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Identification, Evaluation and Control of Risks at the Middle Stage of the M&A by Baoneng Clique

—AHP-AGA based Improved Fuzzy Comprehensive Evaluation

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***Abstract*—At present, the battle for equity ownership between Baoneng Clique and Vanke Clique has become a point at issue among scholars and media. This paper first identified the risks possibly arising at the middle stage of the M&A by Baoneng Clique, and built a four-layer risk index system. It then improved the fuzzy comprehensive evaluation method based on analytic hierarchy process-accelerating genetic algorithm (AHP-AGA); figured out the weight coefficient of the risks in each layer in accordance with expert estimation, and conducted a consistency test on it; carried out three-grade fuzzy comprehensive evaluation and weighted average calculation by weight coefficient vector and membership matrix, rating the overall risk level. The research shows that overall, there are high-level risks at the middle stage of the M&A by Baoneng Clique, and specifically, payment timing risk, financing pattern selection risk, competition risk and public opinion risk are decisive. Baoneng Clique should pay more attention to these risks. Finally, this paper took control of the above higher-level risks, in hope to warn Baoneng Clique of the risks and give it advice on risk management.**

***Keywords*—Middle stage of M&A; risk; AHP; AGA; fuzzy comprehensive evaluation**

I. INTRODUCTION

The sensational “Vanke-Baoneng Spat” attracted extensive attention from all sectors of the society, and some experts even argued that this battle for equity ownership would trigger off a tide of M&A in the domestic real estate industry. Baoneng Clique (the acquirer) refers to the capital group dominated by Shenzhen Baoneng Investment Group Limited led by Yao Zhenhua. After more than ten years of development, Baoneng Group, which was founded in 2000, has now grown into a huge conglomerate specialized in five major sectors, including modern logistics, finance and comprehensive property development, and owning many subsidiaries, such as Foresea Life Insurance, Jushenghua and Baoneng Real Estate. Vanke Group (the acquire) has cemented its status as the leading enterprise in the real estate industry with its business gradually expanded to most part of China and lots of regions abroad since its entry into the real estate industry in 1988. By the end of 2015, Vanke’s market value had approached 270 billion yuan, and Wang Shi held the post of board chairman.

The battle for equity ownership between Baoneng and Vanke that began on December 1, 2015 is in itself a fight for the first largest shareholder of Vanke Group. From a perspective of heavy weight, Baoneng Clique purchases Vanke like “a snake swallowing an elephant”. Currently, Baoneng Clique increases its share ratio mainly by purchasing stocks in the secondary market, with Foresea Life Insurance and Jushenghua fighting in the van. In December, 2015, Baoneng Clique increased Vanke’s market value by 1.7 times on 15 consecutive trading days (limit-up on four days), and quickly became the first largest shareholder of Vanke after Foresea Life Insurance and Jushenghua Investment Corp. increased holding dramatically (as of December 17, Baoneng Clique already held 22.45% of Vanke Group’s stocks with more than 24 billion yuan invested).

The war, instead of being over, became even more violent from that time on. As both parties shouted at each other, the battle for equity ownership finally evolved into a public confrontation on December 17. Yao Zhenhua, head of Baoneng Clique, made a declaration on observance of market discipline and buyout of Vanke; the Vanke management team led by Wang Shi sworn to repel the invasion from “Barbarian Baoneng” by claiming to safeguard Vanke’s interests and protect the corporate brand and credit security. They also doubted the source of the purchasing funds offered by Baoneng. On December 18, 2015, Vanke suspended trading urgently, and announced that it planned to issue shares for significant adjustment of assets. After that, the incident cooled down for 3 months. On March 13, 2016 (namely when the deadline-March 17, 2016-for suspension approached), Vanke declared that it had signed a memorandum of understanding with Shenzhen Railway Group on a project of cooperative investment in a target company that was based on the model of “property plus subway”. According to preliminary estimates, the trading volume of this project was between 40 billion and 60 billion yuan; according to the terms of trade, Vanke would issue additional targeted shares to Shenzhen Railway Group as payment consideration and buy the equity stakes held by Shenzhen Railway Group from the target company. If the memorandum of understanding played its role effectively, Shenzhen Railway Group would become an effective strength that could hinder Baoneng from acquiring stocks. Therefore, an originally simple M&A activity became increasingly complex, and the various parties changed their tune repeatedly. Even China Resources, an “old buddy” of Vanke, also changed its attitude delicately. At the general meeting held by Vanke on March 17, Baoneng, the first largest shareholder, and China Resources, the second largest shareholder, approved of “A Proposal for Continual Suspension of Trading of Vanke’s Stocks in the A-share Market (until June 18)”. This proposal was passed overwhelmingly.

