Investment Attractiveness Evaluation on International Markets for Shengli Oilfield

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Abstract. In recent years, Shengli Oilfield continues to expand its international market for the aim of comprehensive, sustainable and high-quality development. This paper established an investment attractiveness evaluation index system (including 3 categories, 12 indicators) for the international markets and made a quantified evaluation of environmental risk in the five target markets including Middle East, Central Asia, North Africa, America and Southeast Asia. Based on the value of the investment attractiveness evaluation, this paper ranked the five target international markets and gives some further investment advices considering the current international strategy of Shengli Oilfield.

1. Preface
In accordance with the strategic goal of “building a world-class energy and chemical company” and the overall requirements of “advancing to a world-class enterprise” of Sinopec, Shengli Oilfield established the development philosophy of specialization, marketization, internationalization and high-end, and unswervingly take the road of comprehensive, sustainable and high-quality development. The international market is the breakthrough to build comprehensive, sustainable and high-quality development of Shengli Oilfield, and furthermore, it is also an important measure to comprehensively improve the enterprise’s risk control level and value creation ability. Therefore, it is necessary to carry out environmental risk evaluation on the five international markets, including the Middle East, central Asia, north Africa, America and southeast Asia, further strengthen Shengli Oilfield’s international market planning, pursue appropriate input-output ratio and resolutely withdraw from ineffective markets and low-end markets.
2. Investment Attractiveness Evaluation of International Market

2.1. Evaluation method of international market
The evaluation method mainly including the following 3 steps:

Step 1, based on the investigation and Delphi method, 3 categories of 12 indicators for investment attractiveness evaluation of target international markets were determined and the evaluation system is established;

Step 2, the analytic hierarchy process method (also named ahp) is adopted to set the weight of evaluation indexes and establish a comprehensive evaluation index system [1];

Step 3, index calculation and transformation, to get an indicator that can reflect the overall situation, and then ranked the current five target international markets according to the value of the index.

2.2. Establishing of investment attractiveness evaluation system
Three categories of investment attractiveness indexes are established to quantitatively evaluate the overall impact of oil industry investment in the international market, including oil & gas investment cooperation attractiveness index (A1), exploration & development business attractiveness index (A2) and oil & gas resources attractiveness index (A3) [2]. Table 1 shows the 3-index judgment matrix.

Table 1. Investment attractiveness index judgment matrix A—Ax

| A—Ax | A1    | A2    | A3    |
|-------|-------|-------|-------|
| A1    | 1     | 8/7   | 7/6   |
| A2    | 7/8   | 1     | 49/48 |
| A3    | 6/7   | 48/49 | 1     |

Consistency test has been made after set up the judgment matrix, the calculated weight vector of index A is

\[ W_A = (0.3660, 0.3203, 0.3137)^T \]

as \[ CI = \frac{\lambda_{max}(A) - n}{n - 1} \] , then \[ CI_A = 0.000 \],

and because \[ RIA=0.580 \], based on the equation \[ CR = \frac{CI}{RI} \],

then \[ CRA=0.000<0.10 \]

Therefore, the judgment matrix of investment attractiveness index A has a satisfactory consistency.

Investment cooperation attractiveness index (A1) contains 3 indicators: investment guarantee, facility guarantee and the number of licenses granted, mainly reflecting the prospect and potential of oil and gas cooperation.

Investment guarantee (A11), Investment enthusiasm and mutual benefit, which reflects the status of investment cooperation and preferential policies of signed cooperation;

Facility guarantee (A12), the degree of infrastructure guarantee for foreign oil investment;

Licenses granted (A13), number of licenses granted in recent 3-5 years.

Table 2 shows the Investment cooperation index (A1) judgment matrix.

Table 2. Investment cooperation index judgment matrix A1—A1x

| A1—A1x | A11 | A12 | A13 |
|---------|-----|-----|-----|
| A11     | 1   | 7/6 | 9/8 |
| A12     | 6/7 | 1   | 27/28 |
| A13     | 8/9 | 28/27 | 1 |
Similar to matrix \( A-A \times \), Consistency test has been applied to matrix \( A1-A1 \times \), and the calculated weight vector of index \( A1 \) is
\[
W_{A1} = (0.3642, 0.3121, 0.3237)^T
\]
and the value of
\[
CI_{A1}=0.000, RI_{A1}=0.580,
\]
then
\[
CR_{A1}=0.000<0.10
\]
So, the judgment matrix of investment cooperation attractiveness index \( A1 \) has a satisfactory consistency.

