



# Maximizing Investments through Operational Excellence

Enhancing Production, Reliability, Safety, and Sustainability

A company's management team is **constantly evaluating how and where it will invest its finite capital resources**, and where not to invest. Naturally, there will always be differences within the team as to where those resources can generate the highest return. Some may seem trivial, while others are highly strategic.

## UNDERSTANDING TOP QUARTILE RANKINGS

Solomon Associates' World's Best Refineries report "evaluated key refinery financial metrics together with key operating metrics using a balanced scorecard approach to avoid too much focus on operating costs." Here are four critical ways that Emerson has found top quartile performers earn and leverage their operational excellence:

- **In terms of production**, they spent 30% less on operational expenses when compared to industry averages, while maintaining higher utilization.
- **In terms of asset reliability**, they gained 15 additional production days each year against industry averages, while spending half as much on maintenance.
- **In terms of safety**, they had one-third the number of personnel and process incidents when compared to industry averages.
- **In terms of sustainability**, they use 15% less energy than industry averages, resulting in 30% lower carbon emissions.

"With a global contraction in capital spending, the industry is under tremendous pressure to hit financial targets with existing assets. The key to setting and achieving new performance goals is first understanding what is possible given today's technologies, and which levers can deliver measurable, predictable results."

### MIKE TRAIN

Emerson, Senior VP and Chief Sustainability Officer

## ADVANCING OPERATIONS ACROSS FOUR DOMAINS

-  Production, to reduce operating costs while maximizing facility utilization.
-  Reliability, to maximize equipment availability while reducing maintenance costs.
-  Safety, to reduce personnel injuries, reportable accidents, and disruptive process incidents, while increasing production and product quality thanks to elimination of such obstacles.
-  Sustainability, by reducing energy consumption, thereby also reducing emissions.

The opposite is also true.

Companies that don't invest in operations, or don't prioritize investment, invariably find themselves stuck in a devolutionary cycle of using outdated, unreliable, and inefficient systems. Simply performing both common and critical tasks becomes haphazard and inefficient as workers deal with such drudgery. Truly skilled people may leave for better opportunities and replacing them is difficult. This can cost a company millions in unrealized revenue, reducing profit margins, operational efficiency, and workplace safety. A previously successful facility can quickly slip behind its peers, falling into the third and fourth quartiles.

People in a process manufacturing facility are a critical element of this approach, and their buy-in with improvements makes a huge difference. When they recognize that capital investments are improving their work life, they become more engaged in day-to-day activities. Engaged personnel become innovators and problem solvers, making it much easier to respond to changing business demands. They will find ways to avoid operational losses, reduce costs, protect coworkers, and generally improve profitability.

