



Protect Profits and Prevent Margin Loss in Downstream

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Capture Incremental Margin in Refining and Petrochemicals

Most downstream leaders agree there are many opportunities to improve margin performance. Focusing on the most obvious adjustments, such as replacing or revamping aging equipment and optimizing spare part inventories, delivers growth, but still leaves ample room for improvement. With downstream margins globally close to a 10-year low, according to S&P Global Platts Analytics and ExxonMobil, companies need to find new areas for improvement.ⁱ Where should the refinery executive look for the next steps? The symptoms are often clear, such as monthly plans that actual operations never attain, yields that fall quite short of design capacity and fluctuating utility costs. Embedded AI, machine learning and other advanced technologies equip downstream organizations to treat these symptoms to capture greater profits. McKinsey projects that “AI could potentially deliver additional economic output of around \$13 trillion by 2030, boosting global GDP by about 1.2 percent a year.”ⁱⁱ

Current digital solutions offer ways plants can move beyond mechanical and equipment investments to drive greater profits. Technology is already enabling leading operators to outperform their peers in growing margins, often by more than 10-15%. Organizations that embrace digitalization now can maximize profits well into the future. A McKinsey study suggests that AI’s contribution to growth may accelerate, increasing to three or more times higher by 2030 than during the next five years.

The following framework outlines high impact operational improvements that deliver immediate results.



Run Your Existing Assets at Their Greatest Potential

Most downstream companies have invested heavily in infrastructure that must function effectively for decades. These organizations must focus on getting the most out of their existing investments with intelligent updates, revamps and process changes to increase efficiency. At the digital level, tools such as process simulation, digital twins, operational models, prescriptive maintenance technology and advanced process control can help drive significant operational improvements with existing equipment.

Leveraging digitalization to get the most return out of existing assets is becoming imperative. According to Accenture's Global Resources Industry X.0 Lead and Managing Director Tracey Countryman, refineries and chemicals have reached an inflection point where digitalization is at the top of the agenda. Few in the industry have achieved real maturity; many organizations are just beginning to explore trials and proof of concepts for technology.

Companies that have embraced digitalization have seen their margins increase. They're able to more accurately align actual production to plans, reduce product giveaway, optimize processes and energy use, debottleneck and minimize unplanned downtime. They're also better able to respond to shifts in the market, such as the sweetening and lightening of the U.S. crude supply or stringent new environmental regulations like the marine fuel sulfur content limits stipulated in IMO 2020, and pressure to increase sustainability.



Cross-Disciplinary Optimization Paves the Way for Larger Profit

Isolated technology improvements to equipment or processes can certainly help increase margins. The broader advantage for downstream, however, lies in connecting different disciplines. Incorporating insights from engineering, maintenance, operations and supply chain gives leaders the intelligence to achieve even higher levels of optimization and stronger business outcomes. Understanding the impact of different operational choices across functional areas and within the context of the organization's overall goals and strategic plan empowers leaders to make the decisions that deliver the greatest value.

Adopting technology that unifies and analyzes data from various functions across the business to identify the best courses of action will deliver significant competitive advantage and help achieve the highest possible profit margins.

Increase Margins by Adapting to Change While Controlling Costs

Downstream faces significant challenges, ranging from changing demand and shifting feedstock to pricing volatility, increasingly strict environmental regulations and growing concerns about sustainability. According to Deloitte's 2018 survey of oil, gas and chemical industry executives, "cost and regulations top the list of downstream concerns, including environmental and permitting issues."ⁱⁱⁱ Infrastructure bottlenecks and operational issues, including reliability and safety, are also focal points. The circular economy adds a new aspect of volatility.

Many refineries and chemical companies see themselves as locked into inflexible equipment and processes, as well as expensive technology options that make it difficult to adapt. Overlooking the many ways businesses **can** cut costs and optimize, however, keeps them from making changes that could generate significant financial returns.





Stop Losing Money to...

- **Unplanned downtime:** Advance notice of pending equipment failures allows plants to schedule downtime, reduce repair costs and adjust production to avoid losses.
- **Process and equipment constraints:** Constant process optimization and controllers that adapt to changing plant conditions allow plants to run to the limits of performance.
- **Inaccurate planning models:** Leveraging models that reflect actual operating conditions results in more achievable plans and improved profits.
- **Product giveaway:** Inconsistent product quality and inability to maximize production of the most profitable products keeps downstream companies from reaching their full potential.
- **Feedstock variability:** Better insight into crude properties and processing requirements empowers refinery owners to quickly adapt, reduce operational risks from processing unfamiliar feedstock and maintain the most optimal product slate and trading.
- **Inefficient energy use:** Ineffective heat transfer and utilities management add up — especially for large organizations operating multiple sites. Optimizing energy use can yield from 2% to 10% in savings.

