



# Study on the adaptation of economic evaluation methods under the oil company model

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**Abstract.** The "oil company" model is a new oil and gas field operation and management model proposed by the Group on the basis of studying and learning from the advanced experience of foreign oil and gas enterprises. The connotation is to set up a project-based management organization with the oil or gas extraction plant as the main body, with the oil and gas reservoir operation as the core, fully relying on the internal and external social resources, and carrying out market-oriented operation; it achieves the effect of streamlining the organization without raising a specialized service team, reducing construction and operation costs, and improving economic efficiency. Streamlining institutions, not to raise specialized service teams, reduce construction and operating costs, improve economic efficiency, is the future production and operation of the Group's units and departments and the focus of the reform and construction of the objectives and priorities. In this paper, the adaptability study of economic evaluation method is carried out for the characteristics of production and operation of "oil company" mode, which provides better decision-making support for benefit development, production and operation strategy decision-making and program investment optimization.

**Keywords:** "oil company" model, economic evaluation methodology, adaptability study.

## 1 Introduction

The core feature of the "oil company" model is a new type of reservoir management system and operational mechanism. From the organizational perspective, the core feature of the "oil company" model is the specialization and social division of labor around the whole value chain. From the perspective of management, the core feature of the "oil company" model is a systematic, integrated and diversified oil enterprise management system. <sup>[1]</sup>The "oil company" model is characterized by the marketization of project operation, the high efficiency of the first party, the streamlining of human resources, the intelligence of production management, the flattening of the organizational structure and the differentiation of the remuneration system, which is an important achievement and the crystallization of wisdom of the Group in promoting the reform of the "three systems". It is an important achievement and wisdom

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crystallization of the Group in promoting the reform of the "three systems", and will provide useful reference and learning for the subsequent development.

## **2 Evaluation Characteristics of production and operation under the "oil company" model**

The principle of "comparison with or without" is the basic principle of benefit evaluation for long-term planning of oil and gas exploration and development and "comparison with or without" refers to the identification of incremental inputs and benefits of the project to be evaluated by comparing the differences in the obtainable quantities of inputs and outputs of the project in the two cases of "project with" and "project without", Comparison of "with or without project" refers to the identification of incremental inputs and benefits of a project by comparing the differences in the obtainable quantities of inputs and outputs of the project to be evaluated under the "with project" and "without project" scenarios.<sup>[2]</sup>

The difference between the "with project" data and the "without project" data in the calculation period is the incremental benefit of the project to be evaluated, and the "with or without comparison" excludes the influence of various conditions before the project to be evaluated is implemented according to the new program design, and emphasizes the importance of the project. <sup>[3]</sup>The "with or without" comparison excludes the effects of the conditions that preceded the implementation of the project under the new programmatic design and highlights the effects of the project's new activities. The scope and period of calculation of benefits and costs in the "with project" and "without project" scenarios should be consistent and comparable.

## **3 The main common methods used in the economic evaluation of current gas field projects**

According to the characteristics of the project, following the evaluation principles and evaluation indexes, the economic evaluation methods of the project are categorized into the probabilistic evaluation method, the discounted cash flow evaluation method and the risk evaluation method. <sup>[4]</sup>

### **3.1 Approximate evaluation method**

The approximate evaluation method is mainly to judge the economy of the evaluation indexes by calculating the value of the physical volume indexes and comparing it with the value of the economic threshold;<sup>[5]</sup> it can also be the initial evaluation of the project benefits such as calculating the minimum economically recoverable reserve size. Often used in the economic evaluation of reserves calibration. Among them, the minimum economically recoverable reserve size refers to the minimum economically recoverable natural gas volume estimated under the current technical conditions and according to the economic conditions (gas price, cost, etc.).