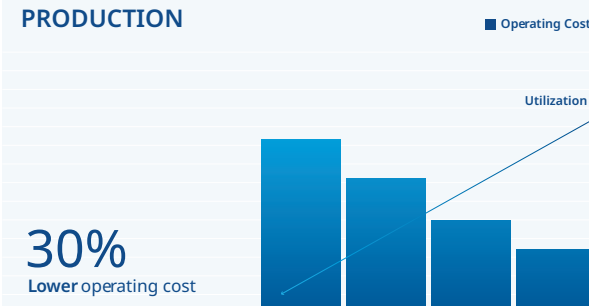
Approximately

# ONE TRILLION DOLLARS

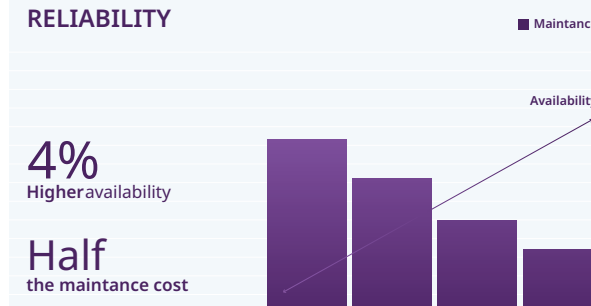
in company value is lost every year to

## SUBOPTIMAL OPERATING PERFORMANCE

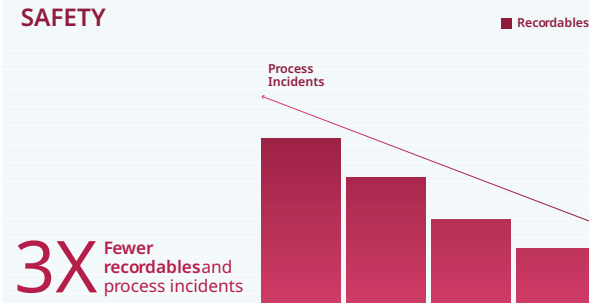
### PRODUCTION



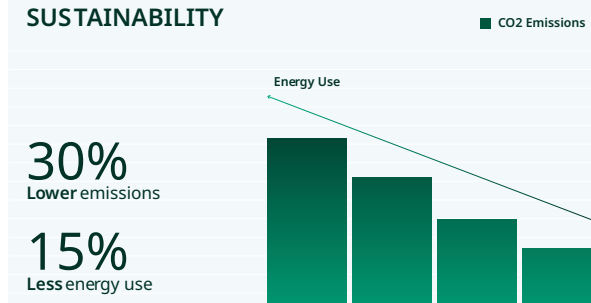
### RELIABILITY



### SAFETY



### SUSTAINABILITY



# Applying Operational Excellence

## ADDRESSING KEY CHALLENGES IN PRODUCTION, RELIABILITY, SAFETY, AND SUSTAINABILITY

**Production:** Budget constraints preclude major plant upgrades. How can we get more from our existing equipment with incremental improvements?

**Reliability:** We lose too much production to outages and maintenance can't stabilize operations. How do we focus our efforts and increase production through higher availability?

**Safety:** Our rate of accidents is too high, along with process upsets. How do we improve personnel safety and reduce outages?

**Sustainability:** Fuel consumption increases multiplied by energy price increases are costing too much and slowing our sustainability program. How do we reduce energy consumption and our overall carbon footprint, without obstructing production?

## PRODUCTION

Over the last 50 years or so, plant and process automation have advanced enormously in parallel with digital transformation initiatives. Putting the question, "Is your plant automated?" to any operating refinery or chemical plant, the answer would be "yes," likely on the basis of the facility operating with some sort of distributed control system (DCS). There may be additional automated subsystems as well. But a thorough audit of the plant would likely yield a range of manual processes

where operators still perform functions necessary to bridge islands of automation and keep the automated and manual elements working together. Upstream sites suffer from this problem particularly.

Today, there are many digital and automation solutions available for process applications, ranging from pervasive sensing technologies and asset management software, to intelligent flow meters and remote monitoring services.

Many process facilities are working with Emerson to digitalize their operations, while changing the ways their workforce interacts with new technologies and processes at all levels. This includes applying a portfolio of advanced automation solutions to deliver secure software and services to enable industrial digital transformation.

Encompassing a full range of services, from sensing technologies and advanced instrumentation, to data analytics and networking, these solutions are designed to help operators improve performance and achieve operational excellence by securely linking operational technology data to their existing information technology infrastructure.

## EMERSON'S PORTFOLIO INTEGRATES INTO ASPENTECH TECHNOLOGIES, PROVIDING MAJOR ADVANCES IN THREE CRITICAL AREAS

**1** Digital twin and simulation capabilities, implemented using AspenTech's HYSYS® process modeling platform, make it much easier to automate procedures, including startup, shutdown, grade changes, etc. These tend to be the last things that plants still do manually, and they are often frequent sources of upsets, and even process safety incidents.

**2** DeltaV™ Mimic for AspenTech HYSYS combines the powerful training, integration, and testing framework of Mimic Simulation Software with the engineering and design capabilities of AspenTech HYSYS. This creates one unified process simulation toolset for multi-purpose dynamic simulation, operator training simulation, and immersive training simulation.

**3** AspenTech's Advanced Process Control (APC) algorithm can deliver higher production and reduce energy use, even with highly complex processes. Using multivariable APC, this tool finds an efficient solution plan for each variable within all process and operating constraints. Its model identification creates high-fidelity, linear dynamic models to predict the open-loop behavior of controlled variables.

