Maintaining Refinery Assets for High Performance

An Accenture point of view for the downstream refinery sector
Across the downstream refinery sector, Accenture sees two main factors affecting production and overall operations performance. First, day-to-day costs for maintaining assets in a petroleum refinery continue to rise. The challenge for executives is to reduce maintenance costs and sustain those cost reductions in an effort to improve razor-thin profit margins without jeopardizing future production plans.

Second, many refineries operate with originally installed equipment dating back two or more decades. While some components have been updated, the heavy use of aging assets has brought the issue of asset reliability to the fore. This urgency is due not only to production loss and increased operating expenses, but also to the potential to adversely affect the health and safety of employees and local communities (and thereby damage a company’s reputation) in the event of an asset failure.

Accenture has identified three leading practices for maintaining assets for reliability and, ultimately, high performance:
• Develop equipment-specific strategies to focus on effectively addressing failure modes.
• Improve maintenance efficiency to ensure all work (whether proactive or reactive) is executed effectively.
• Enhance support efforts to better enable, accelerate and sustain equipment-specific strategies and maintenance efficiency.
Each refinery likely will have a different starting point on its journey to improving asset maintenance and reliability. For example, some facilities may require full improvement initiatives, while others may require only a re-evaluation of existing operational strategies, or a reinforcement of the processes necessary for the sustainability of performance improvements (see Figure 1).

Figure 1. The journey to maintenance excellence.

<table>
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<tr>
<th>Stage 1</th>
<th>Maintenance improvement initiatives required</th>
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<tr>
<td>What steps can a refiner take at this stage?</td>
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<tr>
<td>• Develop equipment-specific strategies to improve efficiency of planned work.</td>
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<td>• Implement an analysis of root causes to solve repetitive problems.</td>
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<td>• Begin to monitor performance and develop a proactive culture.</td>
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<th>Stage 2</th>
<th>Maintenance improvement activities under way</th>
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<tr>
<td>What steps can a refiner take at this stage?</td>
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<td>• Evaluate supply chain support to reduce working capital and further improve productivity.</td>
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<td>• Implement a program to manage deployment of improvements across facilities.</td>
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<th>Stage 3</th>
<th>A focus on continuous improvement</th>
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<td>What steps can a refiner take at this stage?</td>
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<tr>
<td>• Investigate optimal systems and technology enhancements to better enable the continuous improvement program and drive for root-cause problem solving.</td>
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<td>• Ensure full life-cycle approach to asset performance by integrating capital-replenishment and supply chain considerations with refining strategies based on obtained performance.</td>
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Leading practice No.1: Develop equipment-specific strategies

The primary objective of developing equipment-specific strategies is to improve the reliability of each asset over its life cycle. These strategies can help maximize an asset's cost-benefit ratio as defined by routine "proactive" maintenance plans. Before developing equipment-specific strategies, Accenture recommends considering:

• What are the critical assets of your refinery?
• Based on risk, how do different activities reduce the probability of failure for each asset?
• How are the strategies for specific pieces of equipment leveraged and applied to other assets?

Each refinery's processing unit has its own compressors, pumps, exchangers, tanks, piping network, instrumentation and valves. These are all necessary for production. But can engineers pinpoint which factors cause each asset to fail and determine the impact of these failures? What actions, if any, should be taken to mitigate the causes of failure? Maintenance strategies are most effective when refiners understand equipment failure modes and the benefits that may be realized through alternative mitigation measures.

Accenture believes that developing equipment-specific strategies is the first step in achieving leading practices for refiners. Once a complete understanding of asset criticality is developed, a risk-based analysis of failure modes and their effects is used to define the right tasks and actions to implement per asset and failure mode. This process can help engineers understand what happens if they continue with current maintenance plans or apply different strategies. For example, would a strategy such as vibration monitoring better mitigate an asset's failure?

An analysis of each asset can help facility managers identify the most appropriate techniques for predictive maintenance and operator care practices. In some cases, developing an equipment-specific strategy may reveal that repeat failure is caused by a misapplication of an asset and a redesign is required to "refit" a machine for its "purpose." In addition, operating and maintenance procedures may require adjustment to further address the causes of failure.

