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Evaluation of input output efficiency of oil field considering undesirable output —A case study of sandstone reservoir in Xinjiang oilfield

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Abstract. Based on the input and output data of sandstone reservoir in Xinjiang oilfield, the SBM-U model is used to study the technical efficiency of each block. Results show that: the model of SBM-U to evaluate its efficiency and to avoid defects caused by traditional DEA model radial angle, improve the accuracy of the efficiency evaluation. by analyzing the projection of the oil blocks, we find that each block is in the negative external effects of input redundancy and output deficiency benefit and undesirable output, and there are greater differences in the production efficiency of each block; the way to improve the input-output efficiency of oilfield is to optimize the allocation of resources, reduce the undesirable output and increase the expected output.

1. Introduction

With the deepening of oilfield development, the contradiction between cost control and economic benefit is critical. Companies that do not consider the optimize the allocation between input and output of measures but instead reduce the total cost index, or increase the output by increasing cost often find that all these condition drives oilfield exploitation situation get worse. At the same time, considerable water is consumed during oil exploitation, due to both maintain the reservoir pressure and process needs. And large amount of waste water with high concentrations of toxic substances pollute the surface water, groundwater and the surrounding environment. It requires the managers in oilfield should not only realize a simulation and stable production from the angle of input-output efficiency of economic benefit, but also take the sewage treatment and environmental protection into account, all these measures have an important meaning to the sustainable development of the oilfield.

As the petroleum enterprise is a complicated system with multiple input and output, the nonparametric Date Envelopment Analysis (DEA) can make an objective and reasonable evaluation of this system. Ye Jingen, Zhang Zaixu uses the data envelopment analysis method to evaluate the investment benefits of Shengli oilfield during 1986 to1998, and puts forward some measures to solve the problems of oilfield exploitation [1]. Bao Hanrui [2] analyzed oilfield enterprise production efficiency and Malmquist index by using Bootstrap technique, adjusted the outcome of conventional DEA, and studied the general rule of entire life-cycle productive efficiency management. An Guixin, Peng Xiujuan [3] established an indicators system to evaluate the develop efficiency of oil enterprise based on the analysis of the factors that affect the petroleum development, and conducted empirical study of the develop efficiency of oil enterprise with the help of DEA model. Liu Huahua, Zhang Jing [4] take natural gas operation cost as the research object, the forecast on its natural gas operation cost
of oilfield enterprise is conducted, the prediction method is the grey theory, and optimized the prediction structure by using DEA. Li Kaizhou, Yang Huixian [5] evaluated the DEA efficiency of each block in oilfield by using data envelopment analysis, and judge whether the input-output achieved optimal effect. Song Jiekun, Song Qing [6] evaluate the allocation effectiveness of input-output in oilfield development units from technology or scale by using CCR model, BCC model, projection model and the super-efficiency model, and provide some suggestions for non-DEA efficiency of oilfield development units to realize the optimal allocation. Zhang Shuying, Li Deshan [7] analyzed the input-output efficiency of improved well by using the generalized DEA model and traditional DEA model, and found that the result of the generalized DEA model is inconsistent with the results of the traditional DEA model when the sample unit be selected is not the decision making unit.

In summary, these literatures give a more overall research on economic efficiency, production efficiency, resource allocation efficiency of oilfield enterprise, but they are not taken undesirable output into account. If we ignore undesirable output factors when we evaluate the efficiency of decision-making units, and require the desirable output the more the better is not reasonable, so, this require that we should establish a DEA model with undesirable outputs. To this end, in this paper, we take undesirable outputs into account, and conduct an empirical study of each block’s input-output efficiency of Xinjiang oilfield sandstone reservoir by using SBM-Undesirable model, and provide scientific and reasonable advice for the oilfield enterprises decision-making level.

