Dr Bart JA Willigers, MBA and **Dr Felix Majou** speculate that recent advances in computing technology combined with a pragmatic approach to portfolio risking creates an opportunity for the E&P industry to develop practical portfolio systems that can be used for strategic corporate analysis

STRATEGIC PORTFOLIO ANALYSIS

Many people working in the E&P industry would agree that the creation of a business plan can be a time-consuming, disruptive and tedious exercise. However, fewer people might realise that the value of most business plans as a basis for strategic portfolio analysis is surprisingly limited. An important objective for companies to collect and aggregate project data relates to budget allocation. The criteria for an effective budgeting tool are however very different to the demands for a strategic portfolio tool. The traditional tools used in the generation of business plans are not suited for advanced portfolio analysis and those analyses that are developed tend to be very basic and of limited value.

Traditional portfolio planning

A prerequisite for successful corporate management is an in-depth understanding of business performance. This insight is provided by the development of a portfolio roll-up, which is a consolidation of the past and expected performance of all assets owned by a firm. In order to create this portfolio view, most oil and gas companies undertake a planning, forecasting and budgeting process once every calendar year. The development of a portfolio plan is not an easy task. The information generated during the planning process is passed through different formats across many different disciplines. The process involves engineers, geoscientists, planners, finance experts and board members. The consultation between disciplines is often poor and the process is both time consuming and prone to errors. The planning process as executed by most companies provides a snapshot of corporate performance which is updated once a year. Unfortunately, given the lengthy nature of the process this view is often already obsolete by the time it is finally signed off by the managing board.

The portfolio view developed utilising traditional planning tools is generally not suitable for portfolio analysis. ‘What-if’ scenarios lie at the core of many portfolio analyses. Economists use this type of assessment to investigate the impact of the variation of a certain assumption on characteristics of a portfolio. These ‘What-if’ analyses require that the project dependencies are captured in a portfolio simulation. For example, the results of one project might be dependent on the execution or findings of another project. Most organisations do not explicitly model these dependencies in their planning process. The portfolio plan generally represents a deterministic outcome and correlation between projects is captured assuming this single outcome. A strategic portfolio analysis does not necessarily require the same granularity of data at a project level but does greatly benefit from a probabilistic assessment of the most valuable projects of the portfolio. A probabilistically modelled portfolio allows the risk exposure associated with a corporate portfolio to be quantified.

State-of-the-art software technology

The data required for effective decision-making typically exists within the enterprise, unfortunately much of the data is generally not readily available for analysis. While computing technology has been a cornerstone in portfolio management for several decades, most data is stored in non-integrated systems incapable of generating useful management reports or operations dashboards. In addition, some of the data is redundant or modified, and a lot of the important strategic and operational analytics are kept on undocumented spreadsheets. As a result, vast amounts of human resources are dedicated to the low value activity of transferring data between different systems.

Recent developments in software technology have enabled the creation of solutions that have the potential to overcome many of the obstacles that prevented a lean portfolio management process in the past. Modern software systems ensure that data is entered and

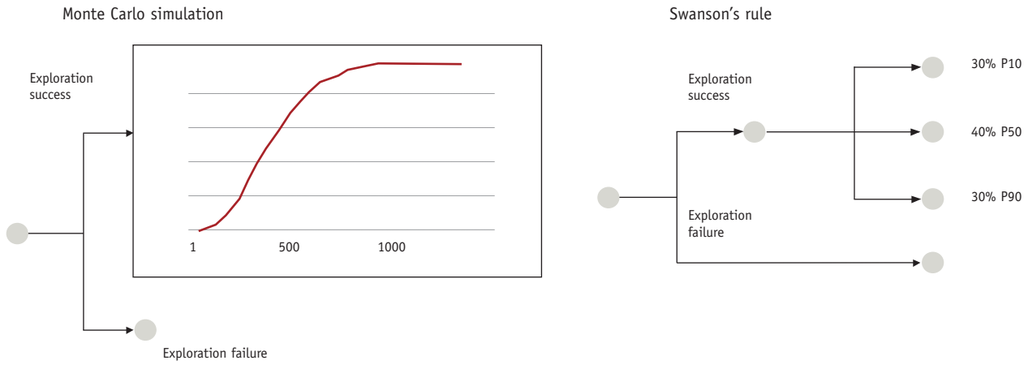

FIGURE The project valuation methods simulate (1) the exploration risk as a Bernoulli distribution that yields either a successful or a non-successful outcome and (2) commercial uncertainty as either a continuous lognormal distribution (Monte Carlo simulation) or a discrete with three possible outcomes (Swanson's rule)

processed in a consistent manner. In these systems, data is centrally stored in databases as opposed to a variety of stand-alone applications.

An additional key aspect of modern software development relates to the creation of open software architecture. This method of software development employs data formats based on open standards, such as XML, to improve interoperability and data flow between different software components. For example, a reservoir engineer can generate a production forecast using a reservoir modelling tool and export the created production profiles into an economic valuation tool. This economic valuation tool also receives a cost forecast generated by a facility engineer using a software tool that provides costs estimates for specific installation designs. The economic valuation software then combines all production and costs forecasts with economic assumptions such as future hydrocarbon prices, forecasted exchange and inflation rates, in order to generate an estimate of the future performance of both individual assets and the overall portfolio. An efficient portfolio process requires a system which ensures that the data gathering and manipulation processes are consistent from a security and data integrity perspective.

