Integrated computer digital decision for Offshore production automated management

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Abstract. Rising requirements for the hydrocarbons production management system state are based on the industrial situation control necessity according to the environmental conditions. Development of the system construction and complexity indicates the integrative approach implementation reasonability for the producing capacity main indexes estimation and regularity of pace parameters evaluation as well as the layer productiveness level identification. Data processing and management tasks are the waymarks for the industrial multilevel structures models creation. Computer integrated model includes the estimated analytical tool for the extended operational functional support for the production parameters evaluation and technological process state diagnostics in changeable conditions and productive region origin and features traceability. Based on the well observations it is possible to apply the systematic approach for the trends occurrence and dynamics evaluation of the reservoir development time series data. And integrated decision includes the information value degree identification tool for the hydrocarbons production digital model updating.

1. Introduction
In sophisticated conditions of reservoir researches and production operations organization it is necessary to create the adjusted computing digital application for the productive region main features identification [1] and management decisions support [2] according to the actual equipment state estimation and cooperative technological tools working capacity, effectiveness and productiveness evaluation. Through the rise of measurement base volumes and improvement design level it is actual to formalize the digital platform for the development of the processes quality control increase and productivity operations growth recommendations. Moreover, the opportunity of operative observation and feasible explanation of technological process status and industrial structural object represents the basics for future risks evaluation for the probable accidental releases, damaged reactors state and site contingency. And system-related engineering apparatus, mathematical tools for the aimed clarification and sharpening of the developed model and data mining approaches with appropriate functional arrangements and intelligent processing applications can be the possible and prospective ways for the management, forecasting and planning tasks solution in oil and gas production industry.

Practical details of essential processes research, interpretation and improvement in hydrocarbons production industry increasingly prove the suitability and utility of potential reasons and grounds formalization and verification for the plausible factors which can conduce to the technological subsystem uncontrolled behavior and parameters unpredictable dynamics. Therefore, the multistructural design and complex construction of the system with the platform for the certain levels systematical organization and hierarchical building can be the effective and rational way of the data
processing and estimation velocity rise, hydrocarbons volumes production rates rise and reservoir potential sustaining, facilities activity and capacity support and uncertainty reservoir model degree reduction.

Digital computer integrated model has such tools as evaluated module for operations producing capacity and pace regularity estimation. Also the offered systematical decision includes the hydrodynamic three-dimensional model correction [3] according to the true well observations. Developed and configured model has the essential engineering technological application for the well testing equipment functionality [4] reliability evaluation as well as correctness, fullness, timelines acceptance and confidentiality of the information resources identification. These sources reflect the data cluster of the licensed reservoir region development and exploitation. The offered systematical decisions and approaches to the hydrocarbons production management processes model improvement, updating and calibration [5] are supposed to be the ways for the rational methods of oil and gas industrial components application and development.

2. Task solution and applied methods

For the safety and stable state of the offshore production object and process support the developed computer model has the engineering technological application for the equipment work reliability evaluation as well as corrections and informativeness and confidentiality of the main resources of the licensed regions development and exploration [6]. The reached results correctness defines the success of the future strategical decisions about the production energy resource mode choice (Figure 1), the external operations on the layer degree identification, production subsystems reconstruction power and level explanation. Valuable signification has the character of the reservoir exploitation management system modernization.

The lifecycle of the offshore production technological object improvement with planning events of the productive region exploration and enhanced hydrocarbons recovery methods makes the basics for the resources production paces and state regulations necessity.

Due to the computer modules and application functionality it becomes possible to identify the unique index of the licensed region state and behavior, ecological and economical requirements choice, scalability of the management structure level definition and reasons for the additional procedures implementation for the stable and reliable character of the industrial system elements processing and operations.

Through the integrated digital model applications work the unique licensed region parameters state vector can be obtained and updated. With help of the developed model comparison possibilities the consistency degree for the ecological and economical criteria concerned to the PVT-region of exploration can be clearly defined. Due to the fact of the sophisticated and multicomponent design of the production subsystems it is valuable to determine and correctly explain the scale level of the management structure as well as external mechanisms implementation for the stable and reliable character of each element functionality [7].
Figure 1. Integrated computer digital decision (ICDD) formalization stages.

According to the measurements obtaining from the control and regularization operations structure it becomes obvious the advantage of adjusted systematical approach to the scales and mathematical methods calibration for the economical, organizational and industrial risks detection and prevention (Figure 2). This estimative way can be the basis for the producing capacity and paces regularity control of the main objects parameters identification in changeable environment of the offshore production processes. The unconditionally valuable significance of the systematical approach and engineering integrated tools implementation proves the researches of the hydrocarbons exploration and production technological modes features definition as well as data transfer quality and confidentiality requirements consistency control organization.

Figure 2. Risk management and estimation application.
In external factors influence action on the sensitive offshore hydrocarbons production elements it is essentially important to create and update the tools for the strong data accuracy control and improvement system and storage network reliability support, system confidentiality level estimation. And the integrative approach application can lead to the excellent and quick paces of processes tendencies dynamics and enrichment of industrial multilevel structures. The systematical way of the production objects investigation can be the resultative decision for the events planning for the save and rhythmical problems solution in the aims of hydrocarbons production volumes rise in natural environment conditions.

