Research of the Post Evaluation model for the Productivity Construction Project of Oilfield Based on the AHP

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Summary
In order to improve the investment efficiency, decision-making and management level of the productive capacity construction project of oilfield, on the basis of analysis of work processes and work content in detail, for uncertainty, high risk, investment and other characteristics, proposed a design scheme on computer technical supporting of auxiliary systems of the post evaluation for the productive capacity construction project of oilfield based on the AHP. First, determined the evaluation weights reasonably with the AHP; then got the composite score; finally, researched and developed the intelligent systems of satisfying engineering and technical personnel and the decision-making needs of project management according to the actual needs. The system is used in the work of the productive capacity construction project of oilfield, evaluate efficiently and objectively and the decision-making scientifically.
Key words:
Productivity Construction,the Post Evaluation,AHP, Fuzzy Logic

1. Introduction

The post evaluation about oil field productivity construction projects is a comprehensive key work, which has a practical meaning for improving the projects approval, decision-making and implementation levels. It is necessary to analyze and evaluate all aspects of projects in a round and systematic way after the projects are implemented. That is to say, make post evaluation for projects [1]. The study about evaluation theories and methods are mainly contains the following three directions: the evaluation method based on mathematical theories, the evaluation method based on mathematical analysis, the valuation method based on decision support. The establishment of target system is the key step of the whole multiple-attribute comprehensive evaluation. To build a scientific target system is the basis and premise of accurately sorting and classifying evaluation objects [2-3]. Experts often adopt vague words like very good, well and not bad during the process of project post evaluation because there are many uncertain factors, high risks and great investment in oil field productivity construction projects, which leads to that the evaluation results are fuzzy and difficult to quantify, besides, it is hard to measure whether the implementation results of different projects are well or not by using only one or two indexes. So the paper puts forward the important degree of each index that affects projects success, calculating its reasonable and relevant weights with AHP analysis methods, then grades every index through objectively synthesizing experience and subjective judgment of experts, finally gets the comprehensive grade of a project [4]; establish a post evaluation assistant system for oil field productivity construction projects. The system will analyze the post evaluation work of oil field productivity construction and study a set of intelligent evaluation system that can be popularized and applied into the post evaluation on the basis of mastering specific enforcement regulations, methods and ways of evaluation work. Therefore, the development of this system has a very wide application prospect.

2. Establishing the hierarchical structure with AHP method

2.1 The basic principles of the AHP method

In the 1970s, American operational researcher T.L.Saaty put forward AHP method (analysis hierarchy process) and applied fuzzy logic into it [5]. This is a comprehensive evaluation method about system analysis and decisions, a flexible multiple-criteria decision-making method, which can reasonably quantify qualitative problems. The AHP method firstly establishes a recursion order hierarchy and transfers subjective judgment into the compare of importance degree between two quantities. Its principle is to classify all the selection indicators and schemes of all the research questions in accordance with their properties and divide them into some hierarchies, turning questions into sequencing problems about good and bad of each index and scheme. Then judge the matrix through structures and calculate the weights of single sort and total sorts of each index that one hierarchy is relative to the last hierarchy.

2.2 The basic steps of AHP

Step 1: build a hierarchy evaluation model of AHP and classify evaluation indexes into multiple hierarchies

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through deep analyzing the research questions, then establish a multilevel indexes evaluation model.

Step 2: structure judgment matrix R and suppose the evaluation index set about the intercomparison of importance degree is:

$$A=\{a_1,\quad a_2,\quad \cdots \quad a_i,\quad \cdots \quad a_n\}$$

a_i is the i index that is remained to be compared while n is the evaluation index. Each index of the same hierarchy corresponding to the importance belonging to certain criterion from the last hierarchy is compared in pairs, then confirm the index importance and structure the pairwise comparison judgment matrix R:

$$R=\begin{bmatrix} r_{11} & r_{12} & \cdot & r_{1n} \\ r_{21} & r_{22} & \cdot & r_{2n} \\ \cdot & \cdot & \cdot & \cdot \\ r_{n1} & r_{n2} & \cdot & r_{nn} \end{bmatrix},\left(r_{ij}=1, i=j, r_{ij}=1/r_{ji}\right) \quad (1)$$

The index weight of $a_1, a_2 \cdots, a_n$ is respectively $w_1, w_2 \cdots w_n$, r_{ij} refers to membership degree that index a_i is more important than a_j. The bigger of the r_{ij}, the bigger of the important membership degree that a_i than a_j; if r_{ij} =1, it indicates that the two indexes have the same important membership degree.

Figure 1. The post evaluation target system

First class indicator	Second class indicator
Aims achieved A1	Coincidency rate of productivity A11
	Coincidency rate of output A12
Preliminary work A2	Decision-making basis integrity A21
	Decision-making process normalizationA22
	Job content of preliminary study A23
Geological oil reservoir project A3	Coincidence degree of new recoverable reserves A31
	The rationality of oil reservoir scheme A32
	Coincidence degree of development indexesA33
Well drilling project A4	Normalization of engineering supervision A41
	Control degree of project quality A42
	Technology adaptabilityA43
Extract oil（gas）project A5	Normalization of engineering supervision A51
	Control degree of project quality A52
	Technology adaptability A53