At present, the buyout of Vanke is at its middle stage and Baoneng is in a relatively favorable position. If other parties choose to increase holding, Vanke’s float profit will increase, as a result of which its share price will rise as well. If Baoneng continues to increase holding to 30%, it will become the controlling shareholder and launch a mandatory tender offer. The tempestuous storyline drove the media nuts about reporting, and they defined Baoneng Clique as a “barbarian hostile acquirer”. This shows that currently, Baoneng is facing many risks.

Risk management usually includes risk identification, evaluation and control. Along with the increase in the number of uncertain factors, more and more enterprises have begun to realize its important significance. [1] Currently, Baoneng Clique has entered the middle stage of the M&A, a key stage, and is facing the risks characterized by diversity and low controllability, so it is increasingly urgent and important to strengthen risk management. However, what are the risks possibly arising at the middle stage of the M&A? What is the size of these risks? When will they occur and what economic consequences will be brought about? What’s the severity of these risks? How should these risks be controlled timely and effectively? For Baoneng, these problems demand prompt solution.

II. Research Design

Previous scholars made lots of empirical studies on M&A risks, but since the risks were hard to accurately measure; fuzzy mathematical or valuation method was mostly adopted. For instance, DeLone et al. [2] researched informatization and hot engineering issues using fuzzy mathematic theory. According to the characteristics of the risks at the middle stage of the M&A by Baoneng, this paper will identify, evaluate and control these risks using AGA-AHP fuzzy comprehensive evaluation method.

A. Fuzzy comprehensive Evaluation

Zadeh, L.A. [3] first proposed fuzzy set theory and evaluated the uncertainty of things by the use of fuzzy mathematical quantification. In recent years, many domestic scholars have started analyzing risks by fuzzy comprehensive evaluation. This method is based on AHP and expert estimation. According to the mapping relation between the lower index and upper index, it calculates the comprehensive evaluation score of the total target from bottom up, and then provides decision making reference for the stakeholders.

B. AHP

AHP, which was put forward by American operational research professor Saaty, T.L [4] in the 1970s, is a systemic analysis method mainly used to break complex target problems down into simple subproblems for qualitative and quantitative evaluations. It was soon widely adopted by domestic and foreign scholars after being proposed. Its basic idea is to first decompose a target problem into measurable or analyzable indicators in line with membership relation and mapping relation; then compare and grade the relative importance of the indicators in a certain layer and the layer below to determine the relative weight coefficient of each indicator; finally identify the importance of each factor to the total target in accordance with the hierarchical mapping relation, and calculate the weight vector of each factor and the order of quality.

C. AGA

AGA is set up according to migratory biology in which biological evolution follows the principle of “survival of the fittest” and genetics in which intragroup chromosomes follow the principle of information interaction. It is used to solve the optimization problem of complex decisions. [5] As an improved edition of SGA, AGA’s stable global optimization function provides a guarantee for the enhancement of reliability and validity in the processing course of expert estimation. [6] This algorithm takes full advantage of all valid data and runs based on a nonlinear optimization model, making the weight coefficient of each risk in AHP not limited to linear testing. Therefore, this paper will eliminate the subjective factors of expert scoring using the advantages of AGA, and then make an improvement in the existing fuzzy overall evaluation and AHP.

First of all, this paper will identify the risks faced by Baoneng Clique at the middle stage of the M&A of Vanke and set up a risk index system, then improve the fuzzy overall evaluation based on AHP-AGA, with the improved method called AAF for short, afterwards rank the importance of the risks arising at the middle stage, finally evaluate the overall risks arising at the middle stage comprehensively, and meanwhile conduct control over the higher-level risks.

III. Identification of Risks at the Middle Stage of the M&A by Baoneng

According to subject scope, overall M&A risk is generally divided into internal risk and external risk, and its index system is divided into 3-4 layers. On the basis of the previous theoretical studies of non-cross border M&A risks and in view of the M&A by Baoneng Clique that is now at the middle stage, this paper designs an index system for the identification of medium-term risks, as shown in Fig.1 [7] below:

