

The New Resolve:

Digital's Imperative for Canadian Oil and Gas



Foreword

The current global crisis has lain down the gauntlet for Canadian oil & gas. A window of opportunity is open for the industry to strengthen balance sheets and prepare their organizations for future demand growth. For the oil patch, that means focusing on operations excellence and becoming more resilient against future disruptions.

This study aims to help IT executives, by providing use cases, examples, and advice from industry leaders who are reaping significant benefits from their digital transformation efforts. Our goal is to assist organizations in acting on the digital imperative for Canadian oil & gas.

The IT Media Group (ITMG) undertook this project with sponsorship from Salesforce Canada. It is a comprehensive update to our December 2018 strategic insights report, *Digital's Role in Reshaping Canadian Oil and Gas*. In this new report, we substantiated that there have been significant changes in attitudes towards digital technologies, and the pace of adoption has increased dramatically.

This report contributes to ITMG's mission of supporting and adding value to the IT executive community in Canada. It is our goal to provide a wide range of opportunities for direct engagement between IT vendors and industry executives, enabling them to share knowledge and opinions, provide thought leadership, build relationships, and engage in a dialogue of benefit to both parties.

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Executive Summary

Until a few years ago, the Canadian oil & gas industry enjoyed more than 100 years of relatively steady progress. A business built on a model that expected demand to increase in lockstep with global population growth was upset when worldwide production outstripped demand and environmental concerns delayed much-needed midstream infrastructure. Most recently, the global crisis has led to a catastrophic drop in prices. An industry that was already preparing for slower economic growth and rising trade tensions is suddenly finding itself in a fight for survival.

Canadian companies cannot afford to simply curtail production and slash capital spending and hope to exit the crisis healthy and competitive. The current circumstances open a window of opportunity for CIOs in the oil patch to continue advancing their digital transformation agendas to keep balance sheets healthy. By investing in digitization, oil & gas will be able to improve operational excellence and be more resilient against future disruptions.

Methodology

The IT Media Group used its extensive experience with the Canadian IT executive community in the preparation of this document. Our research included analysis of ITMG's content repository and examination of every segment of the oil & gas industry. We determined the top business priorities for Canadian companies and focused on how they are using digital technologies to address them. We also provide insights and comments for realizing the benefits of digitization from interviews with oil & gas IT executives.

Scope

This study provides CIOs with examples of how their businesses can emerge stronger and more durable once the economy recovers. We explore use cases for how companies realize wins in these uncertain times.

The narrative for this report takes the reader on a digital transformation journey that mirrors the oil & gas value chain. We transpose terminology from upstream, midstream, and downstream segments so that domain experts can internalize the approaches described herein. Each step of the voyage is actionable by any part of the industry.

Key findings

Our research revealed that the adoption of digital transformation in Canada is gaining momentum. All segments are embracing digitization to improve reliability, production, operations, maintenance activities, and customer engagement. An industry that once had a reputation for lagging others is quickly leapfrogging older technologies and moving directly to modern digital solutions.

We documented more than 20 examples that describe how digital technologies are addressing Canadian business priorities. These examples provide support for 15 digital transformation approaches that CIOs are using to accelerate adoption within their organizations. These findings help make a case for continued and focused digital transformation in oil & gas.

While digital transformation delivers significant benefits, cybersecurity considerations loom over the enterprise. Businesses need to acknowledge that this is no different than other industries that have already been successful in digitization. Oil & gas CIOs can take advantage of dozens of mature cybersecurity offerings to protect their data and systems from malicious actors.

Advice for CIOs

The advancements in digital technologies are helping companies address their top priorities and challenges in the current economy. Successful CIOs will focus on business outcomes and assist their business peers in visualizing the digital paths that lead to success.

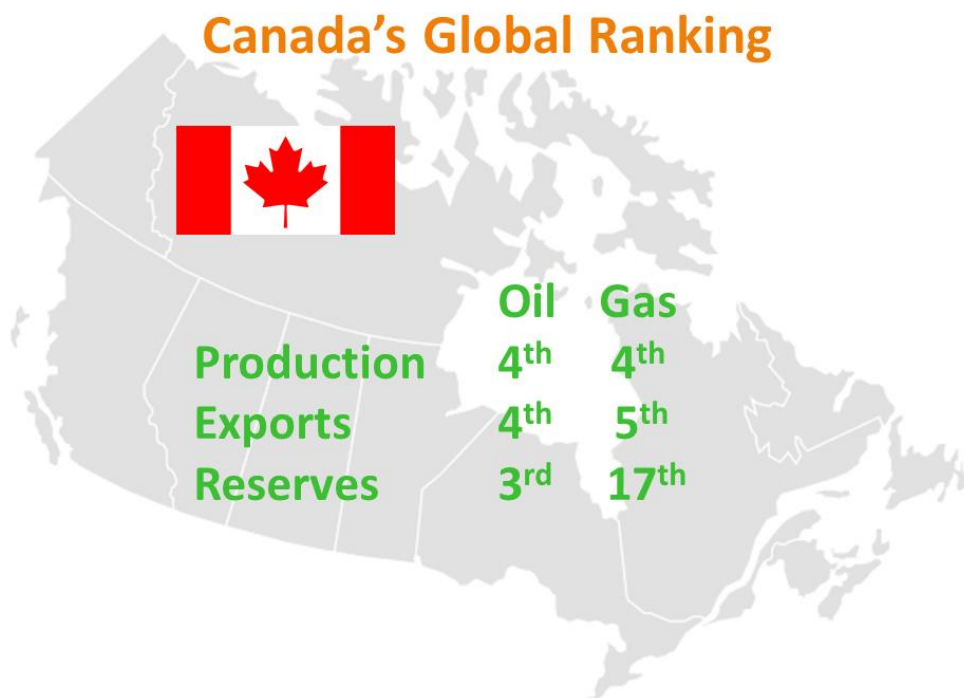
We encourage CIOs to explore the use cases described in this study. To aid in this effort, we have included a digital roadmap that summarizes the approaches that Canadian oil & gas companies are using to realize value from their investments in technology. The roadmap provides a logical sequence for transformation in the industry to help augment existing digital strategies.

This study has endeavoured to offer practical advice for CIOs to help them satisfy current business priorities, while also keeping an eye to longer-term transformational objectives. It is our goal to promote conversations and spur action between employees, business units, and service providers to address the digital imperative for Canadian oil & gas.

Introduction: The digital imperative for oil & gas

Canada has a long history of being a pioneer, starting when Canadian geologist Abraham Pineo Gesner^[1] refined a liquid from coal, oil shale, and bitumen that was cheaper and burned more cleanly than other oils. He dubbed this liquid 'kerosene' and founded the Kerosene Gaslight Company in 1850, using the oil to light the streets of Halifax and later the US.

