white paper

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Creating a High-Performance Downstream Petroleum Supply Chain

Managing the downstream petroleum supply chain presents some of the most difficult challenges found in Supply Chain Management today. Maximizing the value of hydrocarbons throughout the supply chain has become the crucial key to profitable success. Maximizing this value requires that executives have the tools to decide what products, in what quantity, are manufactured, bought, sold, stored, moved, exchanged, or marketed and where these activities take place. To this end, a powerful combination of Internet collaboration and advanced planning capabilities is being rapidly pressed into action to understand demand, integrate the plan, and coordinate the commercial and operating activities. These innovations aimed at maximizing the value of inventory throughout the supply chain can provide lessons from which companies in other industries may also benefit.

The Unique World of the Petroleum Supply Chain

The downstream petroleum supply chain is unique in a number of important ways. Raw materials and products are more fungible, and, in many cases, perfectly substitutable. However, the capital assets employed to manufacture, store, and move raw materials and inventory are inflexible. There are many ways to participate in the industry, and prices are extremely volatile and reasonably transparent (though not easy to predict). In other words, there are many choices to be made at each stage along the supply chain pertaining to what, when, and where to produce, buy, or sell products.

In recent years, the supply chain has become even more challenging to manage (see Figure 1.0). Most downstream companies have reduced or eliminated excess operating inventories, making the entire industry more susceptible to disruptions in supply or demand. Environmental regulation has caused a dramatic increase in the number of products that must be segregated and managed. Nontraditional participants (for example, national oil companies or independent marketers) achieve returns on their investments through means other than refinery or fuels margins. The physical infrastructure of the industry is evolving as refining capacity is being both shut down and expanded, and new infrastructure, such as pipelines, is being built. In general, the economic fundamentals of the business continue to be poor.

Key Issues that Drive Success

To respond to these challenges, different value levers and capabilities are becoming important for managing the downstream petroleum supply chain. Because price levels are determined by large liquid markets and by local competitor behavior, there is a premium on evaluating competitors' economics and anticipating their behavior. The large number of "make versus buy" possibilities along the value chain necessitates understanding the market value and cost at each link in the supply chain. The large volatility in gross margins over the operational planning horizon requires frequent and speedy reevaluation of all alternatives.

For many industries, traditional supply chain value levers are found in transportation, inventory, and warehousing. These levers are important for the downstream petroleum supply chain as well; however, they are not as important as managing the value of the hydrocarbon itself. Consider, for example, the inventory value lever. In many industries, it is a given that a unit of inventory will be worth less

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Energy

tomorrow than it is today. The life cycle of a computer is so short, for instance, that prices are always declining. Thus, a one-dimensional strategy of reducing inventory is appropriate. Hydrocarbons, on the other hand, could be worth less tomorrow, or they could just as easily be worth more. Additionally, the location of the inventory can also have a major influence on its value. Therefore, managing when and where inventory is held is far more critical than just reducing the amount of inventory. In addition to complex inventory management, the multidimensional aspects of managing hydrocarbon value includes decisions about sourcing, timing of buys and sells, and distribution to various markets.

Sourcing decisions can be very dynamic if a company is operating across a geography with more than one spot market that influences price. For example, in the United States, a mid-Atlantic market could be supplied from the Gulf Coast via the Colonial pipeline or from New York Harbor via marine transport. If you were to examine a record of gasoline spot prices and transportation costs from the past few years, you would see that the optimal source point changes frequently and that the amount of money at stake is large. For example, if you were to source Baltimore from the Gulf Coast as a matter of policy, you would have made the correct decision 43% of the time and had a $.69 per barrel disadvantage. Having the ability to switch sources rapidly and accurately could be worth more than $.60 per barrel on more than one-half of the barrels moving through a Baltimore terminal. However, the differing transit times between sourcing products from the Gulf Coast versus New York Harbor, along with the integrated constraints of the supply network, make it difficult to execute a strategy based on such flexibility.

The downstream oil industry faces a number of new issues. These challenges have significant impacts on Supply Chain Management.