### CASE STUDY

## Simulation for optimization

A Brazilian pulp and paper company was evaluating biorefining opportunities through the simulation of kraft processes, driving collaboration and open innovation by teaming with Emerson. A recent project focused on a digital twin to support operational decision-making and optimization. AspenTech digital twin solutions provided insights into the operations to optimize the processes for the new conditions, ensuring stable operations and process safety.

Using the AspenTech model, the project team performed property regression using experimental data, developed the appropriate process models to represent equipment, and validated it against plant data. The model was used to study the effect of various input parameters on the final solids' concentration after evaporation. The next move is to extend these types of high-fidelity models to optimize all operations.

**UNPLANNED DOWNTIME IS THE LARGEST CAUSE OF LOST PRODUCTION.**

Source: McKinsey & Company (2020)



## RELIABILITY

Many process manufacturing facilities have high maintenance costs and struggle with reliability issues. This means there are opportunities for improvement in both areas, cutting costs and increasing production via higher availability, if appropriate strategies can be implemented. If we think of this as a contrast between top quartile companies against lower performers, as the earlier graph illustrates, maintenance costs for lower performers can be several times higher. According to the same study, top-quartile plants also experience very little downtime as a result of equipment problems. Fourth quartile (poorest) performers also experience disruptive levels of down time almost 15% greater than top performers.

This affects a facility's bottom line directly. Doug White, one of Emerson's industry experts, reckons,

**"Every 1% gain in availability is worth \$8.4 million of additional margin capture per year in a typical 200,000 bpd refinery."**

How does a reliability strategy work? Research shows that top-quartile performing organizations invariably possess a set of well-linked elements, illustrated as the Reliability Value Chain. This ties together elements in four categories: data, information, knowledge, and action. It sets the path for transforming data into information, into knowledge, and into action. Ultimately, the ability to achieve top performance status depends on the strength of each element, along with effective connectedness of all into a continuous improvement cycle.

*Each time a company completes the circle, it builds a stronger base for further improvements*



Reliability strategy begins by using analysis to understand and catalog failure modes. Once these are characterized, they can be mitigated by careful selection of maintenance procedures, process parameter data collection, equipment condition indicators, and spares stocking strategies. Asset health analysis is interpreted from an understanding of the failure effects observed from process data and condition indicators, while striking a balance between the engineering characteristics of the assets and the capabilities of the organization to perform the function required within each ring in the chain. Here are two examples of how companies use the Reliability Value Chain.

### CASE STUDY

## Improved Flow Meter Accuracy

A global industrial gas supplier constructed a high-purity gas production unit as a utility for a semiconductor manufacturing facility. The company was running gases into different production areas at different flow rates, but still needed high-accuracy flow readings for each, and the existing technologies were

not providing sufficient precision or reliability. Moreover, the existing flow meters required calibration each year, necessitating system shutdowns.

Emerson provided Rosemount™ 3051S MultiVariable Transmitters in a range of sizes appropriate for each application, each outfitted with a Rosemount™ 1595 Conditioning Orifice Plate. This flow meter solution provided better flow accuracies, including temperature compensated flow, without the periodic maintenance and expensive annual gas audits required with the solution it replaced. The new flow meter solution provides measurements for closed loop control, general purpose monitoring, and custody transfer applications. The gas producer now uses this

multivariable flow meter as a pay-meter for billing transactions between the gas plant and the end user. It is a cost-effective approach and can be calibrated online without a production interruption.

### CASE STUDY

## Developing Predictive Maintenance

Bayer Crop Science operates a plant in Muscatine, Iowa with about 3,200 instruments and field devices across its eight production units. All are linked to AMS Device Manager software and managed by four DeltaV™ DCSes in a cross-domain architecture. Bayer also operates about 750 control valves communicating via Fisher™ FIELDVUE ValveLink software, plus 1,000 plus motors and related assets.

The data yielded by this arrangement made it possible for the reliability team to analyze the alerts sent throughout the facility and determine which required the most attention. They realized that 12 device types

were responsible for 91% of all alerts, and 10 individual bad actors produced 41% of all alerts. Solving those problems saved a lot of effort. The resulting shift from reactive maintenance to a mix of preventive and predictive maintenance practices has increased cost avoidance savings by 67%. A reliability engineer from the site says predictive maintenance capabilities have saved the plant up to \$230,000 per year.

