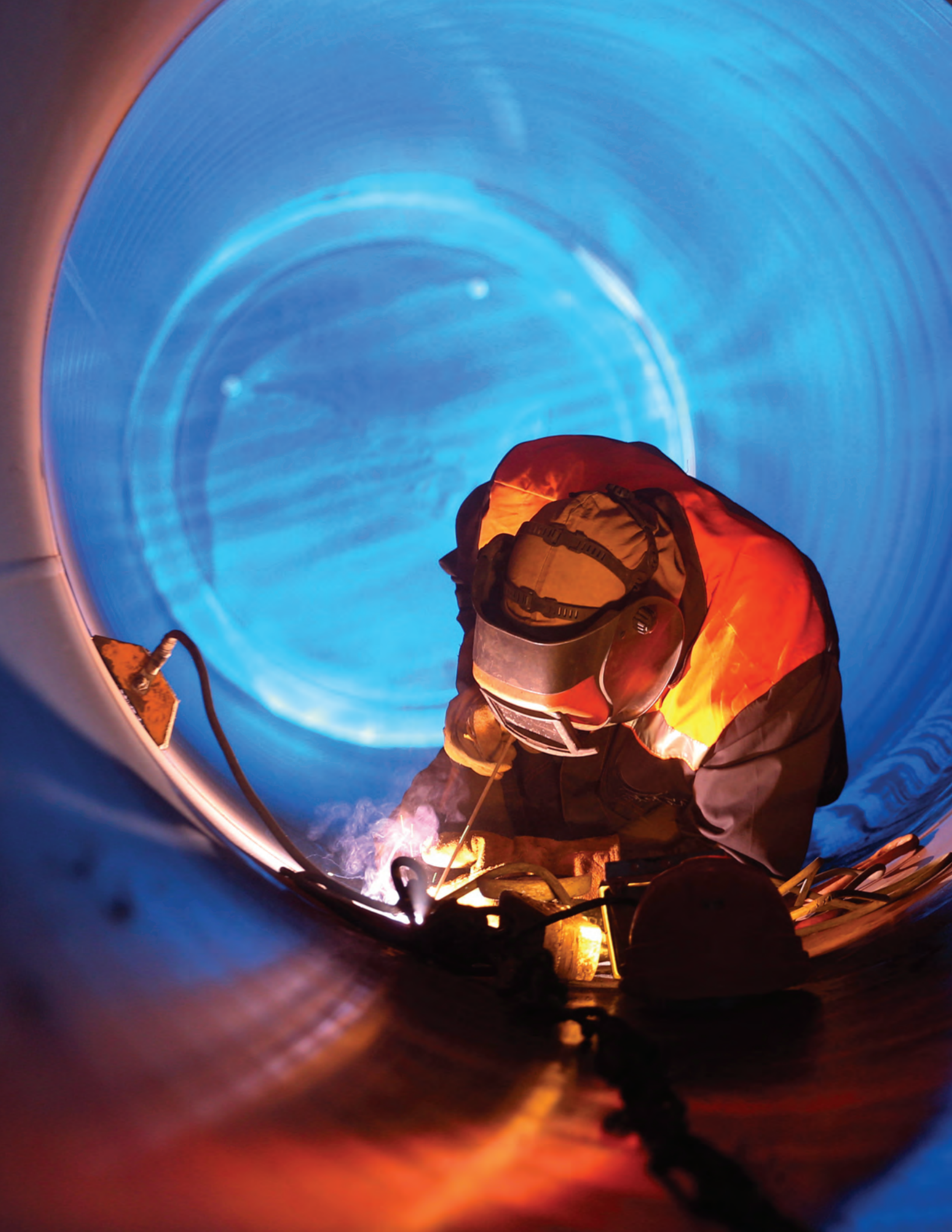
Deloitte.

Gaining ground in the sands 2015

Pipeline 2020



We need a radical technology transformation in pipelines. The good news is, there's one available.

At the edge

Has there ever been a more challenging time to be a pipeline operator in Canada?

