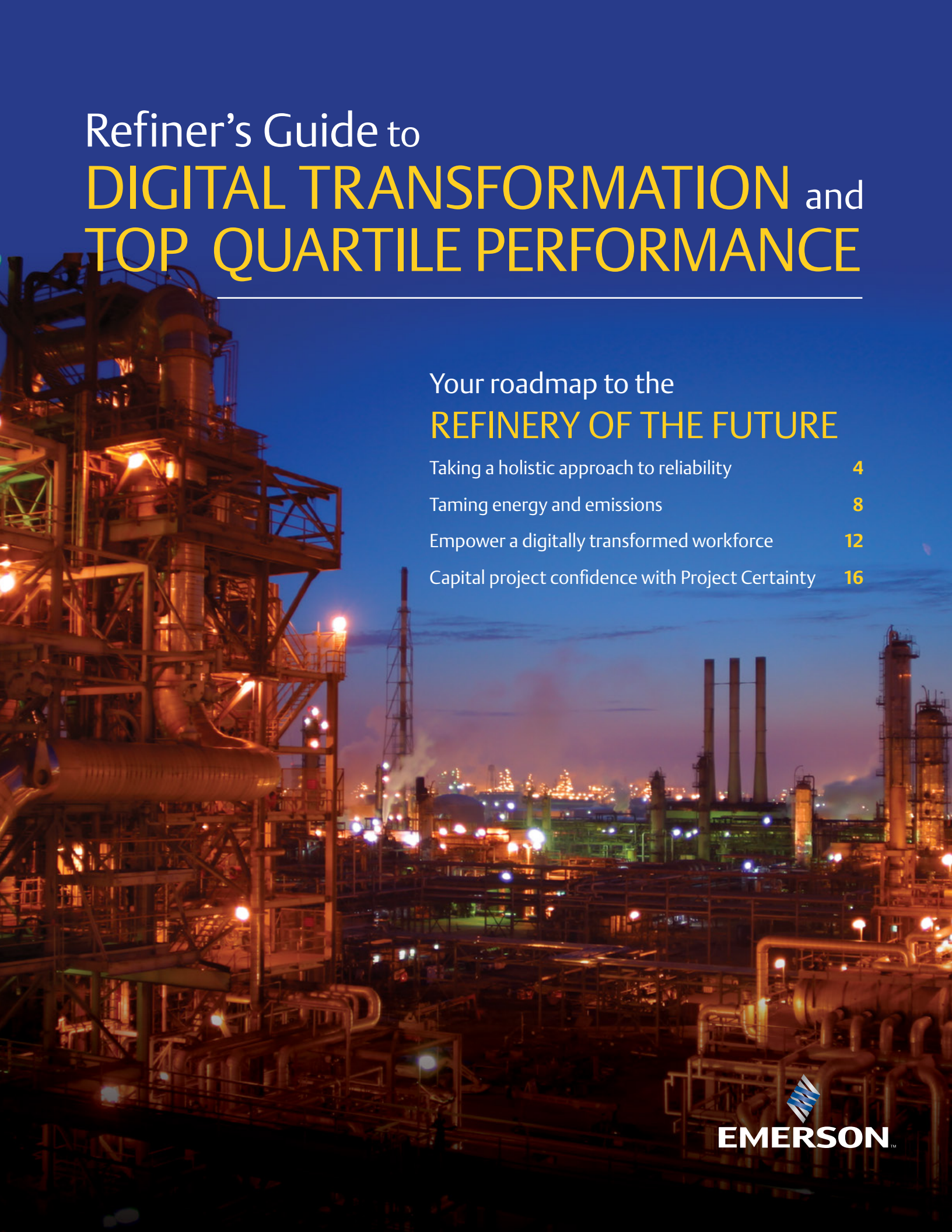
Refiner's Guide to DIGITAL TRANSFORMATION and TOP QUARTILE PERFORMANCE



Your roadmap to the REFINERY OF THE FUTURE

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Creating a clear and actionable roadmap for **digital transformation**

Marcelo Carugo
Vice President
Global Refining and Chemical Industries

The refining industry is constantly changing. There are new regulations, new opportunities with discounted crude oils, changing distribution patterns, and new competitors on the scene. As a result, refineries are challenged to adapt to an extremely complex and dynamic environment—from optimizing process operations to training and upskilling staff—to be flexible enough to capture favorable market conditions, maintain compliance and meet safety standards, while improving efficiency. That's where digital transformation can make a difference.

Digital transformation is not just a buzzword in the refining industry. It is a gateway to Top Quartile performance which translates into profitability. Industry leaders have embraced this transformation because it's a driving force enabling them to gain a competitive advantage and achieve their operating and business objectives.

Based on extensive interviews with refinery executives globally, three essential conditions were identified as the keys to digital transformation for the refinery of the future. The first one is operational agility. This involves being able to efficiently process different feedstocks while avoiding asset degradation, becoming more flexible to accommodate changing demands for different products, and producing more products for markets not traditionally served.

The second imperative is achieving Top Quartile performance-level availability, which is related to operational and mechanical availability, asset reliability at the site, and best-in-class strategies and technologies.

Finally, the refinery of the future must embrace and implement shared intelligence, where sophisticated new technologies deliver the right information to the right person who can take the right action when needed. In essence, it's about bringing the data to the expert, instead of the expert to the data.

While the industry has incorporated digital technology—such as wireless measurements—into their operations for years, they are currently able to accelerate their digital transformation with new, cutting-edge technologies. Industry leaders who have implemented smart technologies into their operations have access to real-time diagnostics that enhance visibility into their plant operations, turning data into actionable information via advanced analytics. For example, your operators can be alerted to an issue that requires a unit target modification or immediate maintenance on an asset before its performance degrades, which can result in substantial maintenance savings.

We often hear manufacturers asking questions like:

- Where do we start our digital transformation?
- How do we quantify its business impact?
- How do we know if we've accomplished it?

In fact, in a recent study Emerson conducted with the leaders charged with digital transformation in their companies, 90 percent said that having a clear and actionable roadmap was critical for success. Yet only 20 percent said they had such a roadmap. Hardly confidence inspiring.

