GDA DIGITAL REFINING SURVEY

2ND GULF DOWNSTREAM ASSOCIATION INDUSTRY SURVEY

By Mirko Rubeis, Graeme McMillan and Samuele Bellani

Among oil firms, International Oil Companies (IOCs) are the most advanced in applying digital technologies and realizing the benefits in their refining operations. Refiners in the Gulf Cooperation Council (GCC) believe in digital, but not all of them have progressed as far as IOCs. Many GCC refiners have piloted digital applications, but only a few have industrialized them, even as significant value goes untapped. What holds them back?

A survey of leading GCC refiners conducted by the Gulf Downstream Association (GDA) in collaboration with Boston Consulting Group (BCG) earlier this year reveals the answers. GCC refiners face two major hurdles. First, they face difficulties in designing and implementing a company-wide integrated strategy for digitalization. Refiners apply digital technology in select areas, but integrating the efforts is complex, therefore the full potential is not always reached. The second hurdle is fear of the unknown that holds refineries back. Wide-scale investment in digital technology is a major business risk that few GCC refiners have been willing to take.

Yet, GCC refiners understand the growing importance of digital to their business. It is a difficult question, but there is a solution for the confident development of digital and a realization of its benefits.

We look at the most promising digital areas, the steps GCC refiners have taken so far, and explore a way they can collaborate through the GDA to realize the strongest digital benefits by sharing best practices and limiting individual exposure to risk.

GCC Refiners Value Digital

The GCC has grown to become a refining powerhouse in the world, in terms of its scale and complexity. GCC refiners, in turn, recognize the value of digital technology in addressing refining challenges. They also know the necessity of its adoption to outpace competitors.

ABOUT THE DIGITAL REFINING SURVEY

The GDA, in collaboration with Boston Consulting Group (BCG), conducted a survey of GCC refiners about their use of digital technology in operations.

The Gulf Downstream Association (GDA) is a non-profit organization that brings together downstream companies, suppliers, and experts with interests in the Gulf region. Created in 2016 and based in Bahrain, GDA is determined to become a leading internationally recognized association, contributing to further developing the industry and drawing mutual benefits for its members by sharing knowledge and best practices. GDA is also the host of landmark conferences and exhibitions in the GCC.

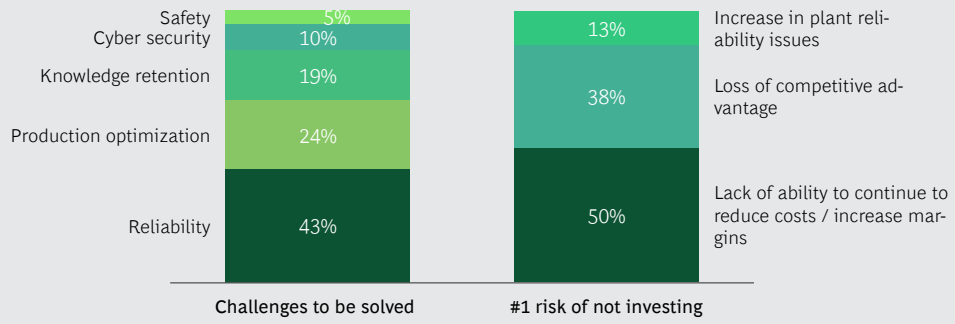
The survey took place in late 2018 and early 2019 and was designed to illustrate that in the Middle East, digital refining has begun, but still offers much-untapped potential. The survey queried twelve refineries owned by nine GDA-member companies operating across the GCC. The refineries represent more than 3 million barrels per day of distillation capacity and have Nelson complexity indexes ranging from five to greater than twelve. The survey covered digital readiness in the key areas of the refining business, including Production Planning & Economics, Operations, and Maintenance.

This second survey follows a previous industry survey conducted by GDA and Boston Consulting Group in 2017

In fact, 67% of GCC refiners we surveyed hope that digital technologies will solve their top two challenges: reliability and product optimization, as shown in Exhibit 1 below. They also believe digital can improve knowledge retention, cybersecurity, and safety.