Thrust increasingly into the public spotlight, their regulatory audits posted online and every development the subject of a steady stream of news headlines, oil and gas pipelines – Keystone XL, Northern Gateway and Energy East in particular – have become a prominent fixture in our national daily dialogue. Never before has the movement of oil and gas across North America been such a heated source of debate – between Canada and the U.S., between Canadian provinces, between Canadians themselves. Add to this attention and scrutiny the growing need for capital investment to extend the lifespan of existing, decades-old infrastructure and there's no denying it: the industry is at a crossroads.

But maybe the situation isn't so dire. Maybe it's an opportunity – challenging, but hardly end-times. Our view is this: we're at an inflection point that, if acted upon with diligence and imagination, will lead to new economic growth and improved operations.

True, in the wake of the steep and ongoing decline in commodity prices since June 2014, the sector is down – but it is not out. Shale gas development, despite being implicated in the price slump, is triggering unprecedented capital expenditure; some say it will redraw the map of North American energy transport.

At the same time, disruptive technologies are ushering in a new era of sensors, intelligent machines and analytics software that hold forth a tantalizing promise – the ability to diagnose problems before they happen.

But the stakes have never been higher for pipeline companies – nor certainly for oil sands producers, whose vulnerability to the fraught dynamics of infrastructure development in this country is arguably most pronounced of all. Meanwhile, the magnitude and seriousness of operational risk in the oil sands cannot be overstated, such that every decision has, and will continue to have, untold ramifications. In order to compete and thrive, then, leading pipeline companies will need to make operational risk management an imperative. More than that, they'll also have to harness data-driven technologies to build stakeholder acceptance, gain efficiencies and outperform not just their competitors but their own past performance.

It might be a tall order for some but, in many ways, they can't afford not to do it.

Four moves leading pipeline companies will make

Seizing the advantages of "big data," smart connectivity and new sensor technologies will become an important differentiator for leading pipeline companies in the future. But it won't be enough. Tomorrow's successful innovators will carve out a competitive edge by harnessing predictive analytics, enabling real time decision-making in the field and building centralized systems of command and control.

They will also, however, have to start soon, if not today.

Just imagine: the pipeline field worker of the future approaches a compressor station, the heads-up display (HUD) on his smart helmet overlaying an image of the station and pinpointing the malfunctioning generator. The worker then calls up the generator's service manual and specific maintenance records for reference on the smart helmet's HUD. After the repair is complete, a quick visual inspection of the compressor station is made. Meanwhile, the smart helmet "reads" an analogue gauge – one of the few yet to be digitized – and immediately transmits the reading to a centralized "nerve center" where a team of operational and data specialists track everything in real time.

While scenarios like this are not yet widespread in the oil patch, they are becoming the next decade's new imperative. There is, in fact, no question: technology has always been a core driver of operational excellence in the oil sands and in pipelines – from the first supervisory control and data acquisition (SCADA) systems to robotic pipeline inspection gauges (PIGs). However, the digitization of business information will force unprecedented changes in how pipeline companies reduce risk, detect leaks, reduce decision-making times and create value.

Consider sensors, the number and kind of which has only been expanding (see sidebar). Leak-detection is one use, while radio-frequency identification (RFID) tags are another, used in many industries to track parts. Airbus, for example, places 10,000 RFID tags on removable parts – seats, brakes, etc. – aboard each of its A380 jets.[1] Similarly, affixing RFID tags to each of the millions of components that comprise a pipeline could streamline and improve maintenance activities. If a part needs to be replaced, scanning it at a distance could provide exact information about the part type and its life-cycle expectancy.

Field sensors, in other words, are an extremely useful source of data – they just aren't the *only* source. By analyzing their own financial records, for instance, a company could identify a spike in the purchase of first aid supplies, indicating a possible cluster of health and safety incidents in a specific area of the pipeline. Public data, such as weather information reported by Environment Canada, can help characterize information – for example, rising air pressure or rapidly cooling temperatures may distort measurement of volume-in/volume-out. With this level of detail and insight, more accurate readings can be produced.

Insights, after all, gain value when data sets from different sources are brought together. Similarly, each of the four "moves" discussed below will enhance the others.