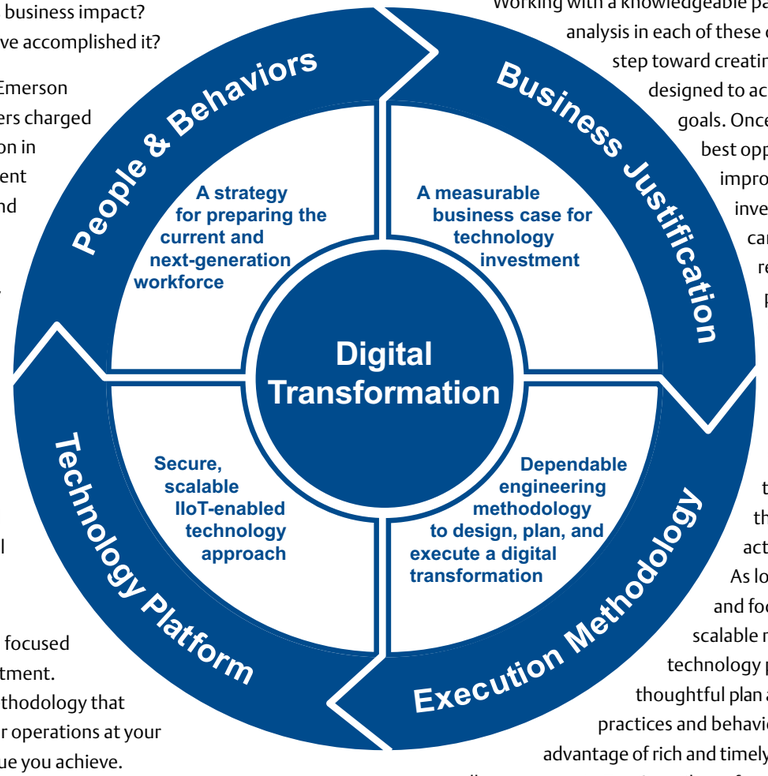
By collaborating with refiners and petrochemical producers around the world, we have observed that there are four critical elements for digital transformation success:

1. Developing a clear and focused business case for investment.
2. Creating a scalable methodology that lets you transform your operations at your pace, based on the value you achieve.
3. Incorporating a flexible technology platform that allows you to effectively start anywhere.
4. Choosing a strategy that includes people and work practice.

Customize your transformation

It's important to note that everyone's roadmap to digital transformation is different, including refineries across the same fleet. Each processing facility needs a customized plan that allows them to start at different places, because no two sites are truly the same. Added to that, each operating unit is at a different stage in its digital maturity. Understanding where you currently are and where you need to go—for measurable business benefit—is the most important part of creating a digital transformation roadmap.

In previous projects, we have typically identified critical operating areas where refiners can benefit from digital transformation, including production optimization, reliability and availability improvements, value chain innovation, sustainability enhancements, and advances in safety and risk management.



Working with a knowledgeable partner to perform a gap analysis in each of these critical areas is the first step toward creating a digital roadmap designed to achieve your operational goals. Once you assess where the best opportunities for improvements and return on investments (ROI) are, you can evaluate the gaps with respect to your other performance goals. Then you can prioritize projects based on ROI, feasibility, operational priority, and available resources.

So, the reality is, digital transformation is not that complicated. It's actually very predictable. As long as you have a clear and focused business case, a scalable methodology, a flexible technology platform, and a thoughtful plan about updating work practices and behavior changes to take advantage of rich and timely information, you can be well on your way to Top Quartile performance.

Emerson has more than 30 years of experience consulting with refineries and other processing plants to digitally transform their operations. In fact, we have developed a proven workshop methodology that enables manufacturers to target the highest value opportunities and create an action plan that minimizes risk. We have implemented this method with dozens of refineries around the world, and manufacturers are finding it to be an extremely effective way to not only get started on their digital transformation, but also achieve measurable improvement quickly.

Achieve Top Quartile performance in refining.
Emerson.com/Refining

From cultural shifts to tactical strategies: Ensuring refinery reliability takes a **holistic approach**

Will Goetz
Vice President
Digital Transformation

To achieve the highest return on investment, the goal is to extract as much margin as possible from an asset, which means being able to run your refinery at the rate of demand needed to make the highest margin products. This requires identifying the areas where you're missing opportunities and losing money, and then taking action.

Companies performing in the Top Quartile are doing just that. By generating dramatic asset performance gains of more than 400 hours of operations per year, they gain two additional weeks of productivity, allowing them to capture more margin opportunities that go right to the bottom line.

But to realize these benefits, refiners should take a holistic approach to reliability, beginning with a top-down vision rather than taking a reactive maintenance approach, while at the same time, empowering their personnel to affect real change at the most tactical, fundamental levels.

Start by assessing common problems

Perform an assessment of the three most common problem indicators—unplanned downtime, overstocked spare parts, and stranded technology—to find opportunities to optimize asset performance. From there, you can then develop a roadmap and cultivate the organizational cultural shifts necessary to improve reliability, and ultimately, production.

Making this journey is well worth the effort. Those performing below the Top Quartile will often see 2-to-14 percent more downtime, according to a recent Solomon reliability and maintenance study. The study also indicates that poor performers can spend two to four times more on maintenance costs than Top Quartile performers.

These percentages add up to serious money. A 250 thousand BPD, lower quartile refinery, for instance, spends an average of $10 to $30 million per year more on maintenance than a Top Quartile refinery.

That is a lot of profit left on the table. In refineries that rely on preventive and reactive maintenance, as much as 60 percent of maintenance labor is unproductive or unnecessary. Underutilization of data from process sensors and equipment monitoring technology and overinvestment in spare parts are also areas that can be improved to free cash flow for more strategic purposes. By benchmarking plant operations against peers, companies can identify which of the three major issues presents the biggest opportunity for financial gain and how they can devise strategies that drive improvement across all three.

