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Optimizing portfolios amid falling oil prices

Numerical and statistical analyses of shale plays turn up some interesting results.

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E&P companies need extreme capital efficiency to survive and grow. Previous strategies of trial-and-error and traditional appraisal sequencing will not achieve this objective. In fact, they tend to oversimplify or ignore key operating and subsurface constraints. To optimize capital efficiency, a straightforward approach to quantitatively evaluate and manage multiple appraisal and development decisions under conditions of uncertainty is necessary.

A methodology based on Halliburton's patent-pending process registered as "System and Methods for Determining Appraisal Locations in a Reservoir System" that considers these factors was implemented. It uses a comprehensive appraisal process to rank and then delineate the acreage based on a group of items like wells, blocks, asset areas, regions or country areas. The purpose is to establish priorities for implementing strategies in a range of time frames. It factors in both surface and subsurface uncertainties and can determine optimized appraisal locations within a few weeks.

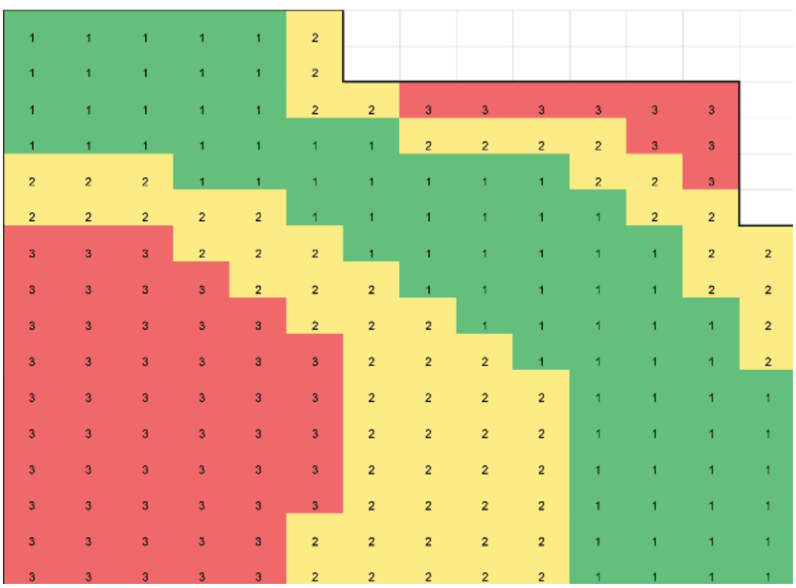

FIGURE 1. In the second step, areas are colored in terms of their corresponding level of priority. (Source: Halliburton)

In 2011 this methodology was used for the appraisal of a North American unconventional exploratory play with great success. The operator had to quickly evaluate and make delineation decisions of an area with significant uncertainties from subsurface and surface parameters. The area contains more than 330 sections of 2.6 sq km (1 sq mile), each with different ownership, operatorship, permitting obligations and mineral rights. The area also has complex landforms, difficult access, limited infrastructure, major uncertainties in reservoir characterization and commercial uncertainties.

The methodology is a front-end process, so the results of each stage are the building blocks of the subsequent stage. It follows a systematic way to determine value promise and associated risk to identify priorities. The process is divided in three stages, starting with a technical assessment of the data available followed by a ranking and priority analysis and concluding with development strategies.

Technical assessment

This stage focuses on determining the study area (the system) based on data available. In the technical assessment, specific parameters are filters to define the system, where each represents an uncertainty range so that this filtering process is performed stochastically. This process determines which areas are in the study.

Ranking and priority analysis

The second stage focuses on ranking and priority analysis and is a three-step process. The first step consists of selecting the most important variables to define the valorization criteria and formulation. The valorization in Step 1 is performed at different levels of participation. Initially, the core team and managers discuss and select the parameters necessary for decisions to appraise the system. Then the core team initiates the uncertainty characterization and valorization criteria to determine a

