

Shale Gas

New conventions for unconventional development for the engineering and construction industry

Optimizing the play



*The successful development of tens of thousands of shale basin wells requires speedy and efficient responses to complex challenges. PwC, through its industry-focused shale gas publications, is tracking the opportunities and the rapidly evolving management practices that are aimed at addressing these issues. To broaden the perspective we have developed a new three-part series, **Shale gas: New conventions for unconventional development for the engineering and construction industry**, in which we discuss the related implications. In this second part of our series, we outline key considerations for delivering greater returns in shale well development by aligning operating expenses, capital investment, and resources across the full portfolio of development and production.*

In the first installment of our shale gas series, *Reducing the drag to achieve speed and efficiency*, we examined an integrated planning approach aligning functions and resources around a common set of processes across the production life cycle. Rather than thinking about the process as a series of discrete projects, oil and gas companies would benefit by viewing it as a holistic task; the integrated planning approach helps companies eliminate the broken hand-offs between functions that impede drilling and production programs. Reducing the drag also helps companies increase returns on capital by improving asset utilization, reducing cycle times, and eliminating waste. Through a clear link between strategy and execution, land drilling and production operations can gain greater consistency, predictability, and efficiency across the basin.

When, for instance, an oil company's leadership feels as if its resources are being strained in the course of managing all of the moving pieces inherent in shale development,

an E&C company can help relieve that burden by acting as a general contractor for any given project. In doing so, an E&C firm can meet its customers' most urgent needs for project assistance while gaining access to projects that ultimately may require a longer time commitment and will drive greater revenue.

In this second installment of our publication series, we delve into the next step that is involved in driving improvement through the shale gas value chain: How best to optimize the play?

When developing shale wells, an oil and gas company should ensure that it is able to proactively adjust to the ever-changing dynamics of managing the process elements, whether related to the supply chain or otherwise. A company should expect the unexpected and plan for a variety of circumstances—including the timing of wells coming online and design issues—that will arise at unpredictable times as shale fields are being developed.

E&C companies can respond by leveraging acquired skills and core competencies that they have developed through managing large-scale engineering projects. The latter typically require companies to address unexpected developments across a wide spectrum of processes. Ultimately, an E&C company can rely on its well-practiced flexibility and existing skill set to take a leadership role in shale development while serving as an optimal partner for its oil and gas clients.

Optimizing the play hinges on developing a process for managing operating expense, capital investment, and resources across the entire development and production portfolio. The optimization process is based on three broad steps:

- Balancing supply and demand
- Advancing performance
- Finding the efficient frontier

Balancing supply and demand

Balancing supply and demand lets an organization link its capabilities, capacity, and extended supply chain to the requirements of field work execution. When it comes to shale development, this balance is known as “manufactured drilling,” which is increasingly on the radar of shale basin operators. Manufactured drilling allows for balancing the forecast demand for resources—labor, equipment, rentals, and materials—with the constraints in the organization and its supply chain. The end game: the right resources are available in the right place at the right time.

Drilling down into manufactured drilling

In manufacturing, the process of balancing supply and demand is known as sales and operations planning (S&OP). The goal is to align resources and activities so the company can optimize profits, while effectively managing supply and demand constraints and fluctuations. In doing so, issues related to inaccurate products, location, timing and resources are minimized. In traditional manufacturing, end producers work collaboratively with

their supplier base to align processes and standards, developing what the industry refers to as a “horizontally integrated supply chain.”

The flow of timely and accurate information allows for demand data to pass through the horizontally integrated supply chain of companies. This leads to an appropriate amount of products and services to pass through the system. Changes in demand or delivery are quickly identified, and revised “signals” move up and down so the system can adjust. Enabled by enterprise technology, the process is anchored on standard processes and information.

Although shale basin development and production are admittedly not manufacturing, the development of each well shares a key manufacturing characteristic: a general process that repeats tens of thousands of times. That repeatability lies at the heart of applying S&OP concepts and processes to shale.