Utilize data to fix asset issues early

Many plants have incorporated smart technologies to manage the production process, along with devices capable of indicating equipment failure that leads to downtime. Companies have also spent substantial money on protection systems to shut down machines, vastly reducing the possibility of catastrophic failure and long downtimes. What if these same tools could provide even earlier notice of developing problems?

They can. Often, multimillion-dollar investments in process management and condition monitoring systems include capabilities for detecting failures that are not being used. More information can be extracted from these investments to identify the cause of failures and fix equipment earlier and plan repairs at times when the output of an asset is least valuable. Even more importantly, this information can be used to evaluate when continuing operation of an asset could pose a safety risk.

Equipment condition information can be leveraged to remedy all three problem indicators. By better understanding when a problem might arise, a refinery can stock only those parts needed when a situation requires action, freeing capital for more productive uses. Unplanned downtime can also be dramatically reduced, since you will see failures well in advance, opening many more opportunities for improving margins. In addition, the ability to plan and perform repairs only when needed can allow staff to shift from reactive and periodic maintenance to more productive activities.

Changing the mindset, one step at a time

Still dubious about the gains that can be achieved by taking actions to recap these excessive expenditures? While it's important to set the right tone for improved reliability at the top of your organization, it's equally imperative to empower your staff to start small by identifying the root cause of issues at a single plant or unit.

This means embracing the notion that big changes often come from a series of small changes over time. By creating a work environment that welcomes seemingly small process-related improvements and fosters better work habits, over time you'll see dramatic, reinforcing impacts down the line. The organization can then measure the effectiveness of the actions taken to validate the improvements, and benchmark those results against peers. And once assured of the benefits, they can confidently extend those process improvements to other areas of the refinery.

By taking a holistic approach to reliability and a tactical, step-by-step approach to empowering your staff to be good stewards of that approach, you'll see considerable financial benefit for your refinery. A measured data-based approach which can reveal when an asset is going to break or fail, will not only decrease maintenance costs and increase profits because you will be producing more, it will also make your refinery safer for your people.

And that's good news because otherwise no one in a large company could ever make a difference. There are many examples where one person started a major change in company dynamics from a seemingly small initiative. Seen in this light, reliability is all about taking that small step, no matter how seemingly tactical or even insignificant, toward broader, systematic reliability goals. And when the big ideas work in concert with the smaller, continuous changes, it's a winning combination.

Learn about Operational Certainty for reliability.
Emerson.com/RefineryReliability

Making refinery safety a top priority
for your people, plant, and processes

Tim Olsen
Business and Technical Consultant
Refining Industry Solutions

The risk of storing, processing, and transferring toxic, hazardous, and flammable materials can keep any refinery manager on edge. And although the refining industry has always been focused on safety—and overall rate incidence reports have been decreasing—there is still room for improvement. According to the American Fuel and Petrochemical Manufacturers (AFPM), the top three leading causes of Tier 1 and Tier 2 incidents between 2012 and 2016 were due to issues with piping, atmospheric tanks, and pumps.

Refiners who embrace new strategies and technologies that reduce their personnel's exposure to hazardous environments and materials, and integrate more accurate, reliable, and regulatory-compliant process equipment, not only enhance personnel and site safety, but also improve uptime and production, and protect their refinery's reputation and bottom line.

Personnel safety first

For your people who make the rounds to enable your refinery to operate smoothly, safety is everything. Even though a typical refinery spends less than 10 percent of its time in transient operation—those hours surrounding a plant shutdown or startup—it's also the time when 20-to-30 percent of process safety incidents occur.

What often leads to these dangerous shutdowns and startups is loss of containment due to overfills, leaks, and corrosion of the processing equipment itself. Also, the dual threats of a malfunctioning safety instrumented system (SIS) can result in a failure to act during an emergency or falsely trip and cause an unscheduled shutdown.

Reducing risk to your personnel starts by understanding where the imminent risks reside within the refinery and the methods and equipment available to best address the situation. For newer refineries, access to additional information and insight to impending issues make risk mitigation in hazardous environments significantly easier to address, while older refineries must find new methods to retrofit older wiring and instruments to safely operate the plant and reduce risks.

These solutions should include better methods of flame and gas detection in the most hard-to-reach and dangerous refinery environments, the ability to use more wireless sensing and analytics to eliminate the need for personnel to do manual data collection in dangerous areas, and more accurate, reliable methods of toxic gas detection that further keep your personnel out of harm's way.

Widening the lens, location awareness technology makes refinery-wide safety measures even easier to integrate, giving managers a snapshot of the location of everyone in the plant through rechargeable wearable tags, and in emergencies, the ability to quickly account for personnel. This is especially useful for confined space entry and activities related to turnarounds when numerous contractors are present who may not be as familiar with your refinery.

The inseparable link between site and personnel safety

With personnel safety top of mind, shift your focus to the underlying root causes for site safety incidents themselves—process equipment failures. According to the National Response Center Database, approximately 40 percent of process safety incidents can be tied to mechanical integrity across all processing industries.

If the SIS incorrectly alerts users to a problem that doesn't actually exist or fails to act, it can mean an imminent issue is not properly detected and acted upon. This can cause serious and potentially life-threatening incidents such as a fire or explosion, resulting in extended shutdowns, staff injuries, lost production and revenue, and fines.

With the direct correlation between improving asset reliability and equipment health to the cascading effects on personnel safety-related incidents within the refinery, it's easy to see why automated solutions and third-party safety expertise can be helpful in providing a clear path forward to mitigating site safety incidents.

Using wireless and online monitoring solutions for overfills, leaks, and corrosion issues, you'll gain better insight into the integrity of your refinery, as well as minimize the need to send personnel into dangerous areas. Also, safety-certified instruments and partial stroke testing help optimize SIS performance to ensure your plant operators and safety managers have high confidence in safety system monitoring and responses.

No matter the issue, the age of your refinery, or the current state of your safety strategy, Emerson can help. With our certified functional safety experts and professionals, along with world-class automation and monitoring capabilities, you'll be able to reduce risk to refinery personnel and mitigate site safety incidents, allowing you to focus on what matters most—keeping staff safe while maximizing your plant's production and profitability.