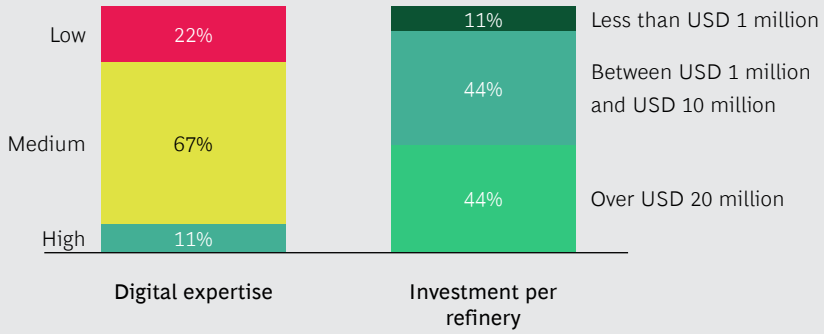
Just as clearly, they see great risk in not investing in digital. For 88% of refiners, the greatest risk of non-investment is a lack of ability to improve margins and a loss of competitive advantage.

EXHIBIT 1 | GCC refiners have high expectations for digital



GCC refiners' understanding of digital technologies and capabilities is at a moderate to high level, with 78% of those surveyed saying their companies possess digital expertise at those levels, as shown in Exhibit 2 below. Yet their investment in such capabilities and technologies is limited. Fewer than half of GCC refiners invest more than $10 million cumulatively in digital, with many investing just $1 million to $2 million in total, a low amount to achieve any significant impact.

EXHIBIT 2 | GCC refiners investment in digital is only moderate



Pinpointing Barriers to Digital Success

Two reasons stand out for GCC refiners' conservative approach.

No integrated digitalization strategy.

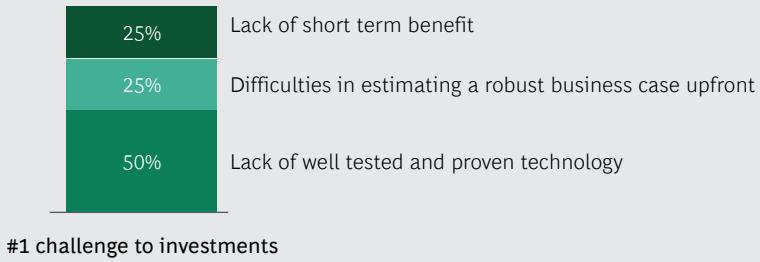
Fewer than half of GCC refiners said they have an integrated strategy for adopting digital across their operations. Among those that do have a strategy, more than 80% lack a single point of responsibility and oversight. To succeed at digital, each department, from finance to process engineering, cannot pursue digital on its own. Instead, a refinery should develop an integrated, centralized digital plan, led by a digital task force or its technology department.

A fear of the unknown that holds refineries back.

50% of the respondents in the GCC said that a lack of proven technology is the biggest challenge to investment, as shown in Exhibit 3 below. Digital technologies have been around for a few years; however, a fear of the unknown holds refineries back, even if the technology itself is proven in most of its applications.

Instead of jumping feet-first into digital waters, GCC refiners stick their toes in here and there. Their typical approach is to pilot a digital application in select use cases on one or more process units. If outcomes are good, they may industrialize the