### 3.2 Discounted cash flow evaluation method

Discounted cash flow evaluation method is an evaluation method to examine the economic characteristics of the project such as profitability and solvency based on the cash flow of the project on the basis of the technical program. With the calculation of the internal rate of return as the main evaluation index, and it is a common method of economic evaluation of the project at home and abroad at present. [6]

This method of comprehensive evaluation of the inputs and outputs of the project, with a comprehensive set of dynamic evaluation indicators to give a comprehensive description of the project's economy, is the most commonly used method of project evaluation, the use of discounted cash flow evaluation method can be a comprehensive evaluation of the project's ability to make a profit in the years of the construction period and the production period. It estimates the financial benefits and costs of the project and conducts financial analysis and sensitivity analysis. [7] The discounted cash flow evaluation method consists of the following main parts of the calculation: Investment estimation, i.e., estimation of all costs required for the project on the basis of the technology development program; Estimates of total costs and expenses, including oil and gas operating costs, depreciation expenses, administrative expenses, operating expenses and exploration expenses. If financing is considered, consideration should be given to calculating finance costs; Estimation of operating revenues, i.e. estimation based on the sub-yearly production, natural gas price and commodity rate determined by the technical program; the natural gas commodity rate can be determined with reference to the actual production of the previous year, and the natural gas price is calculated in accordance with the regulations of the Group Company. Estimation of business taxes and surcharges, including urban construction and maintenance tax, education surcharge, resource tax and special petroleum revenue, of which urban construction and maintenance tax and education surcharge are calculated on the basis of value-added tax, and income tax is a kind of tax levied on enterprises in respect of their income from production and operation and other incomes, and the amount of taxable income is correctly calculated in accordance with the national laws and regulations on enterprise income tax and relevant policies, and the appropriate tax rate is adopted for the calculation of enterprise income tax, while attention is paid to the correct use of relevant income tax incentives and explanations thereof. In accordance with the relevant national laws and regulations on enterprise income tax and related policies, correctly calculate the taxable income and adopt the appropriate tax rate to calculate the enterprise income tax, and at the same time pay attention to the correct use of the relevant income tax incentives and explain them;

Financial analysis is based on the estimation of the financial benefits and costs of the project, the calculation of evaluation indicators, and the analysis of the project's profitability, to determine the financial feasibility of the project. Its main calculation indexes are: financial internal rate of return of project investment, financial net present value of project investment, and payback period of project investment. [8]

### 3.3 Risk evaluation methodology

The risk evaluation method is to analyze the likelihood of the occurrence of risk factors and the degree of economic loss to the project. The analysis process is risk identification, risk analysis, risk evaluation and risk response, and the method is mainly to qualitatively evaluate the level of risk by drawing on the experience of technical experts, industry standards or practices, or to quantitatively evaluate the probability of project risk by using methods such as probability tree analysis and Monte Carlo simulation.

## 4 Application case studies

### 4.1 Calibration of economically recoverable reserves in Block G gas reservoirs

Based on the operating costs, prices, tax/rate and other data of the gas field, the economic limit production is calculated; based on the production forecast, the cumulative production at the point of extrapolation to the economic limit production is the economic recoverable. According to the production history, the natural gas production of Block G in the late stage of exploitation conforms to the exponential decreasing law, and the probabilistic evaluation method is used to predict the natural gas production of the Block G reservoir using this decreasing law, with the economic limit production of a single well as the truncation condition, and the cumulative production of  $249.13 \times 10^8 \text{m}^3$  of gas as of 2048, then the economically recoverable reserves of the Block G reservoir are  $249.13 \times 10^8 \text{m}^3$ .

### 4.2 Evaluation of the economic benefits of the Z-well test mining program

Investment estimation should reflect technological progress. In the oil and gas industry, oil and gas drilling engineering occupies an important position. Oil and gas drilling project investment accounts for 60%-70% of the investment in oil and gas exploration and development projects, tight gas wells in the Sichuan Basin have long horizontal sections, large-scale fracturing and other characteristics that make their drilling investment accounted for a greater proportion of the total investment in the project. The long-term planning project of tight gas exploration and development should strive to reduce drilling investment in phases by optimizing well structure, optimizing drilling technology, fine field management, optimizing fracturing plan and fracturing construction technology.

