Full Field Development

PetroVisor™ helps standardize and automate processes to reduce decision time when determining new well placement and identifying workover candidates

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Using the PetroVisor platform, the operator delivered an NPV improvement of $751 million (34%) and reduced CAPEX by $15.4 million (34%).

A National Oil Company in the Middle East wanted to implement an automated process for improving new well placement and identifying workover candidates in an offshore field to stabilize well production declines. In the field, there were numerous locations identified for new wells through infill drilling, along with producing wells that were candidates for workover. The PetroVisor solution was selected to help develop and implement streamlined processes for evaluation, focusing on wells with the highest estimated production and return on capital. Multiple applications and databases were linked through the platform to evaluate and rank the opportunities. This automated process allowed the best candidates to be identified in days as opposed to the previous manual process that took months and sometimes years.

Objectives

- Facilitate the descriptive analysis and classification of well performance, status, losses, availability, downtime and failures
- Identify contributing factors to well productivity decline or well failures using data-driven, machine-learning techniques and suitable engineering analytic models
- Recommend well candidates for workover or infill drilling, ranked by financial metrics, production, probability of success, and other technical indicators
- Anticipate risk-mitigating actions to enhance and ensure reservoir production by recognizing certain patterns and common failures, using a problem score to identify issues on underperforming wells

Challenges

- Reservoir conditions and well performance parameters are continually changing
- The opportunity ranking process is performed manually for over 400 wells and 700 perforation intervals
- Engineering team is slowed by the need to evaluate every candidate, which takes away focus from the most promising ones
- Lack of automation inhibits the desire for continuous well optimization

Success Criteria and Metrics

- Generate a list of infill drilling candidates that either overlaps with the existing list of candidates or explains differences between the two sets of opportunities
- Implement faster candidate selection and a more accurate ranking process
- Automate and standardize the workflows for selecting both workover wells and infill drilling candidates
- Create a transparent process to help ensure complete knowledge transfer to operator personnel
- Reduce the manpower involved in the selection process, enabling valuable resources to be allocated to other activities.

Project Execution

Over the course of six months, PetroVisor personnel worked with the operator to bring together and link multiple applications and databases in the PetroVisor platform to improve data accessibility. Four workflows were selected from the platform to help streamline and process well candidates more quickly and to determine which wells would deliver the highest estimated production returns based on a 10-year production forecast. These workflows included:

1. Behind casing opportunities
2. Workover candidate selection
3. Sidetrack candidates
4. Infill drilling candidates

Behind-Casing Opportunities

To identify wells with promising behind-casing opportunities, a machine learning algorithm was utilized that combined reservoir properties, fluid saturation and production history. This allowed feature aggregation based on offset perforations using an existing production forecast that was used for ranking.

- Using a short-term production forecast, predictions were utilized to rank opportunities in each layer
- The workflow identified over 220 behind-casing opportunities

Workover Candidate Selection

The operator wished to reduce the number of uneconomic workovers by consistently selecting the best candidates based on creaming curve or risked incremental production over NPV. PetroVisor's workover candidate selection workflow was used to automatically detect problems in producing wells such as underperforming zones, gas injection problems, water coning or channeling. The opportunity selection and estimated production gain was based on reservoir potential, historical problems and offset wells performance.

- Determine the remaining potential in the current perforated layers
- Automate scoring and opportunity selection for each reservoir
- Standardize KPIs and methodology
- Generate daily financial and technical KPIs
- Rank wells with well intervention potential

Sidetrack Well Candidates

Wells that are candidates for sidetracks come with certain restrictions. For example, the well trajectories and the azimuth from existing wells must be taken into consideration. Knockout filters were assigned in the PetroVisor workflow that eliminated sidetrack candidates in areas where there were constraints, or where the operator could not drill due to interference with existing wellbores. The platform automatically identified restrictions in some wells and provided the best direction to drill sidetracks in other wells. Both technical and financial metrics were visualized in the interface to determine the top-ranked sidetrack opportunities.

Infill Drilling Candidates

The infill drilling workflow integrated static well properties such as reservoir data, well trajectories, reservoir boundaries and dynamic production performance data. Individual KPI calculations could then be used to score the opportunities. If data inputs are missing from the available information, the workflow can tailor data, logic, visualization and input parameters to compensate.

Because each customer's legacy data system and producing fields are different there may not be a consistent set of inputs from one customer to the next. The PetroVisor platform is designed to work with existing inputs such as historical production data and past issues encountered and automate and standardize the process to determine the best candidates for future opportunities.