The ensuing 100 years witnessed the creation of major oil companies as the global economy became dependent on fossil fuels for transportation and production. The industry has experienced a long heyday since its inception, with Canada playing an important role throughout.



- Oil^[2]: Canada is the fourth-largest producer, has the world's third-largest proven reserves (96% found in the oil sands) and is the fourth-largest crude oil exporter.
- Gas^[3]: Canada is the fourth-largest producer, has the 17th largest reserves and is the fifth-largest exporter.

Canadian oil & gas companies are poised to be critical players in both the domestic and global economies as demand for hydrocarbons increases gradually over the next 20 years. That participation, of course, depends on whether companies can survive the current crisis. When it subsides, the spectre of 'lower-for-longer' will continue to loom over the industry for the foreseeable future. Every sector must find new ways to improve margins and change business models to be competitive once the economy establishes a new normal.

The role of digital

The Internet era that began in the 1990s enabled businesses to achieve vast productivity and efficiency gains, while also accelerating the creation of new business models. What is known as the Third Industrial Revolution, ushered in the Internet of Things (IoT), characterized by the widespread use of technology to interconnect people, processes, and devices. Today, the resulting accumulation of data that IoT created has already given rise to the Fourth Industrial Revolution: The revolution of analytics and artificial intelligence.

The oil & gas industry has a strong history of technology and process innovation; however, it has been relatively slow to adopt widespread digitization. In our view, the lag is partly the result of a risk-averse culture coupled with a historical business environment where demand and revenues would seemingly increase forever. Even though the industry was already preparing for slower economic growth and rising trade tensions, the recent crisis has quashed those plans and increased the urgency to maintain healthy financials.

Companies must anticipate that the good times may never come back to quite the way they were before. That means corporations must focus on operational excellence to keep balance sheets healthy and look for new ways of doing business to keep revenues flowing in – and the path to achieving those goals is digital technology. Experts^[4] concur that digitization is vital because there is a documented role of technology in lowering break-evens during a downturn. The good news is our research shows that oil & gas is turning the corner on digital transformation. The industry is increasingly becoming digitized and, consequently, reaping significant benefits.

For this study, we analyzed corporate objectives by industry sector and how digital transformation is helping to achieve them. We provide examples that emphasize why oil & gas companies across the value chain should stay invested in harnessing the capabilities of digital technologies to address business priorities.

Upstream: Focus on operational excellence

Deloitte Insights^[5] reported that upstream oil & gas companies did not see their fortunes improve despite a recovery in oil prices in 2019. This finding substantiates that underlying problems in the sector are more than cyclical and reiterates the importance of high-grading portfolios across cycles.

In the current climate, upstream companies that prioritize digital technology to improve operational excellence will have a higher probability of delivering profitable growth once worldwide demand begins to increase again.

Services: Leverage innovation and be determined

There are many challenges for Service companies due to declining wells, production curtailment, and cancelled capital projects. What has been good for producer bottom lines has spelled doom for the sector.^[6] Service companies need to find the right mix of innovation and determination to enhance the value of their offerings.

This sector will have increased opportunities because producers are focused on reducing costs and improving productivity. Keys to success include optimized field worker management and the development of enhanced well designs through the use of digital technology.

Midstream: Differentiate the business

Pipeline constraints due to midstream bottlenecks have increased transportation costs, increasing the discount rate applied to producers. These challenges not only limit producers from accessing key export markets, but they also result in a dichotomy where Western Canada exports oil while Eastern Canada imports it.

While geopolitical issues cause many of these problems, midstream companies can differentiate themselves by delivering extra value to their clients by leveraging digital solutions. Some examples include running advanced autotuning algorithms on diverse data sets, turning idle asset time into opportunity, and understanding the financial consequence of day-to-day business decisions.^[7]

Downstream: Concentrate on future growth

Refineries have been the biggest beneficiary of the lower-for-longer oil price environment. According to Deloitte^[8], operating margins grew because of oversupply, high price differentials between crude grades, and higher-than-expected growth in petroleum products demand.

The growth of petrochemical demand paints a positive future for downstream players. Petrochemicals represent 1/3 of world oil demand growth between now and 2030 and nearly half by 2050.^[9] Apart from regular usage in everyday products, the use of petrochemicals to manufacture many parts of the modern 'green' energy system is increasing.

Still, there are significant opportunities to improve margins in this sector. Downstream companies can employ digital technologies to enhance the retention of their customers and create virtual models of production facilities to reduce construction and maintenance costs.

Succeeding in a crisis

The industry was already preparing for a lower-for-longer price environment, which would see oil remain below US\$80/bbl for the foreseeable future.^[9] The current crisis has made the situation much worse. For oil & gas, this means less capital and liquidity for significant investments. To compound the problem, behavioural changes during the coronavirus outbreak could accelerate the peak demand trajectory. This trend will require the industry to adapt its core businesses even sooner. As reported by the Financial Times^[10], most oil companies believe that broader adoption of electric vehicles or stricter emissions regulations could see demand peak as soon as 2030.

What could bring back a sense of balance to the oil & gas ecosystem? How can the industry emerge stronger and more durable once the economy recovers? And more importantly, how can companies succeed in these uncertain times?

Unfortunately, there are no easy answers. These questions are a challenge for even the best companies in the industry. After review of the most recent company reports from players in every sector, we have determined that the following business priorities are being set by Canadian oil & gas to weather the storm:

- Keep the balance sheet healthy enough to succeed once the crisis is over
- Focus on operational excellence to reduce costs and increase productivity
- Be better prepared for future disruptions

Our research has found that Canadian oil & gas is moving the dial on all three of these areas by leveraging digital technologies. We identified use cases that have resulted in tangible benefits, with broader organizational adoption promising more results. These benefits extend to all sectors of the industry and include:

- Reliability improvement
- Production optimization
- Facilities operations effectiveness
- Maintenance efficiency
- Worker efficiency
- Project execution excellence
- Supply chain optimization
- Safety, security, health, and environment excellence
- Management and controls effectiveness

According to Meade H. Lewis^[11], CEO of a technology provider for pipeline systems, “The future of oil and gas is to be digitally native and cloud-connected and to embrace a relentless quest for ways to improve operational efficiency across the entire lifecycle.” This requires that organizations proactively look at new technologies while organizing and extracting value from their data. Meade adds, “It means learning to accept proof-of-concept failures as necessary steps along the journey to a digital-first future.”

“Overall, when we look at digital, we think there is a greater than \$500 million per year value opportunity here.”

John Whelan, SVP Upstream, Imperial

Mead’s words provide authoritative advice for an industry that has typically avoided risks and has waited for proven technology solutions before implementing them. That attitude is changing as companies accept that the benefits of going digital more than offset the risks. As John Whelan^[21], SVP Upstream at Imperial, states, “Overall, when we look at digital, we think there is a greater than \$500 million per year value opportunity here.”

