



Research Article

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The research of health development evaluation on oil-field enterprises

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ABSTRACT

Now most of domestic oil-field had entered the latter part of development, the problems, such as, improving cost, poor reserves, etc, had dragged down the development of oil-field enterprises. It makes the healthy development of exploration of oil-field play a much more important role, therefore, it's necessary to evaluate it scientifically. On the basis of establishing the standard index system of healthy development for oil-field enterprises exploration, and with the domestic oil-field enterprises examples, the article determines the level of exploration healthy development, and evaluates it with DEA method. Through the analysis, finally it supplies foundations for the healthy development of oil-field exploration.

Keywords: Oil-gas exploration and exploitation, Health development, Standard, Data evaluation analysis

INTRODUCTION

With the acceleration of China's economic development, raising the level of per capita income and the gradual popularization of cars, China's consumption of oil increased significantly. The domestic major oil field has already been in the latter part of exploitation, the problems such as the increased cost and the lack of replace troubled the development of China's oil companies. Facing this challenge, according to the situation of domestic oil resources, in order to realize the sustainable development of industry, China's oil industry enterprises must take corresponding measures to find out the existing problems in production management and to improve it, to achieve a healthy sustainable development of oil companies.

2. The Healthy Development Connotation

Oilfield company is a kind of excavate company whose main business is producing and operating the oil and gas, the characteristic of the industry decide its healthy development must focus on the exploration, exploitation and product of oil and gas, so we can define the healthy development of the oilfield company as the development pattern, which realize the sustainable development of oilfield company is the most important, it focus on the exploration, exploitation and product system of oil and gas, the institution and mechanism of all the departments of the company are perfect and the departments is effective and coordinated, use the development of functional supporting department such as science and technology or human resource department to ensure the operation of the oil and gas production system, use the development of oil and oil gas production to promote the development of functional supporting department; the company has a higher self-adjustment ability and it can react rapidly to the changing environments, choose the good and reject the bad to promote the development of the company; the company has the innovation ability and it can stabilize and increase production through technology innovation, it can solve the new problem of enterprise management through the system innovation and management innovation; the company has an harmonious outside relationship and it can deal with the relationships well between the head office, left corporation, chemical corporation and local government, these departments coordinate and develop together.

The exploration system's healthy development of oilfield company requires the harmonious development of exploration and development, the exploration penetrating the development, the combination of evaluating exploration phase and evaluating development prophase, forming a new evaluating exploration phase after combining with the prophase, combining fulfilling the economical recoverable reserves with development and designing the wells' positions and deploying them as a whole one, healthy development requires not only accelerate the deploying of recoverable reserves but also accelerate the production construction to get the goal of increasing the economical profits of exploration and development, keep the highly increase of demonstrated reserve, pay attention to the replacement of reserve, set up a logical resource array, make the exploration development show a long benign circulation.

3. Evaluation Index System Of Oil And Gas Exploration And Exploitation

The index of the child-system of oil and gas exploration must be a multi-dimensional index which can reflect the staged exploration achievement, the whole exploration profits and the circulate development, it is an index system includes the combine of dynamic state and static state of real thing quantity and value quantity. According to the existing evaluating index of exploration of oil and oil gas, the index system of oil and oil gas exploration system was established as follows:

The index which reflects the exploration input of oil and oil gas. The index mainly includes the index of exploration investment, index of beforehand exploration cost, 2D seismic index, 3D seismic index and exploratory well drill footage index as so on.

The index which reflects the exploration output of oil and oil gas and it mainly embodied in ascertained oil reserve. The integrated indexes which reflects the effect of input and output. The effect of exploration input and output can be reflected by the oil founding cost index, succeed ratio of exploratory well, resource array, replacement ratio of oil reserve and other indexes.

The healthy development evaluating index system of the oil company is establishes as Fig-1.

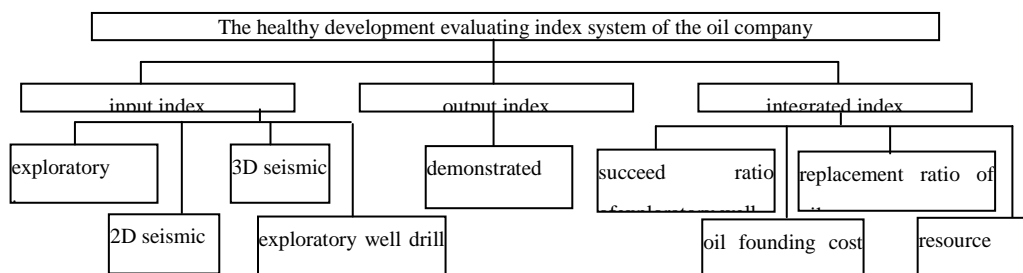


Fig-1 Evaluating index system of the exploration management child-system for oil

4. Establish The Standard

The oil-field enterprise health development is considered it as an organism, reflect the production and management condition by the way of measuring an organism's health condition. The health standard of a enterprise is the same as of a person. We classify the health level into five sorts: strong, healthy, sub healthy, sick and dying.

