What’s Behind the Numbers?

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integrated simulation is one of the key elements of a digital field. It makes it possible to integrate separate models of production chain facilities, assess their mutual effect and create a complex mathematical representation of ongoing processes. However, generation of charts and summary data is just the first step toward efficient field management. It is important to correctly interpret calculation results in order to understand the essence of the problem, and timely make proper decisions.

Today, many leading companies involved in development of industry software — such as Schlumberger, Roxar, Petroleum Experts and others — have tools for integrated simulation in their portfolio. These products are platforms for fulfillment of complex mathematical calculations. At the field development planning stage they make it possible to plan bringing on stream new wells, select optimal well designs and modes of operation, design pipelines and oil treatment facilities, pick downhole and compressor equipment and analyze the system’s total throughout capacity. At the design stage, these systems provide monitoring of well flow rates and promptly make correct conclusions. Assessment of the potential effect stemming from the implementation of integrated simulation and calculated by the industry leaders’ average results is shown in Fig. 1.

However, our long-term experience of use of similar systems shows that it is difficult even for skilled engineers to comprehend immediately multi-page spreadsheets of numbers and data-laden diagrams, interpret received results and quickly make correct conclusions. Moreover, it’s necessary to provide ceaseless adjustment of models as new data from production systems keep panning in. For this purpose, it is important as much as possible to automate routine operations on loading and initial processing of this data. Thus, in order not to wipe away the value of integrated simulation, it’s necessary to have a powerful and convenient tool for working with data: on the one hand, for online collection of initial data to components, has brought about a 2-3-percent increase of daily oil output. Shell’s implementation of similar tools has helped the Anglo-Dutch major rake in an additional $5 billion in revenue. Assessment of the potential effect stemming from the implementation of integrated simulation and calculated by the industry leaders’ average results is shown in Fig. 1.

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be used in calculations, and on the other – for visualization and quicklook analysis of the calculation results. Setup of a rapid response expert system is an efficient way of solving this issue. The basic functionality of this system ensures monitoring of key indicators characterizing the field status and its development processes, and also delivery of proactive (anticipatory) signals on potential problems. A more advanced version of the expert system also includes tools for simulation modeling – capabilities for quick analysis of several various “what if” scenarios and selection of the optimum method of problem solving or, rather, problem prevention.

In particular, the AVIST platform – the product of Parma Telecom, which is part of ITPS Group – is used at the Karakuduk field in Kazakhstan, operated by LUKOIL Overseas. Automated interfaces for on-line telemetry data loading from the production systems were created with the help of this platform, and there was also adjusted visualization of calculation results by the integrated model and its separate components, and their publication at the unified management portal. Actuality and visualization of data provided by AVIST facilitate making decisions on optimization of particular elements of the production chain and the entire field (Fig. 2).

With the help of AVIST, LUKOIL Overseas experts daily analyze well operation in real-time mode, simulate operating practices taking into account interaction of system elements (start-ups and shutdowns) and formation pressure dynamics, perform multiple calculations of the time for recompleting producer wells into injector wells, identify “bottlenecks” in the gathering and transportation system, select downhole pumping equipment, and make short-term forecasts. As a result, it becomes possible to form the optimum sequence of actions aimed at maximizing the cumulative output at the field, reduce the time required to identify loss-occurring zones, and, thanks to proactive monitoring of production equipment operation, the efficiency of scheduled preventive maintenance increases.

The first results achieved via this approach were unveiled in 2014 at Schlumberger Information Solutions’ annual forum, showcasing a 2012-2014 pilot project at Karakuduk field with a $17 million forecast (and partially achieved already) effect from integrated simulation, while spending $3.7 million on the project. The resulting integrated simulation platform, supplemented by the AVIST data integration and visualization tools, provided substantial support to LUKOIL Overseas in making decisions that aim to address the issues of problem prevention and proactive response, reduction of capital and operating expenses and the most efficient use of resources.