First class indicator	Second class indicator
Flooring work A6	Rationality of feasibility and preliminary design A61
	Rationality of construction design A62
	Normalization of engineering supervision A63
	Control degree of technical quality A64
	The adaptability of technology A65
Production run A7	Production arrangement A71
	Coincidence degree of operating index A72
	Production and operation management A73
	Effectiveness of safety and environment protection measures A74
	Effectiveness of energy saving and emission reduction measures A75
Investment and economic benefits A8	Control degree of investment A81
	Cost control A82
	Benefit index A83
Influence and persistence A9	Resource supersede prospect A91
	Technological innovation ability A92
	Policy influenceA93

Step 3: calculating weights, elements in a line of the judgment matrix are calculated in multiplication by adopting the root method, then extract the n root.

$$w_i=\sqrt[n]{\prod_{j=1}^{n} a_{ij}} \ (i, j=1,2,...,n) \quad (2)$$

Get weight coefficient w_i after standardization:

$$w_i = \frac{w_i}{\sum_{i=1}^{n} w_i} \quad (3)$$

The weight vector is :

$$W = (w_1, w_2, \cdots, w_n) \quad (4)$$

Figure 2. Judgment matrix and Index weights

Indicators	Weights	Judgment matrix						Weights
A1	0.200	A11	1.000	0.818				0.450
		A12	1.223	1.000				0.550
A2	0.100	A21	1.000	1.000	0.818			0.310
		A22	1.000	1.000	0.818			0.310
		A23	1.223	1.223	1.000			0.380
A3	0.100	A31	1.000	1.000	0.818			0.310
		A32	1.000	1.000	0.818			0.310
		A33	1.223	1.223	1.000			0.380
A4	0.100	A41	1.000	1.223	1.223			0.380
		A42	0.818	1.000	1.000			0.310
		A43	0.818	1.000	1.000			0.310
A5	0.100	A51	1.000	0.818	0.591			0.255
		A52	1.223	1.000	0.689			0.307
		A53	1.693	1.452	1.000			0.438
A6	0.100	A61	1.000	1.000	1.000	1.000	1.000	0.200
		A62	1.000	1.000	1.000	1.000	1.000	0.200
		A63	1.000	1.000	1.000	1.000	1.000	0.200
		A64	1.000	1.000	1.000	1.000	1.000	0.200
		A65	1.000	1.000	1.000	1.000	1.000	0.200
A7	0.100	A71	1.000	0.689	0.818	0.818	0.818	0.162
		A72	1.452	1.000	1.223	1.223	1.223	0.241
		A73	1.223	0.818	1.000	1.000	1.000	0.199
		A74	1.223	0.818	1.000	1.000	1.000	0.199
		A75	1.223	0.818	1.000	1.000	1.000	0.199
A8	0.100	A81	1.000	1.000	0.818			0.310
		A82	1.000	1.000	0.818			0.310
		A83	1.223	1.223	1.000			0.380
A9	0.100	A91	1.000	1.000	1.452			0.372
		A92	1.000	1.000	1.452			0.372
		A93	0.689	0.689	1.000			0.256

Calculate the maximum eigenvalue $\lambda_{\max}$ of *R* by using *MATLAB* evaluate the coincidence indicator (*CI*) and the random consistency ration (*CR*) through the checking formula (5)

$$CI = (\lambda_{\max} - n) / (n-1), CR = CI / RI \quad (5)$$

RI is the average random consistency ration. When $CR < 0.10$, the judgment matrix has a satisfying consistence; on the contrary, adjust the judgment matrix.

2.3 The calculation of index weights

The paper conducts the post evaluation of oil field productivity construction projects. Build a hierarchy evaluation model according to the step 1. The basic contents of the post evaluation of oil field productivity construction projects are: aims achieved, preliminary work, geological oil reservoir, well drilling projects, extract oil(gas) projects, flooring work, production run, investment and economic benefits, influence and persistence. The evaluation target system about the post evaluation of oil field productivity construction projects is shown in figure 1, adopting the scale:

$$\ln(\frac{9}{9}e) - \ln(\frac{17}{1}e)$$

Compare the important membership degree between each pair of indexes in accordance with the step 2, and structure judgment matrix, then calculate index weights on the basis of the step 3. The results are shown in figure 2.

3. The design of the system

The data collected by management and operating units of this project about the post evaluation of productivity construction projects mainly contains the basic information of these evaluation projects, such as project management units, project geographical locations and project structure units; the project decision-making process is inputted by management and operating units, development departments and planning departments; as for the project development indexes, these that before evaluation time-point are collected by project management and operating units or imported from the existing data base according to well numbers while the part that after evaluation time-point are collected and input by the planning office in accordance with the predicted results of exploration and development research institutes or directly collected on the basis of software predicting according to the practical truth; the investment data is collected and inputted by planning departments in the light of the reported data of project management and operating units; the running cost and evaluation parameters are collected and input by the planning office.

The implement of the evaluation system depends on the foreground language of the computer and the support of background system. The development of this system adopts B/S model and ExtJs frame as well as chooses oracle 10g as the background data base in order to accomplish the post evaluation assistant system for oil field productivity construction. When a certain project is evaluated, users can look up the evaluation result; besides, users can examine the variation trend of the index values that they are concerned and create a corresponding area chart. Then people can summarize experience and lessons from the whole links during the phrase of setting and deciding a project to the project implementation and basic accomplishment, which has an important practical significance for other capacity and project construction of the next year, including improving the project establishment, decision-making and implementation level.

Conclusion

Project post evaluation is the last link of project overall process management, and is also a key step. The paper conducts the post evaluation of productivity construction projects with AHP method and designs a evaluation system. This system has been passed operational testing and applied into practical post evaluation of oil field productivity construction. It can accurately and efficiently evaluate projects, which provides meaningful reference value for the post evaluation of productivity construction.

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