EXHIBIT 3 | Lack of proven technology is an investment challenge



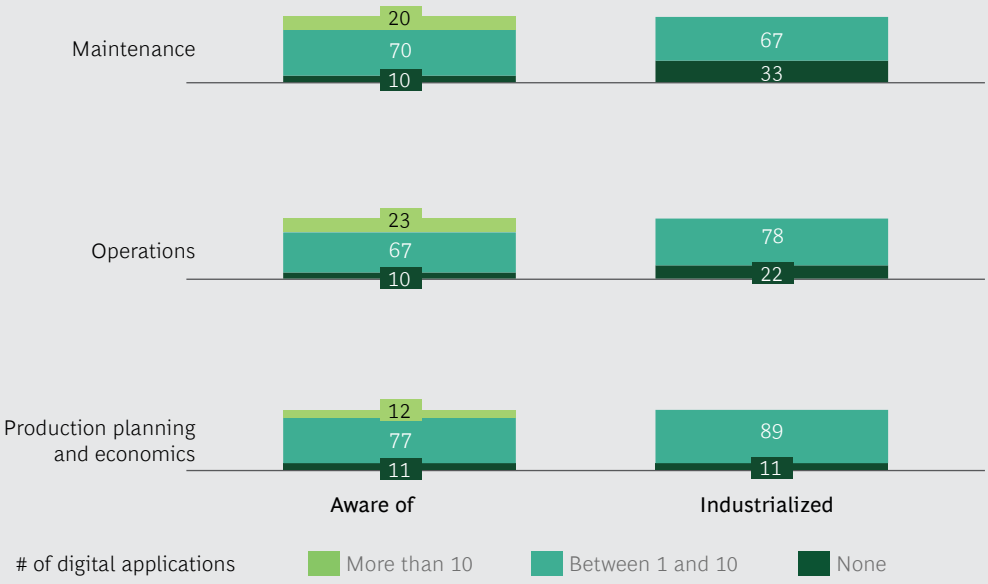
technology across the entire asset or group of assets.

That approach works for a while, but for GCC refiners to surge ahead with digital success, they will need to understand in which areas to apply their resources and attention the most.

Digital Progress in GCC Refiners

When it comes to the progress in GCC, we surveyed refiners about their level of digital maturity. Exhibit 4 shows that, while GCC refiners are aware of several digital applications in maintenance, operations, and production planning & economics, the shift from digital use cases awareness to industrialization is relatively slow.

EXHIBIT 4 | The shift from digital use cases to industrialization is slow



Predictive Maintenance with Analytics and Artificial Intelligence.
Predictive maintenance is a logical and common area where GCC refiners have piloted digital applications, such as advanced analytics and Artificial Intelligence (AI). More than 90% of survey respondents say their refineries have installed technologies to produce and analyze sets of data that track pressure, temperature, and other factors, measured in real-time. Advanced analytics and AI allow the number of variables in the examined data set to be increased by orders of magnitude beyond the practical limitations of machinery engineers alone, leading to optimized maintenance interventions.

Two-thirds of refiners use predictive maintenance algorithms on select machinery only, such as pumps, compressors, and heat exchangers. A quarter of them have applied predictive maintenance to an entire portfolio of process units, which is the ultimate goal.

Advanced Process Control in Real Time.
The refining industry has used Advanced Process Control (APC) for years. Ninety percent of our survey respondents report using APC on more than 50% of their process units.

While the technology is not new, refinery operators are now using digital

applications with APC to move beyond manual control to optimized real-time- decision-making. Yet, GCC refiners lag in adopting real-time optimization for APC and other aspects of performance improvement. They also lag in using AI for production planning. These advancements require not just technology but marked changes in how refiners manage their organization, with people at all levels encouraged and equipped to make decisions in any area, at any time of day or night to match the production of real-time information and link it to key performance indicators for decisions that are economically better for the company, done in real-time.

Production Planning with AI.
In production planning, 60% of refiners surveyed were aware of AI applications – but none of our respondents reported that they had implemented such technology, including margin forecasting and supply-and-demand balance forecasting.

International IOCs Are Pursuing Digital in Six Areas

In contrast to GCC refiners' experience with digital in the Gulf region, IOC digital leaders and their refining subsidiaries are integrating digital into six areas of the refining value chain, as shown in Exhibit 5 below.

IOCs have achieved notable success in some of these areas and are still experimenting with use cases in others.

Safety is the first priority of IOC refineries, of course, as it is for most refineries, so IOCs are adopting digital safety advice in use cases. They are piloting digital in other areas, including geo-location and connectivity infrastructure, smart operator applications for inspection activities, virtual reality training, field communication with remote experts, and guided operations for panel operators.

