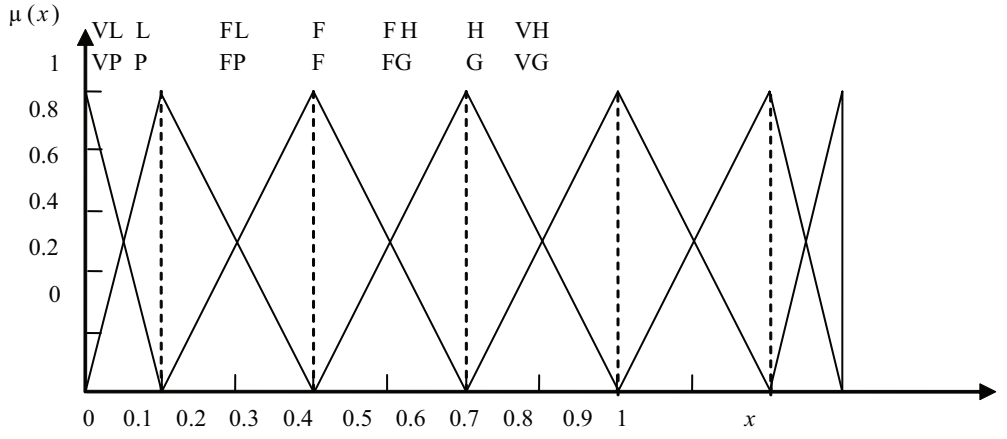

Figure 2. Distribution of linguistic terms for ratings and weightings of attributes

4. FUZZY COMPETITIVENESS RATING

As the competitiveness assessment process involves uncertainties and fuzziness, a fuzzy competitiveness rating approach is proposed by incorporating the fuzzy subjective judgment on the competitiveness of real estate developers. Considering that competitiveness is assessed by a panel of experts. Assume that there are t assessment panel members, denoted as $D = \{d_1, d_2, ..., d_t\}$. The competitiveness indicators formulated in previous section are used as the competitiveness attributes in the model FCR including forty-two factors under three groups (see Table 1). Individual assessment panel members will assess the competitiveness attributes' rating and weightings by selecting appropriate linguistic terms (refer to Table 2 and 3). Fuzzy ratings and fuzzy weighting vectors are denoted as $\tilde{r}_i^{(k)}$ and $\tilde{w}_i^{(k)}$ respectively, i = 1,2,…,n (n denotes for the number of attributes); k = 1,2,…, t(t is the number of panel members). In order to aggregate the assessment panel members' opinion, the average fuzzy decision ratings and average fuzzy weighting vectors are used to pool their opinions. Previous studies (Lin and Chen, 2004) suggest that the average fuzzy decision ratings and average fuzzy weighting vectors can be obtained by following formula:

$$\begin{aligned} \tilde{r}_i &= \frac{1}{t}[\tilde{r}_i^1 \oplus \tilde{r}_i^2 \oplus ... \oplus \tilde{r}_i^t], \ i = 1, 2, ..., n \\ \tilde{w}_i &= \frac{1}{t}[\tilde{w}_i^1 \oplus \tilde{w}_i^2 \oplus ... \oplus \tilde{w}_i^t], \ i = 1, 2, ..., n \end{aligned} \tag{3}$$

Based on the above, a fuzzy competitiveness rating (FCR) model can be expressed as follows to measure a real estate developer's competitiveness.