Regarding maintenance cost expenditures, the rank order of assets and equipment failure rates can help senior management understand the relationship between cost and an asset's criticality. For example, if an asset is not available, how well can the refinery produce? What is the impact on production, safety and the environment with a functional failure? Based on the risk analysis, management can better understand investing in mitigation measures. This analysis supports a life-cycle management approach to asset performance.

Analyzing critical assets from A to Z may seem like a comprehensive plan, but that type of step-process requires a lot of time, cost and labor. In the meantime, asset failures continue and maintenance costs keep rising.

Accenture recommends approaching equipment-specific strategies without making them major undertakings. Where possible, leverage developed strategies across asset classes and focus on critical assets first. For example, take the bulk of the defined work (i.e., the understanding of each asset's failure modes) and leverage that information across similar equipment in all areas and process units. While one centrifugal compressor may act uniquely in a different production environment, failure modes typically are similar from one process unit to the next; some are simply more prevalent in one process environment than in others.

To help refiners achieve the lowest possible cost for repairs and activities in proactive and reactive work, Accenture recommends applying Lean Six Sigma principles. This group of methodologies is widely used in diverse manufacturing industries because it addresses process efficiency and quality. Many facets of Lean Six Sigma should be applied throughout a refiner's organization, beginning with improvements in the planning and execution of work.

Leading practice No.2: Improve maintenance efficiency

Lean Six Sigma is an important methodology to help drive operational excellence in a company. Accenture defines operational excellence as the integration of a set of strategies with excellence in execution so that new sources of growth, optimized processes and balanced costs are delivered with minimal complexity, maximum speed and effective change management. The Accenture High Performance Business research initiative has found that the pursuit of high performance—including operational excellence—is not only a worthy enterprise, but practical and necessary.

A refiner's objective is to increase the "wrench time" percentage of its craft personnel (i.e., the actual time craft personnel are at work, using tools, in front of jobs), completing more work with the same resources by eliminating waste and non-value-added activities. Based on our experience, we have seen improvements in craft utilization and wrench time translate to an increase in craft capacity. Examples of waste or inefficiencies can include:

• Excessive motion to find parts, materials or information about a job.
• Disorganized work environments.
• Poor communication of needs, timing and scope for the work.

The ability to increase worker efficiency and productivity comes by enhancing the planning and scheduling process—not only for the internal workforce, but also for contractors who augment the
staff. If a refiner can determine the correct timing (when nonemergency work should be completed to avoid unacceptable risk), then the maintenance department can be given enough time to plan and organize the work in order of priority. This prioritized scheduling can help reduce the costs associated with the repair—for example, by avoiding overtime, expediting material/equipment supply and reducing the need for additional contractor resources.

Leading practice No. 3: Enhance support efforts

Asset maintenance and reliability cannot be improved in a vacuum. Enhancing support efforts is critical once transformational activities are under way. “Support” refers to anything required (but outside the core maintenance function) to execute the processes previously described. The procurement, warehousing and supply of materials, parts and services is of primary importance in this area. The effective management of the supply chain efforts can be an advantage for refiners. For example:

• Improving the reliability of materials supply can contribute to lower ongoing maintenance costs.
• Materials can be stored onsite or purchased as needed—whichever is more cost effective.
• Packaged materials can be warehoused and “staged” for scheduled, cost-effective deliveries.

In addition to the use of hard-good materials, the use of contractor services is an important part of support efforts. Based on our experience, a refiner’s best opportunity for efficiency is to integrate contractors seamlessly into an overall maintenance effort. Regardless of the company logo on their work uniforms, in-house experts and contractors should function as one workforce. Often, refiners assign personnel to a job, but their plans lack sufficient detail. To specify the full extent of a resource’s activity sequence, the exact resources (e.g., electricians, pipe fitters, etc.) and where they are coming from (internal or external talent) need to be determined. Without predefined work plans, we have seen many companies end up planning as they go along. This approach takes longer and is inefficient. When contractors participate in inefficiently planned projects, their services can end up costing more due to the terms and conditions of their contracts.
Sustain improvements to asset maintenance

In our experience, we have seen some refiners approach improvements to asset maintenance and reliability, but then lose focus or get bogged down with the other time-consuming efforts that do not produce early wins.