Estimation of total costs and expenses Components of Total Costs and Expenses: Total natural gas costs and expenses include oil and gas operating costs, depreciation, and period expenses. Natural gas operation costs include extraction operation costs, downhole operation costs, logging and testing costs, natural gas purification costs, maintenance and repair costs, transportation costs, other auxiliary operation costs, and plant and mine management costs. Projects with workload and physical consumption that can be provided by the program and for which the "Parameters for Economic

Evaluation of Investment Projects" has clear calculation provisions are measured on the basis of physical quantity; other projects refer to the average level of the previous year. Depreciation is calculated for oil and gas assets using the production method. Discarded cost accounts for 5% of the original value of oil and gas assets. Period expenses include administrative expenses, financial expenses and operating expenses.

Financial analysis Product operating income: the average annual operating income during the evaluation period is 56.45 million yuan. Business taxes and surcharges: the business taxes and surcharges involved in the financial evaluation of the project are resource tax, urban maintenance and construction tax and education surcharge. Profit and income tax: the average annual profit of the evaluation period is 20.66 million yuan, and the after-tax profit and depreciation are all used to repay the loan during the repayment period; the average annual income tax of the evaluation period is 3.3 million yuan. Financial Profitability Analysis: After calculation, the internal rate of return (after tax) of the project investment is 10.07%, the financial net present value (after tax) of the project is 32.71 million yuan, and the payback period (after tax) is 7.54 years.

### **4.3 Evaluation of the economic benefits of the Z-well test mining program**

The scope of evaluation of this project is mainly based on the recommended contents of the Z well test mining program, and the financial evaluation of the costs and revenues incurred in the implementation of the program (including secondary well completion, dynamic monitoring and special costs, internal gathering and transportation, field station and ancillary projects).

The economic evaluation was based on the "Methods for Economic Evaluation of Oil and Gas Exploration and Development Investment Projects of China National Petroleum Corporation (Document No. 22 of CNPC [2017])" issued in 2017.

Including the evaluation period, annual natural gas production, tax rate, benchmark yield, etc., the specific values are as follows: evaluation period: 20 years; natural gas VAT rate: 9%; urban maintenance and construction tax rate: 7%; education surcharge: 5%; resource tax rate: 5.32%; and income tax rate: from 2021 to 2030 at 15%, and from 2031 onwards at 25%;

According to the schematic design, well Z is expected to be put into test production on June 1, 2023, with a cumulative gas production of  $8.73 \times 10^8$  m<sup>3</sup> over the evaluation period;

This evaluation is based on the document "Economic Evaluation Parameters of Investment Projects of China National Petroleum Corporation (2020)" (CNPC [2020] No. 14), and the benchmark rate of return is taken as 8%.

The main evaluation parameters used in this evaluation, such as natural gas price, commodity rate, personnel costs and plant and mine management fees, refer to the actual operating costs of the previous year. Natural gas price: RMB1,275/thousand cubic meters (excluding tax); natural gas commodity rate: 94.59%; operating cost: during the evaluation period, the unit operating cost was RMB380/thousand cubic meters; other costs and taxes: calculated in accordance with the relevant regulations

on the economic evaluation methods and parameters of oil and gas exploration and development investment projects of China National Petroleum Corporation.

Total cost components: Total natural gas costs include oil and gas operating costs, depreciation, and period costs.

Natural gas operation costs include extraction operation costs, downhole operation costs, logging and testing costs, natural gas purification costs, maintenance and repair costs, transportation costs, other auxiliary operation costs, and plant and mine management costs. Projects with workload and physical consumption that can be provided by the program and for which the "Parameters for Economic Evaluation of Investment Projects" has clear calculation provisions are measured in physical terms; other projects refer to the average level of the previous year.

