WHITE PAPER

DIGITAL INITIATIVE FOR PETROLEUM REFINING INDUSTRY TO ACHIEVE OPERATIONAL EXCELLENCE

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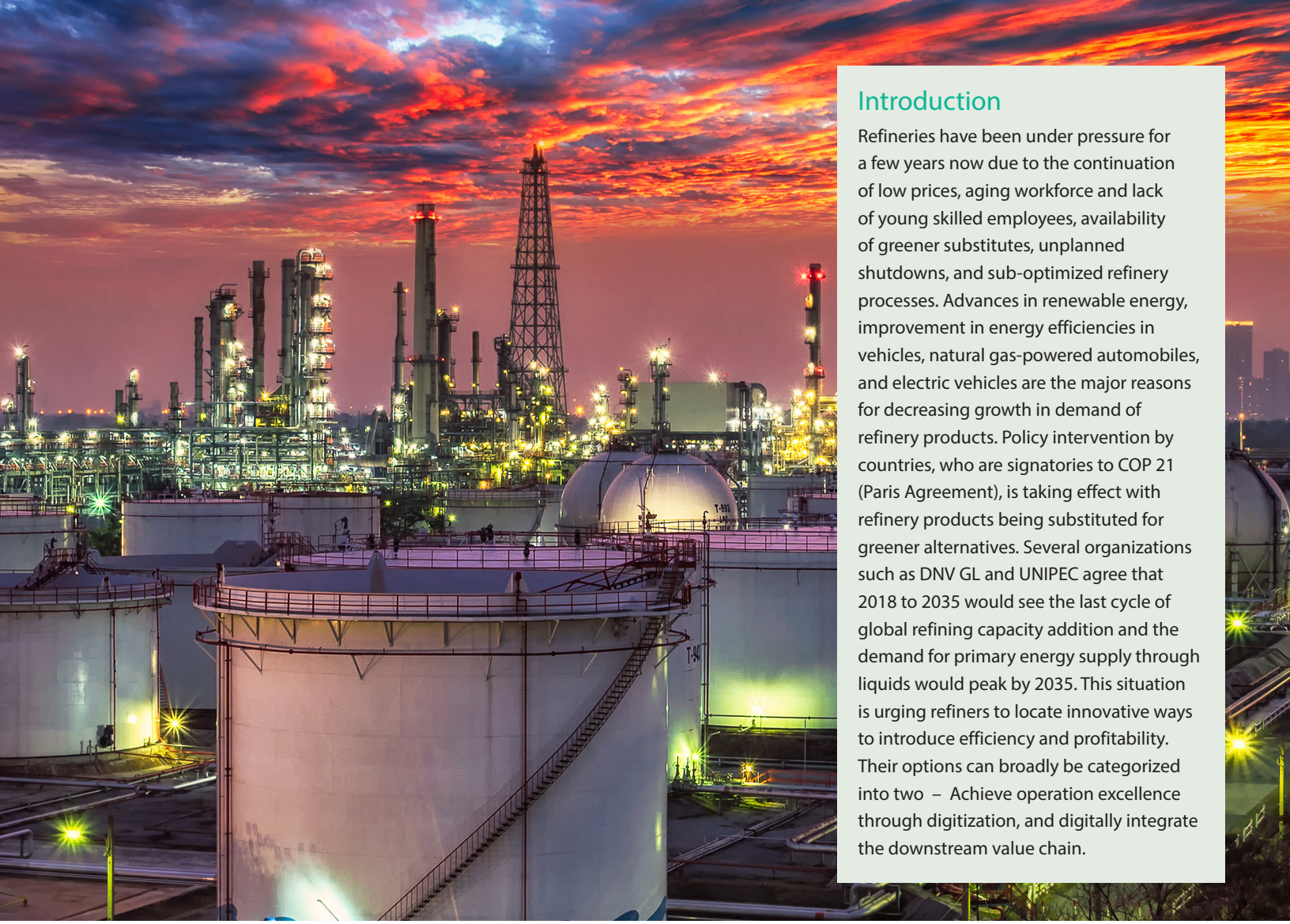
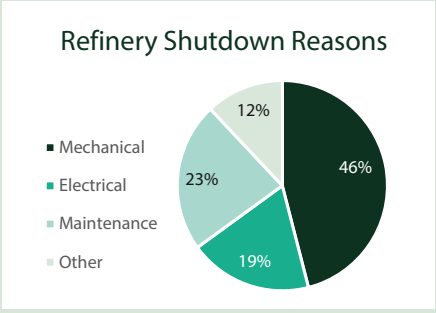