Learn more about improving safety.
Emerson.com/RefinerySafety

2012–2016 Tier 1 and Tier 2 Safety Events Reported by AFPM

Leading causes often involved fixed equipment mechanical integrity issues caused by corrosion, erosion, cracking, and less than adequate inspection.

Minimize refinery **energy** losses

Pete Sharpe
Principal Consultant
Refining and Petrochemical

While talk of reducing greenhouse gases and carbon emissions tends to dominate headlines, it's the actions we take now on energy consumption and usage that can affect real, positive change, and reduce your bottom line. This is especially true in refining, where energy is normally identified as the second largest operating cost behind crude oil feedstock. And as the cost of that energy fluctuates around the globe—natural gas is currently cheaper in the U.S. but at a premium in places like Europe and Asia—the need to optimize its usage throughout the refinery is on the rise.

Changing feedstock can stress the process

Refineries are taking advantage of discounted crude feedstocks that may not totally match the capabilities of the refinery. This puts additional strain on process systems not originally designed to handle these fluctuating operating conditions and increases the complexity of balancing the necessary energy loads across the sprawling physical footprint of the refinery, all while multiple process units vie for the same sources of energy to operate.

Additionally, processing varying crude oils can accelerate the deterioration of equipment performance. This not only forces operators to increase energy usage when equipment performance starts to lag, it can ultimately lead to costly shutdowns and turnarounds when this equipment fails—dealing a substantial setback to a refinery's productivity and operating margins.

You can't manage what you don't measure

The challenges don't end there. Many refineries lack the necessary flow measurements to avoid unnecessary losses in energy usage. Varying fuel gas properties and fluctuating steam demand can be troublesome because the root causes are difficult to pinpoint and can lead to overly conservative operations that result in producing excess steam beyond requirements just in case more is suddenly needed. And when too much steam is present, it must then be vented or condensed.

Lower your energy usage through optimization

Historically, the traditional methods of dealing with these types of concerns would often involve labor-intensive, time-consuming, and expensive steps. But by understanding these constraints, including the relatively new ones such as varying crude feeds and product slates, refinery managers are in a unique position to evaluate new technologies and opportunities that exist today to help reduce overall energy consumption in a much more timely, safe, and cost-effective manner.

These include solutions that not only enable refinery staff to better plan and prepare for the various crudes coming into the refinery, but give them greater visibility into equipment performance and help them better manage energy needs across the refinery. Other tools and technologies offer the ability to implement predictive diagnostics that give operators information about equipment degradation, provide real-time asset monitoring through wireless sensors and existing infrastructure, and receive real-time alerts for any detected issues. They are the kinds of innovative solutions that help the refinery plan ahead for maintenance prioritization.

Better still, advanced technologies available today are now designed to more accurately and efficiently analyze the feedstocks coming into the refinery. This saves time, money, and energy usage as more reliable crude characterization translates to more informed decisions on how the refinery supplements its various feedstocks and how it optimizes its blends so that varying crude feeds and product slates work better with existing process equipment.

With Emerson, you'll have the software solutions you need to automate the process of mapping and managing energy consumption across your refinery, as it is being consumed—so you can keep your people safe and meet regulations.

Learn more about reducing energy usage.
Emerson.com/RefineryEnergyEmissions

Control **emissions** to meet changing regulations

Ed Schodowski
Director, Refining Sales
Industry Solutions

As environmental regulations across the globe change at a rapid pace, refineries need to do more than simply adapt. Not only must you keep pace with these regulations, you've got to seek proactive and predictive methods for reducing emissions.

While North America is enjoying the benefits of lower fuel costs, many world areas are struggling with the high cost of energy in their facilities. However, in both situations, it greatly benefits refineries to decrease energy usage, not only to become better producers by keeping production costs down, but to minimize greenhouse emissions. With that in mind, top performers in the industry who strategically invest in their energy and emissions performance can achieve a competitive advantage with lower energy costs and less risk of fines. And those fines can be hefty. In the last decade, U.S. refiners have paid millions of dollars in fines for flare violation penalties alone.

Rollout a plan to reduce emissions and increase ROI

You can start developing a strong flare management plan by employing wireless pressure relief valves (PRV) monitoring solutions that can quickly identify the source of release in your flare system, as well as deliver information needed for compliance. Plus, efficient gas analyzer technologies that add a fast, 1-minute BTU measurement for precise control of flares, enable refineries to easily comply with new regulations that tighten monitoring frequency of flare vent gas components.

These solutions can also deliver a large return on investment (ROI). One of the largest refineries in the world benefited from using a continuous online acoustic monitoring network. Due to the alarms and asset health indications, operators were able to initiate corrective actions which saved the refinery $500,000 in hydrogen from leaking vent valves and PRVs, and over $200,000 in hydrocarbon losses from leaking flare valves.

By working with Emerson energy and emission consultants, refiners can implement an enterprise-wide program to save energy and reduce emissions. For example, because the physical footprint of a refinery presents constant challenges for detecting gas leaks and fugitive emissions, experts can help you discover problem areas and suggest solutions to better control and reduce emissions. With access to a complete line of automated solutions and resources that eliminate the root causes of emissions—you can launch a customized emissions control program and rest easier knowing your refinery will meet environmental regulations which will protect your people, community, and reputation.

Enhance your ability to meet changing regulations.
Emerson.com/RefineryEnergyEmissions

Production levels: Are they all they could be?

Unlock the **rich data** in your refinery to achieve Top Quartile performance

Doug White
Principal Consultant
Refining Industry Solutions

Ensuring that your refinery is flexible enough to accommodate a variety of discounted crudes and adjust production to meet critical customer commitments sometimes feels like walking a tightrope with just the right balance between the financial benefit these crudes offer and the increased fouling and corrosion they cause to your assets.

Unfortunately, when your refinery takes advantage of the increasing number of discounted opportunity crudes, your assets are at risk for corrosion in unexpected places, and accelerated fouling that can impact production capability for the entire refinery. This makes it challenging to meet your production targets.

