

# Simulation improves decisions

*Integrated simulation programs enhance strategic decision-making.*

## AUTHORS

Jeff Tomlinson, Decision Strategies Inc.,  
and Victor Koosh, Caesar Systems LLC

Global forces are stirring change in the exploration and production (E&P) industry, marked by rapidly increasing ambiguity as we move forward in this century. This “New Era” demands a change in strategic investment decision-making from the processes of the past 50 years. The E&P industry has realized the value of advanced technical simulation and modeling of reservoirs and should now apply a similar approach to strategic investment decision-making.

An approach now being termed *integrated business simulation* combines planning and business analysis with advanced business simulation software, which can play a significant role in transforming the accuracy and reliability of E&P forecasts.

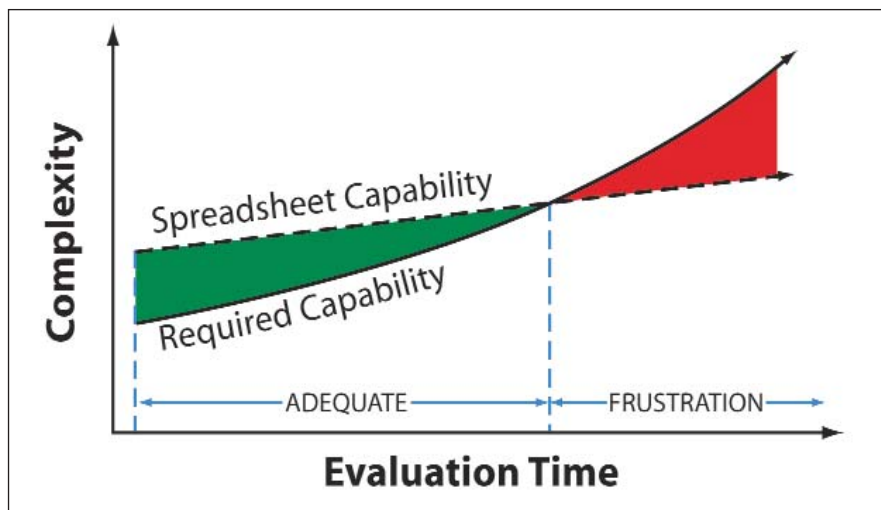
## Forces driving change

The change drivers we are pointing to are well known. The economic emergence of India and China contributes to an irrevocable shift from a supply-driven to a demand-driven world. Commodity prices — significantly more volatile than the industry envisioned only a few years ago — result in commercial projects at the margin. New developments available to international oil companies (IOCs) are remote (Arctic, ultradeep water) or unconventional (oil sands, tight gas, shale) where logistics are challenging.

Up to US \$20 trillion will be invested over the next 30 years to develop the resources required to meet global energy demand. Even an incremental optimization of this investment will be significant.

## Planning limitations

Over the past half-century, strategic



**Figure 1.** The complexity of E&P projects is moving beyond the capabilities of spreadsheets and related decision-making processes. (Graphic courtesy of Decision Strategies Inc.)

investment planning has consisted primarily of linear, nonintegrated and manual processes that employ some software tools, most often spreadsheets, developed over time by an individual or a small group. These are based on historical or analog analyses and tend to be deterministic (one set of input produces only one conclusion or result). Various technical disciplines cannot interject data dynamically to permit integration, although in reality, these factors are interrelated and, if integration is lacking, it results in an inconsistent model.

Many companies have developed sophisticated spreadsheet functionality and even some dynamic processes. However, as the team proceeds through an evaluation and questions arise that were not considered (perhaps could not have been considered) at the beginning of the project, nonintegrated tools are simply too limited to incorporate the increasing ambiguity we face. Today’s business environment requires a more structured decision process (Figure 1).

## How it works

Integrated business simulation combines collaborative planning processes with advanced business simulation software to 1) generate multiple project scenarios considering all key uncertainties from reservoir to market, 2) test management decisions over time against the possible scenarios and 3) determine the truly important factors that will influence the project outcome.

Business simulation software plays a vital role. It must have a well-designed user interface and a rigorous business simulation engine. Ideally, functionality should include probabilistic logic to account for and simulate real-world uncertainty.

Teams must be able to dynamically adapt to change and to drill down from results to the inputs to determine how those results were produced.