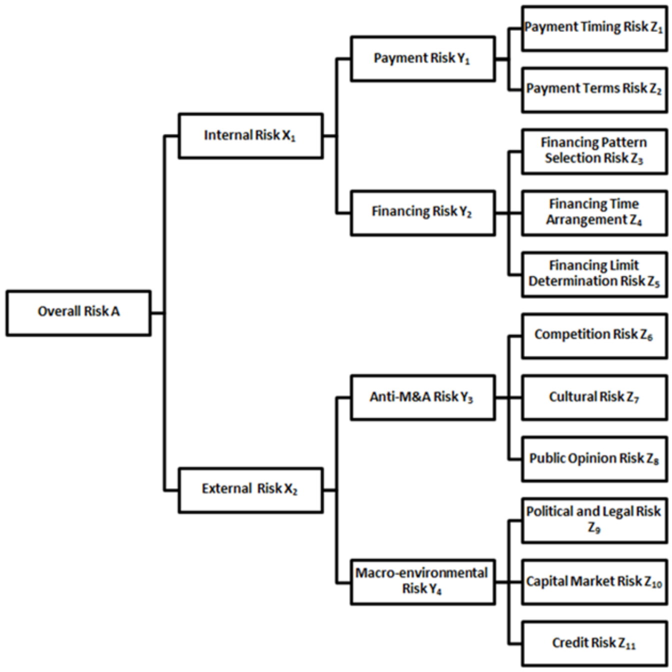

Fig. 1. Index system for identification of the risks at the middle stage of the M&A by Baoneng Clique.

IV. EVALUATION OF RISKS AT THE MIDDLE STAGE OF THE M&A BY BAONENG CLIQUE

A. *AHP-AGA method to determine the weight of each risk indicator*

As is shown in fig.1, risk identification indicator system at the Middle Stage of the M&A by Baoneng Clique is divided into four levels: A Level is aggregate risk; X Level includes internal and external risk, and so on. Take AB level as example, A Level, father node, connects to two child nodes (X_1, X_2) directly, which meets the necessary conditions for constructing judgment matrix. Saaty, T.L [8] put forward 1-9 scaling method and had been widely used the experts' estimation of Delphi method according to psychologist identification principle. To guarantee the objectivity and validity of data, the author has invited nine experts of risk management (including college professors, investment bank analysts, private equity fund managers, vector capital institutions, head of the risk management department, government officials, etc.) to do enclosed and isolated estimation. At last, we got the raw data. [9]

1) Construction of the transition matrix

To compare X_1 and X_2 based on 1-9 scaling method determines each element in the transition matrix. The concrete matrix form and the meaning of elements are as follows:

$A = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}$, for example, $a_{12} = \frac{X_1}{X_2} = \frac{4}{1} = 4$ expresses by

$$\begin{cases} \text{The importance of } X_1 \text{(internal risk)} \\ \text{relative to A(overall risk) is 4,} \\ \text{The importance of } X_2 \text{(external risk)} \\ \text{relative to A(overall risk)is 1.} \end{cases}$$

TABLE I. $A - X_I$ LAYER TRANSITION MATRIX OF EXPERT M.

A	X_1	X_2
X_1	1	4
X_2	1/4	1

As is shown in Table I, the numerical values in matrix represent the specific values of the importance of two corresponding risks. Obviously, the internal risk is more important than the external risk. Other layers are similar. Because there are 7 nodes meeting the condition, there are 7 transition matrixes.

2) The middle parameter calculation

Construct the indicators evaluation sample set $\{x(i,j) | i = 1 \sim n, j = 1 \sim m\}$. Then, we can get the Eq(1) through standardization, and we calculate the standard deviation of each evaluation indicator and relatively important parameters to have Eq(2) and Eq(3) respectively:

$$R = [r(i,j)]_{n \times m} = \frac{x(i,j)}{[x_{max}(i) + x_{min}(j)]}, \tag{1}$$

$$s(i) = \left[\frac{\sum_{j=1}^{m}(r(i,j) - \bar{r}_i)^2}{m}\right]^{\frac{1}{2}}, \tag{2}$$

$$a_m = \min\left\{9,\ \text{int}\left[\frac{s_{max}}{s_{min}} + 0.5\right]\right\}, \tag{3}$$

where int represents integral function and min represents minimum function.

3) Judgment matrix construction

We substitute a_m and $s(m)$ into Auxiliary diagonal element formula (shown as Eq(4)) using matlab programming software, then we can get 7 judgment matrixes.

$$a_{ij} = \begin{cases} \frac{s(i) - s(j)}{s_{max} - s_{min}} \times (a_m - 1) + 1, s(i) \geq s(j) \\ \frac{1}{\left[\frac{s(i) - s(j)}{s_{max} - s_{min}} \times (a_m - 1) + 1\right]}, s(i) < s(j) \end{cases}. \tag{4}$$

4) Single-level Sequencing and consistency check

We can calculate the importance of a layer relative to the upper layer according to judgment matrix, which is recognized as the weight coefficient of this layer. The calculation method of single-level Sequencing is to solve the biggest characteristic root w^* of judgment matrix M, namely, $Mw = \lambda w$. Combining with the accelerating genetic algorithm to calculate the weight coefficient of various factors, we can avoid some harsh conditions, for example, the target function does not meet nonlinear, non-differentiable or multimodal. Thus, we can adopt rapid global adaptive search method in [0,1] to find the optimal solution. In addition, due to the influence of the initial value, weight coefficient calculation result lacks of stability. This paper used nonlinear model to control the random items through Matlab programming method. [10] Then we can get 7 processed largest eigenvalue vectors, as shown in Table II.