### 2. Undesirable outputs Non-radial SBM model

The SBM-DEA model constructed by Tone work the slack variables into the objective function, which not only solve the problem of the relaxation of input-output variables, but also avoid the deviation caused by the difference of radial and angle selection. In the case of non-decreasing desirable output, we adjust input and undesirable output in different proportion according to practical needs and establish the non-radial SBM model considering undesirable outputs.

\[
\begin{align*}
\min \rho &= \frac{1 - \frac{1}{m} \sum_{i=1}^{m} s_i^b}{\frac{1}{q_1 + q_2} \left( \frac{1}{\Sigma_{i=1}^{q_1} s_i^+ / \mu_i + \Sigma_{i=1}^{q_2} s_i^b / b_i k} \right)} \\
\text{s.t.} & \quad X\lambda + s^- = x_k \\
& \quad Y\lambda - s^+ = y_k \\
& \quad B\lambda + s^b = b_k \\
& \quad \lambda \geq 0, s^- \geq 0, s^+ \geq 0
\end{align*}
\]

In the formula, the objective function \( \rho \) is strictly decreasing, \( 0 \leq \rho \leq 1 \), if the efficiency value of the SBM model \( \text{isp} = 1 \), DMU is strong efficiency, and there is no weak efficient problem of radial DEA. \( s^- , s^+ , s^b \) represents slack variable for input, desirable outputs and undesirable outputs, respectively; \( x_k , y_k , b_k \) represents decision-making units for the value of input, desired value and undesired value; \( \lambda \) is weight vector; the projection value (target value) of DMU \( k \) is evaluated the value of for:

\[
\begin{align*}
\hat{x}_k = x_k - s^- \hat{y}_k = y_k + s^+ \hat{b}_k = b_k - s^b
\end{align*}
\]

If the not-expected output is to be fixed in the above model, and the objective function does not contain non-expected outputs. That is to say, the degree of discretion of the undesirable outputs is 0 %, and the weight of undesirable output is set to 0, then the target value is fixed to the original value, and the target value is not included in the objective function. The above model can be transformed into as the follow:

\[
\begin{align*}
\min \rho &= \frac{1 - \frac{1}{q_1} \sum_{i=1}^{q_1} s_i^+ / \mu_i}{\frac{1}{q_1} \left( \frac{1}{\sum_{i=1}^{q_1} s_i^+ / \mu_i + \sum_{i=1}^{q_2} s_i^b / b_i k} \right)} \\
\end{align*}
\]
\[
\begin{align*}
& \text{s.t.} \\
& X\lambda + s^- = x_k \\
& Y\lambda - s^+ = y_k \\
& B\lambda = b_k \\
& \lambda \geq 0, s^- \geq 0, s^+ \geq 0
\end{align*}
\]

(5)

Owing to the model is a nonlinear programming model, it can be transformed into a linear scale model according to the Charnes-Cooper transformation method.

3. Data sources and explanation

3.1. Partition block
This thesis regards sandstone reservoir of Xinjiang oilfield as the object of research. According to the needs of research, we divide the sandstone reservoirs in Xinjiang oilfield, and there are some representative blocks: Ji 7, Di 20, Chepaizi, Xiquan 1, Shinan 21, Mo 116, Mo 116, Mobei 11, Erchangsanqu (see Table 1).

Table 1. Division of sandstone reservoir in Xinjiang Oilfield

| sandstone reservoir                      | Middle porosity | Ji 7 | Di 20 | Chepaizi |
|-----------------------------------------|-----------------|------|-------|----------|
| Low permeability                        | Xiquan1         | Shinan 21 | Mo 116 |
| Very low permeability                   | Mobei 11        | Erchangsanqu |

3.2. Selection of decision-making units
Selecting the decision-making unit (DMU) is to determine the reference set. Because the data envelopment analysis is the relative validity analysis of the same type of DMU, the basic requirement of DMU is the same type of DMU. According to the actual situation of sandstone reservoir in Xinjiang oilfield, this paper selects the representative blocks, and each block is regard as a DMU, all of this constitutes a panel data.

3.3. Input and output index system
This paper takes the staff costs, maintenance and repair costs, material costs, fuel costs, workover cost of well, well logging and testing costs, power costs, other expenses, depreciation (depletion) as the input indicators, and takes the oil production as the desirable output indicators. In the process of oil production, the main pollution sources and pollutants is oily sewage which is output with oil at the same time, so we take sewage quantity as the undesirable output indicators (see Table 2).

Table 2. Evaluation index system of input and output of sandstone reservoir in Xinjiang Oilfield

| input indicators                                      | staff costs, maintenance and repair costs, material costs, fuel costs, workover cost of well, well logging and testing costs, power costs, other expenses, depreciation (depletion) |
|------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| desirable output indicators                         | oil production                                                                                                                                                                                    |
| undesirable output indicators                        | sewage quantity                                                                                                                      |

4. A case study of sandstone reservoir in Xinjiang Oilfield
In this paper, the SBM-undesirable model is used to evaluate the efficiency of eight sandstone blocks in Xinjiang oilfield, and divide the result into technical efficiency and scale effect (see Table 3).