Like many refineries, your staff may lack sufficient visibility into equipment health. Without visibility and analysis on the condition of your equipment, it is impossible to accurately know the current state of your refinery. Compounding this issue, many refineries still choose route-based data collection. Unfortunately, this basic method of manual monitoring is performed infrequently and uses valuable and limited resources that should be eliminating problems rather than hunting for them. And, because this approach results in large gaps in asset health data, your refinery is at greater risk for downtime, which may result in revenue loss—not to mention an increased risk for a safety or environmental incident.

How to increase asset availability and plant utilization

Refiners rated as having Top Quartile production performance greatly benefit from lower operating costs and increased asset utilization. A first step toward reaching a higher level of performance involves gaining insight into the state of your refinery's assets, so your operators can get the right data and analysis on performance to take corrective action before equipment failure results in a shutdown or slowdown.

This approach worked well for a large Gulf Coast refinery which made an automation upgrade for a coker and hydrocracker, resulting in a 50 percent reduction in lost availability due to unscheduled shutdowns and slowdowns. The improvement in these two units alone was worth $1–$2 million per year in increased margin.

Tips for producing more yield

Accurate knowledge of refinery losses and consumed energy is another key to maximizing product yields. In fact, many refinery managers discover that through systematic review and upgraded measurement data, software, and procedures, these losses can be significantly reduced.

Of course, with technology continually becoming more complex, having a highly skilled workforce is vital. Lack of training often prevents your staff from making full use of the available technology and results in your plant running at performance levels that are below its potential. Fortunately, there are cost-effective and efficient training alternatives available that can rapidly help your staff become proficient with applying these technologies.

While Emerson's automation and monitoring capabilities can empower refineries to maximize availability and production efficiency, to get the most out of any advanced technology it must be used correctly. Working with Emerson consultants, you'll gain the ability to implement processes that will help your staff make the cultural shift and behavioral changes needed to take full advantage of these technologies.

Ready to maximize availability?
Emerson.com/RefineryProduction

Dennis Belanger
Director
Operational Certainty Consulting

While online data from sensors has been available for decades, the low cost and quick installation time of wireless sensors compared to their wired counterparts is driving a new digital transformation in refineries around the world. The data from wireless sensors not only provide real-time measurements and valuable insights into asset health, it can spur new ways to integrate work processes and improve the timeliness and accuracy of decision-making for personnel.

With immediate awareness of what's happening around the plant, the potential benefits of a good data analytics program speak volumes—no small feat considering that one refiner indicated it produced 80 billion data items for storage in one year from four sites, while another manufacturer referenced a corporate historian with 10 million tags across 15 sites.

Big data translates to big dollars

McKinsey has ranked Big Data Analytics as one of the top potential technologies that can increase productivity and GDP over the next few years. Among business sectors, manufacturing was the lead with an estimated overall GDP yearly increase of $125–$250 billion. Bottom line benefits include lowered maintenance costs and energy usage, reduced downtime, and mitigated safety and environmental incidents.

So, what's standing between refiners and this more digitally-connected, data-driven, dollar-rich future? For starters, given the huge volume of data being generated by more sensors and instruments found in the plant, one can imagine it's simply a steep uphill climb to decide where to begin, whether to store onsite or in the cloud, and how to make sense of what's being acquired.

Once refiners have conquered ways to handle this raw data, they must then be able to validate and analyze using the appropriate parameters and alerts to uncover the trends—and account for the anomalies—that will help predict equipment or process failures.

Training staff is critical

While new technologies are making it easier than ever to get a head start on analyzing this data, refiners will need to also ensure they have properly trained staff that act on the findings and take timely corrective actions as needed.

With challenges outlined, solutions emerge. These include working with an automation solution partner that has the deep industry and technology expertise to understand the refinery's strategic goals and current situation. It also requires an understanding of the business workflow, operations and maintenance philosophies of the site, and the existing roles within the refinery and the need for collaboration between those roles. The emergence of digitalization has noticeably increased the need for IT skills, and collaboration with OT is essential.

It continues by implementing more of today's modern automation systems to unlock the value found in advanced process control, statistical monitoring, data quality verification, and more. From there, a control room operator can be presented with not just more data, but more effective information that allows him or her to make the required decisions and actions in a timely manner.

Once a refiner's finger is on the pulse of the plant, the benefits—and positive returns—will validate the case. Because for all the data and numbers in the world, wouldn't zero be a nice one to achieve when it comes to safety incidents, excess energy usage, unscheduled downtime, and lost-profit opportunities?

Turn data into usable information to transform your business.
Emerson.com/RefineryDataAnalytics

How refiners can empower a **digitally transformed workforce**

Peter Zornio
Chief Technology Officer

It's no secret that the refining business has a people problem. Like manufacturers in other industries who rely heavily on technology to stay competitive, refiners understand the need to transform their operations by extending the Industrial Internet of Things and other digital innovations across a wider range of possibilities. What many managers struggle with is how to integrate these changes into their workforce while considering the impacts they will have on their broader organizations over time.

While challenges certainly exist, the truth is that only when refiners link their technology and personnel strategies to their business objectives, embed expertise into their work processes, and optimize their operations in every way they can using real-time data does achieving Top Quartile performance become possible.

Managing the skills shortage

As operations become increasingly complex, skill requirements increase, and a generation of seasoned experts retire, millions of manufacturing jobs sit unfilled because of a fundamental mismatch between the available workforce and the skills necessary to fill the jobs. A November 2018 study by Deloitte and the Manufacturing Institute found that 2.4 million open positions currently lie vacant due to skills shortages in the U.S. manufacturing industry.

While many low-skill jobs are being replaced by advances in automation, refiners are short of workers with computer experience, programming skills, and especially, critical-thinking and problem-solving skills with knowledge on running refineries. It should also be noted that the talent shortage, which the industry has seen coming for years now, isn't just about the number of workers entering retirement; it's about how much time—studies show about seven years—is required to get their replacements up to speed so they feel able to do their jobs independently and competently.

Upskilling the existing workforce

Many refiners are finding out the hard way that if their training methods and operational procedures fail to evolve along with technology, then opportunities to maximize the value of automation investments could be missed. Continual investments in ongoing training and work process renewal will pay dividends in obtaining benefits from the new technologies.