**A REPORT FROM LLOYD'S REGISTER POINTS OUT THAT PREDICTIVE MAINTENANCE HAS BEEN PROVEN TO LEAD TO COST SAVINGS OF 10% TO 40%, YET ONLY 18% OF THOSE SURVEYED IN THE US OIL AND GAS INDUSTRY HAVE ADOPTED THIS APPROACH.**

Source: Haun, 'Predictive Maintenance', Offshore Engineer, (2019)



## SAFETY

Process manufacturing environments create safety concerns with high temperatures, pressures, and volumes of flammable and toxic products as common elements. Safety incidents are highly disruptive to people, can damage equipment, and often bring production to a halt. Hence the need for training and protective equipment for people, combined with a safety instrumented system (SIS) for equipment.

*Safety has many aspects, and Emerson has systems and hardware for all areas.*

With an extensive portfolio of safety and security products, including the widest range of safety-certified instruments and valves, Emerson helps plants reduce risk, avoid incidents, and operate with certainty. From an integrated SIS to fire and gas leak detection solutions, plants can prepare for the unpredictable. Unprepared plants often see an equipment outage escalate into a larger incident because personnel didn't know it was

coming and they don't know how to respond. These situations can be chaotic as workers scramble to diagnose and make repairs under the extreme pressure of getting the plant back up and running.

An integrated SIS combined with effective reliability practices provides predictive insights and actionable data so that maintenance practices can shift to a more proactive mode. Using these tools, workers can track the health of equipment and act to prevent breakdowns, rather than responding to them as they occur. These practices can make a huge difference in both safety and efficiency, with top quartile performers seeing an average of 97% facility availability, and most downtime carefully scheduled for upgrades and repairs. On the other hand, bottom-quartile performers see 86% availability on average, with most downtime unplanned. Instruments, sensors, and monitoring devices, including both safety-certified and conventional, keep an eye on key equipment so performance data can be compiled, shared and analyzed. This reduces the need

for manual inspections of equipment, which means less time for employees in the high-risk operational areas of a facility.

### CASE STUDY

## Refinery Makes Turnarounds Safer

Turnarounds can be difficult as multiple maintenance teams and contractors are all focused on performing many operations in a very short period of time. One refinery was working on tightening up its cleaning and flushing operations so decontamination procedures would not slow larger turnaround objectives. It looked at its existing practices where local instruments for temperature and pressure were mounted on decontamination piping and headers to monitor the steps, requiring operators to read these during manual rounds. This made consistency a challenge, and in some cases, required those steps to be performed multiple times.

To lower safety risks and improve data collection, the plant implemented a wireless approach for instrumentation used with the temporary decontamination equipment. Emerson provided Rosemount Wireless Pressure Gauges with extended remote seals, and Rosemount 648 Wireless Temperature Transmitters, so operators could monitor the processes continuously from inside the control room. When the turnaround was complete, these were reused in multiple applications throughout various process units. These new wireless temperature and pressure devices provided

accurate monitoring with far less risk of upsets or personnel injuries.

### CASE STUDY

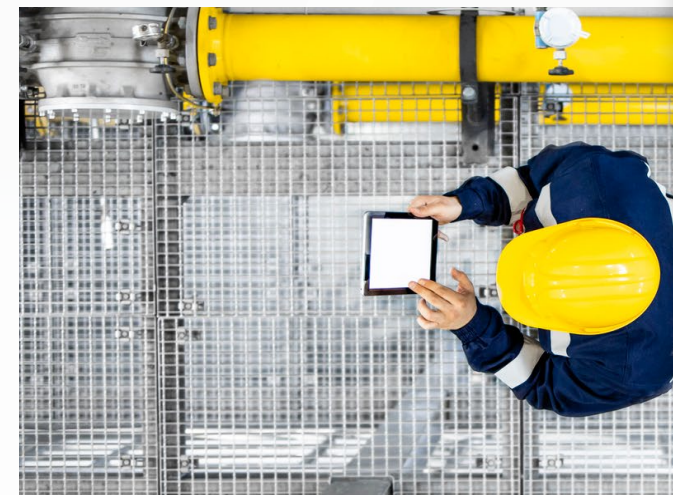
## Replacing Obsolete SIS

An ammonia and nitric acid plant had a 700-point standalone SIS that had reached its end-of-life. The plant wanted to comply with IEC 61511 requirements, which require an upgrade. It installed a DeltaV™ SIS, supporting 354 I/O points with 84 analog inputs, 22 analog outputs, 170 discrete inputs, and 78 discrete outputs. To achieve true redundancy, duplex logic solvers were installed. The DeltaV SIS made it possible to access the safety device information from the plant's AMS Suite asset management system.

