

A large industrial facility, possibly a power plant or refinery, with a worker in the foreground. The worker is wearing a dark jacket and a plaid shirt, holding a white hard hat and a black mallet. The background shows large blue and yellow industrial equipment, including a large yellow cylindrical tank and various pipes and structures. The ceiling is high with a complex steel truss structure and bright lights.

Focus on reliability to improve  
availability, profitability and safety.

## Prediction and Protection for Production Assets

Recognize business goals and achieve top-quartile reliability by implementing predictive intelligence and integrated protection technologies

# Unreliable equipment increases risk to both safety and profits

Unscheduled downtime caused by equipment failure eats into both the maintenance budget and production goals. Routine maintenance can help, but it doesn't reveal the developing issues that result in process slowdowns or shutdowns. You simply aren't able to avoid these preventable failures.

Introducing technology to monitor these assets sounds like the solution, but where do you start? The budget won't allow you to install the same monitoring system on every asset in the plant, so how would you choose what equipment to monitor and what equipment to ignore?

In addition, your critical assets are required to have API-certified protection systems so the equipment is tripped under unsafe operating conditions. But sometimes those trips aren't necessary – and again your production is shutdown while you determine the nature of the problem.

To keep your plant assets available and producing revenue, you need solutions that are custom to the criticality of the asset being monitored and that identify the assets at risk of failure.

A typical refining facility will spend less than 10% of its time in transient operations. However, 50% of all process safety incidents occur during this time.

-Tame Your Transient Operations, Chemical Processing June 2010.



It costs approximately 50% more to repair a failed asset than if the problem had been addressed prior to failure.

- U.S. National Response Center



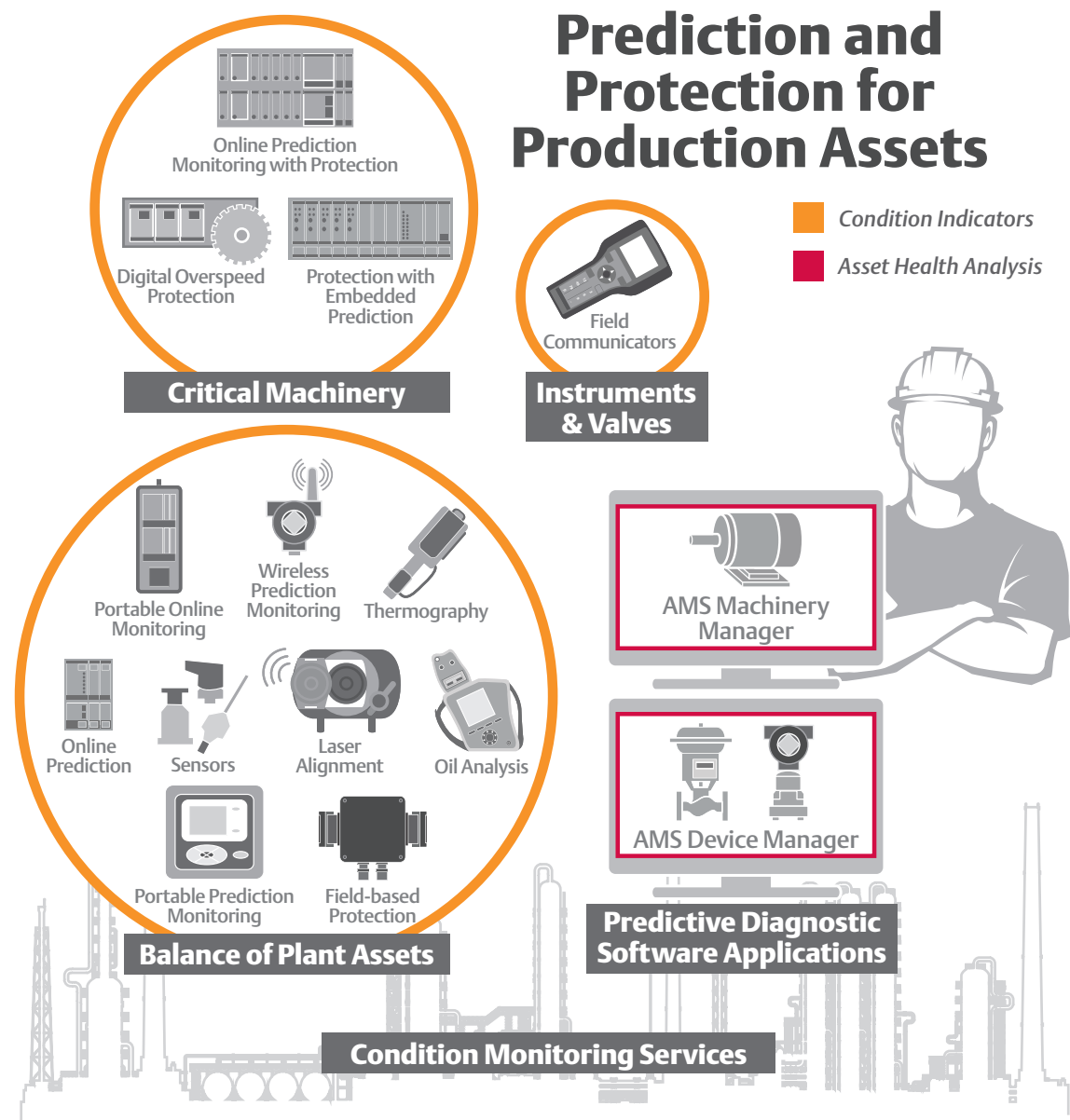
Production capacity is lost to as much as 5% every year as a result of unplanned shutdowns.