Since many refiners are losing institutional intelligence at a faster rate than they can replace it, it's simply not enough for a manager to hold a single training session for their crews to learn a new process or procedure. It's unrealistic to expect students to transfer knowledge gained in a classroom directly to a real-world plant environment without risking safety incidents or production upsets. To ensure knowledge becomes institutionalized, many refiners are utilizing a central support system with subject matter experts who can remotely see and hear what plant personnel are experiencing and provide real-time guidance. Likewise, there is no substitute for hands-on training. The challenge is to find the right blend of training and to also use technology such as traditional or immersive simulation to bridge the gap between the classroom and the real world, accelerating learning.

Attracting tomorrow's leaders

Today there are millions of tech-savvy men and women preparing to join the workforce, but too few of them see refining as a desirable career path. To ensure that it has access to a stream of qualified, motivated staff now and in the future, the downstream industry must shed its age-old reputation and promote the exciting high-tech aspects of the job effectively. The industry is on the cutting edge in many ways, but it simply isn't engaging with recruits to show them how their engineering or programming abilities can be translated into a rewarding career.

Change management is in the air

As integral as change management is to successful digital transformation, it is often one of the biggest roadblocks. This is because of how hard it can be to rethink how people approach their jobs—especially in an industry like refining which has relied on the same work processes for decades. It's easy for management to decree a new policy; implementing it successfully throughout all levels of an organization, with all the psychological factors involved, is another prospect altogether. This may evolve as the new generation of "digital natives" enters the workforce, but it is a real problem now and for the transition period.

A path forward

So how can refiners meet these challenges to transform into a next-generation digital workforce? By analyzing the organizational behaviors of Top Quartile industry performers, Emerson has

identified five essential competencies that are critical to helping workers achieve digital transformation:

1. Automate workflows by eliminating repetitive tasks and streamlining standard operations.
2. Improve decision support by leveraging analytics and embedded expertise.
3. Increase mobility by ensuring secure, on-demand access to information and expertise.
4. Implement change management by accelerating the adoption of operational best practices.
5. Upskill the workforce by enabling workers to acquire knowledge and experience faster.

To help put these best practices into action, Emerson consultants work with refiners to identify knowledge gaps and formulate detailed plans for digital workforce enablement by giving personnel the skills they need to turn data into better decision making.

Giving trainees hands-on experience with scaled-down versions of actual plant processes and simulations, including 3D virtual reality renderings of the plant itself, allows them to experience a variety of real-world situations that promote problem solving skills under safe, controlled conditions. When paired with blended learning packages that cater to a wide range of learning styles and hierarchies of experience through in-person workshops, online learning, and live virtual classroom instruction, both employers and employees benefit from a more flexible and budget-friendly training program.

Change management is as difficult as it is essential. The best way to accomplish it is to bring together strategies, tools, and experts who can teach managers how to redefine and implement new procedures based on the criticality of a refinery's assets, as well as educate personnel on the principles of change management from a behavioral and cultural standpoint. It is also critical to involve plant personnel up front in designing new technology-driven work processes.

Finally, manufacturers and technology suppliers need to be committed to partnering with higher education institutions to build an employment pipeline that will cultivate the industry. Emerson is collaborating with more than 350 engineering and trade schools worldwide, developing classroom instruction, micro-enterprises, and real-world training solutions that use state-of-the-art equipment.

Partnerships between industry and education are critical to delivering the promise of an effective digital workforce and represent an exciting opportunity to upskill personnel to become productive and versatile contributors.

Taking all of these steps towards transforming your workforce will maximize the return on your investments—now and for generations to come.

Enhance your staff's capabilities.
Emerson.com/RefineryWorkforce

Fuel blending: The key to unlocking your refinery's cash register

Patrick Truesdale
Principal Solutions Consultant
Industry Solutions

Many refineries fail to give their blending area the attention it deserves. But it is worth reevaluating this attitude, since fuel blending is essentially the "cash register" of the business. Because this area is where profits can be made or lost, it should receive the investments necessary to be efficient and flexible, and able to quickly accommodate changes in product blend and the shipping schedule, for example. Plus, the continuing evolution toward more stringent product specifications places increasing pressure on the blending area to get it right the first time.

Change the traditional way of holding inventory

Successful refinery managers are making headway in the industry by adopting inline blending to eliminate expenses around building and maintaining tanks and save millions in working capital by no longer holding excessive inventory. This approach is currently used by industry leaders.

Inline blending capabilities save Valero Pembroke refinery millions in reduced tankage inventory and product giveaway.

Valero Energy Corporation took advantage of this business philosophy by implementing a new control system and single-blend optimization system that makes it possible to blend gasoline directly into tanker ships for delivery. This new approach not only saved the Pembroke refinery millions by reducing tankage inventory, but also significantly reduced Valero's product giveaway costs.

Other refineries willing to make changes to reduce or eliminate the need for tankage will dramatically reduce their working capital costs as well. To follow in the footsteps of the Top Quartile performers, you must enhance your refinery's reliability and efficiency, and always operate your process units correctly to eliminate process upsets or unexpected downtime. This will make your refinery a strong candidate for inline blending certification.

Automation upgrades offer strong ROI

Regardless of where you are on the spectrum for inline blending, it's worth taking a hard look at blending improvements you can make within your geographic footprint to eliminate inefficiencies. For instance, in the U.S. market alone, where refiners lose about $3 billion each year due to quality giveaway, there are many cost savings and high ROI opportunities to be gained from the right modernization strategy. By upgrading your blender with advanced automation technologies, you'll improve profits by minimizing product giveaway and excess touch-ups, as well as more easily maintain regulatory compliance. And, when you take advantage of the right inline blending analyzer, you can improve your quality testing processes, saving time and cost. Plus, enhanced automation, monitoring technology, and more precise control is the most economical way to respond to current blending complexity trends requiring blenders to process additional components to meet more stringent product specifications and handle increased throughput.

So, whether you are on your way to becoming a Top Quartile performer preparing for inline blending certification or upgrading your existing operation, there are many options for ensuring your refinery's cash register has the flexibility and agility you need to meet market demand and take advantage of profitable opportunities.