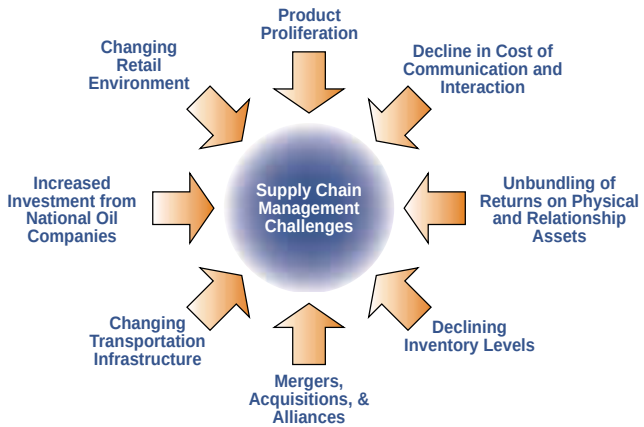

Figure 1.0 **The challenge of managing supply chain in downstream oil industry**

Another critical decision that must dynamically be made to optimize the value created by a downstream petroleum company is the amount of discretionary volume to sell in each market. Non-discretionary businesses are those such as branded retail sales. In this type of business, pure marketing decisions dominate temporary supply optimization possibilities. For example, you would not purposely choose to run branded service stations out of product just because supply costs rose temporarily. On the other hand, discretionary business, by its definition, is business that you can choose to participate in and the degree to which to participate. Examples of this might include gasoline or distillate sales to non-branded distributors. There is a significant price volume relationship for this type of business. The lower your price (relative to competitors) the more of the market share you can attract. Of course, competitors will not idly stand by while you take share away. The competitive structure of a market will determine the shape and slope of the price-volume relationship.

Theoretically, an oil company uses an understanding of these curves to determine in which markets to conduct discretionary (and to a lesser extent, non-discretionary) business. However, in practice, few companies can dynamically integrate decisions about how much to participate in Market A versus Market B or if selling to the spot market might be a better answer for a short period of time. Most companies try to forecast volumes that will be sold to discretionary customers, rather than try to understand the price/volume relationships and position products to maximize the overall margin. Of course, the margin maximizing solution cannot be found without extensive input from both supply and marketing functions within a downstream operation.

Building a Right Business Solution

What's so hard about managing the downstream petroleum supply chain? It hinges on making complex trade-offs in an environment where new market opportunities, unplanned events, and price volatility all interact through a physical system with very tight constraints (see Figure 2.0). Most

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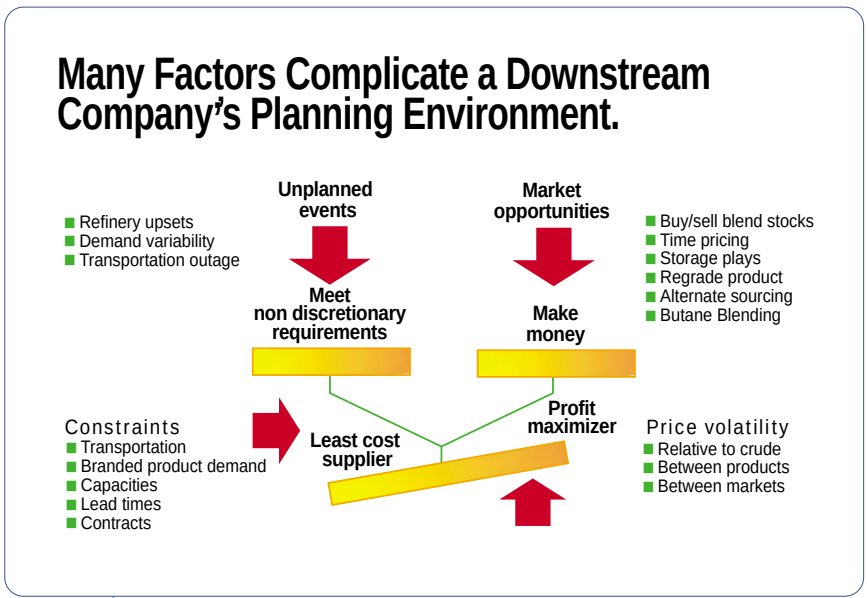

Figure 2.0 **Market opportunities, events, and price volatility interact through a physical system with very tight constraints**

oil company executives will tell you that running the business when everything is going according to plan is straightforward. The problem is that this never happens.