$$FCR = \sum_{i=1}^{n} \tilde{w}_i \otimes \tilde{r}_i \tag{4}$$

This method consolidates the fuzzy decision ratings and fuzzy weighting vectors of all the competitiveness attributes. The higher a real estate developer's FCR, the better competitiveness it has. According to (4), the value of FCR in (4) is also a triangular fuzzy number, denoted as $FCR = (a_l, a_m, a_u)$, which should follow the range of [0, 1], a_l is lower boundary, a_m is middle boundary and a_u is higher boundary. For this purpose, a normalization procedure is needed. According to existing studies (Chen, 2000; Li et al., 2007), the normalization can be undertaken by using the maximum a_u, denoted as a_u^*, to divide $FCR = (a_l, a_m, a_u)$. When there is only one real estate developer, the a_u^* can be obtained by setting all attributes' fuzzy decision ratings set as the maximum rating (0.9, 1, 1), and the maximum FCR will be obtained as $FCR^* = (a_l^*, a_m^*, a_u^*)$ with the maximum a_u. And the normalized fuzzy competitiveness rating (NFCR) can be calculated by following formula:

$$NFCR = FCR / a_u^* = \left(\frac{a_l}{a_u^*}, \frac{a_m}{a_u^*}, \frac{a_u}{a_u^*} \right) \tag{5}$$

According to formula (4) and (5), the normalized fuzzy competitiveness rating can be obtained. And this rating can be further matched to an appropriate linguistic term, which can represent the same meaning of the NFCR, from a natural language expression set. The natural language expression set includes a set of linguistic terms for expressing decision makers' opinion on real estate developers' competitiveness level. An effective natural language expression set has been introduced in previous studies (Lin and Chen, 2004; Li et al., 2007), as shown in Table 4, and this set is also used in this study.

Table 4. The natural language expression set

Extremely Low (EL)	(0, 0.1, 0.2)
Very Low (VL)	(0.1, 0.2, 0.3)
Low (L)	(0.2, 0.3, 0.4)
Fairly Low (FL)	(0.3, 0.4, 0.5)
Fair (F)	(0.4, 0.5, 0.6)
Fairly High (FH)	(0.5, 0.6, 0.7)
High (H)	(0.6, 0.7, 0.8)
Very High (VH)	(0.7, 0.8, 0.9)
Extremely High (EH)	(0.8, 0.9, 1.0)

There are several methods for matching a fuzzy competitiveness rating to a linguistic term from the natural language expression set (Schmucker, 1985; Lin and Chen, 2004). The Euclidean distance is an intuitive form incorporating subjective perception of proximity and is mostly used in researches (Chaudhur and Rosenfeld, 1996; Groenen and Jajuga, 2001). Therefore, the Euclidean distance is used in this study to match the fuzzy competitiveness ratings to the natural language expression set. The distances between NFCR and each member in the natural language expression set can be calculated by using formula (2). Then, real estate developer's competitiveness level can be identified by a linguistic term from the natural language expression set which has the minimum distance.

5. CASE STUDY

A case study is used to demonstrate the application of FCR for measuring a real estate firm's competitiveness. Greentown Property Group Co., Ltd., formerly known as Zhejiang Greentown Real Estate Development Co., Ltd., is the largest developer in Zhejiang Province in China. The organization was established in January 1995 and it has become a large-scale real estate development company in China. The firm was invited to participate the exercise of using FCR model by conducting an internal assessment with the constructive support by the director of the company. A panel of managerial staff in Green Town Property was appointed as assessment experts. The competitiveness assessment process using FCR is as follows:

Step 1: Organizing an assessment panel

Three senior managers from three major business departments are invited for participating this assessment, including human resources department, finance department, portfolio department, and investment department.

Step 2: Briefing session

Before starting the assessment, a briefing session is conducted to facilitate the panel members with the principle of FCR, and have a holistic understanding of the objective and procedures of the exercise. Information and data in Table 2, 3 and 4 are explained to panel members for helping them understand properly the meaning of various grades thus make effective judgment on their company's competitiveness.

Step 3: Assessing the ratings and weightings

After the briefing session, the panel members are invited to measure the ratings and weightings of all individual attributes listed in Table 1 based on their understanding of their company. The ratings and weightings of attributes are expressed by using the linguistic terms proposed in Table 2 and Table 3. For example, the rating of attribute "X_3- Access to a diverse range of capital" could be "very good" if the amount of loan received for land acquisition is large over the past three years; the rating of attribute "X_{36}-Efficient land pricing strategy and success rate of land bidding" could be "very good" if the company have a lot of successful land bids. The panel members need to give their judgment on all attributes. The panel members' judgments on the weightings and ratings of the competitiveness attributes are shown in Table 5.