Introduction

Refineries have been under pressure for a few years now due to the continuation of low prices, aging workforce and lack of young skilled employees, availability of greener substitutes, unplanned shutdowns, and sub-optimized refinery processes. Advances in renewable energy, improvement in energy efficiencies in vehicles, natural gas-powered automobiles, and electric vehicles are the major reasons for decreasing growth in demand of refinery products. Policy intervention by countries, who are signatories to COP 21 (Paris Agreement), is taking effect with refinery products being substituted for greener alternatives. Several organizations such as DNV GL and UNIPEC agree that 2018 to 2035 would see the last cycle of global refining capacity addition and the demand for primary energy supply through liquids would peak by 2035. This situation is urging refiners to locate innovative ways to introduce efficiency and profitability. Their options can broadly be categorized into two – Achieve operation excellence through digitization, and digitally integrate the downstream value chain.

Why operational excellence?

Refiners plan their operations schedule for available crude slates by using software simulators that use Linear Programming (LP). A recent three-year study by Hydrocarbon Publishing Company notes that there were over 1700 refinery shutdowns in the US. This, despite the use of operation technologies such as Advanced Process Control (APC), Multivariable controls (MVC), and Asset Management Tools. Unplanned shutdowns not only pose major HSSE (health safety, security, and environment) risks but also lead to unplanned emissions and monetary losses.



Refiners are trying to find answers for optimizing refinery schedule and maintenance by reducing the number of unplanned disruptions. While this can be achieved by increasing maintenance, it will also increase the operational costs. Also, the LP Schedulers remain simulation based and is not dynamic enough to take into account changes in maintenance schedule, unplanned shutdowns or variations in crude oil supplies. This problem of optimizing maintenance and optimizing refinery schedule can be addressed by digitalizing the activities of a refinery from gate to gate and employ digital technologies such as data analytics, machine learning and artificial intelligence on this digitalized data for achieving maximum optimization.

The objectives for investing in a new initiative that can provide such a huge cost saving should be:

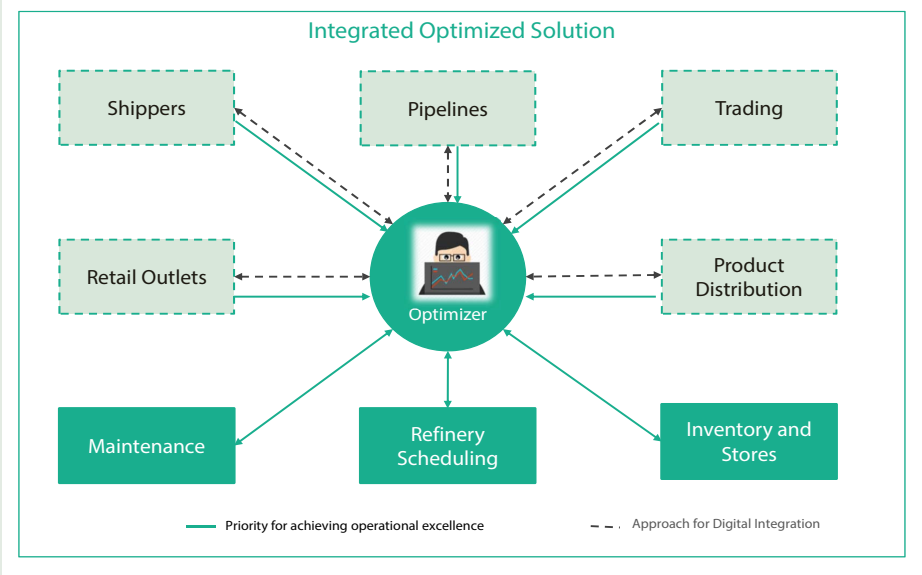
- Enhancing productivity and increasing asset reliability
- Improving health and safety standards to reduce operational hazards
- Providing real-time insights, actions, and decision points
- Providing consensus and transparency