Repeatability dictates the supply chain. Having a dynamically adjustable supply chain that can adjust to unexpected changes in any of the process areas allows an oil or gas

company to accomplish its goals. Because E&C companies are accustomed to tailoring a supply chain to the needs of any given project, they can readily bring that skill set to bear on shale development.

However, shale development has four significant, non-manufacturing characteristics that need to be addressed in order to realize the benefits of an efficient, horizontally integrated supply chain.

1. Rather than being a sales-driven, or “pull,” process using funding and resources to meet sales goals, shale development is a “push” process. It is driven by capital investment and it depends primarily on the availability of land access and capital funding.
2. Land drilling, completions, and production operations can vary significantly from well to well. In addition, the work scope of each well can evolve unexpectedly. Changes from plan are inevitable and should be addressed quickly.
3. Shale development’s constraints vary significantly from those of manufacturing. From permitting, lease terms, and land boundaries

to geology, geography, and infrastructure (power, roads, water, and pipelines) to the availability and quality of mobile resources (people, equipment, tools, and supplies), a wide array of constraints can hamper a company's ability to balance shale development supply and demand.

4. At the basin level, operators manage a hybrid model that combines continuous processing, such as producing wells that still require project attention, and discrete manufacturing, such as new well drilling. These continuous and discrete processes rely on a single pool of funding and resources.

E&C firms routinely address these types of challenges. For example, with a large construction project, a client may decide that while there are not enough funds to complete all aspects of the project, the plant nevertheless should be made operational. How, then, must the delivery plan and schedule be adjusted to accommodate the new reality?

Similarly, perhaps because of a spill, the discovery of an archaeological site, or insufficient purchasing power, a client may no longer have access to develop any given field. An E&C firm can rely on its project modeling techniques to address the problem by taking a broad view of the issue and seeking ways to adjust

to the immediate problem—developing the shale wells—while also strategizing to pursue development on the desired land later, when the land becomes available. Consequently, the oil or gas client will be able to continue to move forward in a cost-effective manner.

The bottom line: E&C firms can help oil and gas companies build flexibility into their approach to managing risk or change for any given project. By doing so, firms can provide real value to their clients and, as a result, can gain the opportunity to support

large-scale projects. And an E&C firm that has a static or non-flexible model, or a modeling approach that is not dynamically changeable, might consider upgrading or adjusting its approach to better serve its customers and win larger engagements.

Applying the S&OP model has proven to reduce cycle times and costs in shale development. To achieve these benefits, however, companies should consider transforming S&OP into investment and operations planning, or I&OP. Next, we turn to how this transformation occurs.



Push versus pull

Instead of sales driving the amount of goods produced, the pace of shale development is based on availability of, and access to, capital and land as well as land production projections. This difference has two implications: First, capital planning, land activity planning, and evaluations should be closely integrated with drilling plans, and updated dynamically on a continuous basis to identify and address changes. And second, activity planning for land drilling and completions should be made with standard models. Activities should account for resources using a standard structure that maps to supply chain requirements and generates accurate and timely demand signals.

Variability and uncertainty

For each well and project, drilling programs and capital projects vary greatly. To effectively manage the variability, operators should deploy three project management fundamentals. First, the organization should apply risk profiles and

robust risk management processes to all investments. Second, businesses should quantify risk. This involves determining the cost levels and schedule contingencies that are needed to deliver the project within the risk tolerance of the organization. Finally, robust change management helps to quickly identify alterations to the plan, and their impact on cost, schedule, and resources. With that knowledge, companies can determine how to best manage this variability.

Managing constraints

All drilling programs and capital projects activities have dependencies, both internal and external, such as when one activity can't begin until another either starts or is completed. If the labor, materials, and equipment aren't available in the right place at the right time, work on a project grinds to a halt. Integrated planning identifies these constraints and builds them into the plan. Activities must be linked to their resource requirements, both within the project and as related to other functions and stakeholders inside and outside of the company.