Step 4: Aggregating panel members' opinions

According to Table 2 and Table 3, the panel members' opinions in Table 5 are transformed to triangular fuzzy numbers and aggregated by using formula (4). The average fuzzy decision ratings and fuzzy weighting vectors of the competitiveness attributes are obtained, as shown in Table 6.

Table 5. Panel members' judgments on the weightings vector (W) and decision ratings (R) of competitiveness attributes

Main and sub-attributes (CCIs)	Member 1		Member 2		Member 3	
	W	R	W	R	W	R
Section I Resources	H		FH		H	
X1	VH	VG	H	G	H	G
X2	VH	G	H	G	H	FG
X3	VH	G	H	FG	VH	G
X4	F H	VG	F	FG	FH	G
X5	H	G	H	FG	H	FG
X6	FH	FG	FH	FG	FH	FG
X7	FH	G	FH	G	FH	G
X8	FH	FG	FH	FG	FH	FG
X9	F	G	F	FG	F	G
X10	FH	FG	FH	FG	FH	F
X11	FH	FG	H	FG	FH	FG
X12	FH	FG	FH	FG	FH	F
Section II Mechanism	F		FH		F	
X13	FL	FG	F	G	F	G
X14	F	FG	FH	FG	FH	FG
X15	FH	G	FH	FG	FH	FG
X16	FH	G	F	FG	FH	G
X17	F	FG	FH	FG	F	G
X18	FH	G	F	FG	FH	FG
X19	H	FG	FH	G	H	FG
X20	F	FG	F	FG	H	FG
Section III Capability	H		VH		FH	
X21	H	G	FH	G	H	FG
X22	FH	G	FH	FG	FH	FG
X23	FL	G	F	G	F	FG
X24	VH	VG	VH	VG	H	VG
X25	H	FG	H	FG	H	G
X26	VH	G	H	FG	H	G
X27	H	FG	H	G	FH	FG
X28	H	FG	H	F	H	FG
X29	F	G	FH	FG	F	G
X30	FH	G	FH	FG	FH	G
X31	F	FG	F	G	F	F
X32	FL	VG	F	G	FL	G
X33	F	FG	FH	FG	F	FG
X34	VH	VG	H	VG	FH	VG
X35	FH	FG	FH	FG	FH	FG
X36	H	FG	FH	G	H	FG
X37	FH	FG	FH	FG	FH	FG
X38	FH	FG	FH	G	FH	G
X39	VH	VG	VH	VG	VH	VG
X40	H	G	H	FG	H	FG
X41	F	FG	FH	FG	F	G
X42	H	G	H	FG	H	G

Table 6. Average fuzzy ratings and fuzzy weightings of competitiveness attributes