Sensory inception

The big advantage of digital information is that it can be copied and shared at near-zero cost, creating opportunities to integrate information from diverse sources and describe events in real time.

While much of the business information produced by pipeline companies remains locked in non-digital formats, a wave of emerging industrial digital sensors will change that. New types of sensors, many already in use, include:

Drones. Small, unmanned aircraft capable of carrying thermal imaging sensors over corridors to capture signs of leaks or decay. Drones are inexpensive and scalable as new imaging hardware is developed. However, Transport Canada heavily regulates commercial drones, requiring approval on a per-flight basis.

Acoustic SmartBall sensors. These softball-sized sensors pass through pipelines, recording audio of their collisions with the interior walls. The data can later be analyzed to identify acoustic variations that may indicate corrosion.

Fibre-optic sensors. Carrying a laser along the interior of a pipeline, fibre-optic cables detect vibrations and/or subtle temperature changes to indicate possible leaks.

Emission sensors. Leak detection can be improved by deploying an array of sensors along the length of a pipeline corridor. Acoustic sensors can identify variations in the pipeline's acoustic signature, while other sensors sniff for gas releases. In both cases, these sensors can provide an instant warning of a leak.

[1] "Extracting Value from the Massively Connected World of 2015." Retrieved Jan. 20, 2015 https://www.gartner.com/doc/476440/extracting-value-massively-connected-world

Move 1: Strive to be on real time

By deploying more sensors that collect richer information, leading companies will harness streams of data at their moment of creation. They will still collect data in batch form, just as they will continuously archive streaming data. But both forms of historical records will refine the meaning the organization obtains from real time streams of data.

By 2017, one out of every two new analytics projects will analyze data *as it is produced,* according to Gartner.[2] Clearly, the sooner one knows about an event the better, but the benefits of harnessing data in real time extend further. Consider these advantages:

Corroboration

In old movies, when a warning light came on in an airplane or ship, the character would tap it to see if the bulb was loose, hoping for a faulty connection instead of a legitimate problem. But if a cluster of 63 warning lights came on in an array of 10,000 – there would be no need to tap as each of the lights would correspond to a separate reading and, even if some were indeed faulty, patterns would nevertheless emerge. Similarly, leading companies will bring together data from multiple streams and historical archives to corroborate one another and statistically eliminate doubt.

Continuous calibration

Over time, we learn how to read the faces of people we know well – one person's grin means pleasure while another's means cold calculation. As industrial assets wear and tear, they can develop their own unique "expressions" that affect the quality of the information they gather. By carefully archiving each sensor's stream of data, leading companies will identify these unique signatures and correct for them.

Characterization

Failing to address small issues can cause them to snowball into big ones. Far beyond a simple control room's warning light, leading companies will characterize suspicious information, helping control room operators answer such questions as "How bad can this get?" and "How fast can it get that way?" These companies will also draw on external and internal data alike to produce value-at-risk estimates of the potential human and economic cost of a given scenario, helping them balance their priorities.

It's critical, in any event, to make sure you assess what you're doing – whether, that is, your systems and controls are sufficient, industry-leading and comprehensive. On these matters, you will find that third-party assurance is just as valuable as it is on financial reporting, a principle applicable to all subsequent moves, as well.

[2] "Gartner Predicts Business Intelligence and Analytics Will Remain Top Focus for CIOs Through 2017." Retrieved January 21, 2015 from http://www.gartner.com/newsroom/id/2637615

Move 2: Shift some critical thinking to machines and manage by prediction

The field of Artificial Intelligence is yielding tangible results in the area of machine learning. Such systems rely on a supervised learning process to recognize patterns and make predictions about the future. In 2011, a team at Stanford University used this approach to teach a computer to recognize cancerous tissue in medical images and from there predict a patient's chances of survival.[3] The approach required no true medical comprehension and instead zeroed-in only on correlation, much as a child who hasn't studied gravity can still learn that a ball thrown up will come back down – s/he doesn't have to understand the science in order to carry out the action.