TABLE II. THE WEIGHT COEFFICIENT OF SINGLE-LEVEL SEQUENCING AND THE TARGET VALUE OF CONSISTENCY FUNCTION.

Judgment matrix	weight coefficients			CIF(n)
	w_1	w_2	w_3	
A	0.7301	0.2699		0.0196
X_1	0.2713	0.7287		0.0114
X_2	0.8779	0.1221		0.0189
Y_1	0.8566	0.1434		0.0194
Y_2	0.7072	0.1123	0.1805	0.0598
Y_3	0.4925	0.0903	0.4172	0.0589
Y_4	0.4558	0.4558	0.0884	0.0654

Consistency check refers to the inspection of the coordination between each element in the same layer and avoids systemic contradictory. The consistency check of AGA based Analytic hierarchy process is more stable and accurate. Traditional consistency check in AHP is to find the largest feature vector and to check consistency, essentially, verifying its authenticity and making no improvements. In addition, if the consistency of judgment matrix is very low, it is difficult to solve the maximal eigenvector. AGA solves this problem. Therefore, this paper introduces accelerating genetic algorithm to construct function CIF (Eq(5)) to measure whether the weight coefficient venture meets the consistency check.

$$\begin{cases} \min \mathrm{CIF}(n) = \sum_{i=1}^{n} \left| \sum_{k=1}^{n} a_{ik} w_k - n w_i \right| / n \\ \text{subject to} \\ \quad w_k > 0, k = 1,2,\cdots,n \\ \quad \sum_{k=1}^{n} w_k = 1, k = 1,2,\cdots,n. \end{cases} \tag{5}$$

The consistency function of AGA based on real coding can calculate the maximal eigenvector and result of consistency check in the same time. According to different weight coefficients, we find the optimal solution. As is shown in Fig. 2, CIF(n) are all less than 0.1, and it illustrate that Seven judgment matrixes all satisfy consistency check. Overall, the internal risk (0.7301) is greater than the external risk (0.2699). Through weights superimposition and normalization, we can get the vector of layer Z is (0.1999, 0.0334, 0.3239, 0.0514, 0.0827, 0.1614, 0.0158, 0.1107, 0.0114, 0.0072, and 0.0022). The risk indicators which weight coefficients are higher than 0.1 are Payment Timing Risk (0.1999), Financing Pattern Selection Risk (0.3239), Competition Risk (0.1614) and Public Opinion Risk (0.1107). It illustrates these four risks are more important which need to be concerned by management of Baoneng Clique.

B. The value of membership matrix given by expert's estimates

Each element in the membership degree matrix of the risk index can be calculated by experts' estimations. Firstly, we establish the comment set $V = \{V_1, V_2, V_3, V_4, V_5\}$. V_1, V_2, V_3, V_4 and V_5 represent that the degree of risk is low, lower, middle, higher and high respectively. Secondly, experts estimate each risk in layer Z. Thirdly, the value of each element in the membership degree matrix can be defined as $N_i / \sum N_i$, where N_i represent the number of a certain risk-level in the comment set. Finally, the membership degree matrixes are given in Table III.

TABLE III. THE MEMBERSHIP MATRIXES.

	V_1	V_2	V_3	V_4	V_5
X_1	0	0.11	0.56	0.33	0
X_2	0	0	0.44	0.44	0.11
Y_1	0	0	0.44	0.44	0.11
Y_2	0	0	0.11	0.33	0.56
Y_3	0	0	0.11	0.22	0.67
Y_4	0.11	0.22	0.33	0.33	0
Z_1	0.11	0	0.22	0.22	0.44
Z_2	0	0.22	0.22	0.44	0.11
Z_3	0	0	0.56	0.33	0.11
Z_4	0	0	0.11	0.67	0.22
Z_5	0	0	0.33	0.56	0.11
Z_6	0	0	0.22	0.11	0.67
Z_7	0	0	0.67	0.11	0.22
Z_8	0	0.22	0.33	0.11	0.33
Z_9	0.22	0	0.56	0	0.22
Z_{10}	0	0.22	0.56	0	0.22
Z_{11}	0	0.56	0	0.44	0

C. The risk-level at the middle stage of the M&A using fuzzy comprehensive evaluation

As is shown in Fig.1, the risks identification system at the Middle Stage of the M&A by Baoneng Clique is divided into four layers, so the comprehensive fuzzy evaluation is divided into three layers. We can get 11 risk indicators from internal and external, and then aggregate risk is derivate through comprehensive fuzzy evaluation method.