- Asdza Nadleehe, "Engineering & Maintenance: Prevention Is Better Than Cure," Oil & Gas IQ, October 2011.



## Focus on reliability to improve availability, profitability, and safety

A key strategy to improving reliability is to monitor the condition of production assets in your plant. Emerson offers a variety of condition indicator technologies specific to the nature and criticality of those assets - online condition monitoring solutions for your most critical and essential machines, and portable or hand-held solutions for the balance of your plant.



### Drive equipment reliability using smart field devices.

Proactively managing your field device assets so that they are accurately configured and calibrated is key to ensuring the value of their predictive diagnostics. With effective asset management and predictive intelligence, you can focus on driving equipment performance.

[Instrument and Valve Prediction p5](#)

### Ensure safer operation by combining prediction with protection.

When your plant requires protection on its critical assets, Emerson integrates API-compliant protection with continuous predictive monitoring technology so you can operate your plant safely and with confidence. Extend protection to other assets in your plant with application specific or right-sized systems.

[Machinery Protection p9](#)

### Cut maintenance costs with predictive intelligence.

It costs approximately 50% more to repair a failed asset than if the problem had been addressed prior to failure. Predictive intelligence from condition indicators improves overall plant reliability by reducing scheduled and unscheduled downtime, driving down maintenance costs and increasing safety and availability.

[Machinery Prediction p7](#)

### Improve the accuracy of your analysis.

Improving reliability requires analyzing all kinds of data. But the analysis can only be as good as the data it relies on. Whatever kind of measurement is required – acceleration, velocity, displacement, speed or pressure – must be counted on for quality and accuracy to avoid “garbage in, garbage out”.

[Sensors p11](#)



## Improve asset reliability using predictive field diagnostics

In a perfect world, your process would be consistent, day in and day out. But the reality is that field device performance, like most things, can degrade over time. Variability is a natural occurrence that must be dealt with.

Predictive diagnostics from field devices help your maintenance team keep sensing devices configured, calibrated, and operating effectively. And the measurements and control from those devices protect the reliability of your production equipment. Emerson's AMS Device Manager provides real-time online access to intelligent instrument and valve diagnostics and alerts, delivering a view of device health and troubleshooting information when an issue is found. The 475 Field Communicator allows your personnel to assess health and repair devices from the field. Whether online or offline, Emerson gives you the tools to ensure your field devices are performing as expected.