Ready to improve your blending operations?
Emerson.com/RefineryBlending

Better business results through flexible **logistics** operations

Joseph Nassif
Director
Terminal Industry Programs

While there are refiners seeking third-party terminal services to reduce complexity in their organization and gain economies of scale, many refineries continue to operate their own site to augment their business. To be competitive and profitable, plant and offsite managers strive to reach Top Quartile performance. This goal requires improving operations to become as safe, efficient, and flexible as possible. For tank farms that also handle fuel blending before transporting final products, flexibility and agility are even more vital since blends are becoming increasingly complex due to ever-changing regulations and market demand.

Safety first

Whether working with crude oil, intermediary, or end-product tanks, tank farm personnel face similar challenges. First, they must ensure safety and maintain compliance with all regulatory requirements. Implementing advanced automation, predictive maintenance technology, and overfill protection can help them achieve these goals. Plus, tank farms that discontinue manual maintenance practices, especially in hazardous areas, will keep personnel safe by using wireless technology as the enabler to automate tank gauging, as well as pump and valve operations.

Of course, cost-effective flexibility can be challenging for a business that runs on fixed coordinates, assets, and related infrastructure. A fixed cost structure for maintaining hourly and salaried staff adds to this challenge.

However, by developing a flexibility roadmap that involves partnering and collaborating with key suppliers, many Top Quartile performers successfully implement automation and technology designed to improve agility and allow them to benefit from a large ROI.

Stop sacrificing profitability

Many offsite managers are implementing sophisticated decision support software (DSS) to efficiently manage terminal scheduling in a dynamic environment. In addition, leaders want solutions for solving other challenges, such as customer transfer, logistical, inventory, safety, and environmental issues—while gaining a large return on investment—to achieve Top Quartile performance. After implementing Emerson's terminal management solution and control system, Vopak—the world's largest independent terminal company—gained substantial benefits, such as reduced project lead times, improved safety, and lower costs.

Reliability is also required for exceptional performance. Complex, stand-alone systems and manual processes can create islands of chaotic processes, resulting in last-minute, hectic maintenance practices due to a lack of predictability and asset performance insight. When personnel are unaware of when and which assets will fail or deliver poor performance, the terminal risks sacrificing revenue.

Working with Emerson experts to develop a conceptual site layout and engineering design, as well as implement an automation strategy with predictive technology and DSS, managers can minimize risk and costs for asset maintenance, while enhancing scheduling and profitability.

Ensure safety while improving flexibility and availability.
Emerson.com/RefineryTerminals-Logistics

Capital project success: Your roadmap

Jim Nyquist
Group President
Process Systems and Solutions

The complexity of today's capital projects is causing a widespread loss of value and confidence due to project overruns. Projects are larger, more technical, and running at a faster pace than ever before. Yet decades-old project methodologies can't keep pace. And that means it is time to rethink capital projects and transform these outdated strategies with digital technologies, high-end expertise, and the power of automation.

When it comes to the current capital project environment, research and experience show that over the past 10 years, 65 percent of capital projects valued at over $1 billion have failed—meaning they were either 25 percent over budget or 50 percent late.

Not only is valuable investment capital being wasted, but company performance is also damaged—which drags down company profitability, shareholder value, and the ability to grow the business.

To gain a better understanding of what's been happening, Emerson worked with an industry benchmarking company and studied over 400 capital projects and found that Top Quartile companies completed the same project for half the cost and in half the time compared to fourth quartile companies. Two primary issues causing this type of variance are increased complexity and outdated methods.

Complexity of scope, challenging locations, and technical complexity may be obvious. But recognizing how "traditional" or outdated methods are holding us back is perhaps a new insight—especially when faced with creating a more sustainable business model in a rapidly changing landscape focused on competition, price pressure, and higher risk.

Leveraging automation to ensure ontime completion

A fresh approach for success in today's market features digital technologies that can automate workflows—and wireless instruments that can eliminate field engineering and wiring costs. There are also new analytics that create smarter plants and of course the ability to build full digital twins of both the plant and the control system.

Over the past few years, budgets have been increasing, but so have expenditures—and larger overruns often exceed those budgets. While best practices are helpful for bringing cost and schedule overruns back in line, they are not enough.

But, what if automation could be leveraged to make the plant commissioning schedule shorter, more predictable, and ensure on-time completion? Making a fundamental and transformational reset of design, engineering, and project management can also have a dramatic and measurable impact on your entire project.

It's time to digitally transform projects. So, where to start?

Begin by eliminating costs. By utilizing technology to automate steps in the process that reduce engineering hours, and using standard technologies to reduce design hours, construction materials, and labor, you can automate workflows and eliminate unnecessary work which can result in substantial project savings.

Next you must reduce complexity. Projects are complicated enough, so you might start to simplify the project by using secure Cloud engineering to decouple supplier dependencies, work concurrently across functions with better interaction, and improve data and document management.

Your third imperative is having the ability to better accommodate changes. The most fundamental values technology can add to a project are speed and flexibility. What if you could end plant start-up delays by better accommodating automation design changes during the project with less impact on the schedule?

All these benefits are possible with Emerson's Project Certainty program, a transformational approach to achieving Top Quartile performance on capital projects. To take advantage of these and other innovative digital technologies and engineering approaches requires defining a strategy early in the project, during Front End Engineering and Design (FEED). After FEED, it's too late.

A foundational element to achieving the project performance you seek is to partner with a Main Automation Contractor, or MAC, to help design and implement the best digital transformation strategy for the project. It is a proven driver of project execution success and starts early—in Pre-FEED and extends all the way through commissioning. If done right, your automation partner will manage all aspects of the digital project and provide information at every stage; bring expertise to optimize design for performance versus cost; create value improvement programs; assist with standardization; bring dedicated teams with formal execution processes; and keep automation on track throughout the project, including during commissioning.

By following more effective methodologies and adopting new digital technologies, you can digitally transform your project and set the stage for maximizing the profitability of your plant and ROI over the next 20 to 60 years.

