




IMPROVING REFINERY  
MARGINS KEYNOTE  
SERIES

# RIDING THE STORM





The downstream industry is currently operating in a difficult environment of shifting demand patterns caused by volatile crude prices. **Allison McNulty, AspenTech, USA**, explains how advanced planning, in combination with scheduling software, can help refiners to successfully navigate the fluctuating economic storm.

**C**apitalising on potential 'downstream dollars' is essential for any business wanting to remain competitive in the energy industry, with manufacturing cost efficiencies determining the difference in the bottom line for global refiners. Shifting demand patterns caused by volatile crude prices, weakening demand in emerging markets, and new crude oil sources can greatly affect a refinery's profitability. Therefore, planners must adapt quickly to navigate the fluctuating economic storm. The use of advanced and innovative planning software can make the difference by easily identifying more robust planning decisions for a true global optimum.

The mismatch between supply and demand, however, has led to a global glut of oil. On the supply side, turmoil in the Middle East has not stifled production. At the time of writing, there has been no reduction in output from regions such as Saudi Arabia or other Gulf states, keeping prices low. However, according to Reuters (22 November) any changes from the Organisation of the Petroleum Exporting Countries (OPEC) will have to extend beyond the six month timeline anticipated to drawdown stockpiles.

Advancements in technology and manufacturing translate into efficiencies, so even though the number of passenger vehicles globally is expected to double to 2 billion by 2040, the more efficient vehicles will require much less oil. This will have significant implications for global refiners, as gasoline today accounts for one out of every four barrels sold.

The global spare refining capacity is already above its low in recent years, which indicates that there will be a long period where refineries are being forced to reduce plant capacity, whilst struggling to be operationally efficient. The high demand growth originally predicted in emerging markets has greatly softened, particularly among the so-called BRIC nations (Brazil, Russia, India and China).

Securing every possible dollar available downstream can be achieved by implementing advanced planning software, which

provides the answer to the burning day to day planning questions, such as: which crudes to buy? Which products to make? How to capitalise on new crudes and feedstock on the market? What is the right crude diet for a refinery? Innovative software helps to make the right decisions, increase accuracy in yield predictions and reduce model maintenance for optimal refinery planning.

Production planning in the refinery is essential to profitability. For example, the crude planner alone in a 200 000 bpd refinery is responsible for decisions which, over the course of a year, spend over US\$1 billion in raw materials (assuming just US\$35/bbl crude). Even a tiny 1% error will cost approximately US\$10 million. Larger errors could easily shatter the already thin margins that most refineries operate under.

As a result, a major challenge to refiners and olefins producers today is ensuring the production planning solution is optimal and robust. In other words, it is absolutely imperative to have an optimal and reliable planning model and tool – one that remains profitable at a range of operating conditions, tested under a number of conditions and analysed to understand the patterns.

Once the reliability of the model is demonstrated, one can consider ease of use – one measure is how long the model takes to solve. If the model is taking too long, the solution is technology: increased computing power drastically reduces solve time. As an example, an Asian refining company, which uses Aspen PIMS-AO to solve more than 800 cases per week, has reduced its solve time from 36 hours to 90 minutes, opening doors to almost real time trading moves and purchasing power. The company leveraged this new agility to capture opportunities before competitors and increase profitability.

## Crude purchase decisions

Determining which crudes will be most profitable to run and anticipating product demand requires the best planning tools to make quicker and more profitable decisions. Reacting to



discrepancies between the plan and schedule is also vital to fully exploit profitable decisions in the supply chain, and to be able to capitalise on newly available feedstocks such as global shale plays.

The challenge with new crudes and feedstocks on the market is: what is the most effective way to manage a crude selection? Which crudes will yield the most profitable products? With options comes complexity, and decisions become much more difficult. For example, process units can be run in different ways to make different products. As the price of crude changes, those refineries familiar with running 'dirty' crudes might change their operations now that the lighter, sweeter crudes are less expensive. In some cases, changes to the refinery configuration itself will require Capex analysis through planning. Spot crude opportunities too could become available that the refinery might consider purchasing. Therefore, the planner has to be agile enough to determine if the crude is suitable and how to change the plan to accommodate the new feedstock.

## Exploiting feedstock flexibility

With powerful planning tools, planners can run more scenarios faster, gain more time for analysis and respond quickly to traders by making more robust decisions in a dynamic environment. This will achieve a realistic and optimal target and achieve accurate planning that increases profit.

For years planners have used model-based planning systems, such as Aspen PIMS™, to help make more optimal decisions. However, historically it was challenging to identify the elusive 'global optimum' that spans across a large number of refinery operating conditions and different crudes types. Many times 'local optima' are encountered, which are sometimes difficult to identify. With the latest advanced optimisation solutions, planners can now quickly determine a global optimum that leads to improved profitability of refineries.

In essence, there are three key benefits to using advanced planning tools compared to standard applications:

- Performance: run more scenarios at a faster pace, allowing more time for analysis.
- Stability: reduce crudes logistics complexity by determining the right number of crudes to run using a feedstock basket reduction tool, reducing switching costs.
- Optimum: easily determine the global optimum for the best possible solution.

Companies have successfully reduced their model run times from hours to minutes with the help of advanced optimisation solutions. This makes an enormous difference to reaching the decision point earlier in the process. Additional time can be spent to further analyse results and different scenarios. On a separate point, case comparison runs have been known to reduce from many hours to only 18 minutes. The speed with which one can make a decision can determine a refinery's profitability, particularly in distress, or spot crude opportunity purchases. Responding to a trader on the other side of the globe can make or break a bottom line by either purchasing crude that will prove profitable or missing out on a distressed or highly discounted crude.