(1) From the perspective of comprehensive technical efficiency, the average efficiency of these eight blocks in different years is invalid. Among the eight blocks, the average efficiency of Shinan 21 for the period 2006-2013 is the highest, and the value is 0.9308; the average technical efficiency of Chepaizi and Mobei 11 is 0.8661 and 0.8923; the average efficiency of Mo 116 and Sanqu is 0.7968 and 0.7245; the average technical efficiency of Ji 7, Xiquan 1 and Di 20 is low, only 0.2273, 0.2474 and 0.3510. (2) From the perspective of pure technical efficiency, the pure technical efficiency of Shinan 21 is valid, and the pure technical efficiency of Ji 7, Di 20 and Xiquan 1 is very low. The pure
technical efficiency of other four blocks is invalid, but they all above 0.75. (3) From the perspective of returns to scale, the average scale effect of the eight blocks is up to more than 0.9.

As for the comprehensive technical efficiency of each decision-making unit, the overall technical efficiency of Ji 7 in the year of 2010-2013, Di 20 in the year of 2012-2013 and Xiquan 1 in the year of 2009-2013 is markedly low. The reason can be clearly seen from table 3 that the scale effect value of these decision-making unit are higher than the pure technical efficiency value, that is to say, the main reason for the low comprehensive technical efficiency is the low pure technical efficiency. The technical efficiency reflects the distance between the inspected unit and the production frontier. Because the cost of the three blocks is large, and the output is low, eventually there is a gap between the technology utilization level of the three blocks and Shinan 21.

In addition, as the table 3 shows, the comprehensive technical efficiency and the pure technical efficiency of Ji 7, Xiquan 1, and Mo 116 decreased with time. Oil managers should pay more attention to this situation, should strengthen the rational allocation of resources, enhance the technological superiority, save cost, improve stimulation efficiency, and narrow the gap between the existing technology and the production frontier. Table 4 is the cost slack variables for each decision-making unit, that is, cost of redundancy.

**Table 3(a). Efficiency value of each block in sandstone reservoir**

| block        | T   | DMU | comprehensive technical efficiency | pure technical efficiency | Scale effect |
|--------------|-----|-----|------------------------------------|---------------------------|--------------|
|              |     |     | ad                                 | b                         | c            |
| Ji 7         |     |     |                                    |                           |              |
| 2010         | 1   |     | 0.281                              | 0.288                     | 0.974        |
| 2011         | 2   |     | 0.24                               | 0.241                     | 0.993        |
| 2012         | 3   |     | 0.212                              | 0.212                     | 0.997        |
| 2013         | 4   | mean| 0.2273                             | 0.2293                    | 0.9908       |
| Di 20        |     |     |                                    |                           |              |
| 2012         | 5   |     | 0.312                              | 0.313                     | 0.995        |
| 2013         | 6   | mean| 0.351                              | 0.352                     | 0.996        |
| Chepaizi     |     |     |                                    |                           |              |
| 2006         | 7   |     | 0.729                              | 0.736                     | 0.99         |
| 2007         | 8   |     | 1                                  | 1                         | 1            |
| 2008         | 9   |     | 0.526                              | 0.528                     | 0.996        |
| 2009         | 10  |     | 1                                  | 1                         | 1            |
| 2010         | 11  | mean| 0.8661                             | 0.8673                    | 0.9983       |
| Xiquan 1     |     |     |                                    |                           |              |
| 2009         | 15  |     | 0.314                              | 0.332                     | 0.945        |
| 2010         | 16  |     | 0.265                              | 0.267                     | 0.994        |

**Table 3(b)**

| block        | T   |     | comprehensive technical efficiency | pure technical efficiency | Scale effect |
|--------------|-----|-----|------------------------------------|---------------------------|--------------|
|              |     |     | ad                                 | b                         | c            |
|              |     |     |                                    |                           |              |
| Chepaizi     |     |     |                                    |                           |              |
| 2011         | 17  |     | 0.257                              | 0.258                     | 0.996        |
| 2012         | 18  |     | 0.206                              | 0.207                     | 0.994        |
| 2013         | 19  | mean| 0.195                              | 0.196                     | 0.995        |
| 2006         | 20  |     | 1                                  | 1                         | 1            |
| 2007         | 21  |     | 0.787                              | 1                         | 0.787        |
Shinan 21

