

THE INTELLIGENT REFINERY

**DISTILLING
DIGITAL, DRIVING
INNOVATION**



**BASED ON SURVEY ANALYSIS
FROM ACCENTURE'S 2018
DIGITAL REFINING SURVEY**

BRIEFLY...

- In 2018, Accenture conducted the second Accenture Digital Refining Survey to understand how refineries are using digital technologies.
- We also sought to understand what the 170 respondents believe are the benefits and barriers to adopting digital technologies.
- Five trends depict where companies are on their journey to becoming an Intelligent Refinery—and what they can do to speed it up.
- This report provides further digital insights based on Accenture's deep industry practitioner experience.

ABOUT THE SURVEY

The Survey was conducted by PennEnergy Research in partnership with the Oil and Gas Journal on behalf of Accenture. Respondents were oil refining and gas industry professionals from a cross-segment of the industry, including:

- Executives and Mid Level Management.
- Business Unit Heads.
- Refinery Managers.
- Refinery Engineers.
- General Oil and Gas Industry Employees.

Over the next few years, the transition to a lower carbon world will offer the global refining industry some opportunities and a range of challenges.

Potentially, the next decade could see one of the biggest ever global oil demand disruptions, with the introduction in 2020 of new specifications for bunker fuel oil for the world's marine fleetⁱ. The global refining system is also experiencing a boost from the expansion of the petrochemicals industry, where growth continues to outpace global gross domestic product (GDP). Challenges include more stringent emissions regulations for plants and fuels as well as newer fuels entering the transportation system such as natural gas, biofuels and electricity (the production of which all bypass the global refining system). These challenges mean that refiners need to invest to capture new margins, and make their plants more efficient and cost-effective.

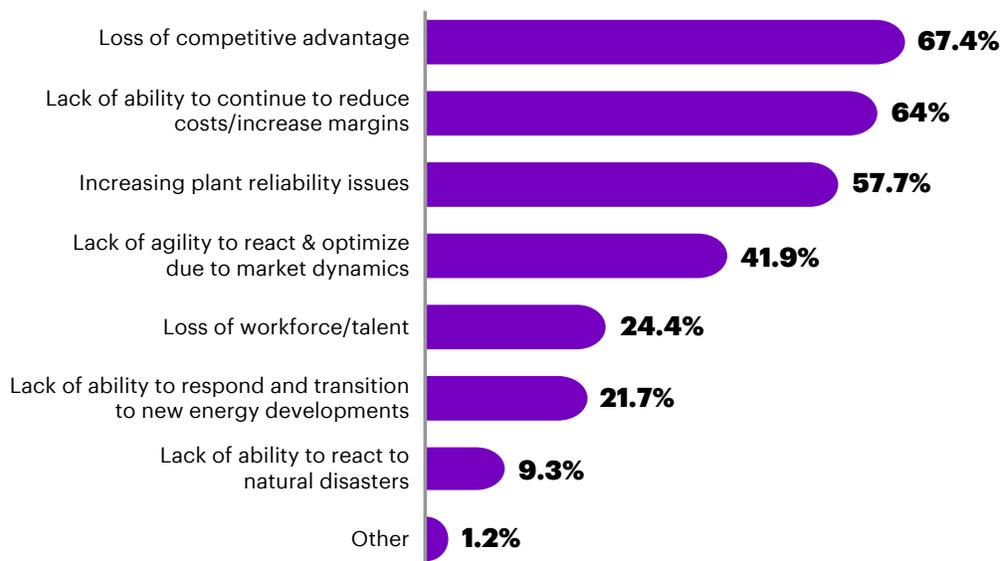
Competitive pressures are also rapidly increasing for many refiners, with a significant amount of new refining capacity coming onstream over the next few years. The International Energy Agency (IEA) expects the global refining system will have to absorb 2.6 million barrels per day (b/d) of new capacity in 2019 alone – the largest annual increase since the 1970sⁱⁱ. Meanwhile, after expanding by 1.4 million b/d in 2018, global oil demand growth is expected to slow to around 1 million b/d by 2023,ⁱⁱⁱ leading to more competition for incremental demand.

To remain competitive, refiners need to look at new ways to improve margins, increase the reliability of operations, and find more agile and speedy responses to market changes. In **Accenture's 2018 Digital Refining Survey**, loss of competitive advantage due to a lack of investment in digital was the number one risk cited by refiners (with over 67 percent seeing it as a risk – see Figure 1). This concern was followed closely by worries over the ability to sustain cost reduction and continue reliability improvements.

