HOW DOWNTIME IS PREVENTING REFINERIES FROM BOOSTING THEIR ENVIRONMENTAL CREDENTIALS

While unplanned downtime will always impact productivity and profitability in an oil refinery or petrochemical plant, the effects often have implications that reach beyond the financial. Safety is critically important, but so is environmental efficiency.

Plant downtime is damaging in this context, with a single, unplanned shutdown that lasts hours leading to the release of a years' worth of emissions into the atmosphere. And that's in addition to the losses in profitability, stemming from reduced productivity, coupled with higher maintenance costs and increased waste. If there's a plant process that illustrates this issue, it's gas flaring, or the combustion of excess product that is typically released when a plant experiences over-pressuring operation — such as during an unplanned shutdown. Excessive flaring is a visual sign that something is outside of normal parameters in the facility, which means safety risk is increased.

Flaring is also a source of greenhouse gas emissions. In fact, according to satellite data published by the World Bank's Global Gas Flaring Reduction (GGFR) programme, each year, 145 billion cubic metres (BCM) of gas is released into the atmosphere from gas flaring. That's equivalent to 270 million tonnes of CO_2 emissions per year.

These figures paint a grim picture, but there is good news from the industrial technology front. By tapping into the power of machine learning and predictive analytics, companies can begin to reduce unplanned upsets and capture all the associated benefits. With technology that eliminates the surprise of unplanned downtime, companies can minimise the most dangerous conditions, reduce gases released into the environment and realise significant financial gains by maximising uptime.

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So, what if energy companies could plan for downtime? What if it was possible to know which pieces of equipment are going to fail, and when, so repairs could be performed as part of a managed shutdown? The benefits are significant, for both improvements in emissions reduction and profitability.

Today's asset performance management technology can deliver advanced warning of failures through a combination of predictive and prescriptive analytics, enabled by integrated software that incorporates artificial intelligence (AI) and machine learning. This type of solution provides a detailed view of all equipment, systems, facilities and networks, thereby enabling a capability we call "decision agility".

This means that, with the time to plan around predicted downtime and a holistic view of the operation, plant personnel can see exactly how a decision that changes any business process also affects the entire organisation. They'll immediately know how it impacts planning and scheduling, how it determines which feedstocks are purchased, how it affects inventory and even how it may impact the sales team and the potential for missed orders.

The right technology can simulate how any event will impact the system, the process and the asset. When the outcome is known in advance, operators and engineers can collaborate to make the safest and most profitable decisions; they can work together to develop a plan. That plan becomes a clear roadmap of where to spend every pound to maximize the return on capital employed. The technology can even be scaled to cover multiple plants across a region to look at how facilities are tied together and to better understand their co-dependencies. So, when there is an issue in one location, the software can show how it will affect the pipeline coming in, the ships going out and whether the facility is at risk of defaulting on any contracts.

By driving the best decisions, this technology also reduces risk across the operation, and there's a recognised value in doing that. Some providers in the insurance industry, which is also driven by data, have begun advising customers about digital solutions for prescriptive maintenance and decision support. They're promoting these technologies as ways to reduce unplanned downtime and associated events — and as incentives to lower their insurance rates.

The ability to see wide and deep enables new ways of running the business. Digital transformation is knocking down the data silos and delivering the tools necessary to make sense of the data available at the enterprise scale.

Achieving this level of technological integration starts with ramping up the organisation's digital capabilities. Companies in every sector now have access to technologies such as high performance computing, artificial intelligence and advanced analytics to generate deeper insights from operating data.

Fuelled by these data-driven insights, leading-edge simulation programs enable operators to quantify the value or cost of

any renovation or improvement project, maintenance change, operations improvement or supply chain constraint. This technology utilizes statistical sampling techniques to predict the future performance of a system, analysing equipment behaviour to derive a "time to failure" estimate.

With the broad view of operations that simulation programs provide, plant personnel can be alerted to impending failures and understand the potential impacts to wider systems. Operators can also model flow through pipes and tank levels, as well as the utilised and available capacities of all units.

This is how it's possible to discover exactly which events are costing money or negatively impacting performance in ways that can lead to environmental issues, for example. With a prioritised list of every event in the business that's impacting performance, the company can apportion budgets and put people where they are needed.

If the software is in place at a refinery, for example, it might alert to a likely failure of a fluid catalytic cracker or part of a cooling tower, which would cause disruption throughout the business. But with the advance notice provided by the software and time to plan before the failure happens, personnel can then use scheduling models to find the best time to take that part of the plant offline, and even insert additional maintenance activities to make the most out of the planned downtime.

And if the alert comes even further in advance, this may enable staff to load the information into a longer-term planning model that can account for impacts on sales or operations planning or integrative business planning.

Through those two models, not only is the organisation protecting itself from unplanned events, it's actually accounting for economic impacts. Personnel are making informed decisions to take the best possible action in a multi-network supply chain with equivalent manufacturing facilities that can produce multiple goods. The greater the window of predictability over the planning horizon, the more powerful the business options. This moves the conversation from "what's feasible" to "what's going to give us the best results as we're trying to deal with this issue."

In short, management can always know when the best downtime is, as well as what activities should be completed during that downtime, in order to preserve orders and maintain commitments to customers as well as keeping emissions to a minimum.

An investment in the right advanced technologies not only delivers a significant return on investment by reducing unplanned downtime, but also improves a company's ability to maintain safe operations and meet environmental goals.

As we have highlighted, unplanned downtime and transient conditions lead to flaring, which means product is released into the atmosphere. This is an area where predictive analytics can have a major impact. It seems clear that a large proportion of emissions caused by gas flaring could be avoided by eliminating unplanned shutdowns.

What if we could see a pending problem on a piece of mining equipment before it starts degrading or be alerted to a failure on an offshore oil platform before it became serious? All this is possible and allows unplanned downtime to be turned into planned downtime.

This technology can also be integrated with planning models that will provide recommendations and advice on what actions to take to maintain greenhouse gas emission limits and quotas.

Beyond the sustainability implications, companies also stand to gain financially as a result of the increased production that comes with more uptime. Those that have optimised their maintenance processes to reduce unplanned shutdowns have realised incredible payback on their investment in predictive analytics technology.

For example, one refinery suffering from repeated hydrogen compressor failures was able to reduce shut-down time by 8 days due to a 35-day time-to-failure prediction. In addition, the cost for planned maintenance was less than 30% of the cost of emergency repairs. Other oil and gas companies using predictive maintenance solutions have similar stories.

Unplanned shutdowns cost oil and gas companies significant sums every year. One source estimates that equipment failures causing unplanned downtime cost oil and gas companies an average of US$42 million a year and up to US$88 million a year in the worst case scenarios. The US Department of Energy reported 1,700 shutdowns at refineries between 2006 and 2017; 46% were due to mechanical breakdown.

Just eliminating a portion of the abnormal events that rob an operation of productivity can add millions of dollars to the bottom line. And when companies are able to quantify exactly how much any particular event affects revenue, they know exactly where to target their technology strategy for maximum impact.

The companies that implement this technology first can put themselves at a distinct competitive advantage, reaching new levels of profitability while also maintaining their "social licence to operate" with improved safety and sustainability performance. Many are already putting the solutions in place to help them avoid

the most dangerous conditions, reduce greenhouse gas emissions and maintain the most efficient operations.

As companies face growing pressures from shareholders, regulators and consumers alike, the need for agility may well be greater than ever but so too is the need for sustainability and environmental efficiency. By reducing risk and uncertainty through the implementation of the advanced technology solutions available today, companies can put themselves in the best position to win in the marketplace of tomorrow.

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