Strong: compositive evaluation of the object is above 90 marks, the system runs efficiently and coordinately, the inner index value between the history and the same industry lies in a high level, the system has a great ability of self-control and self-innovation, and can adapt to the society and economy change quite well. **Healthy:** compositive evaluation of the object is between 75 and 90, the system runs naturally, the inner index value reaches or exceeds the average level of the same industry, the system has a good ability of self-control and self-innovation, and can adapt to the society and economy change well. **Sub healthy:** a condition between healthy and sick. compositive evaluation of the object is between 60 and 75. **Sick:** compositive evaluation of the object is between 45 and 60, part or one important inner index value lies in a low level, the system runs naturally but not efficiently, and the cost is much, the system has a bad ability of self-control and can't adapt to the changes of the society and economy. **Dying:** compositive evaluation of the object is below 45 marks, the system can't run naturally, production pauses basically. The system faces to contabescence.

There are many index of measuring the healthy level of the exploration system. We should avoid repetition when choose it and choose a key index as the standard of measuring healthy level which can reflect the healthy level of the exploration system. So resource order, reserves replace rate and unit oil-gas cost these three key index is chose. We choose some data of an oil-field enterprise in 2004-2009 to set a standard.

4.1 Endue resource order with value

The healthy rank of resource order index is decided by compositive compare method. Cause the closer to the latter part of the resource order, the more important it is, that is to say, proved reserves is more important than controlled reserves, controlled reserves is more important than forecasted reserves, forecasted reserves is more important than trapped reserves, trapped reserves is more important than future reserves. According to standard value, proved reserves: controlled reserves: forecasted reserves: trapped reserves: future reserves=1:2:4:8:16, their weights are decided as follows:

$$\begin{aligned} & \text{proved reserves : controlled reserves : forecasted reserves : trapped reserves : future reserves} \\ &= \frac{16}{1+2+4+8+16} : \frac{8}{1+2+4+8+16} : \frac{4}{1+2+4+8+16} : \frac{2}{1+2+4+8+16} : \frac{1}{1+2+4+8+16} \\ &= 0.516:0.258:0.129:0.065:0.032 \end{aligned}$$

Healthy rank of resource order index is decided as Table 1

Table 1. Healthy rank of resource order index

project	strong	healthy	Sub healthy	sick	dying
Controlled reserves : proved reserves	>3	2-3	1.5-2	0.8-1.5	<0.8
Forecasted reserves : proved reserves	>6	4-6	4-3	3-1.5	<1.5
Trapped reserves : proved reserves	>12	12-8	8-6	6-3	<3
Future reserves : proved reserves	>24	24-16	16-12	12-6	<6
Healthy value	90-100	75-89	60-74	45-59	<45

4.2 Give a value to the replacement ratio of oil reserve

The replacement ratio of oil reserve of some oil company in these years range a lot, the highest ration has reached 1.23(year 2009) ,the lowest ratio was only 0.68(year 2008),according to the practical situation of the oil-field subsidiary company ,the replacement ratio of oil reserve is defined as Table 3.

4.3 Unit oil and oil gas founding cost

The exploration results is good or bad all needs some investment to ensure it, the level of investment is related with the exploration results, but it is hard to judge how many is the unit oil and oil gas founding cost, through the instruction of the average value of the CNPC joint-stock company, and as the exploration extent more deeply, the unit oil and oil gas founding cost should has an increase tendency. The specific standard is set as following Table 2.

