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# Systematic approach in petroleum personnel competence assessment

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**Abstract.** The article is devoted to professional competence improvement of personnel in the petroleum industry. The technique for competence assessment optimization in oil and gas well drilling is developed. The specification for the oil and gas industry competence profiles has been provided.

## Introduction

Research in the systematic approach has been conducted for several decades in Russia. The systematic theoretical foundation description and analysis of the most significant fundamental management schools include human relations, modern organizational theories, industrial sociology, as well as classical management theory which have been represented in the works of D. M. Gvishiani, S. Popkov, V. N. Sadowski [1]. Systematic approach involves planning, engineering design, evaluation, etc. Considering the professional competence assessment within the organization management system, the assessment of both a separate system element and a subsystem itself with its relationships, elements and principles are defined.

### 1. Materials and Methods

A. A. Damadaran, leading scientist in assessment field (as a philosophical category) identifies three important rules for any assessment [2]. Developed by high-qualified and experienced experts this system is influenced to a certain degree by bias of the resulting assessment itself. That can be explained by high availability level of different information in our modern world. It is possible to reduce bias influence on the assessment in two ways:

- before assessment, radical public opinion should be excluded which could possibly lead to its undervaluation or revaluation;
- before assessment, personal convictions should be minimized concerning how overvalued or undervalued the object is.

Systematic approach characterizes organization activities and identifies patterns and relationships with a view to more effective use. Fundamentally, this approach is a problem-solving method, as well as a goal setting method. It is more objective than subjective.

Today, the systematic approach is used widely in economic research. For instance, the academician K. A. Bagrinovsky School developed a systematic approach methodology in strategic business



development planning. Systematic studies are absolutely specific where general systems theory is associated with the work objectives and the nature of the object being studied. To optimize the assessment system, the test item numbers for each competence was correlated to the competence matrix. This was based on:

- the number of *i*-th questions to the complexity level of the *j*-th competence issues;
- the percentage of the *j*-th competence complexity level.

Within the assessment system, the maximum number of tests was given to the competencies having the largest testing percentage. For instance, practically all the organization office and service specialists have been tested for such competencies as “Drilling”, “Oil and gas well drilling technology”, “Oil and gas well installation and operation”. Consequently, the number of these competence tests was the largest in the assessment system. In other words, the assessment system is optimized on the basis of the competence importance.

The competence percentage depended on the *j*-x competences number of *i*-th complexity level, according to the assessment system specifications and codifiers and total number of test items.

The number of questions for each competency was determined by the following formula:

$$m_{ij} = \left( d_{ij} \cdot \sum_{i=1}^n m_{ij} \right) / 100, \quad (1)$$

where, the number of questions the *i*-th level of complexity for the *j*-th competence;

*d<sub>ij</sub>* - the proportion of the *j*-th competence of the *i*-th level of complexity.

The competence percentage was defined as:

$$d_{ij} = \left( k_{ij} / \sum_{i=1}^n k_{ij} \right) \cdot 100, \quad (2)$$

where, *k<sub>ij</sub>* - the *j*-th competence number of *i*-th complexity level.

## 2. Results and Discussion

Individual specialist specifications include a set of competencies, taking into account the complexity level, the number of questions based on their complexity level, the maximum number of points, and the test time. The higher a specialist position in the enterprise structure, the greater range of competencies is included in his /her specification (Table. 1).

**Table 1.** Specification of department supervisor “Capital workover management”

| Capital workover management |  | Competence level | Number of questions | Total score | Test time |
|-----------------------------|--|------------------|---------------------|-------------|-----------|
| Department supervisor       |  |                  |                     |             |           |
| Fundamental Management      | 1. Fundamentals of Management                    | 3                | 3                   | 9           |           |
|                             | 2. Fundamentals of Oil and Gas-Field Engineering | 3                | 2                   | 6           |           |
|                             | 3. Fundamentals of legal studies                 | 2                | 2                   | 4           |           |
| Business organization       | 4. Documents, policies and procedures            | 1                | 3                   | 3           |           |
|                             | 5. Institutional environment                     | 2                | 2                   | 4           |           |