| Year | DM | U | staff maintenance and repair costs | Material fuel | Workover cost of well | Well logging and testing | power | other | depreciation (depletion) |
|------|----|---|----------------------------------|----------------|-----------------------|-------------------------|--------|-------|------------------------|
| 2008 | 22 | 0.659 | 1 | 1 | 0.659 |
| 2009 | 23 | 1 | 1 | 1 |
| 2010 | 24 | 1 | 1 | 1 |
| 2011 | 25 | 1 | 1 | 1 |
| 2012 | 26 | 1 | 1 | 1 |
| 2013 | 27 | 1 | 1 | 1 |
| mean | 0.9308 | 1 | 1 |

Mo 116

| Year | DM | U | staff maintenance and repair costs | Material fuel | Workover cost of well | Well logging and testing | power | other | depreciation (depletion) |
|------|----|---|----------------------------------|----------------|-----------------------|-------------------------|--------|-------|------------------------|
| 2010 | 28 | 1 | 1 | 1 |
| 2011 | 29 | 1 | 1 | 1 |
| 2012 | 30 | 0.773 | 1 | 0.773 |
| 2013 | 31 | 0.414 | 0.416 | 0.997 |
| mean | 0.7968 | 0.854 | 0.9425 |

Mobei 11

| Year | DM | U | staff maintenance and repair costs | Material fuel | Workover cost of well | Well logging and testing | power | other | depreciation (depletion) |
|------|----|---|----------------------------------|----------------|-----------------------|-------------------------|--------|-------|------------------------|
| 2006 | 32 | 1 | 1 | 1 |
| 2007 | 33 | 0.914 | 1 | 0.914 |
| 2008 | 34 | 0.717 | 0.724 | 0.99 |
| 2009 | 35 | 0.857 | 0.875 | 0.979 |
| 2010 | 36 | 0.886 | 0.893 | 0.993 |
| 2011 | 37 | 1 | 1 | 1 |
| 2012 | 38 | 1 | 1 | 1 |
| 2013 | 39 | 0.764 | 0.767 | 0.996 |
| mean | 0.8923 | 0.9074 | 0.984 |

Sanqu

| Year | DM | U | staff maintenance and repair costs | Material fuel | Workover cost of well | Well logging and testing | power | other | depreciation (depletion) |
|------|----|---|----------------------------------|----------------|-----------------------|-------------------------|--------|-------|------------------------|
| 2006 | 40 | 1 | 1 | 1 |
| 2007 | 41 | 1 | 1 | 1 |
| 2008 | 42 | 1 | 1 | 1 |
| 2009 | 43 | 1 | 1 | 1 |
| 2010 | 44 | 0.483 | 0.483 | 1 |
| 2011 | 45 | 0.387 | 0.387 | 1 |
| 2012 | 46 | 0.375 | 0.375 | 1 |
| 2013 | 47 | 0.551 | 1 | 0.551 |
| mean | 0.7245 | 0.7806 | 0.9439 |

a. Comprehensive technical efficiency = pure technical efficiency * scale effect.
b. Pure technical efficiency is the production efficiency influence by enterprise management and technical.
c. The scale effect is the production efficiency influenced by enterprise scale and it is the gap between the real scale and optimal production scale.
d. Comprehensive technical efficiency is used to measure and evaluate the ability of decision-making units’ resource allocation, the rate of resources utilization and others.
e. Errors may occur due to retention of decimal points.