Exploration & development business attractiveness index \( A2 \) consists of five index, namely annual new drilling, growth rate of newly proved reserves, exploration well success ratio, proved reserves of each exploratory well and average discovery size, reflecting the investment potential and prospect of petroleum exploration and development business.

Annual new drilling \( A21 \), the annual increase in the number of drilling, reflecting the trend of exploration;
Growth rate of newly proved reserves \( A22 \), the growth rate of newly increased oil reserves, reflects the potential of reserves;
Exploration well success ratio \( A23 \), the proportion of exploration wells showing the industrial oil (gas) flow to the total wells, reflects the effect of exploration activity;
Proved reserves of each exploratory well \( A24 \), the ratio of proved reserves to the number of completed exploration Wells, reflects the success rate of exploration Wells;
Average discovery size \( A25 \), mainly reflects the oil & gas resources potential and investment potential.

Table 3 shows the exploration & development business attractiveness index \( A2 \) judgment matrix.

|          | A21 | A22 | A23 | A24 | A25 |
|----------|-----|-----|-----|-----|-----|
| A21      | 1   | 3/2 | 3/2 | 2   | 2   |
| A22      | 2/3 | 1   | 1   | 4/3 | 4/3 |
| A23      | 2/3 | 1   | 1   | 4/3 | 4/3 |
| A24      | 1/2 | 3/4 | 3/4 | 1   | 1   |
| A25      | 1/2 | 3/4 | 3/4 | 1   | 1   |

The calculated weight vector of index \( A2 \) is
\[
W_{A2} = (0.300, 0.20, 0.20, 0.1500, 0.1500)^T
\]
and the value of
\[
CI_{A2}=0.000, RI_{A2}=1.120,
\]
then
\[
CR_{A2}=0.000<0.10
\]
thus, the judgment matrix of exploration & development business attractiveness index \( A2 \) has a satisfactory consistency.

Oil & gas resources attractiveness index \( A3 \) reflects the overall scale and potential of oil and gas resources, including the following 4 indices:
Proportion of total oil and gas production \( A31 \), reflects the importance of oil and gas production;
Proportion of remaining proved reserves \( A32 \), reflects the remaining proved scale of oil and gas;
Reserve replacement ratio \( A33 \), the ratio of the newly proved recoverable reserves to the reserves consumed in the same year, reflecting the reserve replacement capacity;
Reserve-production ratio \( A34 \), refers to the remaining reserves at the end of the year divided by the current production, reflecting the remaining years that can be produced at the current production level.

Table 4 shows the commercial oil risk index \( A3 \) judgment matrix.
Table 4. Oil & gas resources attractiveness index judgment matrix $A_3 - A_3^x$

| A3—$A_3^x$ | A31 | A32 | A33 | A34 |
|-------------|-----|-----|-----|-----|
| A31         | 1   | 8/9 | 8/7 | 1   |
| A32         | 9/8 | 1   | 9/7 | 9/8 |
| A33         | 7/8 | 7/9 | 1   | 7/8 |
| A34         | 1   | 8/9 | 8/7 | 1   |

Similarly, the calculated weight vector of index $A_3$ is $W_{A_3} = (0.250, 0.2813, 0.2187, 0.250)^T$ and the value of $CIA_3 = 0.000$, $RIA_3 = 0.900$, then $CRA_3 = 0.000 < 0.10$, so, the judgment matrix of oil & gas resources attractiveness index $A_3$ has a satisfactory consistency.

After setting and defining 3 categories of investment attractiveness evaluation indicators and 12 categories of sub-indicators, the weight of investment attractiveness evaluation index system is defined, as shown in table 5.

Table 5. Investment attractiveness evaluation index system and its weight

| first class index | Weight % | second class index | Weight % | third class index | Weight % |
|-------------------|----------|--------------------|----------|-------------------|----------|
| investment attractiveness index | 100 | oil & gas investment cooperation attractiveness | 36.60 | Investment guarantee | 36.42 |
| | | | | Facility guarantee | 31.21 |
| | | | | Licenses granted | 32.37 |
| | | exploration & development business attractiveness | 32.03 | Annual new drilling | 30 |
| | | | | Growth rate of newly proved reserves | 20 |
| | | | | Exploration well success ratio | 20 |
| | | | | Proved reserves of each exploratory well | 15 |
| | | | | Average discovery size | 15 |
| | | oil & gas resources attractiveness | 31.37 | Proportion of total oil and gas production | 25 |
| | | | | Proportion of remaining proved reserves | 28.13 |
| | | | | Reserve replacement ratio | 21.87 |
| | | | | Reserve-production ratio | 25 |
2.3. Comprehensive evaluation of environmental risks
On the process of evaluation, the evaluation scale $V$ is divided into five degree (1, 3, 5, 7, 9), respectively representing investment attraction from low to high, and estimate the attraction degree and occurrence probability using Delphi method; then analyzed statistically the sub-factors of experts’ evaluation results with probability and mathematical expectation method, and form an investment attractiveness assessment matrix (as shown in table 6); finally, an experts team will carry out the evaluation [3], take middle East as an example.

