A Novel Method of Real Estate Development Project's Feasibility Research Based on SWOT Method and Analytic Hierarchy Process

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Abstract

SWOT analysis is an important part of feasibility research. SWOT method focuses on qualitative analysis, however the result is too subjective, but Analytic hierarchy process (AHP) takes the advantage of combining quantitative analysis and qualitative analysis. Combining the SWOT method and the analytic hierarchy process (AHP) can make up the defect of the SWOT method, provide a more accurate and reliable reference to feasibility research.

Keywords: SWOT method; analytic hierarchy process (AHP); real estate; feasibility research

1. Introduction

Along with Chinese real estate market becoming mature, real estate market has been more and more standard, market competition is becoming more and more fair and transparent, real estate developers have been unable to obtain wealth through their experience and speculation. Real estate project has a lot of features, such as large investments, high risks, many uncertain factors and long period of profit return, etc, which requires developers to conduct a comprehensive and in-depth study, and provides a reliable reference to the investment decision, in order to offer a scientific, rational, orderly project, and reduce developers' investment risk, improve their investment return. A major part of project feasibility research of the real estate is the risk identification, and the SWOT method is an effective tool of risk identification.

2. Research methods

2.1. Brief introduction of SWOT method

S (strengths) refers to the advantages of the project; W (weaknesses) refers to the project's weaknesses; O (opportunities) is the opportunities provided by the environment; T (threats) means threat. From these four aspects, constitute the SWOT matrix (Table 1)

Table 1: SWOT matrix

S(strengths)	O(opportunities)
W(weaknesses)	T(threats)

Pairwisely compare the SWOT matrix, and find the best strategy for each combination. For example: compare S with O, can make full use of their own advantages to seize the opportunities; comparing W with O, can discover their weaknesses and overcome it.

The SWOT method is visual and simple, but the merits also make the SWOT method subjective and not accurate. In order to overcome the weakness of the SWOT method, I used analytic hierarchy process (AHP) to improve it.

2.2. Brief introduction of analytic hierarchy process

Analytic hierarchy process (AHP) is a new method to make concise and effective decisions on complex issues, which is put forward by Satty, an American Operations researcher. With the development of society, in many areas such as economic, biology, management, solely relying on qualitative analysis can no longer meet the requirements of accuracy, quantitative analysis is urgently needed. Analytic hierarchy process (AHP) combines qualitative analysis and quantitative analysis together, which can meet the demand in some degree.

2.3. The steps in the application of analytic hierarchy process (AHP) in SWOT method

The SWOT method focuses on qualitative analysis, but the method is lack of quantitative description. SWOT method combined with AHP can not only make complex problems become clear and structured, but also can carry on the quantitative analysis of the problem, and find out the key.

The first step: Through investigation and study, find out the strengths, weaknesses, opportunities and threats of the project, divide them into four groups. Elements in each group had better not more than 10, because too many elements will increase the difficulty of arithmetic.

The second step: In each group, invite several experts pairwisely compare each element, and figure out the scores in depend on the 1~9 scaling method. (Table 2)

Table 2: the meaning of each score in the 1~9 scaling method

score	meaning
1	almost the same in importance
3	slight difference in importance
5	obvious difference in importance
7	very difference in importance
9	extreme difference in importance
2,4,6,8	transition stage

Through the Table 2, get the comparative matrix. $B=\begin{pmatrix} b_{11} & \cdots & b_{1n} \\ \cdots & \cdots & \cdots \\ b_{n1} & \cdots & b_{nn} \end{pmatrix}$, b_{ij} means the importance of B_i relative to B_j

Calculate the weight, and the Consistency Index (CI), Random Index (RI), Consistency Ratio (CR), and then go on the consistency test.

$$CI=\frac{\lambda_{max}-n}{n-1} \qquad (1)$$

λ_{max} is the largest eigenvalue of the comparative matrix, n is the number of dimensions of the comparative matrix.

RI can be obtained from the Table 3.