Transform your operations with Project Certainty.
Emerson.com/RefineryProjectCertainty

Your **technology modernization strategies** can make or break performance

Duncan Schleiss
Vice President, Business Development
Process Systems and Solutions

In the consumer products arena, we have seen a revolution in the deployment of core digital technology enablers. The connected smart home now offers completely different ways of home management—all enabled by a digitally secure, connected, and often wireless communication infrastructure.

But given the investment required, the industrial sector has been slow to digitally transform its operations, which includes updating industrial facilities with a digital architecture powered by smart sensors and control elements. For those refiners who are ready to transform their organization, there are several major business results that can be realized, including the ability to:

- More easily comply with new safety standards.
- Manage asset obsolescence more effectively.
- Leverage machine analytics to improve availability.
- Increase profitability with embedded advanced control.
- Access remote experts who help fill the skills gap in real time.

How to gain the competitive edge

With global competition, market growth, and in some cases market survival, it is essential for refineries to strive to achieve Top Quartile performance by investing in new technologies and processes while continuing to optimize the performance of their current assets. These investments enable refiners to gain a strategic advantage and competitive differentiation in the marketplace, as well as more easily meet changing clean fuel and emissions regulations.

The key to success hinges on engaging early with an automation partner that can help you minimize modernization project costs and mitigate risks. Additionally, your ideal automation partner should have these attributes:

- Proven track record as a main automation contractor (MAC) for modernization projects.
- Proven experience with hot-cutover migrations to modern secure digital architectures.
- The conversion tools needed to ensure seamless integration of existing configurations into the new DCS.
- A wide variety of built-for-refining solutions including digital twin technology, plant optimization, dynamic alarm management, and layered, advanced machine learning.
- Remote availability to experts who can collaborate and problem solve with plant personnel in real time.
- The flexibility to adapt solutions to your specific priorities to maximize your ROI.

Partnering with an experienced MAC

Working with the right automation partner also means taking advantage of capabilities designed to deliver a payoff with the ability to predict plant asset performance, extend asset life, avoid surprises, and reduce safety and environmental risks.

By engaging Emerson as the MAC early on a project that included more than 400,000 man-hours to retrofit nine units, a North American refiner benefited from zero plant shutdowns during hot cutover. Since the implementation, the refinery realized $40 million in savings due to modernization and continued optimization projects.

Once implemented, you can achieve a variety of sustainable business advantages. In addition to profitability and large ROI, modernization improvements can directly impact other performance metrics such as optimization, reliability, and HSSE.

Ready to take control of your modernization projects?
Emerson.com/RefineryModernization

No more silos: OT and IT team up to tackle **cybersecurity**

Rick Gorskie
Global Sales Manager
Cybersecurity

In today's digital age, cybersecurity threats are pushing refineries to re-examine their cybersecurity strategies. Gone are the days when information technology (IT) and operational technology (OT) could function separately in protected silos. Now, the need to share resources and information is critical, especially when both are working with automation suppliers to better respond to today's complex and costly cybersecurity landscape. In fact, the Center for Strategic and International Studies and McAfee report that cybercrime has cost the world almost $600 billion, or 0.8 percent of global GDP.

> *The Center for Strategic and International Studies and McAfee report that cybercrime now costs the world almost $600 billion, or 0.8 percent of global GDP.*

Begin by assessing current practices

The assortment and complexity of threats have increased enough in just the past few years to invite a re-examination of how well the refining industry protects itself. And that starts by tasking the refinery's IT and OT groups to first evaluate and assess its current cybersecurity practices and analyze any current defense measures already in place. Together, they must look at ways to better bridge gaps and work more closely together to devise strategies based on new technologies to update procedures. But refiners must also not forget about the power and value of expert consultation when devising new cybersecurity strategies, especially when an outside perspective can take an unbiased look at what's working and what needs improvement.

By working with Emerson, a trusted automation supplier and expert well-versed in the network and system security requirements and levels outlined in the International Society of Automation's (ISA) IEC 62443 series of cybersecurity standards, refiners can gain further insights to develop and maintain strong cybersecurity strategies, work processes, training, and ongoing support. And just as continuous monitoring of the refinery's process variables is critical for its control and safety applications, so is ongoing cyberdefense monitoring and having counter measures in place to reduce the risk of a cybersecurity incident.

Develop and update your cybersecurity incident response plan

At a detailed operations and equipment level, refineries also stand to benefit from today's more advanced distributed control systems, which now have many layers of protections based on the IEC 62443 family of standards for how control systems should be developed, deployed, and maintained to dramatically enhance the cybersecurity of these installed systems. It's also critical to develop cybersecurity incident response plans so that plant personnel know what to do in the event of an issue.

No matter the technology already in place, the strategies at your disposal today, or the ways in which your IT and OT teams currently collaborate, the methods to strengthen your refinery's cybersecurity approach are well-established and can improve your plant's cyberdefense posture. Now's the time to get ahead of the issue.

Get ahead of cybersecurity issues.
Emerson.com/RefineryCybersecurity

Discover how digital transformation can accelerate Top Quartile performance in your refinery.

Emerson experts can help you achieve Top Quartile performance

Learn how Emerson's refining consultants can guide you through the digital transformation process with expertise in modernization, digital technology, workforce productivity, and cybersecurity.

Ready for the next step? Visit www.Emerson.com/Refining and ask an expert to help your team identify and prioritize projects for achieving operational excellence.

North America
Emerson Automation Solutions
8000 Norman Center Drive
Suite 1200
Bloomington, MN 55437
USA
T +1 952 838 3500

Europe
Emerson Automation Solutions
Neuhofstrasse 19a
6340 Baar
Switzerland
T +41 (0)41 768 61 11

Middle East/Africa
Emerson Automation Solutions
Jebel Ali Free Zone, South 2,
street no. S210
P.O. Box 17033
Dubai, United Arab Emirates
T +971 4 8118100

Latin America
Emerson Automation Solutions
1300 Concord Terrace, Suite 400
Sunrise, Florida 33323
United States
T +1 954 846 5030

Asia Pacific
Emerson Automation Solutions
1 Pandan Crescent
Singapore 128461
T +65 6777 8211

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