Main and sub-attributes (KCIs)	Average fuzzy weightings	Average fuzzy ratings
Section I Resources	(0.63,0.83,0.97)	
X1	(0.77,0.93,1.00)	(0.77,0.93,1.00)
X2	(0.77,0.93,1.00)	(0.63,0.83,0.97)
X3	(0.83,0.97,1.00)	(0.63,0.83,0.97)
X4	(0.43,0.63,0.83)	(0.70,0.87,0.97)
X5	(0.70,0.90,1.00)	(0.57,0.77,0.93)
X6	(0.50,0.70,0.90)	(0.43,0.63,0.83)
X7	(0.43,0.63,0.83)	(0.63,0.83,0.97)
X8	(0.50,0.70,0.90)	(0.43,0.63,0.83)
X9	(0.37,0.57,0.77)	(0.63,0.83,0.97)
X10	(0.50,0.70,0.90)	(0.43,0.63,0.83)
X11	(0.57,0.77,0.93)	(0.50,0.70,0.90)
X12	(0.50,0.70,0.90)	(0.43,0.63,0.83)
Section II Mechanism	(0.37,0.57,0.77)	
X13	(0.23,0.43,0.63)	(0.63,0.83,0.97)
X14	(0.50,0.70,0.90)	(0.50,0.70,0.90)
X15	(0.50,0.70,0.90)	(0.57,0.77,0.93)
X16	(0.43,0.63,0.83)	(0.63,0.83,0.97)
X17	(0.37,0.57,0.77)	(0.57,0.77,0.93)
X18	(0.43,0.63,0.83)	(0.57,0.77,0.93)
X19	(0.63,0.83,0.97)	(0.57,0.77,0.93)
X20	(0.43,0.63,0.83)	(0.50,0.70,0.90)
Section III Capability	(0.70,0.87,0.97)	
X21	(0.63,0.83,0.97)	(0.63,0.83,0.97)
X22	(0.50,0.70,0.90)	(0.63,0.83,0.97)
X23	(0.23,0.43,0.63)	(0.63,0.83,0.97)
X24	(0.83,0.97,1.00)	(0.90,1.00,1.00)
X25	(0.70,0.90,1.00)	(0.57,0.77,0.93)
X26	(0.77,0.93,1.00)	(0.63,0.83,0.97)
X27	(0.63,0.83,0.97)	(0.57,0.77,0.93)
X28	(0.70,0.90,1.00)	(0.43,0.63,0.83)
X29	(0.37,0.57,0.77)	(0.63,0.83,0.97)
X30	(0.50,0.70,0.90)	(0.63,0.83,0.97)
X31	(0.30,0.50,0.70)	(0.50,0.70,0.87)
X32	(0.17,0.37,0.57)	(0.77,0.93,1.00)
X33	(0.37,0.57,0.77)	(0.50,0.70,0.90)
X34	(0.70,0.87,0.97)	(0.90,1.00,1.00)
X35	(0.50,0.70,0.90)	(0.50,0.70,0.90)
X36	(0.63,0.83,0.97)	(0.57,0.77,0.93)
X37	(0.50,0.70,0.90)	(0.43,0.63,0.83)
X38	(0.50,0.70,0.90)	(0.63,0.83,0.97)
X39	(0.90,1.00,1.00)	(0.83,0.97,1.00)
X40	(0.70,0.90,1.00)	(0.57,0.77,0.93)
X41	(0.37,0.57,0.77)	(0.57,0.77,0.93)
X42	(0.70,0.90,1.00)	(0.63,0.83,0.97)

Step 5: Calculating the FCR and NFCR

According to Formula (5) and (6), the FCR and NFCR for each of the three group attributes can be calculated. For demonstration, the FCR of the group "capability" can be calculated as follows:

$FCR_{(c)}$ = (0.63, 0.83, 0.97) ⊗ (0.63, 0.83, 0.97) + (0.50, 0.70, 0.90) ⊗ (0.63, 0.83, 0.97) + (0.23,0.43,0.63) ⊗ (0.63,0.83,0.97) + (0.83,0.97,1.00) ⊗ (0.90,1.00,1.00) + (0.70,0.90,1.00) ⊗ (0.57,0.77,0.93) +(0.77,0.93,1.00) ⊗ (0.63,0.83,0.97) + (0.63,0.83,0.97) ⊗ (0.57,0.77,0.93)+(0.70,0.90, 1.00) ⊗ (0.43,0.63,0.83) + (0.37,0.57,0.77) ⊗ (0.63,0.83,0.97) + (0.50,0.70,0.90) ⊗ (0.63,0.83,0.97) + (0.30,0.50,0.70) ⊗ (0.50,0.70,0.87) + (0.17,0.37,0.57) ⊗ (0.77,0.93,1.00) + (0.37,0.57,0.77) ⊗ (0.50,0.70,0.90) + (0.70,0.87,0.97) ⊗ (0.90,1.00,1.00) + (0.50,0.70,0.90) ⊗ (0.50,0.70,0.90) + (0.63,0.83,0.97) ⊗ (0.57,0.77,0.93) + (0.50,0.70,0.90) ⊗ (0.43,0.63,0.83) + (0.50,0.70,0.90) ⊗ (0.63,0.83,0.97) + (0.90,1.00,1.00) ⊗ (0.83,0.97,1.00) + (0.70,0.90,1.00) ⊗ (0.57,0.77,0.93) + (0.37,0.57,0.77) ⊗ (0.57,0.77,0.93) + (0.70,0.90,1.00) ⊗ (0.63,0.83,0.97) = *(7.74, 13.29, 18.44)*