Table 2: Healthy rating of the replacement ratio of oil reserve

project	strong	healthy	Sub healthy	sick	dying
replacement ratio of oil reserve	>1.2	1-1.2	0.8-1	0.6-0.8	<0.6
unit oil and oil gas founding cost	<2.5	2.5-3.5	3.5-4.5	4.5-5.5	>5.5
given value of the health	90-100	75-89	60-74	45-59	<45

5. Evaluation OnThe Level Of Health And Management For The Exploration And Exploitation System

Resource order in 2012 is controlled reserves: forecasted reserves: trapped reserves: future reserves=1:1.7:1.4:15.6:65, so oil-field enterprise value in 2012 is: 90:60:15:90:90. So the mark of the resource order is:

$$90 \times 0.516 + 60 \times 0.258 + 15 \times 0.129 + 90 \times 0.065 + 90 \times 0.032 = 72.585 .$$

In 2012, unit reserves found cost is 4.14 dollars per barrel, healthy value is 60, reserves replace rate is 100.57%, healthy value is 75. The weights of resource order、 unit reserve found cost and reserve replace rate are 0.4,0.2 and 0.4. So the general exploration healthy level in 2012 is:

$$M = M_1 \times R_1 + M_2 \times R_2 + M_3 \times R_3 = 72.59 \times 0.40 + 60 \times 0.2 + 75 \times 0.4 = 72.03$$

So, the general exploration healthy level should be sub healthy. There are shortages in oil-filed exploration system, so DEA is used to evaluate its management.

We use DEA to evaluate oil-field sub-system, not only for gaining evaluate results of these years, but also for studying the reasons which lead to these results, such as exploration investment, 2D seismic, 3D seismic and drill

well plan, and finding the enterprise's advantages and shortages in recent years, decreasing the distance between the shortage index and DEA "shadow", in order to guide goal and direction for the enterprise's effective production and management.

Table 3: Index dates of the exploratory management subsystem

index year	input index				output index
	exploratory investment / ten thousand Yuan	2D seismic/ kilometer	3D seismic/ square kilometer	exploratory well drill footage /Ten thousand meters	demonstrated reserve /Ten thousand tons
2007	62462	926	552	17.28	443.7
2008	54366	248	458	17.42	529.1
2009	52570	865	343	15.82	394.3
2010	51638	839	490	20.97	373.7
2011	64969	914	682	25.25	534.3
2012	80827	3426	27710	21.06	437.6

5.1 Select the decision unit and the input/output index system

Select the exploration input and output effect as between 2007 and 2012 as the decision unit of DEA analysis. Select the exploration investment index, 2D seismic index, 3D seismic index and exploratory well drill footage index etc as the output index of DEA analysis, these indexes distinctly denote the exploration fund input, seismic workload and well drilling workload and so on. Select the demonstrated reserve index as the output index of DEA analysis to show the output of exploratory management.

5.2 Set DEA validity analysis model

5.2.1 Size and technique validity analysis evaluation——C2R model

Take data in 2007 as example, according to already set up input and output index system, set C2R model:

$$\begin{aligned}
 & \min \quad \theta \\
 & s.t. \quad 62462\lambda_1 + 54366\lambda_2 + 52570\lambda_3 + 51638\lambda_4 + 64969\lambda_5 + 80827\lambda_6 \leq 62462\theta \\
 & \quad 926\lambda_1 + 248\lambda_2 + 865\lambda_3 + 839\lambda_4 + 914\lambda_5 + 3426\lambda_6 \leq 926\theta \\
 & \quad 552\lambda_1 + 458\lambda_2 + 343\lambda_3 + 490\lambda_4 + 682\lambda_5 + 27710\lambda_6 \leq 552\theta \\
 & \quad 17.28\lambda_1 + 17.42\lambda_2 + 15.82\lambda_3 + 20.97\lambda_4 + 25.25\lambda_5 + 21.06\lambda_6 \leq 17.28\theta \\
 & \quad 443.7\lambda_1 + 529.1\lambda_2 + 394.3\lambda_3 + 373.7\lambda_4 + 534.3\lambda_5 + 437.6\lambda_6 \geq 443.7\theta \\
 & \quad \lambda_i \geq 0, i = 1, 2, \dots, 6
 \end{aligned}$$

The results is as Table 4.

Table 4: Evaluation results of exploration

year	θ^*	λ_1^*	λ_2^*	λ_3^*	λ_4^*	λ_5^*	λ_6^*	Size income
2007	0.845	0	0.839	0	0	0	0	Increase
2008	1	0	1	0	0	0	0	Unchanged
2009	0.995	0	0.745	0	0	0	0	Increase
2010	0.744	0	0.706	0	0	0	0	Increase
2011	0.845	0	1.01	0	0	0	0	Decrease
2012	0.684	0	0.827	0	0	0	0	Decrease

Added table 4: Continuation evaluation results of exploration management sub-system

year	s1-*	s2-*	s3-*	s4-*	s5+*	DEA valid
2007	7213.633	574.858	82.578	0	0	DEA invalid
2008	0	0	0	0	0	DEA valid
2009	11796.59	675.932	0	2.76	0	DEA invalid
2010	0	448.725	40.885	3.29	0	DEA invalid
2011	0	521.914	113.805	3.746	0	DEA invalid
2012	10330.785	2138.667	18578.041	0	0	DEA invalid