Experience with companies outside of oil & gas shows a path to winning in a disrupted global economy. The organizations that were already highly digital were more easily able to pivot their businesses and adjust to new normals. For oil & gas, the current crisis presents an opportunity to leapfrog generations of older technologies and embrace digital transformation to deliver a broad impact to the bottom line.

The digital journey

This study aims to provide IT executives with insights that will help them navigate the challenges that their businesses face. We describe how the industry is using digital transformation to improve outcomes and deliver substantial results.

As a long-time content and event producer in the Canadian technology sector, The IT Media Group (ITMG) has captured a wealth of insights on the impacts of digital transformation. This study taps into that storehouse of knowledge gathered from nine years of hosting private roundtables and workshops with technology executives across

Canada. To supplement that, we completed both global and Canada specific industry research and interviewed select oil & gas technology leaders for their insights on this topic.



This study takes the reader on a digital journey across the value chain. We have transposed industry terminology to make this journey more relevant for oil & gas domain experts. We focus on use cases that are playing a role in strengthening and reshaping the industry. We conclude by tying together the key concepts into a digital implementation roadmap that can augment an organization's digital transformation strategy.

The digital upstream: Preparing for transformation

The start of the oil & gas value chain begins in upstream, where exploration finds sources of raw hydrocarbons, service companies augment the process, and production extracts them. Digital transformation is similar; organizations must understand business needs, explore available solutions, develop a strategy, engage partners, and then build the infrastructure to capture and store raw-data elements.

For the industry to remain competitive, it must wholly embrace and fully utilize digital innovation and its applications. Andy Beck^[11], former Director for the US Department of Energy, stated, "For too many companies, digitization has been relegated to a "nice to have" function, implemented in a piecemeal way with off-the-shelf systems. As a result, the technology has been installed on a siloed basis, limiting its full value."

Exploration: Innovation finds new sources of wealth

Exploration is an excellent place to begin revitalizing a company's digital journey. It uncovers the ideas that an organization will assess to determine if they are worthwhile to develop. We've spoken with dozens of IT executives about innovation and discovered that the reason why it is a challenge is that it requires the workforce to evolve from a model that focusses on performing repeatable tasks, to one that embraces continuous change.

Like drilling for oil, some ideas will pan out, while others will not. To get started, CIOs need to change their company's culture. Once people can relate to change, innovation becomes less theoretical and more practical. This transition can be difficult for the typically risk-averse oil & gas industry. The workforce must learn how to deal with failure, and leadership needs to accept that some setbacks will inevitably occur.

CIOs who have implemented successful innovation programs offer the following advice:

- If you are going to fail, make sure that you fail fast and fail small.
- Very quickly weed out ideas before incurring a lot of time and expense.
- It is cheaper to do some things quickly rather than to analyze them. Take the learnings and then launch a more successful pilot.

This advice often means that the notion of risk needs to change within the organization. One way to get past this obstacle is to ask yourself, 'what's the worst thing that can happen? If it doesn't impact safety and reliability, why not try it?' As identified at a recent ITMG CIO workshop, companies with a steady improvement culture implement ~80% of their employees' improvement ideas. Culture is the foundation that builds success.

Focus on business outcomes

An organization often requires a dedicated digital or innovation team to complete the exploration phase. CIOs need to take a business-focused interactive approach to improve operations, products, and services based on feedback from end-users and customers. One such method is Husky's Innovation Gateway Program^[20], which proactively identifies, evaluates, and adopts new and emerging technologies to improve safety, environment and operational process efficiencies and to reduce costs.

"There is a belief that we need to know if an idea is a good idea before we spend any time on it. We won't know if an idea is good or bad until we spend some time exploring it."

Chris Foster, CIO, TC Energy

The key to successful innovation is to stay focused on business outcomes. Chris Foster^[17], CIO of TC Energy, emphasized this approach, "There's this kind of meshing now. We're blurring the lines between IS and the business." Chris advises that the innovation team needs to become a partner, not an order taker, and be able to connect with the results produced for the business. He adds, "There is a belief that we need to know if an idea is a good idea before we spend any time on it. We won't know if an idea is good or bad until we spend some time exploring it. So, we encourage our people to spend hours on lots of ideas, days on great ideas, and weeks to deliver wins."

To obtain another perspective, we consulted with a leader in the use of digital technology in the Canadian oil patch. Precision Drilling has won multiple awards and was recently named the 2020 Energy Excellence Awards "Innovation & Technology Excellence" champion. Shuja Goraya, CTO of Precision, explains, "Implementation of technology is not going to do anything unless you change the company workflows. Technology implementation and workflows must go hand in hand, which is all driven by business goals. Start with a workflow that technology will enable, and you must be ready to change that workflow; otherwise, the value creation will be small."

These are sage words of advice for the industry. Structured innovation is a tactic that leverages the industry's exploratory spirit and turns that into strategic transformation roadmaps for using digital technologies to meet business needs.

Services: Partnering for success

Oilfield service companies play a critical role in the upstream segment by offering a wide range of products and services that are vital for successful field operations. Likewise, technology vendors provide products and services to assist with digital transformation. Oil & gas companies possess significant domain expertise, and by partnering with technology companies and associations, they can achieve a fast-tracked path to results.

Technology providers accelerate results

Evidence of this trend has become apparent recently as Suncor^[13] and Cenovus^[22] announced strategic partnerships with major technology providers to help accelerate the pace of digital transformation. One benefit of these relationships is to access the provider ecosystem of solutions and to gain real-world lessons from global peers.

Suncor is embarking on a journey to transform the energy industry by creating new business value for their customers, empowering their workforce, and innovating for the future. Collaborating on innovation will include third party resources embedded at the core of innovation teams, working together to explore a wide range of business capabilities. Mark Little^[13], Suncor president and CEO, explains, "This is an example of how we are driving to improve our business in ways that were not possible before – to make our people safer, increase reliability and productivity, reduce costs and improve sustainability."

Associations provide industry collaboration

While technology providers can often bring a multi-industry viewpoint to the table, Canadian companies can also tap into oil & gas aligned associations to help address industry-specific business problems. In Canada, these include:

- [Clean Resource Innovation Network](#) (CRIN): An industry-led network that leverages strengths in a large-scale industrial collaboration by aligning research and technology priorities, addressing gaps, and incenting innovation.
- [Petroleum Technology Alliance Canada](#) (PTAC): An association that serves as a facilitator of collaborative R&D and technology development and operates in partnership with industry stakeholders to help Canada become a global hydrocarbon energy technology leader.
- [Canada's Oil Sands Innovation Alliance](#) (COSIA): An association whose objective is to generate sustainable growth of Canada's Oil Sands through collaborative action and innovation.

Heather Wilcott^[26], Upstream Digital Manager at Imperial weighed in on this topic, "I believe networks like CRIN, PTAC and COSIA are enablers of this collaboration and networking, helping to connect industry peers with common challenges with each other and with innovative solution providers that are rapidly developing technology solutions." Wilcott added, "Imperial's digital initiatives are focused on solving business problems and adding value in the areas of production optimization, maintenance and reliability improvements, worker productivity and time on tools, and safety."