|                           |  |    |    |    |          |
|---------------------------|--|----|----|----|----------|
| Oil and gas well drilling | 6. Technology and technique of oil and gas well drilling                     | 2  | 2  | 4  | 120 min. |
|                           | 7. Repair operations   | 2  | 2  | 4  |          |
|                           | 8. Petrophysics  | 3  | 3  | 9  |          |
|                           | 9. Installation and maintenance of drilling equipment                        | 2  | 2  | 4  |          |
|                           | 10. Pipeline engineering, construction and operation and oil and gas storage | 2  | 6  | 12 |          |
| IT skills                 | 11. *SAP Repairs and maintenance of fixed assets                             | 3  | 3  | 9  |          |
|                           | 12. Internet/Intranet  | 2  | 2  | 4  |          |
| Competence level          | 1 – beginning  | 1  | 3  | 3  |          |
|                           | 2 – user   | 7  | 18 | 37 |          |
|                           | 3 – experienced  | 4  | 11 | 32 |          |
| Total                     |  | 12 | 32 | 72 |          |

After tests, codifiers and specifications, the trial testing was conducted according to the proposed competencies modules [3].

Due to the final personnel testing results, the career development program was established.

Based on these techniques, in some oil and gas companies personnel effectiveness analysis was launched and established - for primary and after career development training testing. Table 2 shows the assessment system of drilling engineers in the petroleum industry.

The results of this study can be summarized as follows:

- based on the competence model and accounting and economic services structure, the general competencies profile was formed;
- codifiers and specifications were designed;
- the test items bank were examined;
- the strengths and weaknesses in specialist training were analyzed;
- recommendations on the advanced training programs were formulated.

**Table 2.** Test questions specification on competence profiles petroleum specialists (Oil and gas well drilling)

| Model elements  | Competence levels |      |             |        | $k_{ij}$ | $d_{ij}$ | $m_{ij}$ |
|---|-------------------|------|-------------|--------|----------|----------|----------|
|   | Beginning         | User | Experienced | Expert |          |          |          |
| <i>Fundamentals of Management</i>                               |                   |      |             |        |          |          |          |
| Enterprise Economics and Management (in oil and gas industries) | 25                | 25   | 20          | 5      | 75       | 3.7      | 37       |
| Fundamentals of Management                                      | 20                | 15   | 10          | 5      | 50       | 2.5      | 25       |