Given the ever-accelerating speed of computer analysis, leading companies will apply machine learning to their streams of data to make real time predictions, such as when a component will fail. Leaning on the processing power of machines, operators will be armed to make better decisions to mitigate events and improve the efficiency of the organization.

Meanwhile, forward-looking companies will come to rely heavily on leading indicators.

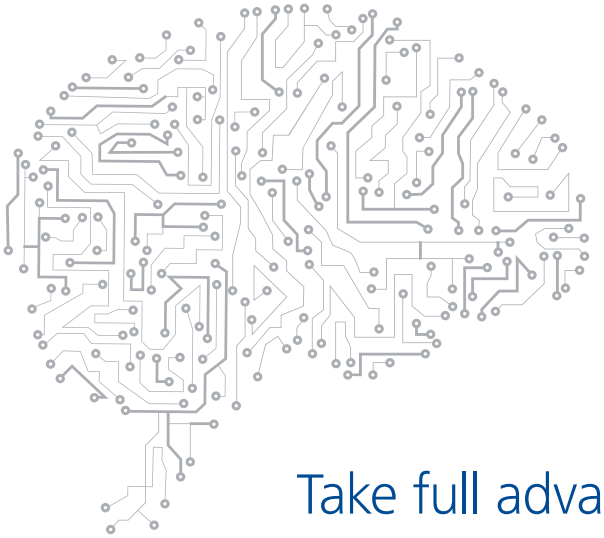
A lagging indicator is one that arrives after an event occurs, such as reportable-injuries-per-labour-hour. Leading indicators, however, correlate with future events, helping companies mitigate unwanted outcomes that are likely to occur. Near misses, for instance, are a form of leading indicator, particularly if they are well corroborated and characterized. Average-days-of-overdue-maintenance is another.

As their volume of archived data grows, leading companies will combine data mining and powerful predictive modelling techniques to predict future events. For example, Deloitte recently analyzed a mine's data across 620 metrics and found that accidents are more likely to occur to individuals who are highly tenured, in the first half of their shift, or who move a lot between zones of the mine.[4]

Predictive analytics are already producing some non-intuitive findings as well. One U.S. analysis found that people are more likely to answer the phone when the weather is snowy, cold or very humid.[5] Ultimately, as data sets grow and analytics engines gain more power, leading companies will use streams of data to predict future events – intuitive and non-intuitive alike – in real time.

The fact is, data analytics enables organizations to make connections, identify patterns, predict behaviour and personalize interactions in ways never before imagined. Many companies, however, invest millions in information management solutions only to inadvertently leave their true value untapped – implementing the system with an initial set of metrics, reports and dashboards but failing to sustain it with technical, functional and industry-specific capabilities. In other cases, they fail to implement the system across the entire enterprise, resulting in standalone projects, rising maintenance workloads and an inability to keep pace with system evolution and enhancement.

To avoid these pitfalls, leading companies will take full advantage of robust business intelligence solutions designed to turn data into a strategic corporate asset where not only will you have the data, you'll know what to do with it and what it means.



Take full advantage of robust business intelligence solutions

[3] "Stanford team trains computer to evaluate breast cancer." November 9, 2011. Retrieved Jan 21, 2015 from http://med.stanford.edu/news/all-news/2011/11/stanford-team-trains-computer-to-evaluate-breast-cancer.html

[4] "Workplace safety analytics. Save lives and the bottom line." Deloitte, 2013.

[5] "Big Data Uncovers Some Weird Correlations." *Wall Street Journal.* March 23, 2014. Retrieved Jan 21, 2015 from http://www.wsj.com/articles/SB10001424052702303369904579423132072969654

Move 3: Create absolute integration

Over the past four decades, SCADA systems have used standardized protocols to integrate more and more operational systems. However, while hardware and software have increasingly come together, most businesses still continue to operate as a sum-of-parts where business-wide initiatives are "add-on."

It's not enough, of course, simply to invest in the technology – although, given that many systems haven't changed much since the 1950s, new technology investment is very much the first next step. If you can't be 100% certain you will never have a leak, you must be able to detect the leaks you have as quickly as possible – which is to say, more quickly than today's standard. A more reliable leak detection system will come when either the risk itself or its consequences are reduced.