$FCR^*_{(C)}$ = (0.63, 0.83, 0.97) ⊗ (0.9, 1.0, 1.0) + (0.50, 0.70, 0.90) ⊗ (0.9, 1.0, 1.0) + (0.23,0.43,0.63) ⊗ (0.9, 1.0, 1.0) + (0.83,0.97,1.00) ⊗ (0.90,1.00,1.00) + (0.70,0.90,1.00) ⊗ (0.9, 1.0, 1.0) + (0.77,0.93,1.00) ⊗ (0.9, 1.0, 1.0) + (0.63,0.83,0.97) ⊗ (0.9, 1.0, 1.0) + (0.70,0.90,1.00) ⊗ (0.9, 1.0, 1.0) + (0.37,0.57,0.77) ⊗ (0.9, 1.0, 1.0) + (0.50,0.70,0.90) ⊗ (0.9, 1.0, 1.0) + (0.30,0.50,0.70) ⊗ (0.9, 1.0, 1.0) + (0.17,0.37,0.57) ⊗ (0.9, 1.0, 1.0) + (0.37,0.57,0.77) ⊗ (0.9, 1.0, 1.0) + (0.70,0.87,0.97) ⊗ (0.90,1.00,1.00) + (0.50,0.70,0.90) ⊗ (0.9, 1.0, 1.0) + (0.63,0.83,0.97) ⊗ (0.9, 1.0, 1.0) + (0.50,0.70,0.90) ⊗ (0.9, 1.0, 1.0) + (0.50,0.70,0.90) ⊗ (0.9, 1.0, 1.0) + (0.90,1.00,1.00) ⊗ (0.9, 1.0, 1.0) + (0.70,0.90,1.00) ⊗ (0.9, 1.0, 1.0) + (0.37,0.57,0.77) ⊗ (0.9, 1.0, 1.0) + (0.70,0.90,1.00) ⊗ (0.9, 1.0, 1.0) = *(10.98, 16.37, 19.57)*

$NFCR_{(C)}$ = $FCR_{(C)}$ /19.57 = (7.74, 13.29, 18.44) /19.57 = (0.40, 0.68, 0.94)

Similarly, the FCR and NFCR of other two group attributes can be obtained as follows:

Resources: $FCR_{(R)}$ = (4.06, 7.14, 10.21), $NFCR_{(R)}$ = (0.37, 0.65, 0.93)

Mechanism: $FCR_{(M)}$ = (1.98, 3.92, 6.18), $NFCR_{(M)}$ = (0.30, 0.59, 0.93)

With the results of three group attributes, the FCR and NFCR of Green Town's overall organizational competitiveness can be calculated by the same method as above:

$FCR_{(O)}$ = (0.62, 1.47, 2.53), $NFCR_{(O)}$ = (0.23, 0.54, 0.93)

Step 6: Matching the NFCR to linguistic terms

With the results in previous step, each NFCR can be matched to an appropriate linguistic term in the natural language expression set for representing real estate developer's competitiveness level. According to formula (2), the distance between $NFCR_{(O)}$ and each member in the natural language expression set (see Table 2) can be calculated as follows:

$$d(NFCR_{(O)}, EL) = \left\{\frac{1}{3}\left[(0.23-0)^2 + (0.54-0.1)^2 + (0.93-0.2)^2\right]\right\}^{\frac{1}{2}} = 0.51$$