### What's your challenge?



Production capacity is lost to as much as 5% every year as a result of unplanned shutdowns.  
– Asdza Nadleehe, "Engineering & Maintenance: Prevention Is Better Than Cure," Oil & Gas IQ, October 2011.

### What's your opportunity?



Even small fixes have big impact. While using AMS Device Manager, Braskem S.A. found a calibration error on a pressure control valve, causing the valve to open 3% when it was supposed to be closed. Fixing the calibration error saved the plant \$300,000 a year.  
– Braskem S.A. in Brazil

## Improve the effectiveness of your maintenance team



**Predictive diagnostics** help personnel focus their efforts on the assets that need attention, while eliminating unnecessary work on healthy devices.

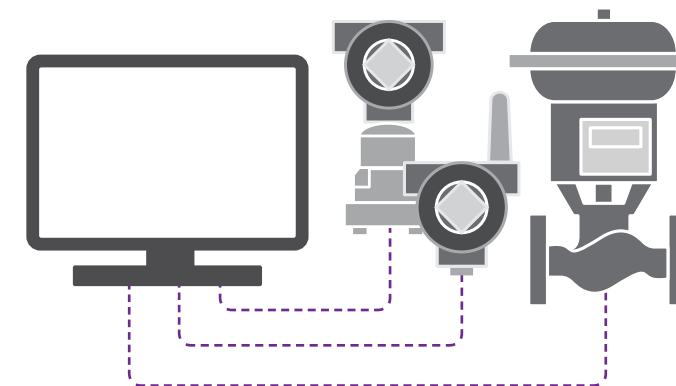


**Troubleshoot problems** directly from the maintenance shop or in the field. Troubleshooting advice helps technicians solve the problem quickly.

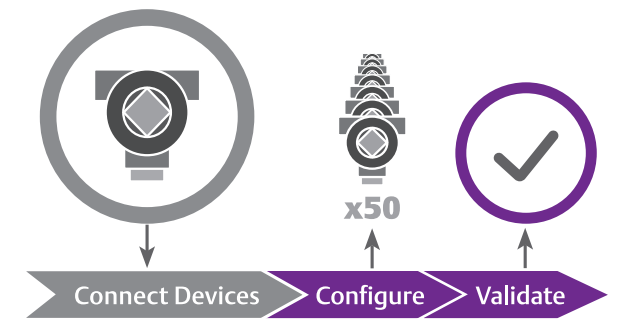


**Easily prioritize work** based on the criticality of the asset and the urgency of the alert. Ensure technicians are spending time on the production critical issues.

## Reduce configuration/commissioning time



**Use device templates** to set up once and configure many, reducing set up errors and improving commissioning efficiency.

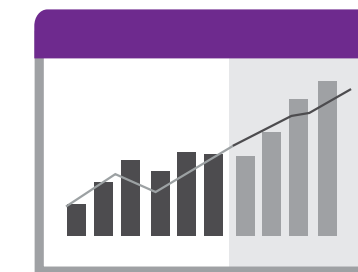


**Configure in bulk** to reduce commissioning time by up to 80%. Once device templates are complete, apply to common devices simultaneously. Then validate configurations quickly with a discrepancies report.

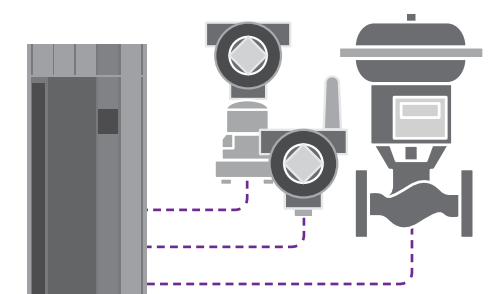
## Streamline calibration work processes and reduce errors



**Eliminate paper-based calibration** by electronically managing routes with AMS Device Manager to reduce calculation and documentation errors.



**Extend calibration intervals** while remaining compliant using historical drift trends in AMS Device Manager. Eliminate the unnecessary effort of scheduled-based calibration.



**Centralize device data** in a single database to enable better analysis of health and performance and improved resource planning and scheduling.