FIGURE 1 – Refiners fear loss of competitive advantage from lack of digital investment

TREND 4 LACK OF DIGITAL INVESTMENT INCREASES RISK

What risks to your business do you see from a lack of investment in digital technologies? (based on top 3 most important risks)



THE MARGIN OF THE FUTURE

Refiners today understand the impact digital can have on their business and most believe it can deliver greater value in operations. In Accenture's digital refining survey, 80 percent of refiners reported that digital is adding up to \$50 million in value to their business and 75 percent stated that they intend to spend more on digital over the next three to five years. However, there is potential for even more value from digital improvements (the survey showed that over 60 percent of refiners believe digital could support more effective and efficient plant management in their refining portfolios).

In the future, data democratization will mean that refineries will be even more connected and transparent throughout the value chain – which has implications for existing operating models and the breaking down of traditional functional silos. A more “intelligent” refinery will use digital investment to continuously sense demand, drive more automated and better forecasting and optimize against real-time operational situations and enable the refinery to react optimally to changing market dynamics.

Ultimately, a refinery can make a theoretical maximum margin from a barrel of crude, but this number is always dependent upon the crude assay supplied and the complexity of the refinery operations. While getting the crude feed is reliant upon the hydrocarbon supply chain (which is bound by supply routes and market dynamics), the ability to source, plan and refine material can be drastically improved through a more real-time and connected use of process insight to meet the constraints of product commitments and processing capability. Where there is potential, product yields can be shifted to capitalize on incremental spot prices. And while no refinery can change the direction of its operations very quickly, any slight improvements in yields or margins through process and workforce efficiencies and optimization can make a significant difference in this increasingly competitive space.

AN INSIGHT-DRIVEN REFINERY

While the digital maturity of refiners appears to be increasing (in the 2018 survey, 48 percent of refiners rated themselves as mature or semi-mature in digital technology deployment compared to 44 percent in 2017) there is no widespread use of digital technologies and, as yet, little use of more cutting-edge digital technologies. Many refiners still consider themselves as relatively immature when it comes to deploying digital technologies.

The survey shows that refiners remain focused on investing in technologies such as advanced process control, analytics, Internet of Things (IoT) and cybersecurity tools. Meanwhile, the focus on cloud and mobility are declining as these technologies reach maturity. However, the impact of emerging technologies such as Artificial Intelligence (AI) blockchain and robotics is still relatively weak (some of these technologies were not even a focus in the 2017 survey).

The areas where digital is having the most positive impact for refiners are in maintenance and reliability processes (56 percent) and production scheduling and planning (50 percent) with other areas like trading or supply chain seeing a comparatively small impact as yet (see Figure 2).



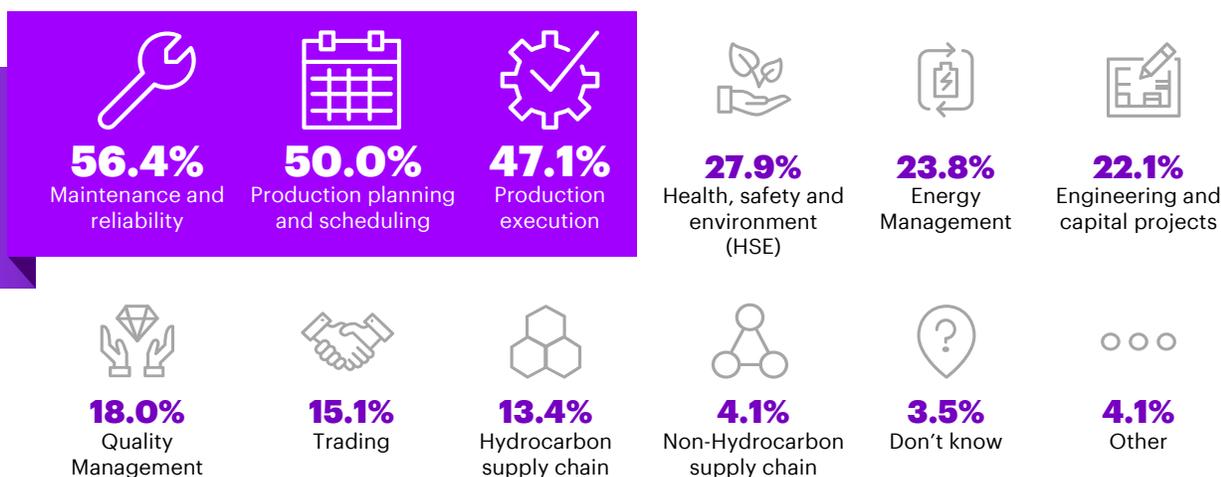
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FIGURE 2 – Most refiners are yet to see potential value from digital technologies

TREND 3

MOST REFINERS ARE YET TO REALIZE POTENTIAL VALUE

Which of the areas in your refining operations are digital technologies having the most positive impact?