Firstly, calculate the comprehensive fuzzy evaluation result of first layer risk at the Middle Stage of the M&A by Baoneng Clique (i.e. 11 indicators in Z layer). The weight coefficient of judgment matrix p is $w_{1\times t}^{*} = (w_1, w_2)$ or (w_1, w_2, w_3) and experts' estimation of each risk represents a membership matrix $U = U_{t\times 5}$. According to Eq(6), we can get the vector $B_{1\times 5} = (b_1, b_2, b_3, b_4, b_5)$ which represents the aggregate risk of this layer.

$$B_{1\times 5} = w_{1\times t}^{*} \times U_{t\times 5}. \tag{6}$$

Similarly, we can calculate the comprehensive fuzzy evaluation result of second and third layer. The component of vector B represents the degree of aggregate risk to comment set $V = \{V_1, V_2, V_3, V_4, V_5\}$. Finally, through normalization processing of vector $B_{1\times 5}$, we define the biggest number in each vector as max, then the result can be transformed as shown in Table 4.

As is shown in Table IV, the maximum component values of Overall Risk, Financing Risk and Macro-environmental Risk correspond to middle level and Internal Risk, External Risk, Payment Risk and Anti-M&A Risk all are at high level. It illustrates most of the risks are at high level, therefore, Baoneng Clique faces tremendous risk at the Middle Stage of the M&A.

TABLE IV. EACH COMPONENT OF VECTOR $B_{1\times5}$.

	b_1	b_2	b_3	b_4	b_5	max
B_A	0.00	0.09	0.54	0.35	0.02	b_3
B_{X1}	0.00	0.00	0.20	0.36	0.44	b_5
B_{X2}	0.01	0.03	0.14	0.23	0.59	b_5
B_{Y1}	0.10	0.03	0.22	0.25	0.40	b_5
B_{Y2}	0.00	0.00	0.45	0.42	0.13	b_3
B_{Y3}	0.00	0.09	0.31	0.11	0.49	b_5
B_{Y4}	0.07	0.26	0.37	0.15	0.15	b_3

Because of the inaccuracy of the evaluation method, we e will further quantify the size of risks in each level. As is shown in Table V, by quantifying the comment set $V = \{V_1, V_2, V_3, V_4, V_5\}$, we define V_1=100, V_2=80, V_3=60, V_4=40 and V_5=20.

TABLE V. QUANTITATIVE CORRESPONDING TABLE OF COMMENT SET.

Interval	Risk level
20~40	high
40~55	higher
55~70	middle
70~85	lower
85~100	low

Comprehensive fuzzy quantitative evaluation adopts weighted average method which is shown in Eq(7), i.e. the result of Fuzzy Comprehensive Evaluation (V')= Comprehensive Fuzzy Evaluation (B) × Comment Set (V^T). Because the components of matrix V and B are all arithmetic numbers, the value of V^' should be 20~100. When V' gets closer to 20, it represents the risk at the Middle Stage of the M&A by Baoneng Clique is higher and it should pay more attention to control the risk. When V' gets closer to 100, it represents the risk at the Middle Stage of the M&A by Baoneng Clique is lower and it will promote the M&A. Take overall risk as example, we can calculate the indicator of overall risk is 54 by using formula $V' = B \times V^T$, which illustrates Baoneng Clique is little risky at the Middle Stage of the M&A.

$$V' = B \times V^T. \tag{7}$$

V. CONTROL OF RISKS AT THE MIDDLE STAGE OF THE M&A BY BAONENG CLIQUE

Through the analysis above, we can get the following conclusion: firstly, the overall risks indicator level is high, representing 54. It illustrates the risk at the Middle Stage of the M&A by Baoneng Clique is high and Need to strengthen risk control. Secondly, according to the fuzzy comprehensive evaluation method and AHP weight coefficient order, we can get the top four risks are Payment Timing Risk (0.1999), Financing Pattern Selection Risk (0.3239), Competition Risk (0.1614) and Public Opinion Risk (0.1107). Therefore, Baoneng Clique should pay more attention to these four risks to control risk at the middle stage of the M&A.

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