## Drive maintenance schedules and budget by improving reliability

When your assets aren't reliable, you can't maintain your schedule or operate within budget. Your assets become the drivers of your success. But with predictive intelligence, you gain the insight necessary to schedule maintenance that supports your production goals. Emerson's technology for delivering predictive intelligence puts you back in the driver's seat.

Vibration data is the cornerstone of predictive intelligence. However, vibration data has historically not been routed to the control room because it required specialized training to extract actionable information. But plant's performing at top-quartile reliability leverage both asset condition and process data together in the control room. Emerson's vibration data collection technologies feature a unique methodology - PeakVue technology - to cut through the complexity of machinery analysis and provide a simple, reliable indication of equipment health that is easily understood by both operations and maintenance. PeakVue filters out traditional vibration signals to focus exclusively on impacting, a much better indicator of overall asset health on pumps, fans, motors, or any other type of gearbox or rolling element bearing machine.

### What's your challenge?



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- U.S. National Response Center

### What's your opportunity?

**5%**

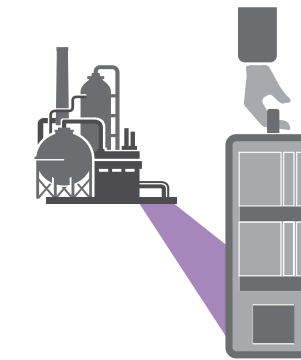
Reduction in maintenance cost

Reduce repair expense. By making use of predictive data to improve the reliability of their rotating equipment, Saudi Aramco, Ras Tanura refinery, reported a total program savings of over \$10 million annually and a 9% reduction in maintenance costs.  
- Saudi Aramco, Winner - Reliability Program of the Year 2015.

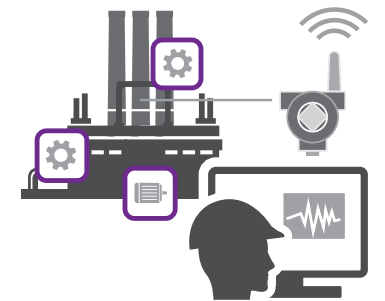
## Safeguard critical assets 24/7 with online monitoring



Continuous monitoring of both critical and balance of plant assets provides real-time machinery health feedback to the DCS - either integrated via CSI 6500 to DeltaV, or embedded as an Ovation Machinery Health Monitor.

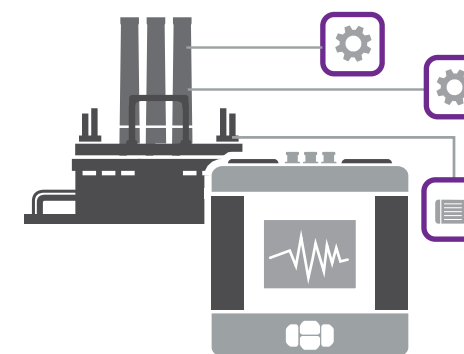


Troubleshoot problems on critical assets without the expense of a permanent monitoring system using the CSI 2600.

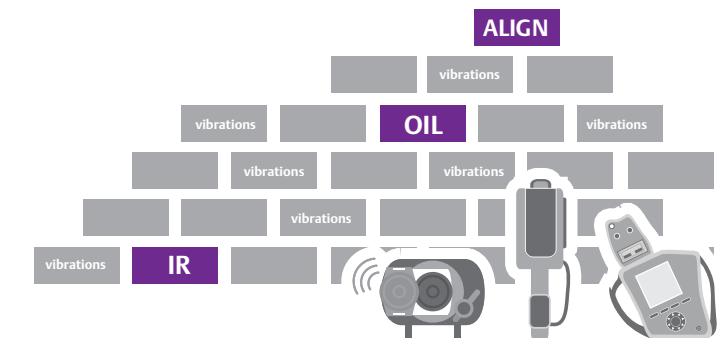


Wireless vibration monitoring using the CSI 9420 extends the maintenance program to remote or hazardous locations with minimal installation costs.

## Maintain availability through periodic monitoring



Route-based monitoring using the CSI 2140 maintains production-essential assets and allows for sophisticated diagnostic testing while in the field.