Table 3 Random Index (RI)

the number of dimensions of the comparative matrix	1	2	3	4	5	6	7	8	9
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45

$$CR=\frac{CI}{RI} \qquad (2)$$

If $CR<0.1$, then pass the consistency test; If not, you need to build a new comparative matrix until you get the $CR<0.1$

The third step: Pairwisely compare the four groups, and then go on the consistency test. Formulas are the same with step two.

The fourth step: Developers can have more comprehensive understanding of the internal and external environment of the project by the calculating results, and make the corresponding strategy

3. The instance

Select a real estate development project as an instance, use SWOT method and analytic hierarchy process (AHP) to analysis the project.

Firstly, find out the strengths, weaknesses, opportunities and threats of the project, list the SWOT analysis table. Table 4

Table 4: SWOT analysis table

S(strengths) S1: land is flat, and conducive to development; S2: Transportation is convenient, the location's public transport system is mature; S3: Ancillary facilities are complete, project has great potential; S4: Near the park, beautiful environment, high quality of life;	O(opportunities) O1: The government support great finance to the development of the new districts; O2: Government buildings, sports center, science and technology center will move into the new districts; O3: The surrounding landscape is beautiful, municipal facilities are also being perfected daily;
W(weaknesses) W1: Room's area is too large, all apartment's types are three-bedroom and four-bedroom; W2: The plot has two sides facing the main road, under the influence of noise and dust; W3: The project is located in the new district, the infrastructure needs to improve;	T(threats) T1: The national policy to regulate and control the real estate; T2: There are many similar projects around, competition is intense; T3: The old city's infrastructure is perfect, will has impact on the new city's real estate;

In each group, invited several experts to pairwisely compare each element, and figure out the scores in depend on the 1~9 scaling method, then go on the consistency test. Here take the advantages as an example.

Advantages' comparative matrix is shown in Table 5

Table 5: Advantages' comparative matrix

Advantages	S1	S2	S3	S4
S1	1	1/5	1/3	1/2
S2	5	1	2	3
S3	3	1/2	1	2
S4	2	1/3	1/2	1

Then get the comparative matrix:

$$B=:\begin{pmatrix} 1 & 0.2 & 0.333 & 0.5 \\ 5 & 1 & 2 & 3 \\ 3 & 0.5 & 1 & 2 \\ 2 & 0.333 & 0.5 & 1 \end{pmatrix}.$$

Each number in $B=(b_{ij})_{n\times n}$ divides the sum of all numbers in its column, then get $B=\left(\tilde{b}_{ij}\right)_{n\times n}$,

$$B=\left(\tilde{b}_{ij}\right)_{n\times n}=\begin{pmatrix} 0.091 & 0.098 & 0.087 & 0.077 \\ 0.455 & 0.492 & 0.522 & 0.462 \\ 0.273 & 0.246 & 0.261 & 0.308 \\ 0.182 & 0.162 & 0.130 & 0.154 \end{pmatrix}.$$

Add up all the numbers of each line in $B\left(\tilde{b}_{ij}\right)_{n\times n}$, then get $\tilde{b}_i$,

$$\tilde{b}_i = \sum_{j=1}^{n} \tilde{b}_{ij} \qquad (2)$$

$$\mathrm{B}\left(\tilde{b}_i\right) = \begin{pmatrix} 0.353 \\ 1.931 \\ 1.088 \\ 0.630 \end{pmatrix} = \boxed{}.$$

Because of $\sum_{i=1}^{n} \tilde{b}_i$ =0.353+1.931+1.088+0.630=4.002, and utilize the formula (3), get the approximate eigenvector.

$$\vec{b} = \frac{\tilde{b}_i}{\sum_{i=1}^{n} \tilde{b}_i} \qquad (3)$$

Then, get the eigenvector $\vec{b}$,

$\vec{b} = (0.088 \quad 0.488 \quad 0.272 \quad 0.157)^T$.