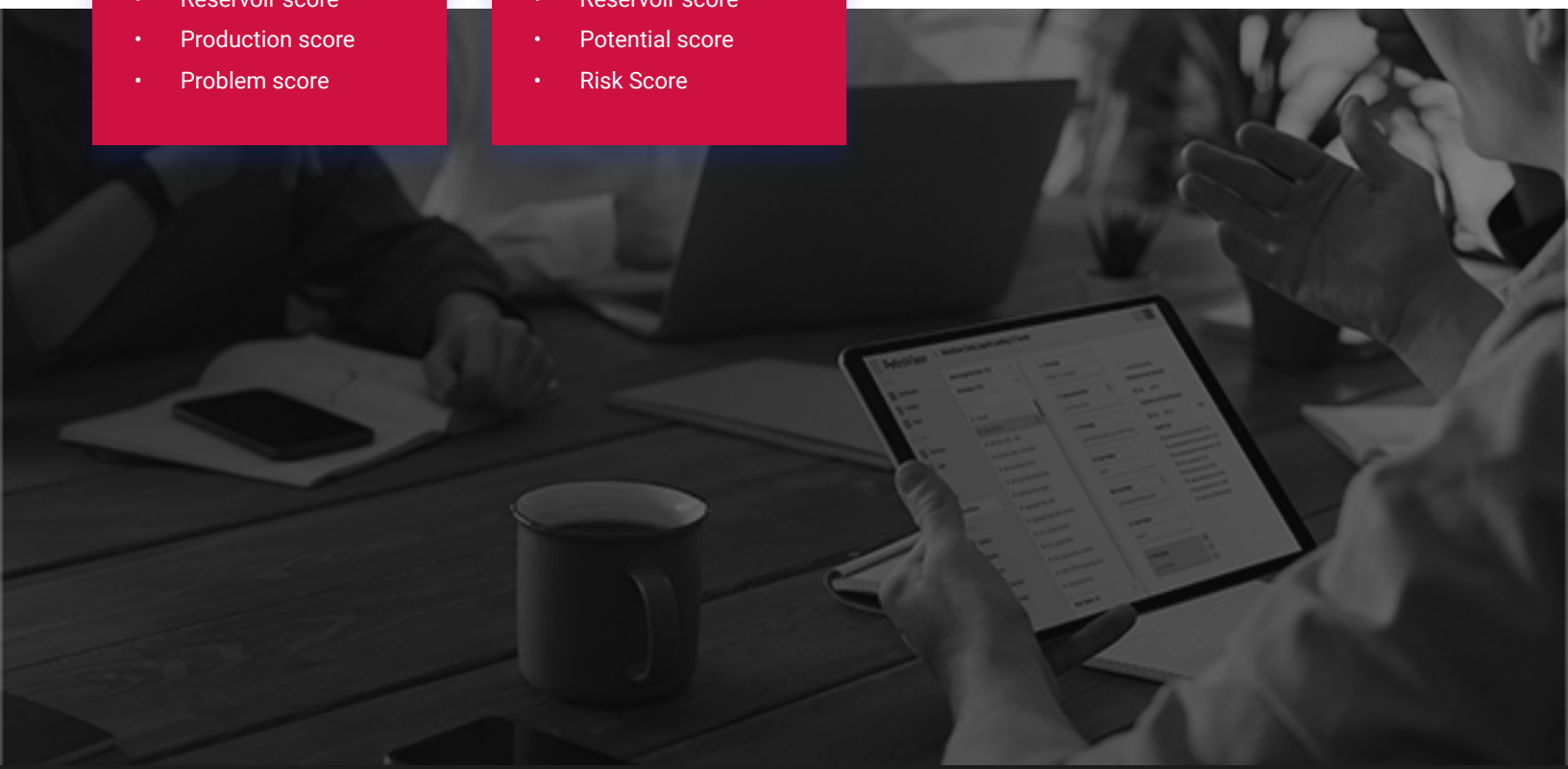
For existing wells, a reservoir score, production score and problem score are generated to aid in cataloging. New well candidates are using the previously developed reservoir score, combined with potential score and risk score. These new contributors are developed using parameters such as distance to neighboring wells, the drainage radius and drainage area, and the distance to the drained area.

Existing Well

- Reservoir score
- Production score
- Problem score

Proposed Opportunity

- Reservoir score
- Potential score
- Risk Score



Data Improvements

The required data for each workflow comes from multiple sources: flat files, simulation outputs, static and dynamic models and legacy data. When a PetroVisor project is complete, the operator is left with a proven solution and more robust data set. This includes an improved data architecture that is trustworthy, more streamlined, and better integrated into a single version of the truth. The data set is available to all discipline including managers, production engineers and reservoir engineers for ongoing analysis and future reference.

Results

In 2019, prior to implementing the PetroVisor platform, the operator conducted eight workovers and drilled four infill wells that yielded an estimated NPV of $2.3 billion on $44.8 million of CAPEX. Using the PetroVisor platform, the operator identified and ranked the top 12 opportunities in the same asset base and proposed a set of well candidates that delivered an **NPV improvement of $751 million (33%) and reduced capex by $15.4 million (34%).** The entire integration project into the PetroVisor platform required 16 man-months of work over a six-month span (equivalent to 2.7 FTEs).

Each of the opportunities relied on one of the four workflows (behind casing opportunities, workover candidate selection, sidetracks candidates or infill drilling candidates) and was applied to both shut-in and active wells. The results were:

- Streamlined process for both well placement and workover candidate selection
- Increased decision-making speed to obtain a ranked list of candidates faster
- Reduced cost and CAPEX and realized a higher ROI compared to the prior decision-making process
- Automated screening for best candidates and faster approvals of well candidates
- An up-to-date system for all current and legacy data: better architecture, more streamlined system, integrated, ‘single version of the truth’ with data available for all disciplines: operator, managers, production engineers and reservoir engineers.
- Real-time performance monitoring and feedback to further validate selection process in future fields