Access to smart device diagnostics empowers plant personnel to repair faulty devices while the plant is running, typically long before a shutdown is tripped. Furthermore, the integration of the DeltaV system and DeltaV SIS system provides a tremendous amount of flexibility in managing trips.



**COMPANIES IN THE TOP QUARTILE IN ORGANIZATIONAL HEALTH HAVE SIX TIMES FEWER SAFETY INCIDENTS THAN THOSE IN THE BOTTOM QUARTILE, WHICH HAVE ALMOST THREE TIMES AS MANY INCIDENTS LEADING TO LOST WORK TIME AS COMPANIES IN THE TOP QUARTILE.**

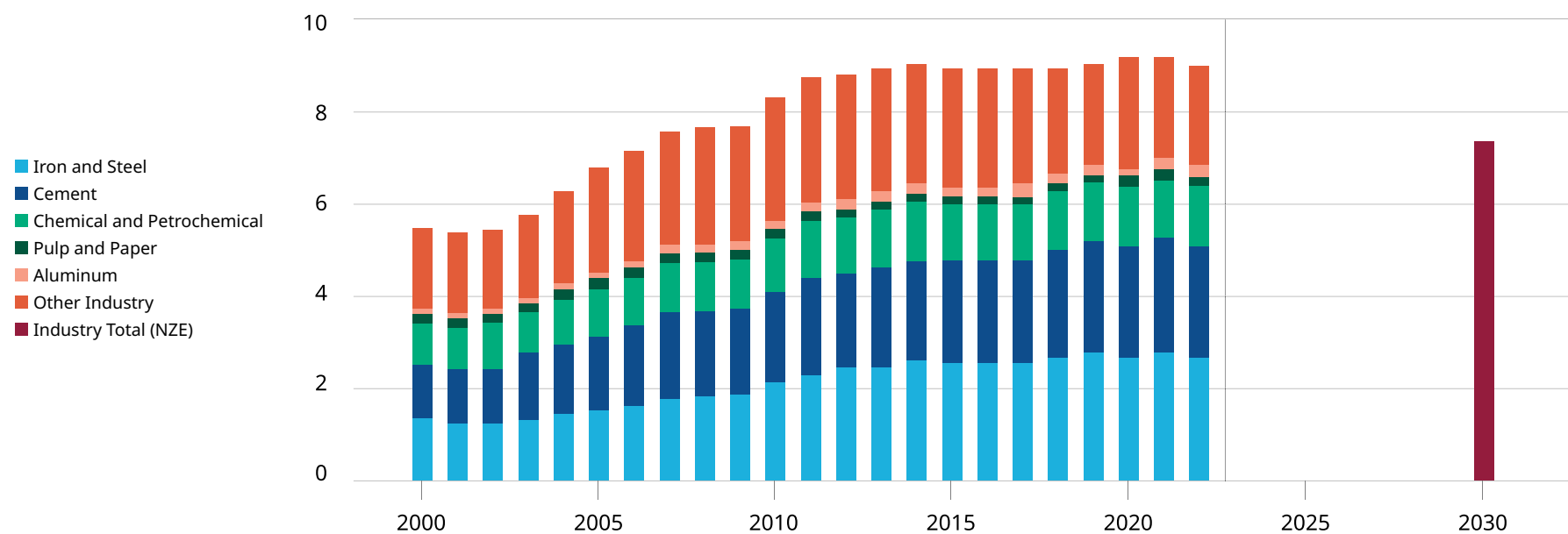


# SUSTAINABILITY

Carbon dioxide emissions impact on climate change has dominated discussions in recent years. Industry, including chemical and petrochemical sectors, have focused attention on their emission footprints, as has Emerson. Fortunately, just as there are many sources of emissions, there are many ways to reduce them.