The methodologies of data treatment and storage in modern software systems ensure data consistency and integrity across different projects. These two factors are instrumental to enhance the corporate ability to create a portfolio view in a time efficient and transparent fashion.

Practical probabilistic portfolio analysis

In a 2006 survey by Booz, Allen and Hamilton, the leaders of 20 oil and gas companies indicated a high demand to improve risk management processes and generally agreed that the industry was dissatisfied with current procedures (McKenna *et al*., 2006). Along the same lines, McKinsey interviewed over 1,000 corporate directors in 2005, 76% of whom stated that they want to spend more time on strategy and risk management (Roberts, 2005). Only 11% of the directors indicated that they have a satisfactory understanding of the risks their companies currently bear, whereas 50% stated that they lack the data to track corporate risk exposure over time.

This lack of insight into the effect of unforeseen events on corporate performance can be catastrophic for a company and can be partially attributed to the techniques used to determine the economic value and risks of a company's assets.

For example, the Boston Consulting Group reported that many energy companies ignore uncertainty and risk and that project decisions are based on deterministic evaluations (Balagopal and Gilliland, 2005). Clearly, if the economic impact of uncertainty is not assessed at a project level, this information and the relevant insights cannot be communicated to corporate decision makers.

As opposed to deterministic modelling, probabilistic modelling does not use single-point estimates for key model variables. Instead, probability-weighted outcomes are defined for all key uncertainties. Probabilistic modelling provides insight into the range of feasible outcomes and creates a much improved understanding on the expected economic performance of a project. The probabilistic results can be translated into statements like: "There is a 60% chance that this portfolio will meet our financial (or production) target" or "We are 45% certain that this investment will yield a positive return".

Although the oil and gas industry has started to realise the value of enhanced financial modelling (Bickel and Bratvold, 2007), most efforts to improve decision-making processes have focussed on project management. The Monte Carlo simulation technique is the best known example of such probabilistic modelling technique and it is widely applied by economists in the E&P industry for project analysis. However, a Monte Carlo simulation in which project data is aggregated into a large asset portfolio is rarely undertaken. The main reason is that present computing systems are not practical when dealing with the vast amounts of data generated in a Monte Carlo simulation of a large asset portfolio.

A pragmatic solution for this issue is to approximate the continuous distribution of feasible project outcomes using a small number of probability-weighted discrete scenarios (Smith, 1993; Figure 1). Hurst *et al*. (2000) demonstrated that a modestly skewed lognormal distribution can be approximated by a discrete probability distribution consisting of the P10, P50 and P90 of the continuous lognormal distribution probability weighted at 30%, 40% and 30%, respectively. This approximation of a lognormal distribution is generally referred to as the 'Swanson's rule'. Swanson initially proposed this rule in 1972 in an internal Exxon memorandum (Hurst *et al*., 2000). Swanson argued that (1) although geoscientists and managers find it difficult to quantify extreme outcomes, they are reasonably confident in defining P10 and P90 outcomes, and (2) most relevant probability distributions in E&P modelling are lognormal and that consequently the projects' expected values and medians are different.

In a simulation, a project sample can be drawn from these discrete distributions as opposed to the original continuous distributions. In a probabilistic portfolio roll up, a large number of portfolio outcomes are simulated by drawing a sample of each of the projects present in the portfolio. The results of the simulation can be visualised as a cumulative probability distribution (S-curve) and the value and risks associated with the portfolio can be determined. Willigers (2009) demonstrated that the precision of this pragmatic approach is satisfactory for the modelling of real-life E&P assets. One important advantage of this methodology is that if either a global assumption needs revision or a single asset requires recalculating, the economics of only a relatively small number of scenarios need to be computed. Thus, there is no need to store or recalculate a large number of outcomes (typically more than 2,000) for each project, as would be required in a conventional Monte Carlo simulation.

Conclusion

The key objective of a strategic portfolio system is to evaluate and compare different strategic options and facilitate well informed decision making. Portfolio roll up processes presently employed by most E&P firms fail to deliver on this requirement. Information is often difficult to access, stored in an unsuitable format or even obsolete. We foresee that new software advances and the implementation of a pragmatic approach to risk modelling can radically alter the current information management practices underlying portfolio management. Modern software allows for a much enhanced information flow and improved data quality which creates an opportunity to significantly accelerate the portfolio roll up process. This allows for a much more frequent updating of the corporate portfolio view. A reduction in cycle time of the portfolio roll up process will ensure that decision makers have an up-to-date and accurate portfolio perspective when making decisions. This approach in combination with new risking tools provides an opportunity to the E&P industry to turn risk into an integral part of the decision-making process. An improved understanding of the risks faced by an organisation will translate in enhanced and more confident decision making. ep

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