The value of improvement initiatives can get sapped if management does not govern the new processes and leading practices:

• Efficiency and cost gains can be lost over time if there is a lack of adherence to the new methodology.
• A lack of knowledge transfer can hamper implementation efforts if external resources are added.
• Insufficient development of skills can create a scenario in which the organization cannot replicate the efforts and gains made during the initial improvement period.
To allow for a refiner's asset improvement program to be sustainable, Accenture recommends refineries:

**Institute a governance and performance review process**

In reality, this is the make-or-break element that determines whether an organization will be successful and sustain its improvements. A good governance process includes:

- Requirements for the leadership in directing and supporting the ongoing effort.
- A structure of defined roles, responsibilities and accountabilities across the organization that gives clarity on process details and requirements, resulting in enhanced decision-making.
- A process for managing the performance of each facility's maintenance effort and everyone involved in it, from the corporate level to the shop floor. This includes the continuous improvement aspect of taking necessary actions to further enhance performance in light of the information being monitored.

With an effective governance structure in place, refiners can continuously monitor and act upon results, long after the spotlight is no longer shining on the effort.

**Manage change efforts and communications**

As refiners start the journey to implement the leading practices described here, managing the change effort and the necessary communications is essential to garner broad acceptance and support for the change that is taking place. For example, within one organization there can be myriad cultural backgrounds, skills and requirements. It is critical to engage personnel early and often so they can understand the changes and what they mean to them. By keeping the lines of communication open, management can keep employees involved and foster acceptance of the program.

Keeping senior management aware and supportive of the achieved gains can help assure competing initiatives and strategies do not derail the effort before this new way of doing things becomes institutionalized. Without information, stakeholders can lose focus on your initiatives and reallocate funding elsewhere.

**Build skills and capabilities**

Changing the guidelines of what is expected and required is a main cause of stress for employees, if they are not given the right skills and capabilities to do their jobs within these guidelines. In any change management effort, it is essential to have a formal training approach to align the right skills with the right role and enhance individual professional development.

Managing talent resources and developing individual capabilities does not only refer to technical issues, (such as how to repair a compressor); it is equally applicable to managerial and organizational improvement areas (e.g., how a program should be led, what are the organizational aspects for planning and how problem solving assists root-cause analysis and continuous improvement.) Building individual skills and capabilities improves the success potential for employees, which benefits the broader organization.

**Make effective use of tools and technology to best enable the improvements**

IT tools and systems make the performance information of an asset more readily available to personnel, which allows for more timely corrective actions. By incorporating data and information from ongoing activities and analyses, refiners can better accelerate the maintenance and reliability improvements within an organization.

Accenture has collaborated with strategic vendors and developed an integrated predictive analytics product. This solution provides more timely information on an asset's condition while providing a seamless dashboard of all pertinent information (including commercial) with which to make better decisions on where to focus corrective and improvement actions. With leaner organizations and the ever-increasing pressures to reduce costs while enhancing production, this product provides the clarity and speed of information to meet these challenges and ensure continued improvement. Moreover, this is an area of improvement that can benefit refiners who are early in the maturity of their reliability performance as well as those looking to distance themselves from the competition.

In Accenture's view, leading practices are sustainable only if they are successful. The ongoing maintenance and reliable performance of assets can help your refinery on its journey to high performance.
About the author

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Mr. Scullin has more than 25 years of experience working with chemicals, energy, utility, forest products, metals and mining companies. As part of Accenture’s Process & Innovation Performance service line, he is particularly focused on plants and asset management and helps clients conceptualize, design and implement process improvements. In addition to earning an MBA from the University of Houston and bachelor’s degree in mechanical engineering from the University of Texas, Mr. Scullin is a Certified Maintenance & Reliability Professional. Mr. Scullin can be reached at patrick.k.scullin@accenture.com.

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To learn more about Lean Six Sigma and the Process & Innovation Performance service line, visit www.accenture.com/Global/Consulting/Process_and_Innovation_Performance/default.htm.

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