Through the eigenvalue formula,

$$\lambda_{\max} = \frac{1}{n} \sum_{i=1} \frac{\left(B\vec{b}\right)_i}{b_i} \qquad (4)$$

$$\lambda_{\max} = \frac{1}{4}\left\{ \frac{(1 \quad 0.2 \quad 0.333 \quad 0.5)}{0.088} \begin{pmatrix} 0.088 \\ 0.483 \\ 0.272 \\ 0.157 \end{pmatrix} + \right.$$

$$\frac{(5 \quad 1 \quad 2 \quad 3)}{0.483} \begin{pmatrix} 0.088 \\ 0.483 \\ 0.272 \\ 0.157 \end{pmatrix} + \frac{(3 \quad 0.5 \quad 1 \quad 2)}{0.272} \begin{pmatrix} 0.088 \\ 0.483 \\ 0.272 \\ 0.157 \end{pmatrix} +$$

$$\left. \frac{(2 \quad 0.333 \quad 0.5 \quad 1)}{0.157} \begin{pmatrix} 0.088 \\ 0.483 \\ 0.272 \\ 0.157 \end{pmatrix} \right\} = 4.014$$

So the largest eigenvalue is $\lambda_{\max}$ =4.014.

According to formula (1), CI= $\frac{\lambda_{\max} - n}{n-1}$, get CI= $\frac{4.014-4}{3}$ =0.005.

Look-up Table 3, get RI=0.900.

According to formula (2), CR= $\frac{CI}{RI} = \frac{0.005}{0.900}$ =0.006<0.1, pass the validation.

So, the weight is $(0.088 \quad 0.488 \quad 0.272 \quad 0.157)$.

According to the same steps to calculate the weaknesses, opportunities and threats, get their weight:

W is $(0.457 \quad 0.357 \quad 0.186)$;

O is $(0.532 \quad 0.276 \quad 0.142)$;

T is $(0.454 \quad 0.306 \quad 0.241)$.

According to the same steps to pairwisely compare four groups, get the weight is $(0.415 \quad 0.127 \quad 0.243 \quad 0.215)$, in the order of advantages, weaknesses, opportunities and threats.

Gather all the weights, get the Table 6.

As we can see from the Table 6, the advantage of the project is at the most important position; the opportunity and threat are at secondly important position. The project should make full use of their advantages in convenient traffic and good foundation facilities to enhance their competitiveness. Make the project more competitive through seize the opportunity that the government develops the new district. Developers also should pay close attention to the government's real estate regulatory policy. Only in this way, developers can improve profitability and reduce risk.

4. Conclusions

The thesis combines SWOT method with AHP method. Solve the defect that the SWOT method is too subjective, in some degree. Improve the accuracy of the analysis, and make the project feasibility research more reliable. Provide a new idea for the real estate project feasibility research.

Table 6: weight

SWOT	weight of each group	elements	weight of each element	The total weight
advantages	0.415	S1: land is flat, and conducive to development	0.088	0.037
		S2: Transportation is convenient, the location's public transport system is mature	0.483	0.200
		S3: Ancillary facilities are complete, project has great potential	0.272	0.113
		S4: Near the park, beautiful environment, high quality of life	0.157	0.065
weaknesses	0.127	W1: R Room's area is too large, all apartment's types are three-bedroom and four-bedroom	0.457	0.058
		W2: The plot has two sides facing the main road, under the influence of noise and dust	0.357	0.045
		W3: The project is located in the new district, the infrastructure needs to improve	0.186	0.024
opportunities	0.243	O1: The government support great finance to the development of the new districts	0.532	0.129
		O2: Government buildings, sports center, science and technology center will move into the new districts	0.276	0.067
		O3: The surrounding landscape is beautiful, municipal facilities are also being perfected daily	0.142	0.035
threats	0.215	T1: The national policy to regulate and control the real estate	0.454	0.098
		T2: There are many similar projects around, competition is intense	0.306	0.066
		T3: The old city's infrastructure is perfect, will has impact on the new city's real estate	0.241	0.052

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