$d(NFCR_{(O)}, VL) = 0.42$ $d(NFCR_{(O)}, L) = 0.34$
$d(NFCR_{(O)}, FL) = 0.27$ $d(NFCR_{(O)}, F) = 0.22$
$d(NFCR_{(O)}, FH) = 0.21$ $d(NFCR_{(O)}, H) = 0.24$
$d(NFCR_{(O)}, VH) = 0.31$ $d(NFCR_{(O)}, EH) = 0.39$

The competitiveness level of Green Town Property can be identified by the linguistic term which has the minimum distance to the NFCR. In the above calculation result, the minimum distance is $d(NFCR_{(O)}, F) = 0.21$.

Therefore, the overall competitiveness level of Green Town Property is **"Fair high"**, which is illustrated in Figure 3.

By using the same method, the distances between main attributes' NFCR and the natural language expression set can be calculated and the results are shown in Table 7. With the results in Table 7, Green Town Property's competitiveness of three group attributes are expressed as:

– Resource is **"Fairly high"**;
– Mechanism is **"Fairly high"**;
– Capability is **"High"**.

Table 7. Distances between NFCR and the natural language expression set

Competitiveness Levels	$NFCR_{(O)}$	$NFCR_{(R)}$	$NFCR_{(M)}$	$NFCR_{(C)}$
(EL)	0.51	0.57	0.54	0.59
(VL)	0.42	0.47	0.44	0.49
(L)	0.34	0.38	0.35	0.40
(FL)	0.27	0.29	0.29	0.31
(F)	0.22	0.21	0.21	0.22
(FH)	**0.21**	**0.16**	**0.18**	0.16
(H)	0.24	0.162	0.20	**0.14**
(VH)	0.31	0.21	0.26	0.19
(EH)	0.39	0.29	0.34	0.27

Step 7: Strength and weakness analysis

The results can be further used to identify the strengths and weaknesses of the company. The competitiveness levels of three group attributes of Green Town Property can be illustrated in Figure 4, from which it can be noted that the developer's strengths may come from the capability, and its relative weakness is resources and mechanism.

6. CONCLUSION

It is essential for business such as real estate enterprises to assess and understand their competitiveness properly, and therefore adapt to their competition environment by applying adequate methods to improve their competitiveness. There is a need of an appropriate assessment method for helping real estate firms to achieve this understanding. This paper introduces a set of effective competitiveness indicators as the guidelines for real estate firms with reference to Chinese environment. A fuzzy competitiveness rating method is proposed for helping real estate developers to conduct competitiveness assessment. Linguistic terms are used to assist decision makers in making judgment on ratings and weights of competitiveness attributes within the framework of a fuzzy model.