To more profitably operate the downstream petroleum supply chain, an oil company must be able to make the complex decisions and change those decisions as necessary (and as feasible) when circumstances change. To do this, it is essential that an explicit planning basis be developed to encompass all of the essential planning variables. Such a planning process and engine must be used to convert the plan basis into a comprehensive, economically sound plan, and the actual results should be measured and compared to the plan for evaluation and instructive lessons (see Figure 3.0). A Web-centric planning process, supported by advanced supply chain planning and measurement tools, forms the basis for all three of these capabilities (see Figure 4.0).

The Web facility enables collaboration across the organization to gather and evaluate the plan inputs, which include both structural and temporal elements. Many of these elements are challenging (if available at all) to collect on a frequent and accurate basis. The Internet can enable rapid communication and a discussion of key elements each time one of the elements changes significantly. The Internet can even be used to set system alarms on critical elements to signal that a plan should be revised due to some unforeseen change in market or company conditions. With older technology, most petroleum companies simply haven't been able to easily access this necessary information – many companies are still faced with difficult manual procedures just to determine a company-wide inventory position in a timely enough manner to act. However, as petroleum supply chains become increasingly sophisticated, the Internet will provide an inexpensive and efficient way to integrate the supply chains of multiple oil companies. Applications for Internet trading, exchanging, and tracking are being launched and will be used by the more advanced companies shortly.

With the new technology, advanced supply chain planning software can be used to optimize the supply chain and generally to maximize profit while observing all constraints. While traditional supply chain software companies have targeted their planning tools at discrete manufacturers, their software can be used to solve the more continuous/batch supply chain problems common in the petroleum industry. Any solution must handle both discretionary and non-discretionary activities that oil companies participate in.

Another critical tool is the performance measurement system. This system must be able to compare actual results to the plan and explain to management where and why there are differences. Most supply chain performance measurement systems stop far short of this goal. They can only report the raw overall differences between plan and actual with perhaps a few variance analyses to provide some indication of what happened. A system that is integrated with the planning process and an oil company's ERP system can provide management with far more insight than can be gained from traditional approaches. In fact, the system must answer questions such as "Did the adjustments we made to capture an opportunity make us money?" Or, "How well did we mitigate the consequences of a refinery upset?" Configuring the measurement and feedback approach around a series of accounting books or "supply books" allows the segmentation of results into meaningful business insights. For example, one oil company could not easily answer these questions. At the end of a month when they closed the books, it was a surprise to them how much money the supply chain made or lost. After a rather terrible month, the CEO asked the straightforward question, "Why did we lose such a large amount of money?" After two more months, the supply chain executives admitted that they had no real idea. The firm's systems and measurements simply could not diagnose the causal factors. This company did not learn from its mistakes and consequently was resigned to committing the same or similar mistakes in the future.

The Internet can also be used to coordinate commercial and operational activities. Key elements include publishing the plan to all involved parties, monitoring actions as they are taken, and distributing the findings and learnings from the previous plan period to all involved. Actions that

deviate from the plan are then immediately obvious and will either trigger re-planning or management actions to correct the activity and return it to plan.

The Right Time for Change

There will certainly be resistance to implementing these ideas in most oil companies. In most companies' supply chain planning departments, there tends to be a bias toward internal activities rather than an external focus on planning. The strong measurement philosophy requires putting a stake in the ground for the plan, which may be culturally resisted. Typically, traders don't like the additional constraints and oversight. Finally there is a perception that the systems might not be up to the task.

However, there has never been a better time to implement this kind of solution. Oil companies are more ready for change than they have ever been. After a series of difficult transitions, their organizations are more accustomed to change. People are more technology-savvy and less wary of the technology required. At the same time, the information technology infrastructure is much stronger; enterprise resource planning systems and the Internet have improved data availability and quality while making collaboration less costly. Finally, the decision support technology has advanced dramatically as computing power continues to escalate and software vendors have devoted more of their resources to the process industries.