More intelligent refineries are starting to use analytics at scale, and are quickly linking this information to the planning and execution processes in the refinery.

Using data from sensors in the refining process is not new; electronic signals and data process analysts have existed for over a decade. The Intelligent refinery can link real-time information and predictions on equipment performance to the impact on their planning and scheduling activities, enabling more insightful and profitable decisions to be made much faster.

Knowing what to do and when to do it, is now critical for all refineries. A key goal is to systematize new ways of working in refineries, since this ensures continuous knowledge retention and development. Mobile tools enable workers to consistently use and improve procedures, perform more value-added actions, and reduce risks to health and safety. For example, electronic passes for workers takes a relatively simple technology and substantially increases the operational effectiveness of the

plant. Tracking the movement of workers around the plant removes the need for tedious and time-consuming paper-based processes. But more than that, the connected worker is more visible—generating data that can be used for compliance and health and safety improvements.

Meanwhile, using more advanced technologies, such as machine learning and AI, will allow refineries to better monitor the state of equipment. For example, predicting fouling on the crude unit heat exchangers is generally beneficial, but planning the bundle washing to ensure optimal maintenance and capital spend according to market demand is a potential game-changer for a refinery. The same processes can improve the performance of critical equipment across the site, which means that the refinery plan is always aligned to true and real-time processing capability, not just its assumed performance.

Such technologies are also providing insights into major cost factors such as energy consumption, enabling significant cost efficiencies to be realized.

A rotation to digital refining will require fundamental changes. At the most basic level companies will need big data platforms and visualization tools to house and process the real-time sensor data needed to make more dynamic decisions. As digital maturity grows and data science methods start to be adopted and scaled, refiners will need new skills in the form of data engineers and data scientists to make

analytics pervasive in operational decision-making. Over time, once data science methods continue to be trusted and engineers start to adapt to change, work processes can be redesigned to take advantage of insights, thereby making autonomous closed-loop processes a reality. In this way, refiners will be able to turn the data they capture into knowledge, insight, and ultimately value.

A NEW SKILL BASE

One key challenge to becoming a more intelligent refinery is competition for new skills.

Our survey shows that workforce skills are becoming increasingly important for refiners, with 50 percent more respondents citing lack of workforce skills as the greatest barrier to successful digital adoption in 2018 than in 2017 (see Figure 3). Digital natives do not generally exist in refining operations and refiners need to hire outside their organizations for skilled people, develop training programs for incumbents to reskill, or look to third-party partners to help them along their digital journey.

With the complication of the aging demographics of the global refining industry, the move to intelligent refining is imperative both to capture and institutionalize experienced workers' know-how in the new ways of working and to leverage senior personnel to train new digital workers – namely machines.

Refining leaders need to address digital skills gaps and redeploy people whose roles are being replaced by automation and technologies like AI. By retraining employees already familiar with their operations, as well as enabling more collaboration between humans and machines, refiners can not only save time and money but accelerate their digital transformation.



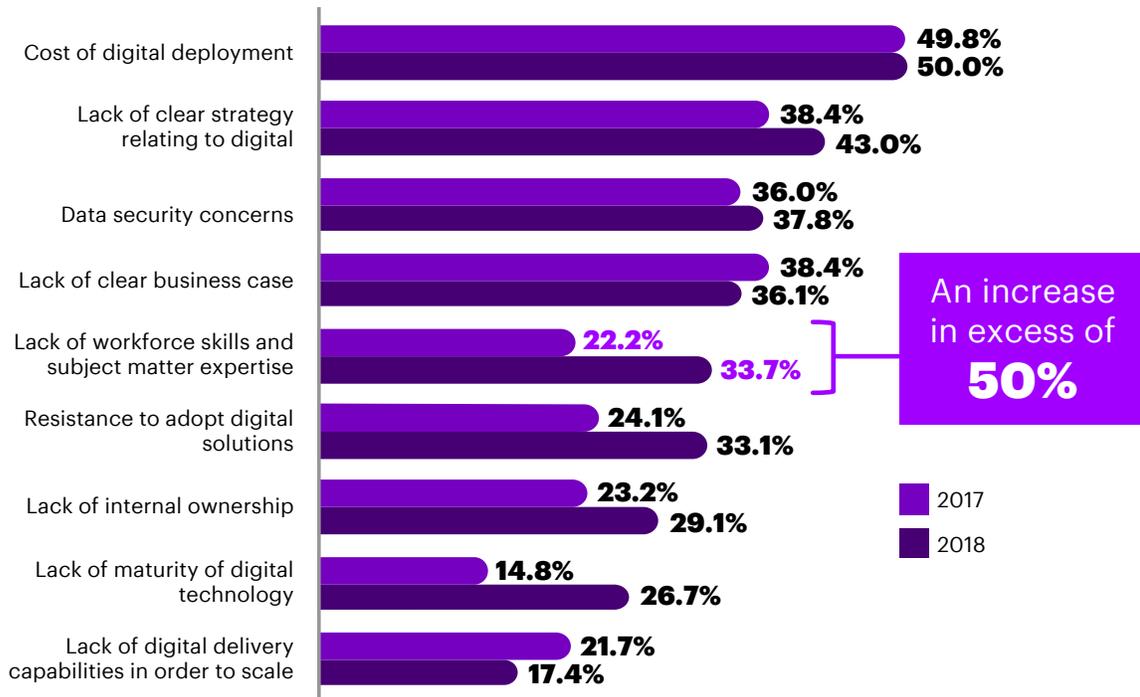
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FIGURE 3 – Workforce skills are important for successful digital adoption