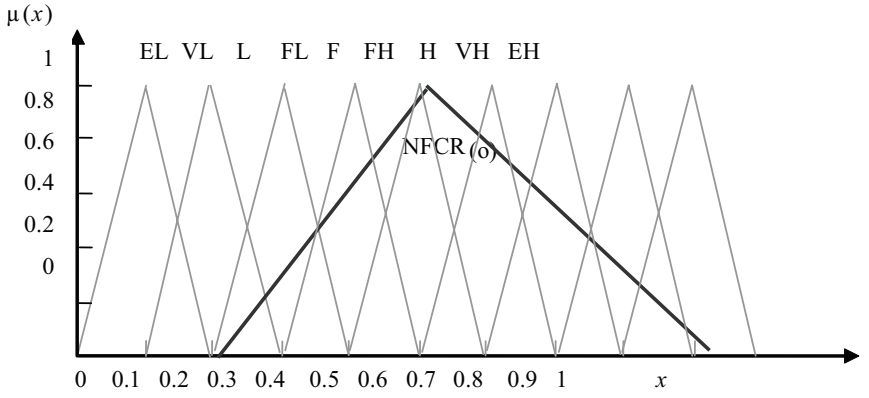

Figure 3. Match $NFCR_{(O)}$ to the natural language expression set

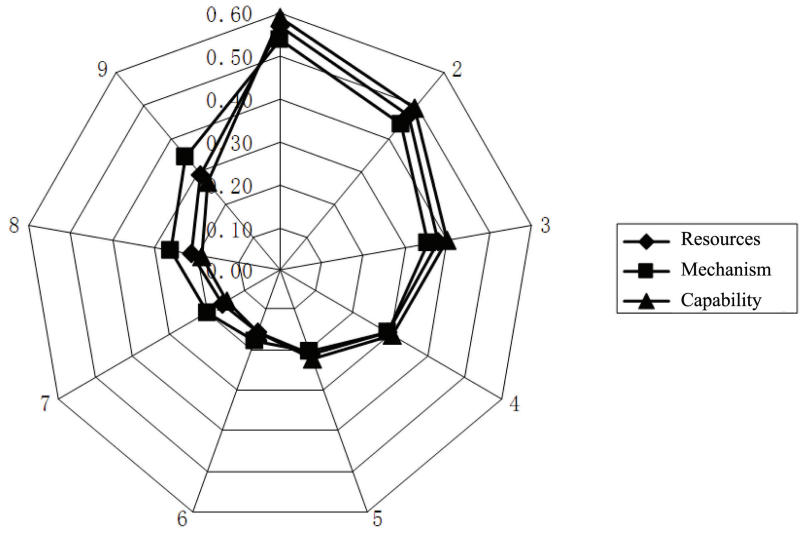

Figure 4. The competitiveness level of the six main attributes

Fuzzy Set theory helps mitigating the impacts of individual respondents' subjectivity and fuzziness in making judgment on organizational competitiveness. The case study shows that the proposed method is effective and practically applicable to evaluate a real estate developer's competitiveness. It provides a valuable tool to help developers to position themselves in a particular market segment and identify their competitive advantages and weaknesses in the segment.

The assessment results by using the fuzzy competitiveness rating (FCR) method provide a basis for businesses to take appropriate actions to compete effectively in the real estate market. Overseas real estate organizations who intend to enter the Chinese real estate market can conduct self-evaluation by using FCR method to identify their strength and weakness, thus take proper strategy for engaging the business in the market.

Whilst the FCR method proposed in this research contribute to understanding organizational competitiveness in the Chinese real estate market, it is appreciated that the FCR method does not provide alternatives of how to help organizations improve their competitiveness. There is a need for further research on the selection of the appropriate competitive strategies. Although the data used for analysis refer to the Chinese real estate practice, the findings from this research are valuable references for studying similar topics in other countries.

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SANTRAUKA

NEKILNOJAMOJO TURTO PLĖTOTOJŲ KONKURENCINGUMO ĮVERTINIMO ALTERNATYVUS BŪDAS

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Straipsnyje pateikiamas neapibrėžtasis konkurencingumo įvertinimo (angl. *fuzzy competitiveness rating*, FCR) metodas nekilnojamojo turto plėtotojų, konkrečiai kalbant apie Kinijos nekilnojamojo turto pramonę, konkurencingumui įvertinti. Analizei naudoti tyrimo duomenys buvo sukaupti nagrinėjant konkretų atvejį įmonėje „Green Town Company“. Neapibrėžtasis konkurencingumo įvertinimo metodas siūlomas kaip alternatyvus ir efektyvus nekilnojamojo turto plėtotojų konkurencingumo įvertinimo būdas. Neapibrėžtasis konkurencingumo įvertinimo metodas pateikia nekilnojamojo turto plėtotojams inovacinį sprendimą jų konkurencingumui įvertinti. Tinkamai suvokdami organizacijos konkurencingumą nekilnojamojo turto plėtotojai gali imtis atitinkamų veiksmų ir strategijų efektyviau naudodami organizacijos išteklius, kad padidintų savo konkurencingumą ir gerintų savo veiklos veiksmingumą nekilnojamojo turto rinkoje.