Production: Extracting the raw digital assets

The goal of the upstream segment is to produce fossil fuels for consumption at the end of the value chain. The production of crude oil and natural gas creates the assets upon which the entire industry relies. Analogous to hydrocarbon production, digitization relies on an infrastructure for the production of data, the most valuable commodity required for successful digital transformation.

Most companies have endless amounts of information available to them, but this data is only as valuable as its utility. If a company does not have the resources and mindset to use that data effectively, then it risks being overtaken by a competitor, or worse, not able to survive in a downturn.

Cloud provides the infrastructure to store and process data

Before a producer can extract crude from the ground, they must build an infrastructure of wells and mines. Similarly, for digital transformation, the first part of data extraction starts with the cloud.

The case for the cloud already exists in the Canadian oil patch. Many companies have a basic cloud strategy to modernize their businesses, and some are already evolving to integrate multiple cloud providers into the mix. The reasons for this trend are clear: cloud computing offers highly scalable, variable-cost storage and processing on demand. Additionally, once the infrastructure is available, businesses can tap into the cloud to analyze data and run software applications not available in their legacy systems.

Cloud computing provides the foundation for agility that companies use to innovate in difficult times. In the past, it could take several weeks to get new compute capacity. This delay impeded trying new things and being agile. The transition to an on-demand service model allows the movement of people to more valuable work instead of the

waterfall method of provisioning compute and storage. Once implemented, the unit price of cloud-based resources approaches zero, resulting in corresponding IT cost savings for the enterprise.

“Our innovation journey is a success because we have transformed from an infrastructure-intense world to value-driven technologies that support our future.”
Tamara Rego, Director – Digital Transformation Office, TC Energy

In TC Energy's article *Gearing up for digital disruption*^[16], Tamara Rego, Director, Digital Transformation Office stated, “We are leading the way for cloud adoption in our industry because of the talented people in our organization who were able to shift their capabilities to learn new skills and embrace change.” Tamara added, “Our innovation journey is a success because we have transformed from an infrastructure-intense world to value-driven technologies that support our future.”

This sentiment is reinforced by Chris Foster^[17], CIO, TC Energy, while describing the flexibility and benefits that come with cloud adoption. Chris stated, “If you want more computing power than you've ever had before ... give me an hour, and we'll have it for you, then if on Monday you change your mind and you decide that that idea you had wasn't so great after all, that's fine. I'll just turn it off for you. In the old days, if you phoned me on Monday and said it was a bad idea, I'd say, Well, that's great, but I already bought the server, and you're living with it for five years.”

Data is the raw asset of digital transformation

If the cloud is analogous to rigs and facilities for production, then data is the crude oil that derives the real benefits of digitalization. Oil & gas companies must turn their data assets into business value. For CIOs, that means identifying what the organization needs to know and locating the source of answers.

“Whatever you want to do with digital, you have to start with data.”
Shuja Goraya, CTO, Precision Drilling

Shuja Goraya explained, “Coming from a world that is very hardware-oriented, every single machine is a self-contained unit. When you switch to a digital world, you tend to go to a widget mindset, where you think digital is a widget. In reality, whatever you want to do with digital, you have to start with data. You must make that run; otherwise, nothing else seems to work. With the right data and the right processing equipment, everything seems to click much faster.”

Other parts of the industry share that sentiment. Craig Walker^[30], Global CIO Shell Downstream, stated, “If I have more data than you and that data is of value, and I know how to use that data to create knowledge, to create information... I have an advantage over you.”

Having access to the right data and storing it in the cloud is half the battle of digital transformation. It lays the groundwork for even more value generation after data is transported, refined, and analyzed to produce business results in later steps of the digital transformation journey.

The digital midstream: Managing data

The next step in the transformation voyage takes us through the digital midstream. Like its oil & gas counterpart, we use the midstream to collect, transport, and connect raw data with downstream services that will refine that data for eventual consumption by business processes.

Collaborative technology platforms that provide real-time communications and tracking capabilities make up the digital midstream. The segment connects workers, assets, and equipment to improve operational excellence and enable new processes.

Collection: Gathering data

As we described previously, the Internet of Things (IoT) characterizes the Third Industrial Revolution. It allows the interconnection of devices, machines, objects, and people over a network. Estimates indicate that there are now 31 billion IoT devices in the world, with 127 new devices being connected to the web every second.

IoT has spurred the deployment of low cost, low power, smart sensors throughout the enterprise, which has enabled remote monitoring instead of people physically watching equipment. Implementations require the integration of data between IT systems such as IoT sensors and Edge processors with OT systems such as SCADA and EAM to gain access to process and event information. For example, Husky^[20] is using fibre-optic cable, drone, and satellite technologies to assist with the early detection of potential pipeline leaks, thereby improving reliability and reducing costs in its midstream business.

Using IoT to improve production at remote facilities

This concept seems relatively straightforward in principle, but what happens when there are large patches of under-serviced wilderness where production facilities, wells, and pipelines reside? To answer that question, we asked Anthony Zerr, Director, Industry Solutions at CCL Networks, for some advice.

Anthony offered two options for doing this wirelessly. The first, build a Wi-Fi network mesh repeated across access points. The second option is to deploy specialized SIM cards connected to SCADA systems and piggy-back on existing LTE networks. To understand how this approach benefited a producer, Anthony explained that sand intrusion from oil and gas reservoirs had a detrimental impact on production. Pipelines carried the sand to nearby production facilities, which only had minutes to react. The additional challenge was that there was no network where these pipes run.

The solution was to build an outdoor Wi-Fi mesh across more than 1,000 acres of industrial production natural gas wells. Then, using IoT microphone sensors with some built-in analytics, a real-time signal was sent to production facilities after detecting a specific frequency. As a result, plant operators were able to prepare for the approaching sand before it impacted production.

Transportation and Logistics: Connecting the enterprise

A large part of the midstream segment is responsible for connecting upstream producers with downstream operations. The sector provides transport and logistics capabilities to get oil & gas to refineries in a cost-effective manner. Similarly, the digital midstream connects workers and devices while providing the tools necessary to make them safer and more efficient.

Autonomous vehicles reduce costs and improve safety

Perhaps one of the fastest-growing areas of digital transformation is the emergence of autonomous vehicles. These include trucks and equipment that can sense their environment and operate with little to no human involvement. Autonomous vehicle solutions are made possible by leveraging digital technologies that include sensors, actuators, complex algorithms, machine learning systems, and mobile networks.

Suncor^[14] is forging ahead with this technology. The company has validated that automated haulage systems (AHS) can be used safely, effectively, and efficiently in its operating environment. Evaluations have shown that the technology offers many advantages over existing truck and shovel operations, including enhanced safety performance, better operating efficiency, and lower operating costs.