3. Key research results
Accuracy of reached results points out the feasibility of strategical solutions about the technologies for the source production, external exposure degree on the layer, the level and the power of the hydrocarbons production subsystems design and engineering, characteristics of the reservoir exploitation management system modernization (Figure 3).

The sensitivity and multistructural construction of the hydrocarbons production subsystems, the reaction and dynamics of the reservoir system evolution, the tool for the risk indexes evaluation system identification and safety control estimation is the actual and appropriate way for the energetic industrial problems solution. Calibration and correct risk management organization can be the base for the rhythmical and effective technologies development and engineering decisions formalization [8].

Mathematical module for the statistical features identification and fractal analysis [9] can be the essential tool for the confidentiality and safety support of information, digital PVT-region model uncertainty reduction [10] and system productivity rising [11]. Developed digital decision is oriented on the rational exploitation [12] and investigation of the hydrocarbons potential with possible increase of the cumulative resources volumes [13].

Figure 3. Integration data processing stages for multistructural models management
4. **Next steps and takeaways**

Reached results of the equipment maintenance and technological modes application and implementation, the quality of the information transferring, obtaining and data storage, elements availability for the intense exploitation [14], components active work duration proves the value of the systematic approach using and engineering decisions improvement [15] during the reservoir development (Figure 4).

![Figure 4. Integrated digital computer model application results](image)

Catching and reliable storage technologies for the layer research and management production objects reconstruction tends to the pace rising, order and hierarchical system architecture organization and correct industrial subsystems state evaluation.

5. **Conclusion**

Mathematical tools and analytical apparatus for the multilevel hydrocarbon production systems research and investigation has the aim to point out the actuality of the scaling forms of objects and processes formalization and visualization as well as the sufficiency of the reservoir model uncertainty methods and equipment quality and capacity evaluation resources implementation and improvement. Functionality and appropriateness of the hydrocarbons production management scenario determination approaches and digital reservoir model correction applications can be presented as the appropriate decision for the industrial processes organization and digital technologies adaptation and corresponding assimilation. Hence the rational forms for the technical and simulation sources definition and improvement in oil and gas production processes and reservoir exploitation procedures make the significant influence on the operations paces regulation and system components distribution.

Developed model and subscribed analytical applications allows to formalize the recommendations for the hydrocarbons production processes analysis accomplishment with productivity and rhythmicality parameters identification methods implementation. And hierarchical digital management tools construction and calibration on the integrated platform base can increase the accuracy and completeness of management system model of the exploitation industrial operations and give the rise for the hydrocarbons production paces.
References

[1] Chavent G and Jaffre J 1986 *Mathematical models and finite elements for reservoir simulation* (Amsterdam: Elsevier, North Holland Mathematical Library) p 375.

[2] Ventsel E S 2001 *Operations Research. Tasks, Principles, Methodology* (Moscow: High School) p 208.

[3] Naevdal G, Johnsen L M, Aanonsen S I and Vefring E H 2003 Reservoir monitoring and continuous model updating using ensemble Kalman filter, *SPE J.* 10(1), 66-74.

[4] Jahn F, Cook M and Graham M *Hydrocarbon exploration and production* 2nd Ed. (Oxford: Elsevier) p 456.

[5] Fanchi J R 2018 *Principles of applied reservoir simulation* 4th Ed. (Oxford: Elsevier, Gulf Professional Publishing) p 364.

[6] Grigoriev L I, Kershenbaum V Y, Kostogryzov A I 2010 *Systematical Basics for Competitiveness Management in Oil and Gas Complex* (Moscow: National Institute of Oil and Gas) p 374.

[7] Kostogryzov A I, Nistratov G A 2005 *Standartization, Mathematical Modeling, Rational Management and Sertification in Systematic and Program Engineering. Application* (Moscow: Central Research Institute of the Russian Defence Ministry) p 96.

[8] Larichev O I 2010 *Theory and Making Decisions Methods* (Moscow: LOGOS) p 391.

[9] Franceschetti G, Riccio D 2006 *Scattering, natural surfaces, and fractals* 1st Ed. (Oxford: Elsevier, Academic Press) p 304.

[10] Wheaton R 2016 *Fundamentals of applied reservoir engineering* 1st Ed. (Oxford: Elsevier, Gulf Professional Publishing) p 248.

[11] Hagoort J 1988 *Fundamentals of gas reservoir engineering* (Amsterdam: Elsevier) p 326.

[12] Ermolaev A I 2010 *Models of well placing types generation in oil and gas deposits* (Moscow: MAKS Press) p 79.

[13] Dubrule O 2003 *Geostatistics for seismic data integration in earth models* (Tulsa, OK: Society Of Exploration Geophysicists) p 279.

[14] Terry R, Rogers J 2014 *Applied petroleum reservoir engineering* 3rd Ed. (US: Pearson) p 528.

[15] Trakhtengerz E A, Stepin Y P, Andreev A F 2018 *Methods for computer support management decisions making in oil and gas industry* (Moscow: SINTEG) p 589.