Recover Profits with Digitalization

Understanding where the organization is leaving money on the table allows leaders to invest in tools that can address the problem and gain profits. According to PwC, “with up to \$1 trillion USD in estimated savings in capital and operating expenditures up for grabs over the next seven years—particularly from using new technology to increase efficiency in project management, operations and the supply chain—oil and gas companies that get a head start on their competition with digital innovation will have a distinct advantage.”¹¹¹ Downstream is a crucial part of this equation.

While downstream companies can invest in tools to address different elements of margin leakage, only one solution provider equips companies to tackle the full spectrum and increase profit by 10% to 15%.





Achieve Deep Insight and Improvement with Connected Technologies

Most downstream organizations have already invested in some level of digitalization and seen positive returns. At AspenTech's OPTIMIZE 2019 event, Accenture's Tracey Countryman said the industry "has been driving around automation and margin improvement for decades, so they have some very great core operational technologies that have improved their performance, so there's always been the question about what's the incremental add for digital. We're now starting to see some proof of concepts and value propositions that are coming to the forefront that are making it real for the industry."

Presentations at OPTIMIZE 2019 demonstrated specific evidence of these investments and project returns. Organizations ranging from BPCL in India, SARAS in Italy, Rompetrol in Romania and ADNOC in the UAE shared their approaches and outcomes.

As the downstream industry works toward developing smart plants and building on the foundational technologies already in place, creating synergies across operations lets companies grow profits. Implementing digital tools in a logical progression offers a clear path to reduce margin leaks. Investing in the most current technologies with the most advanced

capabilities available allows refineries and petrochemical plants to focus on projects that drive improvements across the organization, rather than at single points in the process.

An Effective Path to Developing Digital Maturity for Downstream

Before refineries and chemical producers can start connecting technologies across disciplines, they need to establish certain baseline capabilities. Then they can add additional capabilities to gain greater insight and cross-disciplinary collaboration to reap the greatest returns.

Four Stages of Technology Implementation to Reduce Margin Loss

1. Foundation level technologies

- Production planning
- Plant-level performance management
- Basic advanced process control (APC)
- Offline energy modeling
- Offline engineering modeling

2. Advanced applications

- Advanced planning and scheduling alignment
- Order management
- Adaptive control and dynamic optimization
- Operator training
- Online model-based equipment monitoring