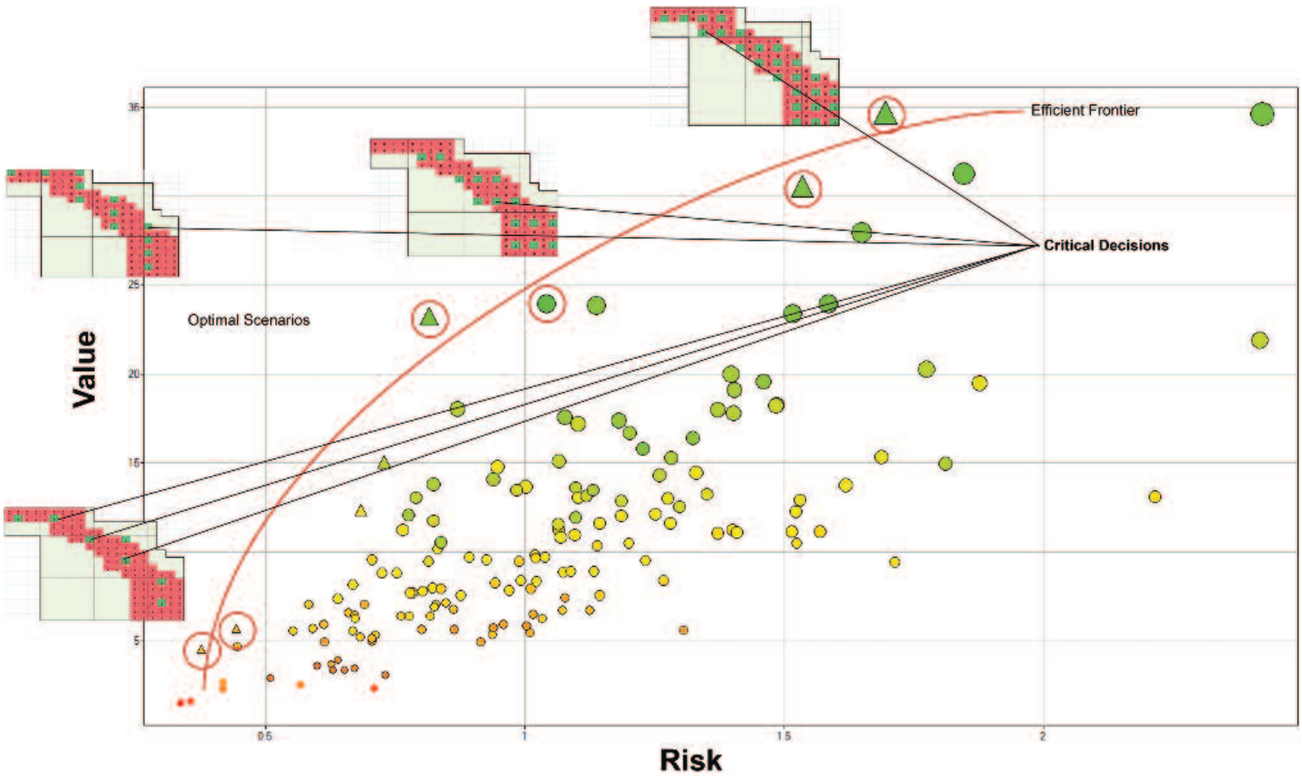

FIGURE 2. Scenarios that define the optimal portfolio represent different patterns of appraisal locations. (Source: Halliburton)

potential development formula, which is called Adjusted Hydrocarbon Recovery Potential (AHRP).

In Step 2 the AHRP is created and tailored by the integrated team to cover all aspects from subsurface to surface to define potential development value and development effectiveness in the system.

The AHRP formula frames about 20 parameters and has distribution throughout the grid under uncertainties. It represents the volume of the oil originally in place (OOIP) that can be effectively developed short-term in the system.

The final step establishes the priority process to delineate where the opportunity is concentrated. The ranking process sorts the blocks in terms of AHRP and then applies the priority rule 60:30:10. The result of this process displays the areas colored in terms of the corresponding level of priority from the highest priority in green (60% total AHRP) to lowest priority in red (10% total AHRP, Figure 1).

Development strategies, field development

In the final stage optimization occurs based on a decision framework, an objective function for scenario generation on the highest priority area. Portfolio theory manages the solutions that these scenarios provide.

Figure 2 shows the whole portfolio by the value expected and the associated risk for each scenario. Each scenario represents a specific pattern of appraisal locations. The system generates multiple solutions at different risk levels, so a special portfolio management algorithm is then necessary to manage these possible solutions in different terms of time. This portfolio analysis identifies the optimal portfolio by using the "Efficient Frontier" delineation concept (red line in Figure 2). This analysis simplifies the number of scenarios but still results in several possible scenarios.

The scenarios that define the optimal portfolio represent different patterns of appraisal locations (the different grids in Figure 2). The patterns have a fixed shape, but nature does not behave accordingly, so a novel idea of generating a special portfolio management and selecting the best appraisal locations was created. Many of these appraisal locations coincide in the same place through these scenarios. Thus, these are common decisions throughout the optimal portfolio; the common factors are called "critical decisions."

Figure 3 shows the appraisal locations that represent critical decisions (colored in green) to be considered in generating the list of ranked appraisal locations.