By using newly developed collaborative tools, these types of sophisticated software systems enable planners to deliver optimal plans faster and more easily. They can visualise and evaluate multiple scenarios along with plant data to make better and more profitable decisions. This kind of approach demystifies the plan by

providing clearly displayed data with an easy to use interface on a common platform available to all key stakeholders.

In today's market, refiners are facing several challenges when creating an improved schedule that is safe, operationally efficient and feasible. While executing the plan, schedulers must adhere to stricter product specifications, market and regulatory requirements that can impact refinery profit margins if not properly managed – and, as new feedstocks become available on the market and complexity increases, having a comprehensive refinery wide view of the schedule becomes vital in today's marketplace.

Accurately tracking crude and finished products to and from the refinery from a single platform is necessary when managing various scheduling events within the refinery, pipeline and dock operations. With best in class scheduling technology a 200 000 bpd refinery of medium complexity can see an increased profit of US\$0.10 - 0.20/bbl for an annual profit of US\$6 - 14 million through:

- Scheduling in a collaborative environment.
- Managing operational upsets.
- Optimising product blends.

## Scheduling in a collaborative environment

Execution of the plan through collaboration is an essential aspect of scheduling for any refiner. Typically, a facility will have crude schedulers, product schedulers and other stakeholders that need access to accurate information on the company's current corporate objectives and refinery capabilities. These individuals work together on the schedule and need to be aligned on the plan, unit operations, outages, feedstock receipts, tanks, product lines, and so on, to create an operationally efficient and feasible schedule for the refinery. This data is interconnected and needs to be readily available to share among various individuals within the organisation. Having all this scheduling information under a single platform is a key enabler for that collaboration.

Currently this is primarily carried out using spreadsheets or other home grown solutions. Initially this approach may seem inexpensive to the refiner. However, disparate tools often lack the ability to account for operational constraints, accurate property and composition prediction, and inventory visualisation. Disparate tools such as spreadsheets that are passed around amongst different stakeholders can leave room for manual errors that can be detrimental to the refinery profit margins; and as complexity increases and additional constraints are introduced, a scheduler often quickly turns to the first viable solution, with little thought to the most profitable solution, due to time constraints.

By bringing all key scheduling activities under a single platform, refiners are able to streamline workflows and gain a greater view of their entire petroleum supply chain. Scheduling automation software enables crude and product schedulers to work from the same schedule to eliminate any disconnect between the functions. This improved visibility into the refinery's activities provides better tracking of the composition and movements for a better understanding of what feedstock is coming in and when it should arrive. Having this visibility allows the scheduler to make the best use of the process units and push them to their limits. When a refinery is able to hit as many constraints as it can in the scheduling process, it can realise an increase in profit margin by maximising operational constraints and throughput.



Within a refinery and olefins plant, upsets are unavoidable. Common upsets that can occur include turnarounds, shutdowns and weather-related events. Some of these events can be anticipated while others, such as operational issues (a compressor trip), weather disruptions (hurricanes), and logistical upsets (a delay in shipments), are typically unexpected and temporarily force a refinery or olefins plant to shut down for safety precautions.

Although the plant is not operating under normal conditions, having a sound plan and schedule can reduce lost opportunities associated with these disruptions. Planning and scheduling software enables refiners to run different scenarios to make the best decision and return to ideal operations quickly.

### Optimising product blends

The purpose of any refinery is to refine crude into different blend stocks that are eventually blended into saleable products such as distillates, gasoline, or fuel oils. Refiners have obligations to deliver these products on-specification (meeting specific requirements), and, if not properly managed, this can result in re-blends and product quality giveaway. With stricter specifications and changing regulatory requirements, the optimal use of a refinery's inventory to create blend recipes can have a significant impact on a refinery's profit margins.

Planners generate blending targets, which are later passed to the blend scheduler to execute. The problem is that these targets can be difficult to achieve and often represent an average for the planning period. They also do not account for operational constraints such as tank ullage, tank heels, discrete blend events, and operational disturbances.

As blend complexity increases and additional constraints are introduced, a scheduler's responsiveness becomes key when creating


an optimal blend recipe. Typically, refiners play it safe and overcompensate in their blend recipes to ensure they meet the specification and contract obligations. With a blending solution, schedulers can accurately model the blending operation, including non-linear properties, tank constraints, component availability and logistic restrictions, to maximise margins and reduce quality giveaway.

### Building best practice

The refining market is continuously changing and the shortage of experienced workers in the refining and petrochemical industries is becoming more prevalent every day. The need for leaders with diverse experiences is also driving many companies to rotate new engineers and managers through planning and scheduling roles, to gain credibility and expertise in economics and decision making. Best in class planning and scheduling technologies are now a must have for refiners to streamline workflows and stay competitive in today's market. These tools have domain expertise and best practices embedded to support better decision making and thus more productive employees, at a faster rate.

Leading edge refiners adopting best in class planning and scheduling technology have gained better visibility across their entire petroleum supply chain and seen an increase in their profit margins.

### Conclusion

Attaining an edge in the energy industry is essential in today's market. The opportunity to capitalise on 'downstream dollars' is achievable with advanced planning and scheduling software. Being able to quickly analyse and produce different scenarios delivers swift results. By opening the gateway to a world of new opportunities, refineries are better equipped to explore even more ways to optimise their planning and scheduling, grow the business and boost profit. 



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