Hybrid production

In shale development at the basin level, regional or asset teams should manage a discrete manufacturing business (drilling and completions) and a continuous business process (production operations) in parallel. To do so requires a common business infrastructure platform and pool of resources. Integrated planning extends beyond land drilling and completions and includes the activities and resources of production operations. Each function has its own cadence and drivers; however, with integrated planning, a basin-level view of all activity provides insight into capacity and performance in to more effectively link strategy and execution.

Advancing performance

Once a company has applied I&OP, it can focus on improving financial and operational performance. The ultimate goal is to increase return on capital employed. That goal is driven primarily by three factors:

- Project cost—labor, equipment, and materials
- Project schedule—the amount of time needed to complete the project and turn it over to operations
- Asset revenue—the product, price, and rate of production

With a clear and forward-looking view into all plans and activities, an organization can reduce its costs by becoming more strategic in its sourcing and more efficient in its deployment of labor and equipment. As is the case with manufacturers, an accurate and consolidated view of demand can create closer relationships with suppliers. Knowing in advance what will be needed along with potential demand changes gives

suppliers a predictable view into what they need to supply and when. That predictability allows them to be more efficient and share the resulting cost savings with their customers.

Better utilization of labor and equipment can further contain costs. With a clearer view into resource needs, it is no longer necessary for companies to supply every crew with all the equipment it might ever require. Instead, equipment can be held in centralized locations and provided on a just-in-time basis. The impact of eliminating equipment duplication can be profound: it can help trim inventory costs by 20 percent or more.

Labor utilization can also become much more efficient. Knowing the composition of crews and when they will be needed, for example, can significantly reduce downtime when crews are no longer assigned to sites that aren't ready to receive them. Moreover,

because processes are standardized and companies can respond to changes quickly, projects require less senior expertise—those who know how to get things done—and can leverage less costly junior professionals.

When all pistons are firing, these processes can help eliminate 20 to 30 percent of a business's costs. And cycle times can also be reduced; if an E&C firm can help reduce the cycle time of a well development project for its oil and gas company client by 30 percent, it can help the client deliver the results of a producing field all the more quickly.

Finding the efficient frontier

The efficient frontier provides a systematic, bird's-eye view into the information needed to optimize the investment portfolio, helping to determine which projects fit, which don't, and why. Oil and gas companies should make these decisions in the face of uncertainty, project interdependencies, and changing economic environments. In the shale basin, investment decisions center on three elements: choice of well to drill; choice of facility, pipeline, or road to construct; and choice of maintenance activities to perform.

Portfolio optimization requires calculating each investment's potential

value. Valuation models normally include quantitative inputs of financial performance, such as production expectations, development and operating costs, and the net present value of cash flows. But in shale development, two types of risk valuation should also be added to the equation:

- **Reserve risks:** With shale, the extent and makeup of ground reserves are uncertain, and the rate of decline from one well to the next can also be difficult to predict. Probabilistic modeling can account for these risks, which can have considerable impact on value and the assumptions used to calculate it.

- **Commodity price risk:** As liquid and gas prices swing, the fluctuations can guide decisions about "sweet spots" and where to prioritize investments in light of market forecasts. Unlike reserve risks, which are independent from site to site, commodity price risks affect the entire shale investment portfolio. As a result, they warrant additional attention and portfolio stress-testing.

As an oil or gas company begins to develop a shale field, it could benefit from understanding commodity price risk and the potential for fluctuation. What are the potential risks and the possible impact? The best approach is to leverage those insights to build the supply chain and establish the pace of development and source of labor. An E&C firm can help an oil or gas company build in the costs and take appropriate steps to blunt the impact on the supply chain if the price suddenly declines steeply, or in a situation where adverse weather conditions affect the transport of materials.



Valuation can also include financial and performance metrics to assess scenarios with “apples and oranges” comparisons, where less tangible factors are considered in making investment decisions. Numerous strategic issues that are difficult to quantify—including public perception, brand reputation, regulatory compliance, and environmental impact and safety—are just as critical.

Although these are non-standard measures of value, they can be calculated. For example, a project’s safety risk can measure how many workers may be exposed, and the potential impact of that exposure in each incident. Including the steps and costs needed to mitigate these risks captures their full impact.