Table 6. Investment attractiveness evaluation matrix

| Risk indicator | Grade of membership weight | weight |
|----------------|----------------------------|--------|
| A1 oil & gas investment cooperation attractiveness | Investment guarantee | 0.1 | 0.2 | 0.4 | 0.2 | 0.1 | 0.1333 |
| | Facility guarantee | 0.1 | 0.1 | 0.2 | 0.5 | 0.1 | 0.1142 |
| | Licenses granted | 0.4 | 0.2 | 0.2 | 0.1 | 0.1 | 0.1185 |
| A2 exploration & development business attractiveness | Annual new drilling | 0.1 | 0.1 | 0.3 | 0.3 | 0.2 | 0.0961 |
| | Growth rate of newly proved reserves | 0.1 | 0.1 | 0.2 | 0.2 | 0.4 | 0.0641 |
| | Exploration well success ratio | 0.1 | 0.1 | 0.1 | 0.2 | 0.5 | 0.0641 |
| | Proved reserves of each exploratory well | 0.1 | 0.1 | 0.2 | 0.2 | 0.4 | 0.0480 |
| | Average discovery size | 0.1 | 0.1 | 0.3 | 0.4 | 0.1 | 0.0480 |
| A3 oil & gas resources attractiveness | Proportion of total oil and gas production | 0.1 | 0.1 | 0.1 | 0.1 | 0.6 | 0.0784 |
| | Proportion of remaining proved reserves | 0.1 | 0.1 | 0.1 | 0.1 | 0.6 | 0.0883 |
| | Reserve replacement ratio | 0.1 | 0.2 | 0.4 | 0.2 | 0.1 | 0.0686 |
| | Reserve-production ratio | 0.1 | 0.1 | 0.1 | 0.2 | 0.5 | 0.0784 |

The comprehensive evaluation set is obtained:
$I_i = A_i*R_i$ ($i = 1, 2, 3, \ldots, 9$)
(1) $I_1 = A_1*R_1$

\[
\begin{bmatrix}
0.1 & 0.2 & 0.4 & 0.2 & 0.1 \\
0.1 & 0.1 & 0.2 & 0.5 & 0.1 \\
\end{bmatrix} \times \begin{bmatrix} 1 \\ 3 \\ 5 \\ 7 \\ 9 \end{bmatrix} = (0.3642, 0.3121, 0.3237) * (0.4, 0.2, 0.2, 0.1, 0.1) = (0.1971, 0.1688, 0.2728, 0.2613, 0.1000) \\
\]

Similarly, $I_2 = (0.1000, 0.1000, 0.2250, 0.2600, 0.3150)$; $I_3 = (0.1000, 0.1219, 0.1656, 0.1469, 0.4656)$.
The comprehensive evaluation set $I$ can be obtained through the above steps, and then
(2) $I = A*R$

\[
\begin{bmatrix}
0.1971 & 0.1688 & 0.2728 & 0.2613 & 0.1 \\
0.1 & 0.1 & 0.225 & 0.26 & 0.315 \\
\end{bmatrix} = (0.3660, 0.3203, 0.3137) * (0.1355, 0.1320, 0.2239, 0.2250, 0.2836) \\
\]

(3) $P_i = B*VT$

\[
(0.1355, 0.1320, 0.2239, 0.2250, 0.2836) * (1, 3, 5, 7, 9)^T
\]
The value of investment attractiveness in the Middle East region is 5.861. Similarly, the investment attractiveness value of other international markets is 4.266 in north Africa, 4.95 in central Asia, 4.59 in southeast Asia and 5.616 in America.

3. Conclusion

According to the investment attractiveness evaluation value, the international markets with high investment attractiveness are, in order, the Middle East region, Americas region, central Asia region, Southeast Asia region, North Africa region. The Americas region and Middle East region belong to the strategic international markets.

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