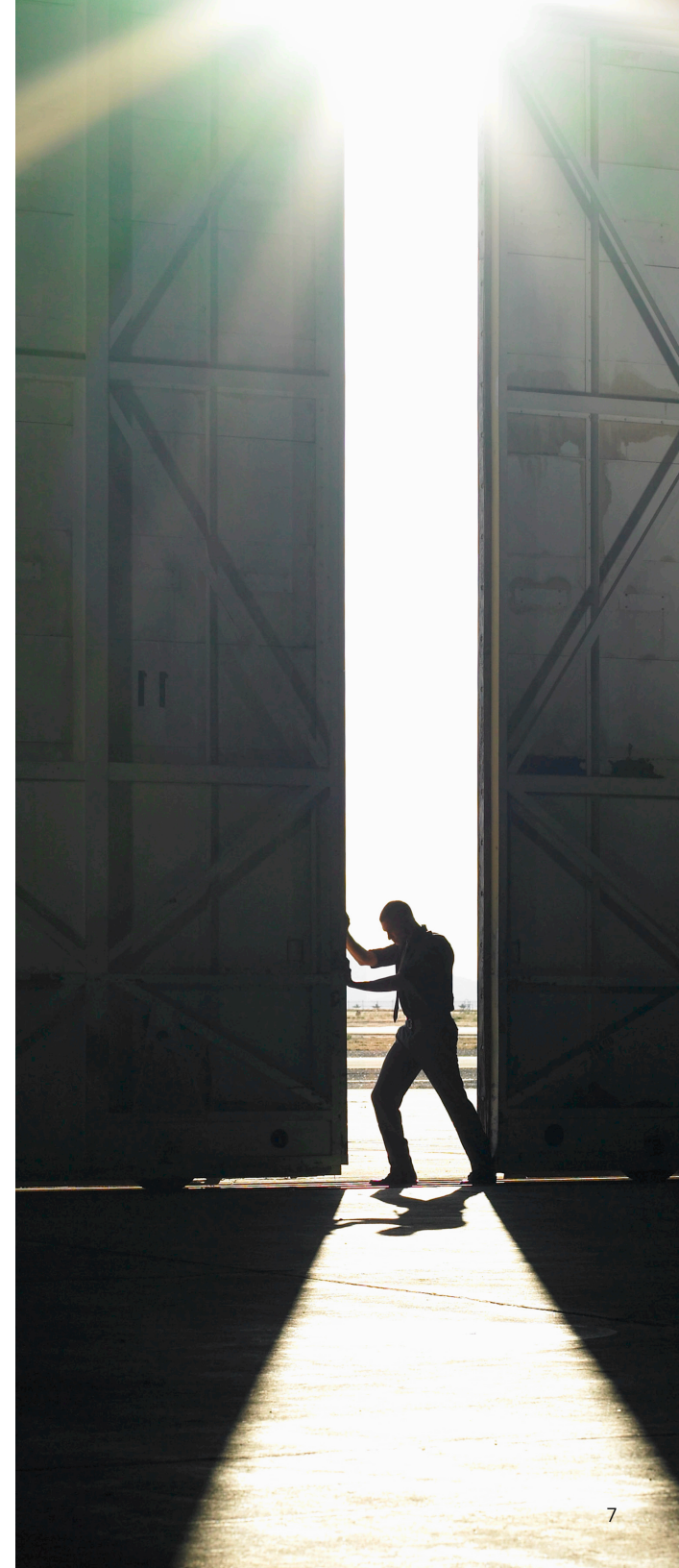
3. Integration of different tools

- Planning model update
- Vertical integration
- Adaptive closed-loop optimization site-wide
- Prescriptive maintenance alerts
- Visualization and automated execution

4. Value chain alignment

- Distribution and trading alignment
- Digital twin to inform operating decisions
- Enterprise-wide data access
- Production optimization
- Enterprise risk modeling

The first two stages (or “maturity levels”) of technology investment offer improvements in individual functional areas — downstream owner/operators see efficiency increase due to automation and digitization, reducing manual processes. The next two multiply those benefits, creating the smart enterprise.



1. Foundation level technologies

Stage one automation involves improving areas with technologies such as powerful planning tools, advanced control, energy modeling, and offline performance models. These tools enable plants to quantitatively identify and address margin improvement in basic areas such as improved planning, energy demand reduction, equipment monitoring, and debottlenecking. With foundation level tools, owner/operators begin to more consistently capture and share data that can be used to drive better decisions and optimize specific processes. Planning software, yield accounting tools, data historians, engineering models and APC provide a crucial starting point for measuring performance across various dimensions and protecting profit.

2. Advanced applications

At the second stage, advanced optimization builds on the foundational tools already in use. Big value comes from tying planning and scheduling together, from applying digital twins to operator safety and performance improvement, and from dynamically optimizing across multiple units. Adopting advanced applications offers plants more sophisticated data collection and analysis; they may begin sharing information across different functions or putting decisions within the broader business context. Planning tools with more advanced modelling capabilities that then feed into scheduling tools offer a prime example. Order management, adaptive process control and dynamic optimization also fit into this level.



3. Integration of different tools

The third level of digitalization improves upon this integration between different tools and functions, aligning different parts of the business and the plant in ways that deliver greater return on investment. High-performance compute power supports tools like general dynamic optimization and predictive maintenance analytics, which harness massive amounts of data to optimize operations, assess performance and recommend repairs before breakdowns halt production. Online adoption of digital twins delivers major margin value from improved yields, energy utilization, and equipment effectiveness. Crucial benefits at this level also include increased visibility across business functions to key indicators for better decision-making. Enterprise insights are accessible at the CXO and operations management level to make key business decisions on an agile basis, as well as providing operators visibility as to the impact of every decision on the enterprise KPIs.