An optimal portfolio should also take operational constraints into consideration, including those related to people, tools, equipment, and infrastructure. The rate of well completions and subsequent production depend on the

availability of resources and infrastructure, and these dependencies must be factored in. With the I&OP approach, they can be dynamically linked to integrated activity planning and reflect the resource constraints in the valuation.

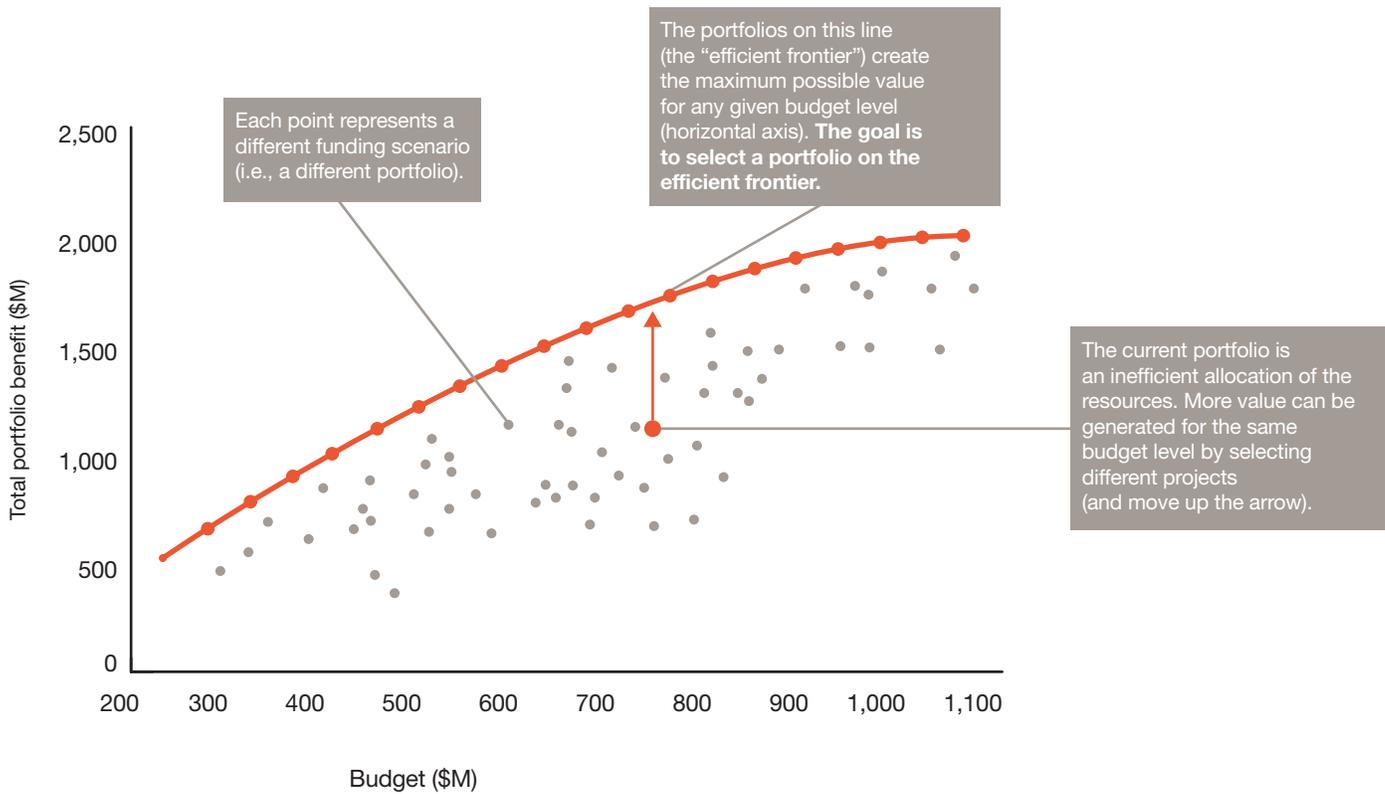
With a holistic perspective regarding the value of any mix of potential investments, management can step back and take a portfolio view of opportunities. Of all the projects that can be undertaken, which combination drives the maximum return on the investment, and how much investment is required to maximize the returns? In addition, a portfolio view allows a company to stress-test its options under different scenarios. If a company must reduce its budget, or if commodity prices drop, for example, it can decide which projects should be eliminated or downgraded.