“Safety is our number one value. Autonomous haulage systems reduce interaction between people and equipment, which decreases incident rates and injury potential”

Mark Little, CEO, Suncor

Mark Little^[14], Suncor CEO, explained that autonomous trucks operate predictably and employ a suite of safety features like prescribed route mapping and obstacle detection systems. He added, “Safety is our number one value. Autonomous haulage systems reduce interaction between people and equipment, which decreases incident rates and injury potential, helping us ensure everyone goes home safely at the end of every day.”

Full automation doesn't have to be the goal. Teck Resources^[25] has deployed remotely controlled dozer and backhoes to access areas that would be hazardous for onboard operators. An operator drives the vehicles using a joystick system. The operator can see what the dozer sees via cameras. Sensors provide real-time feedback, like the grade the machines are operating on, and will automatically stop if it senses the grade is becoming too steep. This approach makes operations safer and more productive.

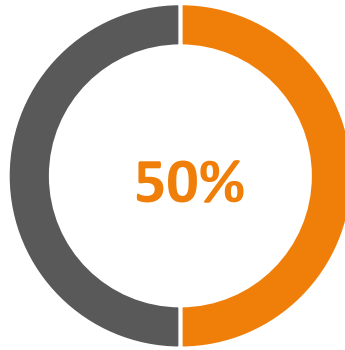
The connected worker improves efficiencies

For all segments of the industry, there are opportunities to leverage mobile technology to connect workers with back-end systems to improve productivity and reduce costs. Companies use connected worker solutions to improve transportation, logistics, maintenance, repair, and construction processes in the field. Since processes become automated and digital, these solutions also support mandates for remote work and distancing.

To understand how this benefits oil & gas, we spoke with Mike Bishop^[24], Director – Digital Transformation Strategy for Trican. Mike explained that Trican purchases 1.8 million tonnes of sand a year, or about 63,000 truckloads. The

trucks pick up the sand at rail yards and deliver it to well sites pretty much in the middle of nowhere. It was a big complex logistics operation that was ripe for automation.

Mike stated, "We're trying to run just-in-time logistics for bulk products in remote locations and keep better track of everything. The sand we move amounts to over \$300 million of product or about thirty-five percent of our entire cost structure."



**reduction in administrative work due to
connected worker technologies**

To help solve this problem, Trican turned to Salesforce, which had a solution that gives oil & gas companies complete end-to-end field-service management. It allowed them to intelligently schedule and dispatch the right tech at the right time, and it provided mobile field workers with comprehensive information and collaboration tools to streamline work and optimize resources. Mike added, "In terms of reducing administrative overhead and paperwork, we're already on track to recover our investment. Upfront, we calculated that we spend about 13,000 hours a year on administrative work. We were able to reduce that work by about 50 percent, or 6,000 hours, in the first quarter."

The digital downstream: Refining value

On the final leg of the digital journey, we arrive at the point where business value accelerates. Companies that have embraced digital transformation receive increasing dividends from their technology investments.

Comparable to downstream oil & gas, this segment is where raw data is refined and turned into insights. The insights are then distributed to stakeholders for use anywhere in the organization.

“I need to do what I need to do with the data at the point of action where the data is generated. I want to trim that a bit for the operators in the onsite operations centre, and I want to bring it back to my experts in head office. I want AI to spot trends that maybe the humans aren't spotting and alert the experts.”

Craig Walker, Former Global CIO, Shell Downstream

We interviewed Craig Walker, SVP, Strategic Advisor for the Office of the CEO at Salesforce and former Global CIO Shell Downstream. He asserted, “We don't run plants as efficiently as we should, and it comes down to the data. I have lots of data streaming from my big plants. I need to do what I need to do with the data at the point of action where the data is generated. I want to trim that a bit for the operators in the onsite operations centre, and I want to bring it back to my experts in the head office. I want AI to spot trends that humans aren't spotting and alert the experts.”

Refinement: Converting data into insights

“Digital technology is a low-capital way to maximize the worth of investments, assets, and data that a company already owns and the people that they already employ.”

Heather Wilcott, Upstream Digital Manager, Imperial

The industry already understands the value of refining raw materials into more valuable products. The equivalent for digital transformation is honing millions of data points from customers, workers, equipment, and operations to provide business value. This concept is summed up succinctly by Heather Wilcott^[26], Imperial Upstream Digital Manager, “Digital technology is a low-capital way to maximize the worth of investments, assets, and data that a company already owns and the people that they already employ.”

There are many tactics that CIOs are using to refine raw data into insights. We identified several use cases that demonstrate how these approaches are helping all industry sectors realize the benefits of data-driven strategies.

Data analytics improve well design

Precision Drilling^[29] has converted data into actionable insights to improve drilling performance to create a “smart rig platform.” The solution uses multiple digital technologies that integrate machine telemetry for several operational parameters to improve company visibility into the overall efficiency of the equipment. The platform can analyze the data to identify causes of rig downtime and suggest process or maintenance changes to increase the rig's yield. This method provides the following benefits:

- Reduces drilling time and environmental footprint, while ensuring worker safety
- Decreases the high variance in cost from well to well by enabling more efficient drilling operations across rigs and crews
- Gains a singular view into overall equipment effectiveness across the fleet
- Lessens the costs of maintenance and unplanned outages

“The industry average for automation is 8%. The intent of digital transformation and Industry 4.0 is to take it from 8% to 25%.

I think we can get to 50% efficiency gains.”

Shuja Goraya, CTO, Precision Drilling

Shuja Goraya^[28], CTO of Precision Drilling, explained, “Drilling is like golf. Sometimes you hit a phenomenal shot, and sometimes you have a disastrous shot. Drilling these days is no different in terms of consistency. We could drill a record-breaking well, and the very next well could be a fiasco in terms of performance. That consistency issue comes from the fact that it is a complex and not a very well understood process. It will need insights (getting the right data to the right person at the right time) and automation (closing the gap between insights and execution). The industry average for automation is 8%. The intent of digital transformation and Industry 4.0 is to take it from 8% to 25%. I think we can get to 50% efficiency gains.”

Well intelligence enables business decisions

In the current economic climate, upstream is shutting down producing wells to curtail output. Extreme care is required to complete this job. To learn more about this, we spoke with Jason Obekson, Global Industry Director - Oil and Gas at Salesforce. Jason said, “Producers need to be strategic, whether it's a geographic cluster or looking at the profitability of a field. What's the cost to take it out? What's the cost to get it to market? You need a holistic view of your portfolio to make strategic decisions. It's not just what the asset is producing now, but what it might produce in one, three, or five years. You have to have a lot of data points to make decisions intelligently.”

“You have a single operator portal. That drives efficiencies in executing day-to-day maintenance, like servicing the most profitable well first.