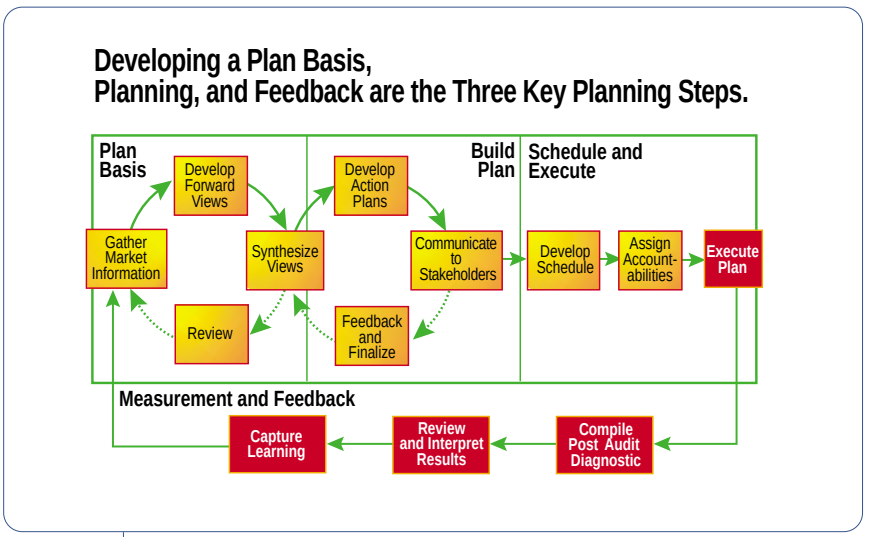

Figure 3.0 **Plan for evaluation and instructive lessons**

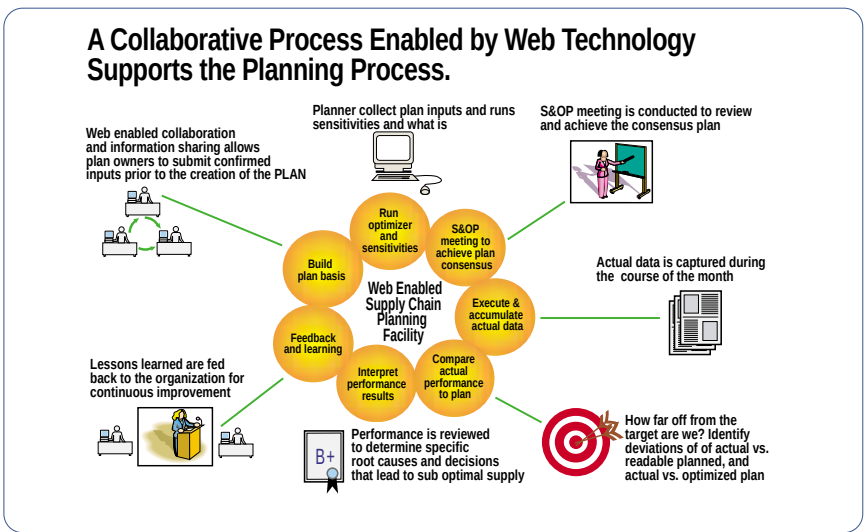

Figure 4.0 **A Web-centric planning process**

In Summary

In summary, success in the downstream petroleum supply chain requires more than driving down costs and managing absolute levels of product inventory. Making the right executive decisions requires a finely tuned understanding of the many parameters that affect hydrocarbon value. It is here that the marriage of the Internet and advanced planning capabilities can create a competitive edge. The arrival of the Internet provides an economic channel for the information gathering, collaboration, measurement, and monitoring. Now that the technological capabilities are no longer the bottleneck, industry leaders must manage the cultural upheaval that accompanies such a radical change in the operating paradigms. But the prize, a more sophisticated and accurate platform on which to make operating decisions, will put petroleum companies at a significant competitive advantage.

Note

This discussion focuses on the products supply chain; however, most of the concepts apply to the crude supply chain as well. "Supply chain" in this context is intended as a non-organizational definition that includes many of the functions that might be located in a refining, supply, trading, or marketing organization.