That begins with new technology but must be followed up with dedicated expertise and controls to ensure that full value is being realized.

Leading pipeline companies will therefore take advantage of the integrative nature of data technologies to drive business integration and create what we call nerve centres. Companies will shift toward a management system that seamlessly integrates information, processes and change-management – and extends from finance to capital projects to operations.

This shift goes beyond a next-generation SCADA system. Rather, it will amount to a fundamental change in the quantity, quality and character of decision-making in energy transport. The end result will be pipeline networks that function more as self-aware organisms, capable of integrating billions of concrete facts each instant to make decisions that mitigate risk and improve operational excellence.

Move 4: Visualize insights by audience

The role of operators will shift from investigating alarms to validating theories and navigating through defined next actions

Once pipeline companies learn how to analyze streams of data each nanosecond by machine learning algorithms, they will still have to communicate the ensuing insights in ways that are useful to decision-makers. By all accounts, the current flood of information already frustrates operators' ability to do their jobs. A 2005 study by the U.S. National Transportation Safety Board showed that pipeline operators feel overwhelmed by the deluge of information, including screen clutter, poor colour usage and nuisance alarms.[6] While alert operators struggle with poor usability, this kind of environment can drive increased fatigue, leading to reduced concentration and judgment. In fact, the study cites poor usability in the human-machine interface (HMI) as a cause in several U.S. pipeline incidents.

Today, Procter & Gamble is a leader in the use of information visualization within the organization. Through their "Decision Cockpit," P&G uses heat maps and other design approaches to draw prompt attention to the insights derived from the data.[7] Leading midstream companies will harness similar approaches to information visualization that improve the HMI. From clean, high-level views, operators will tap interactive screens to drill into root causes and ever increasing levels of detail. Their role will shift from investigating alarms to validating theories presented by the machine learning systems and navigating through defined next actions. When field work is required, they will send instructions instantly to a worker's mobile or wearable device.

Critical applications will include corrosion monitoring and leak and dispersion modeling. If you can predict where the oil will flow in the event of a leak, you can devise more effective response and contingency plans to minimize the potential consequences.

Ultimately, the possibilities in information visualization are endless.

[6] National Transportation Safety Board. *Supervisory Control and Data Acquisition in Liquid Pipelines, 2005.*

[7] "How P&G Presents Data to Decision-Makers." April 4, 2013. Retrieved Jan 21, 2015 from https://hbr.org/2013/04/how-p-and-g-presents-data/

Will "Pipeline 2020" bespeak a brave new world or just a new one?

First steps next

The data-driven pipeline offers tremendous promise. However, while many industrial sectors of the economy have embedded analytics as a core decision-making tool, midstream oil and gas companies have lagged.

Analytics works well with robust historical data. Digitizing a midstream company's records could take years – or longer. The companies that begin the shift now will have a powerful advantage. To kick-start their journey, we consider two actions midstream companies can pursue immediately.

A use case

It can take time for companies to truly understand the broad power of data analytics, and experience is the best teacher. We recommend that companies with limited data analytics experience begin with a single, strong use case – such as a capital planning exercise. Shifting from spreadsheets to analytics-driven planning will teach an organization how to bring data sets together and discover the power of interactive visualizations and analytics.

Asset rationalization

Sector-wide reductions in capital and operating budgets create ideal conditions for asset investment planning (AIP), which helps identify expenditures that can be reduced or eliminated without impacting operations. AIP provides a rigorous process for quantifying the risk and value impact of capital and operating expenditures in order to help management optimize investments. Identifying these items is difficult, as the budget process, while very detailed, is often inconsistent and lacking a solid factual base. For many companies, especially those whose operating budgets contain high-cost/low-value items, AIP can unlock millions of dollars for higher value investment.

But the big question is this: will "Pipeline 2020" bespeak a brave new world or just a new one? As always, that'll be up to us. In any event, organizations that plan now will more fully benefit once the shift toward the data-driven pipeline becomes a true competitive imperative.

Because, trust us, it will.

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