Integration of complementary technologies such as infrared thermography, oil analysis, and laser alignment capabilities creates a complete picture of machinery health.

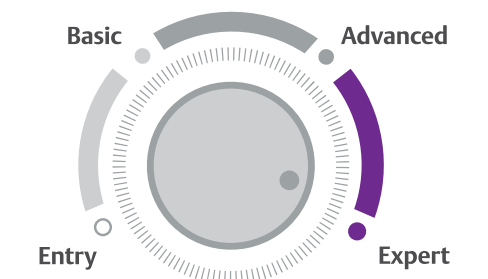
## Supplement your team with expertise and manpower



Machinery condition monitoring services utilize a global network of vibration and oil analysis experts to remotely analyze your data.



Scheduled onsite services provide additional manpower to perform a wide range maintenance services.



Hands-on training with proven educational tools elevates your team's expertise and ensures your plant's performance levels.

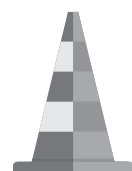


## Be confident a shutdown is necessary

Safety regulations and often insurance requirements necessitate the installation of a shutdown system on your expensive and critical production assets to protect both lives and investments. But protection doesn't have to be just a necessary expense – the right protection system can be a path to integrating the predictive intelligence that allows you to avoid false or missed trips.

Through system integration and unique data access, Emerson protection systems allow you to confidently determine when critical assets can be allowed to continue running safely. By recording data during equipment start-ups, coast downs, and other transient events, Emerson protection systems provide you the information necessary to make informed operational decisions. Systems are compliant to a variety of API standards and SIL environments, meeting the strict safety and insurance requirements such as those in the refining and petrochemical industries.

### What's your challenge?



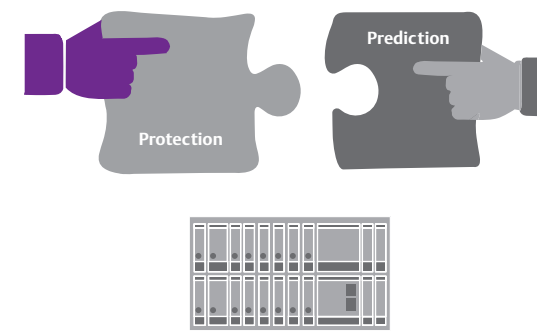
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### What's your opportunity?

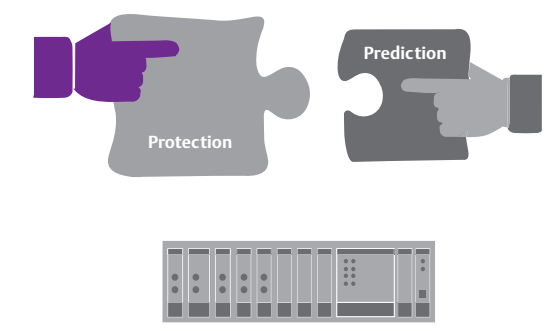


Operate safely during typically dangerous conditions. The startup and coastdown of turbo machinery is potentially the most dangerous operating state due to the rapidly changing conditions. Rather than just snapshots of data, Emerson delivers real-time data on multiple channels simultaneously for the most powerful, accurate diagnostics and safer operating conditions.

## Integrate predictive intelligence with protection capabilities

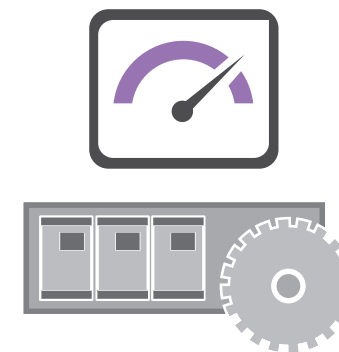


Combine protection and prediction with the CSI 6500, for full prediction capabilities and protection in a single 6U chassis.