Every decision I make as an operator in the field can be translated into the business value to the company.”

Jason Obekson, Global Industry Director - Oil & Gas, Salesforce

Jason spoke about ‘Well 360’, a solution that provides a holistic view across a lot of data sources. “You may have financials, production tracking, and maintenance in different systems. With Well 360, you have a single operator

portal. That drives efficiencies in executing day-to-day maintenance, like servicing the most profitable well first. Every decision I make as an operator in the field can be translated into the business value to the company.” Jason added, “It also provides a holistic view of what’s going on with all of my wells, so if I do have to make shut-in decisions, I make the right decision. It’s the same concept as Moneyball, where you use statistics to drive every decision you make.”

Analytics increase operational excellence

Operational excellence is a substantial consequence of refining data and taking action on the resulting insights. The following three examples demonstrate how data analytics are helping to add value.

In Husky’s^[20] advanced analytics initiative, the company is using big data analytics for preventative maintenance at one of its refineries. The solution monitors mechanical sensor data and uses recognition software to help identify any anomalies, which improves operational integrity, reliability, and process safety.

In another example, Teck Resources^[25] implemented sensors and cameras that provide detailed monitoring of production processes to generate data in real-time. The information is analyzed by powerful algorithms to determine the best operating conditions, and then recommendations are provided to operators at regular intervals so they can adjust parameters. This approach optimizes the performance of plants, generating significant value. Using this tactic, Teck realized a 2.5% increase in throughput and a 2% increase in recovery, resulting in additional production.

For our third example, we interviewed Marvin Wong, General Manager of Operations Excellence at Secure Energy. Their SCADA systems report real-time data to a database capturing historical information. This data is analyzed alongside operations and engineering to create new insights to improve operational decisions. Most recently, the Operational Excellence team used this data for a facility optimization initiative aimed at reducing greenhouse gas emissions and expenses. They have been successful at optimizing pump usage at facilities in relation to market activity and power consumption.

After combining pump VFD information with real-time and future forecasted power pricing, the operations excellence team worked with field operations to create guidance on when to ramp up or down pumps to reduce electricity costs and carbon emissions. To date, this has decreased electricity consumption by 17%.

**“Our analytics solution is where you get innovation –
when you serve complex data in a consumable way to
the people who are most intimate with the task.”**

Marvin Wong, General Manager of Operations Excellence, Secure Energy

“When you are in a higher commodity price environment, power consumption costs are typically overshadowed. The recent oil price compression has created a need to reduce operating costs, and something like this will have a significant impact on our bottom line. We’ve designed our analytics tools to be distributed to our facility managers across Western Canada and North Dakota. With the capability and facts at hand, we empower field operations to make sound decisions to optimize our facilities and improve the customer’s experience. Our analytics solution is where you get innovation - when you serve complex data in a consumable way to the people who are most intimate with the task. Combined with a collaborative approach between operations excellence, engineering, and facility operations, we have made some meaningful impact over a short period.” Marvin explained that this initiative helped

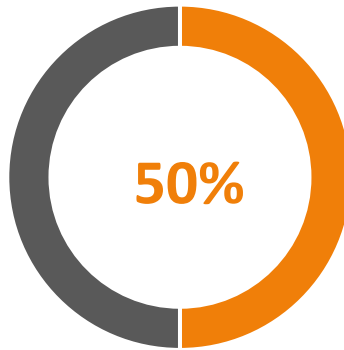
build momentum around using analytics to continue to make fact-based decisions in the organization. It encouraged facility managers to use the deployed dashboard, take the learnings, and make them their own. In addition, the facility managers have started to come up with new ideas and find additional areas for cost-savings and carbon reductions, which they can then share with other groups.

Digital twins reduce construction costs

The concept of digital twins is relatively new but is taking off in Canadian oil & gas. A digital twin is an electronic replica of a physical object or system. It takes in real-world data about the system and produces predictions and simulations of how that system will be affected. The results are often viewed using virtual reality (VR) or augmented reality (AR) to improve the interaction with the digital model.

Oil & gas companies are ingesting schematics and site data from sensors and adapters. They are using algorithms to analyze the data to compare plans against reality, track progress, and identify mismatches. The technology has resulted in significant benefits for the industry:

- Streamlined design processes
- Reduced construction costs
- Reduced maintenance costs
- Improved training



reduction in well pad construction
costs from using digital twins

Digital twins are well suited for sophisticated and distributed capital projects requiring multiple interactions between construction, vendors, fabrication, and engineering. Collaboration between these groups requires a careful balance between safety, cost, quality, and schedule. The Petroleum Technology Alliance Canada (PTAC) reports that the complexity this creates results in rework, which typically adds 30% to the overall cost and delays a project by 17%.

PTAC explains that digital twins can be used to improve quality and reduce fit issues in well pad construction. These issues cause delays, increase costs, and trigger safety issues. By digitally capturing the site in the design process, components can be compared with reality during fabrication allowing fit errors to be detected and corrected before shipping. As a result, perfect modules arrive on site, resulting in a cost-per-well reduction of over 50%.

VizworX ^[26] in Calgary offers an augmented and virtual reality based engineering model that allows teams to walk through full-scale digital infrastructure models to identify design errors and correct them before construction,

avoiding costly rework and potential safety issues. Working with a major oilsands producer and an engineering services company, VisworX enabled a to-scale 3D digital model review of a large facility. “We were able to save them hundreds of thousands of dollars just in material costs in addition to all the related engineering and rework costs so that the total would be in the multimillion-dollar range,” said Jeff LaFrenz, president of VizworX.

Digital twins improve efficiency

Besides lower construction costs, digital twins play an important role in operational excellence. Canadian Natural^[15] is leveraging 3D digital models, VR and AR technologies in innovative ways to make employees safer, improve operational efficiencies, implement new technologies and enhance cost-effectiveness. By using Smart Plant Review (SPR) software, teams can view and perform ‘virtual walkthroughs’ of the models on their desktop computers to identify potential hazards and optimize project planning. SPR is now used by close to 1,500 employees to gain efficiencies and lower operational costs through plant planning activities, particularly during turnarounds and other maintenance periods, facility design changes and orientation/training.

Enbridge^{[18][19]} has embraced digital twin technology in a big way. With millions of data points from in-line inspection tools, strain gauge sensors, and LiDAR remote sensing systems, Enbridge set out to create a digital twin of its 2.24 square kilometre operations in northern Alberta. Previously, the data existed in Excel files, and it was a struggle for engineers to visualize the underlying data relationships. To save countless engineering hours poring over reams of data, Enbridge, with the help of technology partners, created a digital twin for Enbridge’s pipeline network.

“By leveraging such visualization technologies, our engineering teams have the potential to improve speed, understanding and collaboration in the decision-making process.”