|  |    |    |    |    |     |     |    |
|--|----|----|----|----|-----|-----|----|
| Fundamentals of Oil and Gas-Field Engineering                            | 30 | 25 | 20 | 5  | 80  | 4.0 | 40 |
| Fundamentals of legal studies  | 15 | 10 | 10 | 5  | 40  | 2.0 | 20 |
| <i>Knowledge of business organization</i>                                |    |    |    |    |     |     |    |
| Incorporation documents, policies and procedures                         | 25 | 15 | 5  | 5  | 50  | 2.5 | 25 |
| Institutional environment  | 40 | 25 | 15 | 5  | 85  | 4.2 | 42 |
| Business trends  | 15 | 15 | 10 | 5  | 45  | 2.2 | 22 |
| <i>Oil and gas well drilling</i>   |    |    |    |    |     |     |    |
| Geology  | 25 | 15 | 15 | 0  | 55  | 2.7 | 27 |
| Field development  | 50 | 25 | 25 | 10 | 110 | 5.5 | 55 |
| Well drilling  | 50 | 40 | 30 | 5  | 125 | 6.2 | 62 |
| Oil and gas recovery   | 60 | 50 | 15 | 6  | 131 | 6.5 | 65 |
| Production operations metrology support                                  | 20 | 15 | 10 | 5  | 50  | 2.5 | 25 |
| Field gathering system and preparation of production fluid               | 20 | 15 | 15 | 5  | 55  | 2.7 | 27 |
| Repair operations  | 50 | 25 | 15 | 10 | 100 | 5.0 | 50 |
| Oilfield chemistry   | 25 | 15 | 10 | 5  | 55  | 2.7 | 27 |
| Petrophysics   | 25 | 10 | 10 | 5  | 50  | 2.5 | 25 |
| Pipeline engineering, construction and operation and oil and gas storage | 35 | 15 | 10 | 5  | 65  | 3.2 | 32 |
| Mechanics of solid rock  | 20 | 15 | 10 | 5  | 50  | 2.5 | 25 |
| Oil and gas well drilling technology                                     | 35 | 30 | 15 | 5  | 85  | 4.2 | 42 |
| Drilling equipment installation and maintenance                          | 50 | 30 | 15 | 5  | 100 | 5.0 | 50 |
| Geophysical well logging   | 25 | 10 | 10 | 5  | 50  | 2.5 | 25 |
| Horizontal drilling  | 45 | 25 | 15 | 5  | 90  | 4.5 | 45 |
| <i>IT skills</i>   |    |    |    |    |     |     |    |
| SAP Logistics  | 15 | 10 | 5  | 5  | 35  | 1.7 | 17 |
| SAP Repairs and maintenance of fixed assets                              | 15 | 10 | 5  | 5  | 35  | 1.7 | 17 |
| Well drilling production process automation                              | 22 | 15 | 5  | 5  | 47  | 2.3 | 23 |
| Lotus Notes  | 14 | 38 | 7  | 5  | 64  | 3.2 | 32 |

|   |      |           |           |          |      |     |          |
|---|------|-----------|-----------|----------|------|-----|----------|
| Electronic archive system                       | 20   | 21        | 5         | 5        | 51   | 2.5 | 25       |
| MS Office (Word, Excel, Power Point)            | 25   | 52        | 17        | 5        | 99   | 4.9 | 49       |
| Internet/Intranet                               | 12   | 53        | 10        | 5        | 80   | 4.0 | 40       |
| Overall competencies $k_{ij}$                   | 346  | 564       | 147       | 5        | 2007 | *   | *        |
| Percentage of competence questions $d_{ij}$ , % | 32.6 | 53.1<br>1 | 13.8<br>4 | 0.4<br>7 | 100  | 100 | *        |
| Number of questions $m_{ij}$ , total            | 313  | 510       | 133       | 5        | -    | -   | 100<br>0 |

This assessment algorithm of professional competence has been successfully tested to motivate personal and career growth of its employees, in such Russian oil and gas companies as: JSC “Gazprom”, OJSC “Rosneft”, OJSC “Surgutneftegas”, OJSC “GazpromNefte”, “Lukoil West Siberia”, OJSC “NOVATEK”, LLC “TomskNIPIneft”. The system is targeted for Chief Geologist services (geology; field development, oil production, drilling, workover); Chief Engineer services (oil production, production, refining, power generation, automated control system, mechanics).

After the analysis of the personnel effectiveness of primary and after advanced training testing, the dynamics of growth was revealed. The system is constantly being improved: new directions are being developed due to the customer requests and the latest methods of personnel assessment are being applied, etc. Moreover, thanks to the system of competence assessment a number of new short-term courses were developed and more than 400 corporate employees attend them annually.

The study has solved the following tasks:

- perspective systematic approach, methodology questions and personnel competence assessment methods;
- different theories and personnel professional competence assessment models;
- assessment model (codifiers and specifications, personnel competency matrix);
- professional competence assessment method for oil and gas company specialists;
- professional competence assessment system of oil and gas service companies specialists and
- professional competence assessment system of oil and gas companies specialists via developed test programs [4].

### 3. Conclusion

The professional competence assessment improvement requires a systematic approach - firstly, from the standpoint of the methodology application, equipment and technology applied; secondly, taking into account the testing methods and further assessment examination. The assessment system examination should be conducted by the organization leading experts and external auditors, experienced in knowledge and skills of assessment examination and implementation.

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