Direct personnel costs: assessed by reference to relevant well station standards;

Well operation fee operation cost is considered at 1~1.6 million/year; well test cost is measured at 800,000/year based on the physical workload provided by the design of the test mining program;

Natural gas purification fee: RMB 211/thousand cubic meters;

Maintenance and repair costs are measured at 2.5% of the investment in ground works;

Other auxiliary operating costs are measured with reference to the average level of the previous year and are valued at 22 yuan per thousand cubic meters;

The plant and mine management fee is measured by reference to the average level of apportioned management fee of the previous year, which is based on \$500,000/year;

Depreciation is calculated using the production method for oil and gas assets. The cost of depreciation is 5% of the original value of the oil and gas assets.

Period expenses include administrative expenses, financial expenses and operating expenses.

Management costs include other management fees and safety production fees. Based on the actual share of the previous year, other management fees are measured at \$94/thousand cubic meters, and safety production fees are withdrawn monthly at \$5/thousand cubic meters.

Finance costs include net interest expense on long-term borrowings, working capital borrowings, short-term borrowings and abandonment cost finance costs.

Operating expenses are taken as 0.5% of operating income according to the "Parameters for Economic Evaluation of Investment Projects" of China National Petroleum Corporation.

The results of the cost and expense estimates are: the average annual total cost and expense for the measured evaluation period is \$31.07 million, the average annual operating cost and expense is \$20.21 million, the unit full cost and expense is \$787/kcf, and the unit operating cost and expense is \$380/kcf.

Product operating income: The average annual operating income during the evaluation period was 56.45 million yuan.

Business taxes and surcharges: The business taxes and surcharges involved in the financial evaluation of the project are resource tax, urban maintenance and construction tax and education surcharge.

Profit and income tax: the average annual total profit for the evaluation period was 20.66 million yuan, with all after-tax profit and depreciation used to repay the loan during the repayment period; the average annual income tax for the evaluation period was 3.3 million yuan.

Financial Profitability Analysis: After calculation, the internal rate of return (after tax) of the project investment is 10.07%, the financial net present value (after tax) of the project is 32.71 million yuan, and the payback period (after tax) is 7.54 years.

Production Risk: The economic evaluation of this project is calculated on the basis of the predicted production of the gas wells designed in the trial mining program. As the project is a trial mining project, the gas wells put into production in the trial mining program are in the stage of trial mining evaluation, and there is an uncertainty risk that the cumulative gas production during the evaluation period will not meet the expectation (the inverse production break-even point is -34.65%);

Price risk: Natural gas prices are affected by macroeconomic and natural gas price reforms, and the project is subject to certain price risks;

Operating cost risk: As the operating costs of the project are measured based on the current actual costs, they may increase as a result of factors such as rising material prices and increases in various expenses.

Economic evaluation conclusion: the project reported investment of 76.47 million yuan, including construction investment of 74.24 million yuan (including 29.97 million yuan for secondary completion costs, 40.07 million yuan for ground engineering construction costs, 4.2 million yuan for dynamic monitoring and wellbore corrosion testing special costs), 660,000 yuan of interest during the construction period, and 1.57 million yuan of laying down of working capital. ... The project is evaluated under the condition of natural gas price of 1275 yuan/thousand cubic meters (excluding tax price), the financial internal rate of return of the project investment is 10.07% (after tax), the financial net present value of the project is 32.71 million yuan (after tax), and the payback period is 7.54 years. The unit full cost is 787 yuan/thousand cubic meters. The evaluation results show that, in the test mining program of Z well, the test mining is carried out according to the program design, and the economic evaluation of the program is carried out in the case of utilizing the investment in exploratory wells, and all the economic evaluation indexes satisfy the requirement of 8% (after tax) of the benchmark rate of return of the oil and gas development and construction projects of China National Petroleum Corporation.

## 5 Conclusion

"The pilot effect of the new model and mechanism of the "oil company" model reform needs to be verified in practice over the long term, and the potential risks and supporting control measures need to be analyzed and improved; in the process of operation, we should make adjustments and optimizations as we go along, and intensify our efforts in summarizing and assessing the situation. Formation of economic efficiency evaluation system under the unique mode.

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