The Solution

The solution is to have an integrated and dynamic model that leverages IoT for data gathering, cloud computing infrastructure for hosting this data, AI (Artificial Intelligence) and ML (Machine Learning) models to process this data and provide actionable insights. In this model, players in the downstream value chain will have visibility throughout the value chain, which will help the organization to accurately learn about impending changes and take decisions to adapt quickly.

The success of this model will depend on the extent of digitalization, where data would need to be gathered from all possible sources using remote sensors and devices that can transmit data to data warehouses through a communication network. This will mean the refinery will have to deploy IoT technologies and connect all the devices and equipment. Wireless sensors will gather and transmit process parameters across the plant and personnel enabled with smart devices will get actionable analytics and insights. Since most modern refineries now have Advanced Process Controls and Multi-Variable Controls (APC and MVC) for operating the process units, and Asset Management tools for maintenance for equipment and vessels, these systems must be connected to the model. This dynamic model can be more calibrated to provide better decisions for refiners if digitalized data from other departments also flows into it.

The changes that will ride upon this Digital Optimizer will be several. Plant maintenance will move from reactive maintenance to prescriptive maintenance,



solving the conundrums that maintenance managers always confront. Refineries powered by intelligent APM tools will be able to predict mechanical failures in advance, based on vibration patterns that they have learned and will be able to accurately point out to a mechanical seal that is wearing out. It can also learn from the heat patterns of the reformer refractor material and suggest timelines for its replacement. In addition to diagnostics, it will also prescribe a solution for preventing the failure. This data will also feed into the Optimizer, which can in advance suggest load balancing, shutdown of a unit and make changes to the refinery schedule by adjusting the crude slate appropriately.

The Approach

Companies will need to execute a carefully thought out strategy to achieve operational excellence. This will require finding a suitable partner for the digital journey, with expertise in handling transformation projects with various industries, experience, and knowledge in the Oil & Gas industry, and has proven solutions and frameworks to navigate the digital phase. Companies and their partners will have to consider the following three elements for their digital transformation journey.

- IoT Technologies

  The use of IoT technology will ensure speed and accuracy of data gathering across the refinery. Cloud infrastructure will have to be availed for hosting and storing the huge amount of data that is gathered. Since data gathered will be from various sources and of different types, significant focus would need to be given to data management practices and data governance. The extent of interconnectedness through IoT and Cloud will pose significant cybersecurity risks to the organization, which was absent when using standard industrial process controls. Hence, organizations will need to use proven security assessment frameworks and assess common surfaces for cyber threats, such as the various infrastructure components, to prevent cyber-attacks.

- Digitalization

  The optimizer will use digital data to provide actionable insights. The insights from models will have to provide assurance on accuracy. Hence, the model will need to be self-learning - learn from deviations and correct itself to provide accurate insights on refinery and maintenance schedule. Reports, dashboards, and action items that the model suggests will need to be tailored to departmental and personnel needs. The optimizer system will also provide a consensus mechanism for situations where Departmental Managers have to make decisions that will conflict with each other's interests.

- Digital Backbone creation

  Digital transformation will run on a digital backbone that will be an assemblage of processes, workflows, methodologies and new skillset. Agile ways of working will help in delivering IT solutions and shippable increments can be continuously integrated with the cloud. A significant focus will be needed on organizational change management to train both personnel and leaders in new ways of working.

Conclusion

While operational excellence will achieve a greater degree of optimization, maximum optimization for the whole downstream enterprise organization from crude oil supply to the POS at Retail outlet will not be achieved until the whole value chain is digitally integrated. This will be challenging since organizations are mostly departmentalized and work in silos. Enterprise level digital integration would require a more holistic approach where all departments of the enterprise are considered.

Author Profile

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