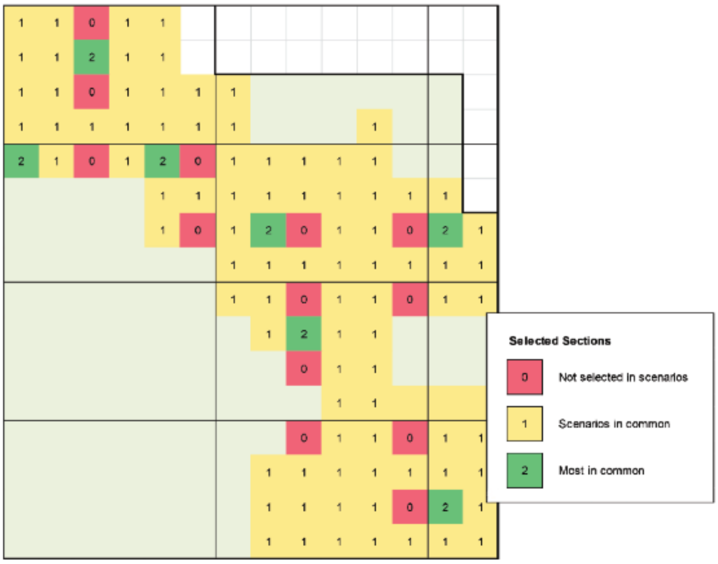

FIGURE 3. Critical locations are identified with 'Efficient Frontier.' (Source: Halliburton)

The final step is taking those locations that are most common and ranking them based on risk-aversion techniques. This fundamentally moves the referent value of AHRP to the minimum possible expectation that negates the risk so that the opportunity is limited by AHRP at P50. In terms of this analysis, the rank is executed; the locations are sorted to delineate the areas and then to determine the value promise associated (Figure 4).

The results shown in Figure 4 describe the first delineation that can be done at the greenfield development stage. In this particular case the results show the top 10 appraisal wells, the sequence in the drilling schedule, the potential number of development wells and OOIP to be developed.

In this case 85% of the area under evaluation could be appraised with 10 wells (in contrast to the client's original plan to drill up to 30 appraisal wells at a cost of $5 million each, resulting in a savings of $100 million). In addition, the methodology derived a logical sequence for the appraisal of areas satisfying multiple company objectives. The results provided company management with an estimation of the potential hydrocarbon content that could be appraised and developed. It also generates a complete updatable workflow to track the appraisal and initial development progress.

Business opportunities

The simulations in this methodology employ huge computing processes managed by using a progressive scale simulation that enables a very large stochastic model and optimization process with thousands of variables to be performed on a laptop. This methodology could manage an integrated environment with the asset team, technology team, stakeholders and consultants to establish the strategic delineation of an exploratory tight-oil area.

The procedure has been updated to optimize several objective functions simultaneously and determine different perspectives in the optimization process. It is adjustable to appraise areas with potential development and to delineate priorities based on the AHRP for block area development.

While this methodology has been used in several companies on exploration and development projects in both conventional and unconventional plays in North America, South America and Asia Pacific, other companies are considering implementing this methodology in 2015 for a fast picture to justify their engineering analysis. E&P

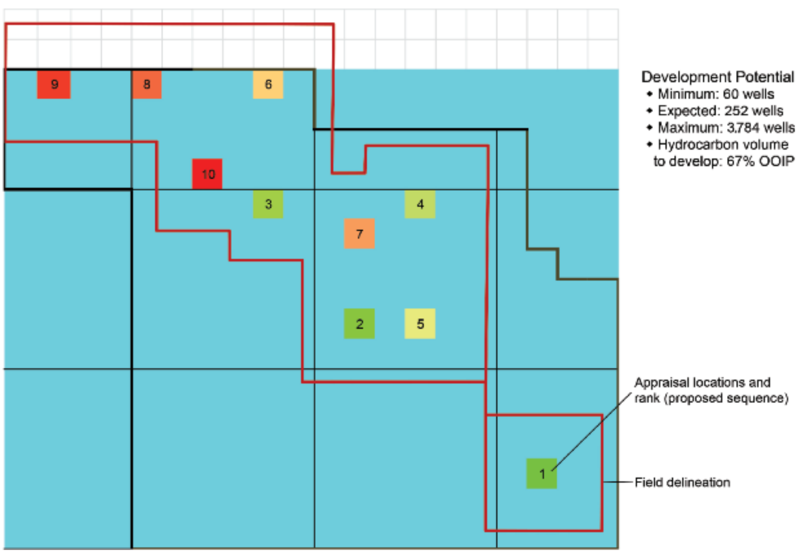

FIGURE 4. The results describe the first delineation that can be done at the greenfield development stage. (Source: Halliburton)

Acknowledgment

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