Tony Khoo, Head of Canadian Technology & Innovation Lab, Enbridge

Chris O’Neill^[18], Manager, Research, Development & Innovation at Enbridge, stated, “Technologies such as augmented reality have the potential to change the way we look at our system and help us begin to appreciate the wider innovative potential when we treat data as an organizational asset.” Tony Khoo^[18], Head of Canadian Technology & Innovation Lab at Enbridge, added, “By leveraging such visualization technologies, our engineering teams have the potential to improve speed, understanding and collaboration in the decision-making process.”

Artificial Intelligence and machine learning automate results

In our 2018 report, *‘Digital’s Role in Reshaping Canadian Oil and Gas,’* few Canadian oil & gas companies had implemented artificial intelligence into their operations. Now, less than two years later, most businesses we studied were using some form of AI technology. The reasons for this adoption rate are clear; artificial intelligence and AI’s newer cousin, machine learning (ML), allow computers to learn from and adapt to data without explicit programming for new data. Both technologies will enable a company to make faster, better, data-driven decisions while freeing up resources to work on higher-value activities.

There is a wealth of opportunities in Canadian oil & gas for leveraging AI and ML. Some of these include:

- Enabling predictive reliability by using machine learning to calculate vehicle and pump component failures to avoid unplanned downtime.

- Transforming maintenance processes by optimizing and scheduling thousands of tasks performed at various facilities to utilize resources better and reduce risk.
- Removing people from hazardous locations and improving fuel economy and safety by using crewless vehicles and drones.

TC Energy^[17] is using machine learning to speed up interactions with regulators. The industry is heavily regulated, and there's a need to provide information quickly. In an environment with a lot of acquisitions, it's often difficult to find the information that the regulators require. TC is using machine learning to find documents, certificates, and testing results much faster than they could in the past. In another example, Husky^[20] is using data from machine learning to assess suspended or abandoned wells in Western Canada to determine whether to reactivate or entirely abandon the assets.

Imperial^[21] is building a machine learning model to solve problems in the oil field. For producers, stream injection helps oil flow, but the challenge is how to optimize the injection across thousands of wells when there is high variability across rock and oil properties. Also, these properties change as oil is recovered. Decisions typically require time-consuming calibration of engineering models.

Using the ML model, combined with optimization algorithms, Imperial has been able to receive continuous operating recommendations to improve recovery. One of the additional benefits is that a real-time view of production is now available that can be compared to predicted rate estimates. This use of ML helps personnel do their jobs better.

Distribution: Deliver insights to stakeholders

The last destination for refined oil & gas is the retail and commercial customers who consume them. That is also the final objective of the digital downstream. The refined data insights are marketed and distributed to stakeholders both inside and outside the company.

These stakeholders include customers, partners, and suppliers at all points in the value chain. We provide a few examples of using data insights to engage the ecosystem that surrounds oil & gas.

Distributing to partners

In our conversation with Walt Sepaniac, Principal Solution Engineer at Salesforce, he talked about how to improve contract negotiations between oil & gas business partners. Walt explained that calculating total exposures and total business with counterparties requires manual processing of hundreds of documents into Excel. Not only does this involve a lot of work, but it also affects contract negotiations because negotiators do not have all the information they need to be effective. He described the Sales Cloud, a customer relationship management system that offers a centralized place to store documents. It's also a system of engagement to negotiate a contract and provides guidance at all stages of the contracting process.

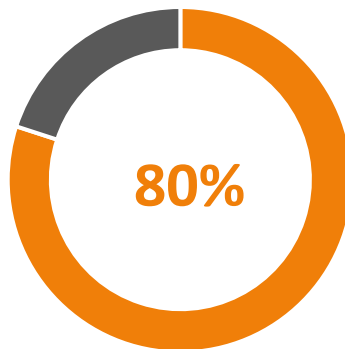
“That’s the power of digital engagement: guidance for negotiating the contract, visibility for everyone, and then intel on your counterparties, all in one place.”

Walt Sepaniac, Principal Solution Engineer, Salesforce

Walt concluded, “We provide best practices and associated activities that can be tracked and managed - for example, intel learned by commercial negotiators and from all the contacts you’ve had with the customer. We provide a way to look at all those activities. That’s the power of digital engagement: guidance for negotiating the contract, visibility for everyone, and then intel on your counterparties, all in one place.”

Distributing to the enterprise

At Husky^[20], their goal was to eliminate roadblocks caused by limitations of their current tools. They also wanted to reduce IT costs and improve agility by replacing costly inflexible legacy systems. The solution was to plan and schedule the enterprise value chain, from crude supply to production distribution, through a single unified system.



reduction in decision-making time for crude purchases through enterprise-wide value chain system

The comprehensive solution provided feedstock data management, trading production planning, network optimization, scheduling, and performance monitoring. The system eliminated a lack of transparency and duplication of effort to define economic opportunities. As a result, Husky was able to reduce the decision-making process for crude purchases from two days to two hours, an 80% reduction. By using the system, Husky is also able to improve margins through refinery optimization.

Distributing to customers

In our interview with Craig Walker, former Global CIO of Shell Downstream, he stated, “Digitalization is all about data. I need to understand enough about my customers, be they B2B or B2C, and present one face of the company to them. It doesn’t matter how they contact me and what persona they represent. I want to know enough about them to make every interaction with me a pleasant and personalized experience. That all comes from data. It comes from business intelligence giving me the big picture. It comes from AI giving me the predictive picture.”

Craig described how Shell uses its mobile application to establish a personal relationship with their customers. Besides finding the nearest service station, the app calls ahead to that station, provides name, vehicle information and ETA. For customers with special needs, someone is waiting for them to arrive, helps fuel their car, offers to buy something at the Shell store, and takes payment, all without the customer having to leave the vehicle.

“If we generalize too much, we leave the margins of society behind, who we want to have as customers. They are very loyal if you go the extra mile for them. The tech is already available to do that today. We are doing that today.” Craig adds, “If you don't treat customers with respect by not knowing who they are, they will go to someone else.”



Cybersecurity considerations

Cybersecurity warrants special attention for the digitally inclined CIO. As the adoption of digitization across the industry grows, so too does the risk of security breaches and unwanted events. For oil & gas, the pervasive integration of information technology with operational technology poses an additional hazard because the convergence could expose production control systems to malicious actors.

Every public oil & gas company we researched includes cybersecurity as a business risk in their annual report. But here's a secret, every other major company in every other industry which has undergone digital transformation has documented the same risk, and that didn't stop them from digitizing to become successful.

87%

have not fully considered
information security
in the current strategy

60%

experienced a
recent significant
cybersecurity event

15%

have a robust incident
response program

EY's^[31] global information security survey provides a wake-up call for industry CIOs. They report that 87% of oil & gas companies have not fully considered the information security implications of their current strategy and plans, with 60% experiencing a recent significant cybersecurity incident. Despite these findings, EY found that only 15% have a robust incident response program.