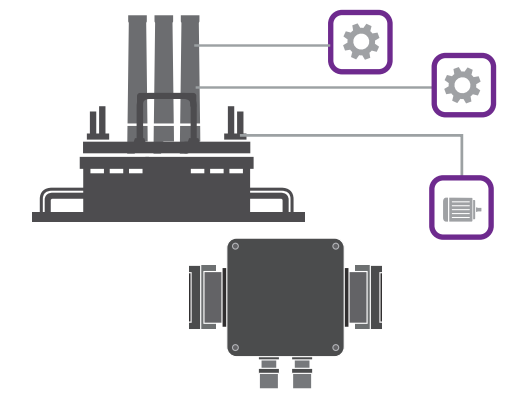


Stand-alone protection with the CSI 6500 ATG allows you to introduce basic prediction capabilities in a single 3U chassis.

## Extend protection to more or specific applications



Overspeed conditions caused by a sudden loss of load are guarded against by the CSI 6300 SIS Digital Overspeed system.



Field-mounted, dual-channel protection from the CSI 3000 delivers basis protection directly to a machine wherever a standard rack-based system doesn't apply.

## One source of responsibility for the entire measurement chain

When there is a problem with your data, where is the source – your sensor? Your collection system? When your tools come from multiple vendors, it can sometime be difficult to pinpoint the responsibility and address the problem.

Emerson offers a full line of quality sensors to complement its prediction and protection systems. Working with a leading third-party sensor supplier, Emerson has introduced a variety of specialized sensors to improve the accuracy of the measurement as well as the ability to physically capture early stage asset failure data.

Emerson's sensor portfolio includes:

- **Accelerometers** – Emerson offers a wide range of options for all applications and budgets.
- **Velocity sensors** – Ideal for protection systems, both economical and premium velocity sensors offer optional additional cable protection.
- **Displacement sensors, converters and transmitters** – Emerson options range from field and enclosure mountings, small and large shaft measurements, and industrial safety ratings.
- **Speed sensors** – Selection includes options for tight installations, portability, and magnetic mounting.
- **Pressure sensors** – Dynamic pressure pulsation measurements are important to analyzing and troubleshooting pumps and optimizing fluid processes.
- **Sensor accessories** – Emerson offers cable armored jackets, probe holders, and other optional accessories to protect or improve your data measurements.

## Better connectivity and reduced voltage

Another aspect to improving the accuracy of an accelerometer is ensuring that it can be easily and properly installed and interact efficiently with the collection device. With this in mind, Emerson introduced accelerometers with unique features to address these concerns:

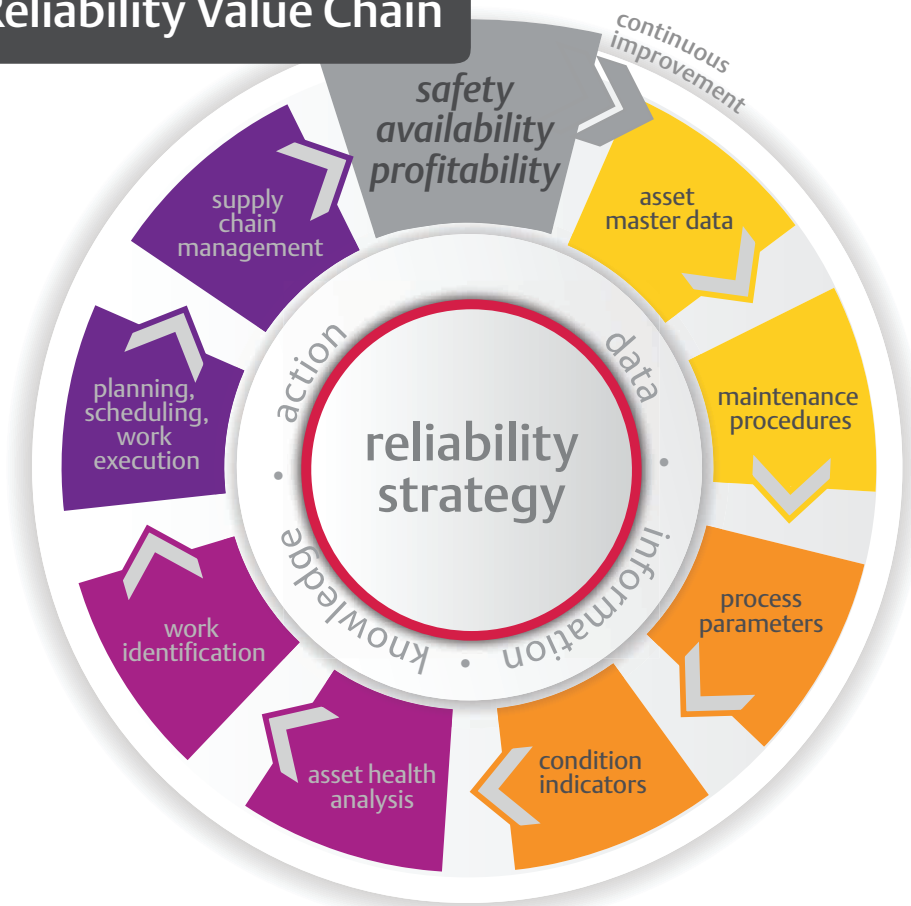
- Swivel-based, low profile designs to eliminate cable strain in tight, small-space environments.
- Low voltage accelerometers for use in wireless transmitter applications, resulting in longer battery life in the transmitter.
- An integrated magnetic base with a matching keyed base as part of Emerson's exclusive triaxial sensor for faster route-based, periodic monitoring. The integrated base ensures solid and secure placement for the most accurate measurement.