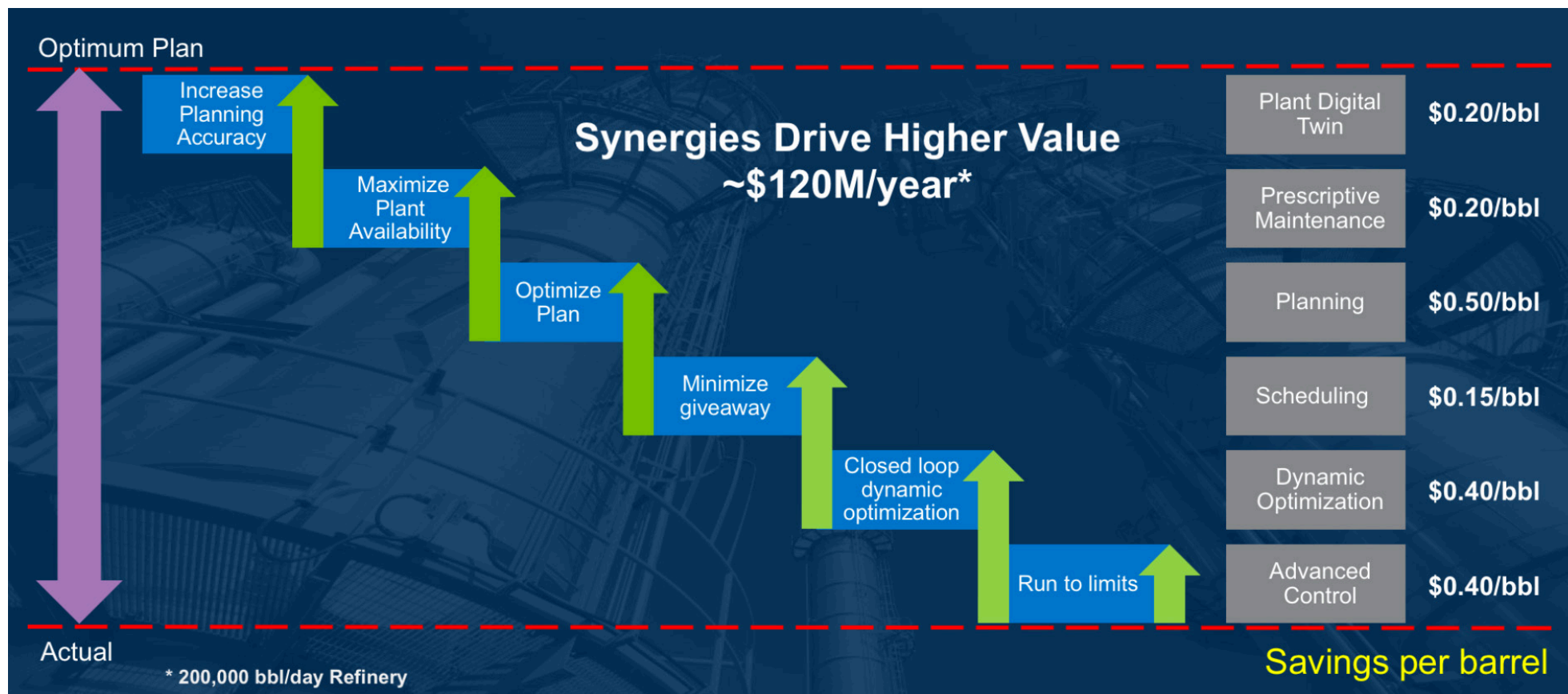
4. Value chain alignment

When downstream organizations reach the fourth level of technology adoption, they begin to optimize across the value chain, from well head to retail gas pump, or through the chemicals value chain to monomer and polymer production. Companies at this stage position themselves to better inform the plan, produce to demand, and make maximum use of their assets. They're able to adapt to align plans and production to the most profitable products based on real-time insight from digital twins. An additional 10-20% margin improvement is achievable through better value chain and asset utilization, more agile reaction to market conditions, and integration across the entire business.



Synergies Drive Greater Value

Software technology can help downstream companies address each of the causes of margin leaks, in specific business areas. But more importantly, beyond those individual value areas, digital transformation will create synergies that transcend these individual business silos to deliver a huge additional boost in value. Building on a number of real-world, customer-audited examples, AspenTech calculates that a 200,000 bbl/day refinery can realize close to an additional \$2 per barrel by addressing different areas that erode margins; implementing changes in ways that create deep integration across functional areas can contribute to even higher value. Examples include visualization across disciplines where engineering models can be applied to update planning models and vice versa.





Start Applying Technology Where Your Organization Has the Greatest Gaps

In an interview at OPTIMIZE 2019, AspenTech President and CEO Antonio Pietri shared that he's seen the greatest success in digital transformation from companies who have taken a practical approach. "What we're finding from the customers that are early adopters is that they're being very pragmatic about the approach they're taking on digitalization with regard to opportunities where they see the low-hanging fruit, the value they can capture. Then as they learn, they expand those opportunities."