Table 4(a). Slack variable of operating cost in each block of sandstone reservoir (unit: 10000 yuan)
|   | 1   | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    | 11    | 12    | 13    | 14    | 15    | 16    | 17    | 18    | 19    | 20    | 21    |
|---|-----|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|   | 158.3| -13.58| -21.01| 3.42  | -90.42| 15.64 | -59.5 | -68.25| -112.36|       |       |       |       |       |       |       |       |       |       |       |
| 2 |   901.1| -75.87| -104.3| 16.1  | -394.28| 63.97 | 297.7 | 420.5 | -482.34|       |       |       |       |       |       |       |       |       |       |       |
| 3 | 2451.64| -166.35| 607.82| 37.7  | -831.85| 174.6 | 654.7 | 631.3 | -1528.39|       |       |       |       |       |       |       |       |       |       |       |
| 4 | 5396.6| -778.37| 800.11| 80.8  | 2719.4| 466.0 | 1432.9| 1436.37| -7154.13|       |       |       |       |       |       |       |       |       |       |       |
| 5 | 1154.38| -116.94| -427.9| 44.3  | -136.44| 25.72 | 869.1 | 410.0 | -2903|       |       |       |       |       |       |       |       |       |       |       |
| 6 | 1146.53| -78.27| 328.02| 39.2  | -173.68| 25.72 | 798.7 | 383.7 | -2195.39|       |       |       |       |       |       |       |       |       |       |       |
| 7 | 200.64| -68.19| 131.98| 0     | -183.66| 23.03 | 245.7 | 221.4 | -1748.29|       |       |       |       |       |       |       |       |       |       |       |
| 8 | 0    | 0     | 0     | 0     | 0     | 0     | 0     | 0     |       |       |       |       |       |       |       |       |       |       |       |       |
| 9 | 1439.76| -951.65| 1746.8| 0     | -571.77| 117.6 | 445.6 | 173.6 | -3363.36|       |       |       |       |       |       |       |       |       |       |       |
| 10 | 0   | 0     | 0     | 0     | 0     | 0     | 0     | 0     |       |       |       |       |       |       |       |       |       |       |       |       |
| 11 | 0   | 0     | 0     | 0     | 0     | 0     | 0     | 0     |       |       |       |       |       |       |       |       |       |       |       |       |
| 12 | 0   | 0     | 0     | 0     | 0     | 0     | 0     | 0     |       |       |       |       |       |       |       |       |       |       |       |       |
| 13 | 0   | 0     | 0     | 0     | 0     | 0     | 0     | 0     |       |       |       |       |       |       |       |       |       |       |       |       |
| 14 | 3396.51| -961.84| -590.5| 0     | -251.27| 301.9 | 830.6 | 246.3 | 0       |       |       |       |       |       |       |       |       |       |       |       |
| 15 | -54.3| -4.06 | -3.4  | 8.76  | -28.69| -8.98 | -26.05| -16.62| -38.51|       |       |       |       |       |       |       |       |       |       |       |
| 16 | 846.08| -77.09| 100.68| 16.1  | -474.27| 85.58 | 320.3 | 377.6 | -535.26|       |       |       |       |       |       |       |       |       |       |       |
| 17 | 1362.56| -113.26| 139.71| 27.1  | -595.68| 92.32 | 450.8 | 704.2 | -653.34|       |       |       |       |       |       |       |       |       |       |       |
| 18 | 1625.55| -115.05| 382.61| 27.3  | -552.11| 115.5 | 439.1 | 447.4 | -941.85|       |       |       |       |       |       |       |       |       |       |       |
| 19 | 981.62| -143.38| 133.69| 13.8  | -495.14| 84.35 | 260.1 | 281.2 | -746.52|       |       |       |       |       |       |       |       |       |       |       |
| 20 | 0    | 0     | 0     | 0     | 0     | 0     | 0     | 0     |       |       |       |       |       |       |       |       |       |       |       |       |
| 21 | -78.64| - -   | -289.91| - -   | - -   | - -   | - -   | -1989.17|       |       |       |       |       |       |       |       |       |       |       |       |
| Shinan | Mo | Mobei | Sanqu |
|-------|----|-------|-------|
|       | 351.4 | 2928.91 | 212.1 | 414.6 | 2617.0 |
|       | 7 | 1 | 9 | 5 | 24 |
| 22 | 923.1 | -129.54 | 1729.3 | 43.9 | -709.87 | 407.7 | 855.7 | 5956.0 | -2719.35 |
| 23 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 24 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 25 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 26 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 27 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 29 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 30 | 411.0 | -0.22 | -67.15 | 2.85 | -92.97 | 71.87 | 226.4 | 0 | -1636.77 |
| 31 | 1070.31 | -594.73 | 562.03 | 26.9 | -887.62 | -106 | -557.1 | 0 | -3429.48 |
| 32 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 33 | -0.02 | -0.63 | -0.46 | 0.02 | -1 | -0.07 | -0.59 | 0 | -11.06 |
| 34 | -3.69 | -3.69 | -9.9 | 0.22 | -6.13 | -2.59 | -5.66 | 0 | -82.87 |
| 35 | -2.9 | -1.39 | 0 | 0.09 | -1.27 | 0 | -3.26 | -1.54 | -44.02 |
| 36 | -2.17 | -1.57 | -0.65 | 0.07 | -2.55 | -0.53 | -1.78 | 0 | -18.37 |
| 11 |       |       |       |       |       |       |       |       |       |
| 37 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 38 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 39 | -9.78 | -4.46 | -6.99 | 0.27 | -7.32 | -0.28 | -3.19 | 0 | 0 |
| 40 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 41 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 42 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 43 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 44 | 1849.42 | -121.66 | 493.94 | 3.98 | -243.92 | 124.0 | 832.8 | -660.9 | -1384.68 |
| 45 | 2322.91 | -193.1 | -712 | -6.6 | -463.35 | 155.6 | 935.7 | 831.4 | -1957.83 |
| 46 | 3038.88 | -264.03 | 529.18 | 10.1 | 1156.9 | 226.8 | 1020.0 | 530.9 | -2640.45 |
| 47 | 3215.0 | -61.18 | 0 | 12.2 | 1053.4 | 259.6 | 1065.0 | -216.5 | -1966.12 |