An E&C firm, because it already has a risk management model, can increase its value to a client, who may be working with multiple partners, by acting as a general contractor

that can help to mitigate pain points and challenges associated with shale development.

As illustrated in each portfolio scenario produces an expected value at an expected cost. For shale development, each point on the chart represents a different mix of capital investments, including wells, roads, gathering lines, process and storage facilities, and water and power supply. By picking the right projects, and analyzing the level and mix of investments, a company can generate the maximum value for a given budget constraint.

Figure 1: Points along the efficient frontier



Each point represents a different portfolio scenario corresponding with a particular cost (horizontal axis) and benefit (vertical axis). The portfolios along the curve generate the greatest shareholder value for any given budget level. Companies should seek projects that are on, not below, the efficient frontier.

Leveraging technology

Technology can help align long-term strategies, financial plans, and forecasts with proposed and ongoing projects through the development of an integrated financial planning model. Currently, there are several companies that provide software solutions as part of their analytics and performance management product suites. These solutions can be integrated relatively easily into ERP and project management systems. They can also support driver-based planning frameworks, workflows, and approval processes as well as help prioritize and approve projects based on predefined KPIs and financial thresholds.

Technology can also help engage stakeholders from different functions by providing a common view emanating from the same systems. Additionally, technology can also reveal the impact of project changes on financial statements, which helps to build multiple scenarios for companies, based on one set of clearly defined assumptions:

Expense plan: With industry-leading planning and forecasting solutions, companies can perform expense planning at the account level (rentals, shipping, travel, and depreciation) as well as the resource level (labor, equipment, and material). They can be based on predefined drivers and used to analyze the impact of each category on a project.

These solutions also support the allocation of organizational overhead to specific projects based on predefined attributes. Overall expenses can be consolidated at the project level, and managers can examine the impact of each expense category over the entire portfolio.

To help with supplier negotiations, the solutions provide overall forecasts by category. All resource plans can be integrated with other systems used for procurement, workforce management, and capital planning and budgeting. This allows for gaining insights into the availability and utilization of current resources and new assets coming online—a key tool in preventing resource hoarding.

Revenue plan: Leveraging technology, companies can create several revenue scenarios based on production expectations, commodity prices, and exchange rates.

Once developed, the integrated financial planning model can be used to create income statements, balance sheets, and cash flow forecasts. Companies can also create scenarios based on various assumptions about labor rates, commodity prices, exchange rates, and interest rates. This ability allows project managers, area managers, and other stakeholders to make informed decisions based on a common view of the facts provided by the I&OP approach.

It is important to point out that in a dynamic environment, where supply and demand needs consistent balance, strong workflow integration is critical. With hybrid production, for example, companies need to integrate information management for both discrete and continuous activities.

In terms of portfolio optimization, some major vendors include analytics models, but these may not fit a company's needs. When this is the case, the business should consider building technology platforms that integrate their own, unique models. Designing a technology platform should account for a software vendor's native capabilities and how to integrate them into the workflow, portfolio optimization models, and dashboards.

Taking a cue from manufacturing, we've analyzed how companies can more effectively balance supply and demand to ensure that the right resources are in the right place at the right time. By becoming more strategic in their sourcing and more efficient in their deployment of labor and equipment, they can significantly reduce costs. When operations and financial planning are efficient, oil and gas businesses can confidently optimize their portfolio of investments by understanding which set of projects provides the best return on investment and what that level of investment should be. Technology eases the process by providing a common, centralized view of information and forecasts.

In the final installment of this shale gas series, we will focus on speed and agility—and how they are driven by analytics.

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