TREND 5

WORKFORCE SKILLS ARE INCREASINGLY IMPORTANT

Which barriers, if any, prevent the successful adoption of digital technologies in your organization? Please select all that apply.



A MORE SECURE REFINERY

As levels of digitization increase in the refinery so does the risk of cyberattacks.

Many refiners still lack awareness of cyberattacks—28 percent of the survey respondents said they are seeing more or significantly more such attacks than in 2017, while 33 percent of respondents said they don't know how many attacks they are experiencing.

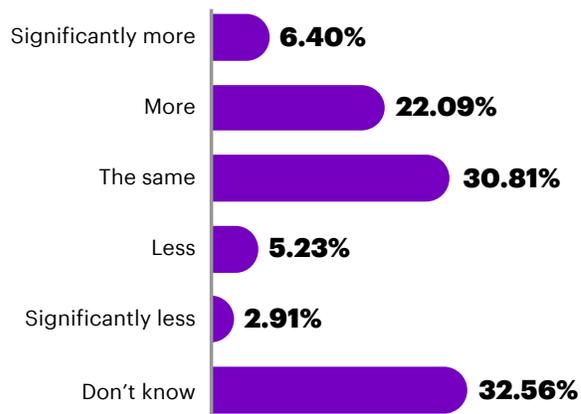
Despite the fact that digital means refiners might become more susceptible to cyberattacks, digital can also offer some protection. The integration of the information technology (IT) and operational technology (OT) landscapes (coupled with the increased focus on true endpoint cyberattacks) means digital architectures must encompass a holistic perspective of the IT-based systems and the underlying industrial control system. By understanding IT and OT vulnerability areas and by incorporating smart IoT devices, securely authenticated communication protocols, and real-time threat surveillance tools, companies can ensure they know about incidents immediately and can respond swiftly. As companies transition to more connected operations, it is even more critical for employees to appreciate and adopt best practices in operational cybersecurity.



FIGURE 4 – Cybersecurity is becoming more of a concern in refining

FURTHER INSIGHTS CYBERSECURITY – A CAUSE FOR CONCERN?

Are you experiencing more or fewer attempts than last year?



TOP 5 NUMBER ONE CONCERNS OF CYBER ATTACK IMPACTS

Operational Impact	37.79%
Impact on Workforce Health & Safety	22.09%
Environmental Impact	12.21%
Data Breaches	8.72%
Commercial Impact	6.40%

It appears cyberattacks are rising and/or they are not being adequately measured

ROTATION TO DIGITAL

Digital should not be thought of as an independent strategy, but as an enabler of business strategy.

While refiners face even greater competitive pressures in the coming years, if digital can be implemented at pace and scale there is value to be captured. The ability to reduce costs, increase plant up-time and safety, and improve refinery margins are at risk without companies targeting their investments on this rotation to the new.

THEREFORE, REFINERIES SHOULD:

- **Be relentless** about focusing on value in terms of both benefit realization and new ways of working.
- **Develop directionally** correct strategies and an evergreen use case roadmap.
- **Invest in new digital** platforms and tools for foundational capabilities.
- **Invest in people** to reskill and adopt the new ways of working.
- **Ensure that leaders lead** – no transformation can be undertaken without visible leadership from the top.

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Note

Based on survey analysis from **Accenture's 2018 Digital Refining Survey**

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