5.2.2 Evaluation of the technological effectively——C2GS2model

Take an example of 2007, the C2GS2model is established as follows:

$$\begin{aligned}
 & \min \quad \theta \\
 & s.t. \quad 62462\lambda_1 + 54366\lambda_2 + 52570\lambda_3 + 51638\lambda_4 + 64969\lambda_5 + 80827\lambda_6 \leq 62462\theta \\
 & \quad 926\lambda_1 + 248\lambda_2 + 865\lambda_3 + 839\lambda_4 + 914\lambda_5 + 3426\lambda_6 \leq 926\theta \\
 & \quad 552\lambda_1 + 458\lambda_2 + 343\lambda_3 + 490\lambda_4 + 682\lambda_5 + 27710\lambda_6 \leq 552\theta \\
 & \quad 17.28\lambda_1 + 17.42\lambda_2 + 15.82\lambda_3 + 20.97\lambda_4 + 25.25\lambda_5 + 21.06\lambda_6 \leq 17.28\theta \\
 & \quad \lambda_1 + \lambda_2 + \lambda_3 + \lambda_4 + \lambda_5 + \lambda_6 = 1 \\
 & \quad 443.7\lambda_1 + 529.1\lambda_2 + 394.3\lambda_3 + 373.7\lambda_4 + 534.3\lambda_5 + 437.6\lambda_6 \geq 443.7 \\
 & \quad \lambda_i \geq 0, i = 1, 2, \dots, 6
 \end{aligned}$$

Solve it and get the evaluating result is in Table5.

Table 5: Evaluation result of the exploration management subsystem

year	θ^*	λ_1^*	λ_2^*	λ_3^*	λ_4^*	λ_5^*	λ_6^*
2007	0.949	0	0.366	0.634	0	0	0
2008	1	0	1	0	0	0	0
2009	1	0	0	1	0	0	0
2010	1	0	0	0	1	0	0
2011	1	0	0	0	0	1	0
2012	0.776	0	0.321	0.679	0	0	0

Added table 5: evaluation result of the exploration management subsystem

year	s_1^{-*}	s_2^{-*}	s_3^{-*}	s_4^{-*}	s_5^{+*}	DEA valid
2007	6075.84	240.294	138.948	0	0	DEA invalid
2008	0	0	0	0	0	DEA valid
2009	0	0	0	0	0	DEA valid
2010	0	0	0	0	0	DEA valid
2011	0	0	0	0	0	DEA valid
2012	9541.789	1990.365	21111.69	0	0	DEA invalid

The index which the slack variable and surplus variable stand for are as follows:

s_1^{-*} : exploration investment ; s_2^{-*} : 2D seismic ; s_3^{-*} : 3D seismic ; s_4^{-*} : exploratory well drill footage ; s_5^{+*} : demonstrated reserve.

5.3 Evaluation and analysis for oil-field exploration and management

Oil-field exploration system in 2007 and 2012 is DEA invalid(C2R and C2GS2), it means it should adjust exploration management in 2007 and 2012 not only in size but also in technique, especially in exploration investment, 2D seismic and 3D seismic. Exploration result should be reinforced, that is to say, pertinence and efficiency of seismic work should be focused.

Oil-field exploration sub-system in 2008 is DEA valid(C2R and C2GS2),is means input and output of this oil-field exploration both reach an optimal condition in both size and technique. We should exert this advantage to enlarge exploration results. Although it is technique valid in 2009-2011, viz. DEA valid (C2GS2), size validity are not realized of exploration input, it is DEA invalid. It means in these three years the technique is good, but the size should be improved, such as if the proved reserves is achieved, compared to investment size, 2D seismic and 3D seismic, proved reserves is a little low.

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REFERENCES

- [1] AnFengquan etc. *Forecasting Our Oversea Investment Benefits in Oil & Gas Exploration and Production and Its Revelation*.2001, (9): 18-21.
- [2] Ma Zanpu. *The dynamic relationship of DEA models*.2011, (12): 26-27.

[3] WEN Guofeng etc. *Research on the Benefit Appraisal Index System and Method of Oil & Gas Exploration*. **2010**, (3):40-42.

[4] Zhang Zaixu etc. *Construction and Application of the Sustainable Development SD Model for the Oil's Exploration and Exploitation*. **2007**, 5(2): 1-6.