**Table 4(b)**
5. The suggestions to improving the efficiency of input and output in oilfield

5.1. Optimize the resource allocation and improve the innovation management of cost elements

With the deepening of market economy, oilfield managers should aim to economic benefit maximization, should improve the innovation management of cost, should perfect the fine management of cost, and build evaluation system of accounting. Oilfield enterprises should optimize the investment projects and strengthen fund investment management of exploratory development, to ensure the high return on investment; they should actively implement cost management and expand to cover every aspect of production, and enhance the three-class responsible working mode of production crew, group and individual; they should push forward the budget management, and try to achieve a comprehensive, integrative budget management, ultimately, they can achieve the rational allocation of element resources, and realize the integration between the oil production stabilization and the oil production costs control.

5.2. Increase input in science and technology and improve limiting economic rate

During medium to late term of oil field, on the one hand, they should increase the fund in the research, improve the science and technology hardware conditions, and strengthen innovative dynamics. They also should take scientific and technological progress as the important measures to decrease the cost and improve limiting economic rate of improved well. On the other hand, they should strengthen technological exchanges and cooperation with domestic and foreign advanced enterprises, bring in advanced production technology and equipment, and learn the advanced production technology and management experience from Shell, BP, Exxon Mobil and other foreign oilfield enterprise. At the same time, they should accelerate the application of petroleum scientific findings, perfect petroleum Science and technology promotion and service system, and conduct with universities’ petroleum development institute in order to increase the scientific input efficiency of oilfield enterprise.

5.3. Enhance the enforcement of harnessing environment and limit the negative external effects of oilfield development process

There are mainly four types of wastes arising from the oil exploration and exploitation, there are oilfield produced water, well flushing waste water, drilling wastewater and downhole operation wastewater. Oilfield managers should adopt corresponding measures in technique: First, they should reinforce the dynamic of setting deadlines for eliminating pollution, and make sure all the wastes meet the discharge standards. Second, they should use the advanced production technology of oil extraction wastewater reinjection, and ensure no discharge of wastewater. Third, they should close the high-water-cuts and non-commercial wells. Fourth, to control pollution from the source, enterprises should find out the causes and sources of environmental pollution and carry on comprehensive treatment to minimize the risk of contamination. Finally, they should raise environmental awareness and establish an effective ecology compensation mechanism of oil-gas field development when calculating the environment cost.

5.4. Strengthen the construction of innovative talents

The survival and development of petroleum enterprises depend on the innovation and progress of science and technology, and the innovation and progress of science and technology needs high-level talents. So the oilfield enterprises must train and enroll the innovative talents of science and technology, strengthen the construction of innovative talents, and improve whole diathesis of personal, which is not only ensure the efficient implementation of the measures to increase production, but also provide the human resources guarantee for realizing high and steady yield in oilfield. Petroleum enterprises should continue to innovate the necessary measures of staff’s selecting, training and evaluating, and lay more emphasis on both career ethics and skills in vocational education. They
should summon a learn spirit of diligently study and endure hardship. They should focus on testing skilled personal in uniting theory with practice, and attention should also be paid to motivate staff's market consciousness, efficiency consciousness and innovation consciousness.

6. Conclusion
We find that each block is in the negative external effects of input redundancy and output deficiency benefit and undesirable output, and there are greater differences in the production efficiency of each block. The way to improve the efficiency of input and output is to optimize the allocation of resources, reduce the undesirable output and increase the expected output.

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