Is your schedule falling short of getting you to the plan? Seek out a tighter integration between the two — and ensure you have the most accurate plan possible by updating the model to reflect actual operating conditions. Need to switch to a new feedstock? Determine how to get the most profitable mix of products with thorough analysis. Consistently suffering unplanned shutdowns due to equipment failure? Invest in prescriptive maintenance analytics. Identify and address bottlenecks with a digital twin of the plant. Improve product quality and throughput with dynamic optimization and adaptive process control. Share data across the plant via common applications that enable timely business decisions aligned with overall strategy.

All of these examples show how to create measurable value in the key areas of operational excellence, process safety, sustainability and margin optimization.

Examples of How Linking Technology Across Disciplines Improves Margins and Creates Value

DYNAMIC OPTIMIZATION

One of the world's largest **energy companies** saw an opportunity to maximize production of specific diesel and jet fuel products at one of its refineries through technology that achieves the integration and synergies described above. The refinery implemented General Dynamic Optimization Technology (GDOT) that aligns multiple process units (and each individual APC controller) with the refinery plan and actual operating conditions. Along with technology, they changed their organizational approach, creating a multi-function refinery optimization center, bringing together console operators, optimization engineers, process control engineers and planners to take advantage of this integrated technology.

This approach enabled the plant to reduce product giveaway (70% decrease in sulfur giveaway, 80% reduction in diesel T90% giveaway, 25% decrease in jet smoke point giveaway) resulting in overall higher margins. Now this is being implemented at other refineries within the enterprise.

A smaller 220,000 bbl/day **refinery** in the U.K. used the same technology to realize a 10% increase in diesel production and a \$10 million USD increase in margin. A refinery leader explained that the system "allows operational instructions and strategies to be consistently implemented, minute by minute, day and night, driving the units toward more profitable operation and improving the competitive position of the refinery."

DIGITAL TWIN

Hyundai Oilbank, a major refinery in South Korea, created a rigorous simulation model of one of its FCC units and applied it in an integrated way across engineering, planning and operations. With the new model in place, the reactor could better adapt to changes in feed quality: planning accuracy for the unit increased to 98% and Hyundai Oilbank uncovered improvement opportunities valued at \$36 million USD annually.

PRESCRIPTIVE MAINTENANCE

An American multi-national refiner launched a digital transformation initiative that uses big data, artificial intelligence, and machine learning (AI/ML) to drive cultural change in the organization. Predictive maintenance became a major part of that initiative. A hydrogen





compressor in one of the company's refineries had multiple historical ring and piston failures costing over \$250 million USD across just 3 events. In a pilot of AspenTech's prescriptive maintenance offering, the organization was able to avoid several similar production losses. The potential to gain tens of millions of dollars from better crude management and scheduling enabled by far earlier warnings of asset failure served as a compelling reason for the company to roll out prescriptive maintenance across a global refinery network.

Maximize Profits by Optimizing Operations in a Broader Context

In a recent interview, ExxonMobil's Chief Computational and Data Scientist Dr. Thomas Halsey stated that he hopes those in the industry soon gain "an understanding of the short-term steps... that they can take within their enterprises that will deliver tangible value and will... position them to harvest the long-term benefits of this technology revolution."

What does that mean for downstream?
Assess your digital maturity then determine which additional tools will best address critical business problems. Find ways to connect

planning, scheduling, process engineers, mechanical teams, operators and other key staff with software that equips them to quickly adapt to capture greater profits from your existing assets. Build on your successes with additional investments that offer more synergies, deeper insight and the ability to eliminate margin leaks.

Choose a technology partner skilled in helping downstream companies connect different parts of the business to drive profits. AspenTech has a track record of delivering effective solutions for downstream at all stages from plant and process design to optimizing planning, scheduling and production to drive higher margins. Simply purchasing the technology isn't enough; **the true value comes in adoption of the technology.** For example, downstream must also implement effectively, quickly educate users on the new software, and develop a strategy for advancing their digital maturity. With technologies that inform operational improvements and reduce expenses, downstream companies can become increasingly competitive and profitable, able to quickly adapt to changes in the market and tightly align production with demand.



Technology That Loves Complexity

About Aspen Technology

Aspen Technology (AspenTech) is a leading software supplier for optimizing asset performance. Our products thrive in complex, industrial environments where it is critical to optimize the asset design, operation and maintenance lifecycle. AspenTech uniquely combines decades of process modeling expertise with machine learning. Our purpose-built software platform automates knowledge work and builds sustainable competitive advantage by delivering high returns over the entire asset lifecycle. As a result, companies in capital-intensive industries can maximize uptime and push the limits of performance, running their assets safer, greener, longer and faster. Visit AspenTech.com to find out more.

www.aspentech.com

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