The cost of cybersecurity resilience is a necessary consequence of digital transformation. It is responsible for safeguarding digital assets, mitigating business risk, and improving public perception. Ironically, this is an area where oil & gas being late to the digital game provides an advantage. Most other industries have already spent considerable time and money to secure their organizations. Oil & gas can take advantage of that investment to apply best practices and choose from more than 100 mature cybersecurity offerings right from the start.

Anthony Zerr, Director at CCL Networks, recommends performing a design basis threat assessment. In general terms, this assessment identifies the impact of undesirable events related to the exposure of a company's critical data assets to malicious actors. Tony advises, "The CIO or CISO is responsible for determining threats that IT can't manage or requires additional funding and presents those findings to the business. It then becomes a business decision on whether to proceed or to document them as a risk."

Cybersecurity needs to become part of the company's security information & event management (SIEM), and security operations centre (SOC) functions. Due to the evolving threat landscape and the newness of digitization for oil & gas, CIOs should consider outsourcing these functions. By implementing a comprehensive cybersecurity framework, the business will gain more confidence in digital transformation, which will result in quicker adoption within the organization.

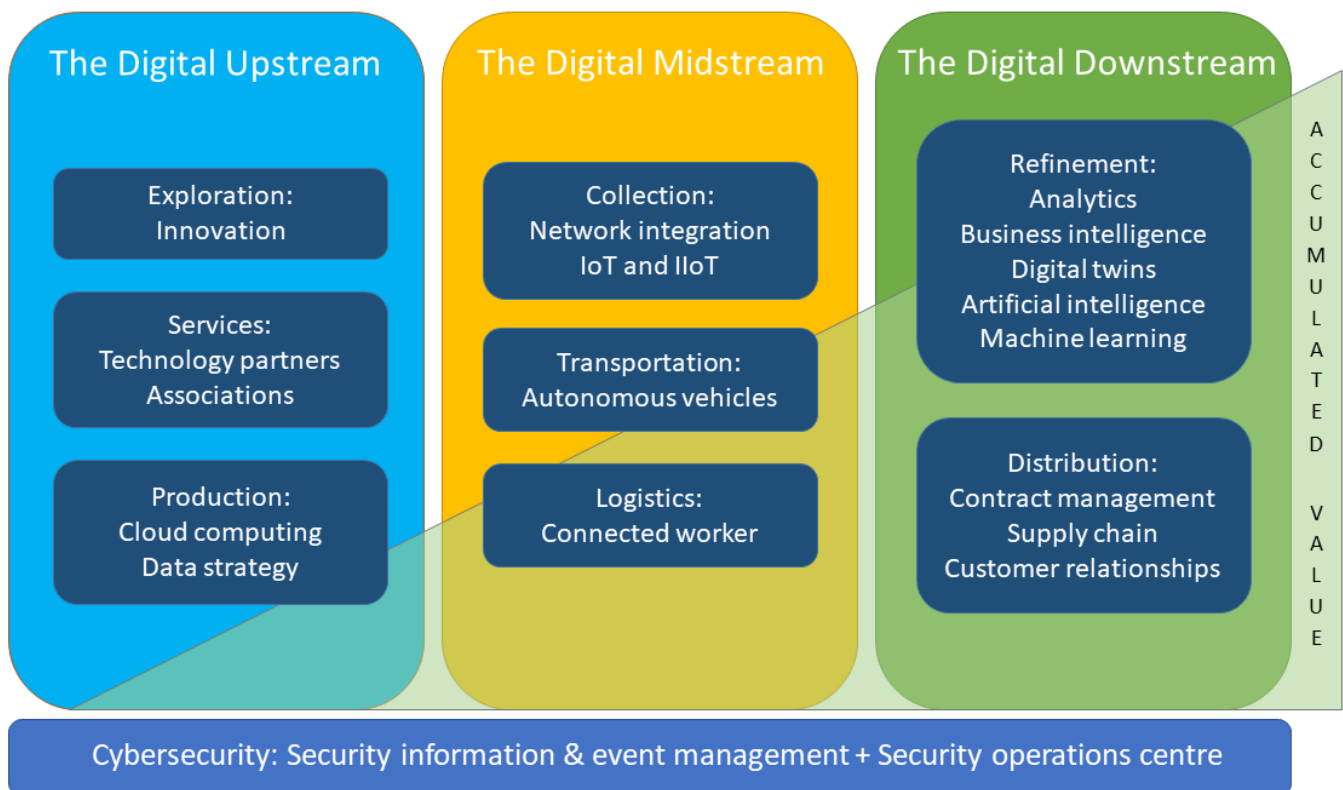
Summing it up: Advice for CIOs

Digital transformation in oil & gas is no longer the issue it once was only a few years ago. Modern technology can do almost anything businesses desire. CIOs can be leaders in their organizations by focussing on business outcomes and by demonstrating results. CIOs must help their lines of business to visualize what the digital future looks like and describe the path to get there.

In this study, we've provided advice, use cases, and examples that have had an impact on every part of the oil & gas value chain. Our research indicates that digitization helps to address the critical business challenges that the industry faces, while also assisting companies to remain competitive after the current downturn is over.

A digital roadmap for oil & gas

The approaches presented throughout this report apply to all sectors of the industry. We have summarized the content of this study in the digital roadmap shown below. The aggregate value to an organization increases as the digital journey proceeds from left to right. The roadmap augments an organization's digital transformation strategy and is used as a guide to locate relevant use cases described in this study.



The oil & gas transformation journey starts in the digital upstream, where businesses begin to explore creative uses of technology by instilling a culture of change and implementing a structured innovation program. Companies use external services to accelerate their initiatives by selecting technology partners and by participating in industry associations. In parallel, the organization adds cloud computing to reduce costs and increase flexibility. The development of a data strategy to extract and store raw information rounds out the segment.

The next phase is the digital midstream, where networks of sensors capture and process data points in real-time. The enterprise interconnects people, devices, and systems to improve transportation and logistics.

The final leg of the journey ends in the digital downstream. The organization uses its digital technology capabilities to refine data and turn them into business and operational insights. Every area of the enterprise makes use of analytics, business intelligence, digital twins, artificial intelligence, and machine learning. The new abilities created help to manage partners, improve the supply chain, and enhance relationships with end customers.

Surrounding digital transformation is a robust cybersecurity framework integrated with the organization's existing security practices. Cybersecurity safeguards data assets and systems to build confidence in the digital capabilities of the company, which leads to accelerated adoption and change.

Final words

We were excited to complete this research project and speak with pioneers and innovators in the industry. It was reassuring to discover that the pace of digital transformation has been gaining speed in the industry. Companies in every segment are enjoying business value from their efforts. In these turbulent times, we encourage IT executives to continue to champion digitization within their organizations. By embracing the digital imperative for Canadian oil & gas, the industry will be able to improve balance sheets, increase operational excellence, and ultimately prepare their organizations for the better times ahead.

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