Direct CO2 emissions from industry, 2000-2030



Source: IEA (2023), Direct CO2 emissions from industry in the Net Zero Scenario, 2000-2030, IEA, Paris

CASE STUDY

## Electrically Powered Offshore Platform

Norwegian oil & gas producer Equinor chose to power its platform in the offshore Martin Linge field from the shore via an underwater extension cord, 162 km long. All power necessary to operate the platform with its DeltaV DCS is from renewable sources and provided by the cable, rather than burning gas on the platform to generate power. This avoids 200,000 tons of carbon dioxide emissions each year.

CASE STUDY

## Replacing Heat with Light

Syzygy Plasmonics has rethought basic chemical manufacturing processes, developing a technology platform using light-driven chemistry instead of heat to produce high-value molecules, all without combustion processes and resulting emissions. Syzygy's reactors, using DeltaV automation, can produce hydrogen by reforming methane without the associated combustion. The process can also produce methanol from methane and carbon dioxide, effectively reusing emissions from an upstream process.

### THERE ARE FOUR MAIN PILLARS SUPPORTING SUSTAINABILITY STRATEGIES



Reducing emissions by examining each process. Some will be easier than others due to the nature of the process, so evaluate each on difficulty.



Utilizing clean fuels such as hydrogen, rather than burning fossil fuels.



Adopting green energy means looking for alternatives to combustion and replacing it with renewable electricity.



Minimizing waste is about more effective stewardship of all resources, including raw materials, energy, and water.

# Proven Methodology

About half of all industrial capital projects today fail in the sense that they are more than 25% over budget and/or 50% late for completion. To counter these problems, Emerson's Project Certainty program provides a transformational approach to enabling top quartile performance in capital projects by digitally transforming any project through modern project management strategies, innovative engineering practices, and digital technologies. Our project execution approach delivers solutions that eliminate costs, reduce complexity, and accommodate change to improve capital efficiency and deliver more reliable project schedules.

By collaborating early during engineering and design studies, we help companies define their automation and project strategy goals, laying the foundation for a successful project startup, along with operational excellence throughout a plant's lifecycle.

## CASE STUDY

### Gas Production Units

Linde Engineering has designed and built more than 4,000 industrial gas production units installed at many facilities globally. Linde works closely with Emerson as its main supplier of field devices and automation. Ralf Bellaire, Head of Global Business Unit, Engineering, says the company faces steadily growing cost and time pressures, along with increasing project complexity. Customers are also pushing more project risk onto Linde and their partners. The Emerson solutions he cites include:

- Cloud-based engineering and collaboration
- Digital technologies, particularly digital twins
- Modular plant design, avoiding the need to tailor each installation

Working with Emerson, Linde has created standardized solutions that reduce cost and complexity, even in the face of significant challenges. These state-of-the-art automation technologies reduce total cost of ownership and improve lifecycle value.

## REALIZED BENEFITS

**50-60%** reduction in hardware design steps

**90%** reduction of system hardware and loop drawings

**15-25%** shorter instrumentation and control project schedule

**80%** reduction of hardware/software FAT hours

**30-40%** reduction in engineering hours

**30-40%** lower total installed costs

# The Path to Top Quartile Performance

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Automation technologies have brought major productivity improvements to the chemical and energy industries. For example, implementing digital and automation technologies has allowed for increased operational efficiency, cost reductions, and enhanced decision-making. According to research, the automation market in these industries is expected to grow at a compound annual growth rate of 5.9% through 2028, driven by increasing adoption of digital solutions like AI, IoT, and data analytics that streamline operations and reduce downtime.

In one case, a company utilizing Emerson's autonomous solutions managed to reduce lease operating expenses drastically by integrating advanced automation and analytics. Similarly, growing adoption of automation and digitalization has led to more proactive operational approaches, helping companies manage data more effectively, increase safety, and optimize production processes.

These strategies for operational excellence are what propel companies into the Top Quartile. Emerson provides the solutions and know-how to make it happen by working closely with end users in this critical sector of the economy.



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