EXHIBIT 5 | Digital areas in refining

Above all, the domains yielding the highest direct economic impact for IOCs are advanced market-driven operations, next-generation planning and scheduling, and asset management 4.0.

Advanced Market-driven Operations.
Several leading IOCs now furnish their panel operators with real-time economic information to help them optimize plant performance. This leads to margin improvement of up to 20 to 50 cents per barrel.

In other areas, IOCs have created digital twins for process unit simulation, assay prediction, and feedstock forecasting, and non-linear process optimization with machine learning on core process variables or performance gaps.

Next-generation Planning and Scheduling.
The area of planning and scheduling can make or lose the refinery margin before any crude is processed. Consequently, IOCs have made it their mission to improve this area using digital applications constantly.

Advanced analytics are allowing some refiners to break the often trial-and-error nature of refinery scheduling by optimizing ship unloading, tank farm management,

and crude and critical unit blending. These technologies have improved margins by 10 to 40 cents per barrel through improved plant optimization, increased unit stability, and capture of opportunity crudes.

IOC refineries are squeezing additional margin from their crude with other digital applications, such as "control tower" platforms that link all planning inputs and programs, advanced lookback analytics, crude blend compatibility analytics, and advanced analytics to improve linear programming.

Asset Management 4.0.

IOCs are taking advantage of improved predictive maintenance applications, particularly for rotary equipment. They are leveraging the scale of their operations to develop their algorithms or use those created by equipment manufacturers and third parties.

Beyond predictive maintenance, digital technology for routine maintenance planning and scheduling optimization increases the probability of the right work being done correctly and on time, thus optimizing maintenance spend.

IOCs are supplying their operators with field tablets and equipment barcoding to improve productivity. They are also using drones, satellites, and sensors for remote asset-monitoring.

Central to several use cases for asset maintenance, is the incorporation of advanced analytics. IOCs are improving or building these capabilities from scratch for their refining companies. In many cases, IOCs have used advanced analytics largely in the upstream and are now transferring these skills downstream.

Collaboration Can Take GCC Refiners Forward

While the survey shows that there is a clear trend to digitalization among GCC refiners, it also suggests that there is still significant value to be unlocked. The early successes with digital, and its obvious potential, point to a need for a way to overcome challenges GCC refiners face that are associated with investment in digital technology not necessarily fully proven.

One way that GCC refiners can compete on the digital front and minimize investment risk is to collaborate through a forum such as the Gulf Downstream Association. By working together on the problems they face, sharing best practices, and developing digital technologies to meet their needs together, GCC refiners can more quickly advance in digital transformation while minimizing investment risk.

About the Authors

Mirko Rubeis is a managing director and partner in the Dubai office of Boston Consulting Group and is a core member of the Energy and Global Advantage practices. You may contact him by email at Rubeis.Mirko@bcg.com

Graeme McMillan is a associate director in the Dubai office of Boston Consulting Group and is a core member of the Energy practice. You may contact him by email at McMillan.Graeme@bcg.com

Samuele Bellani is a principal in the Dubai office of Boston Consulting Group and is a core member of the Energy and Corporate Development practices. You may contact him by email at Bellani.Samuele@bcg.com

Boston Consulting Group partners with leaders in business and society to tackle their most important challenges and capture their greatest opportunities. BCG was the pioneer in business strategy when it was founded in 1963. Today, we help clients with total transformation—inspiring complex change, enabling organizations to grow, building competitive advantage, and driving bottom-line impact.

To succeed, organizations must blend digital and human capabilities. Our diverse, global teams bring deep industry and functional expertise and a range of perspectives to spark change. BCG delivers solutions through leading-edge management consulting along with technology and design, corporate and digital ventures—and business purpose. We work in a uniquely collaborative model across the firm and throughout all levels of the client organization, generating results that allow our clients to thrive..