## Best practice workflow

A best practice workflow includes these discrete steps:

- **Determine objectives and decision hierarchies.** Make necessary tradeoff

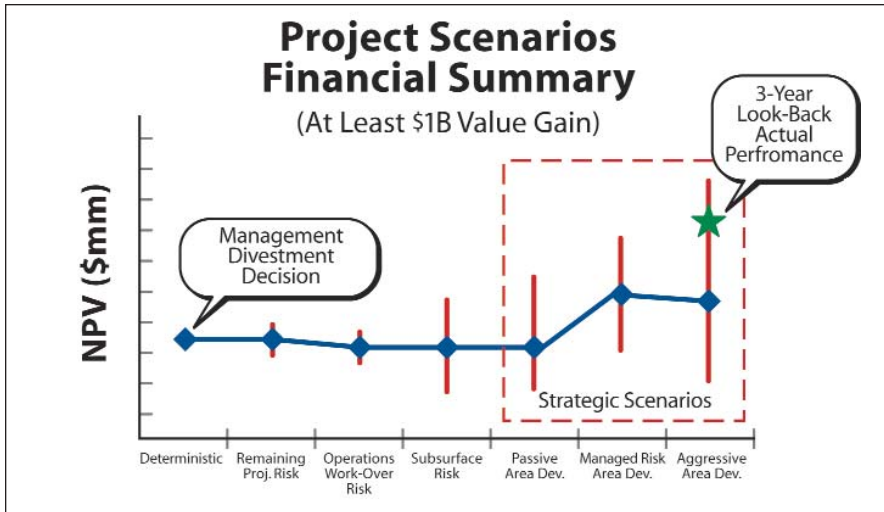


Figure 2. Strategic, integrated scenario assessments changed this asset plan from a divesture to an aggressive development plan, which resulted in a \$1 billion value improvement. (Graphic courtesy of Caesar Systems LLC)

scenarios included various options for a centrally-located, permanently-moored tie-back hub. Thus, the team needed a way to correlate the complexity of variables to increases and decreases in NPV in order to justify multi-hundred million-dollar incremental investments.

The business simulation software offered a Sensitivity Analysis that revealed precise correlations of NPV increase and decrease to variables such as platform expansions, workover costs and construction timing. A Project Schedule Timeline enabled a deeper understanding of project phases, and the team was able to propose scheduling controls to achieve optimum value. A third important feature of integrated business simulation was the NPV Probability Distribution.

Figure 2 shows the distribution of NPV estimates along the Y axis. The first point (most left) was the scenario based on the traditional and deterministic spreadsheet evaluation process.

The three options (near left) on the X axis represent scenario incorporating various project risks. The team simulated each option probabilistically, resulting in a range of possible project NPVs (vertical red lines).

The three options (far right on the X axis) represent project investment strategies — the three areawide development scenarios: passive, managed risk and aggressive — each of which the team simulated. The point in the middle of each bar represents the mean NPV; the red bars are the possible ranges, with the potential upside being greater than the potential downside in all three cases.

Based on these results, the operator retained the asset, originally selected the “managed risk” strategy and eventually executed the “aggressive” strategy. The green star represents the actual NPV performance derived from a three-year project look-back exercise.

The use of integrated business simulation as a standard practice offers the potential to determine alternative investment options that can create substantial additional value. **ENR**

decisions (net present value vs. maximum cash impairment vs. production profile) among the various possible strategies identified.

- **Develop several potential, unconstrained investment scenarios** based on the team’s collective knowledge and experience of the asset and the factors that could influence the project outcome and decisions.
- **Model scenarios.** Business simulation software should allow easy implementation of your team’s scenarios, including dynamically-implemented decisions or various strategic pathways.
- **Run the simulations.** Instead of manually determining end-result outcomes, integrated software uses decision rules defined by the team to calculate many potential outcomes and helps the team identify trade-offs that lead to preferred strategies.
- **Analyze the outputs and do a “reality check”** on the results, bringing the collective experience and judgment of the team to determine if simulation results are viable, realistic possibilities that can be executed in practice.
- **Act on the recommendations** and update your business simulation models with your learning from execution. Use the feedback to enhance the overall corporate capability.

### Case study

This joint development by two supermajors is located in water depths from 5,000 ft (1,525 m) to more than 7,500 ft (2,288 m), encompassing multiple independent fields. Separately, the business plans for the individual fields put them very much on the margin of corporate portfolio requirements, and management had decided to divest.

The development team continued to believe, however, that the value of these assets *combined* (more than 50 lease blocks over several square miles) could have an accumulated net present value (NPV) high enough to merit investment. There was a problem. A significant number of development variables existed across multiple assets over a wide geographical area. The spreadsheet-based models were not capable of managing the degree of ambiguity facing the project.

The team employed the integrated business simulation software program PetroVR. The problem was “reframed” to encompass three areawide development scenarios termed (a) passive, (b) managed risk and (c) aggressive. The passive area development scenario required zero incremental investment, while the managed risk and aggressive scenarios required incremental investments in the \$200 million to \$500 million range. The area development