## Protect and expand the value of your technology investment

Improving reliability in the plant requires more than just acquiring the right monitoring and analysis technologies. You need to actively manage those investments and their lifecycle costs. Emerson offers Guardian Support services designed to optimize the reliability and performance of your machinery health products. It is designed to help improve your competitive advantage and bottom line business results through critical service and support information. Specific, critical information is matched to your system and proactively delivered to you through a secure dashboard portal available 24x7x365. Guardian Support also delivers incident management with access to experts to help you through critical issues. An accurate inventory of all system components and licensing combined with in-depth documentation and resources aids in your troubleshooting.

## Reliability Value Chain



## Impacting the bottom line

Implementing predictive intelligence and protection technologies from Emerson will deliver positive results in reduced scheduled and unscheduled downtime. But for companies pursuing top-quartile reliability, the return on investment is huge.

A study\* of reliability practices measured maintenance costs as a function of the replacement value of the assets. If a top-performing site spends 10 million dollars per year on maintenance, a poor performing plant will spend 3 1/2 times more for the same size plant. In most cases, the value of the operational benefits is 3 to 7 times the value of the maintenance-spend reduction. According to the same study, top-quartile plants also experience very little downtime as a result of equipment problems. Fourth quartile (poorest) performers experience disruptive levels of down time that is almost 15% greater than top performers.

Top – quartile performers also demonstrate an integrated set of elements shown in the Reliability Value Chain. Ultimately, the ability to achieve top performance status is dependent on the robustness of each element and, perhaps more importantly, on the effective connectedness of all of the elements into a continuous improvement cycle.

\*2013 Solomon RAM Study, Solomon Associates, LLC.

*Emerson is your partner for implementing the Reliability Value Chain by providing:*

- *Condition indicators and asset health analysis tools that drive information towards action.*
- *Consulting services to assist in the development of foundational data and enterprise-wide reliability management programs.*

**Emerson's Reliability Consulting delivers comprehensive, scalable asset management and reliability services to diverse industries. Core competencies are centered on two skill sets: reliability engineering and data integrity. Mastery in each skill set allows Emerson to serve clients independently in each area, or with a combined expertise to implement reliability on an enterprise scale.**

**Partner with Emerson Reliability Consultants and Reliability Solution technologies to achieve top-quartile reliability results.**

### PolyOne success

Emerson clients achieve measureable results by implementing strong enterprise-wide standards. PolyOne Corporation, a premier global provider of specialized polymer materials, partnered with Emerson to leverage, set and apply standards for performing maintenance, ascertaining equipment conditions, and measuring performance across 50 plant sites. In addition to being recognized by Uptime magazine as the best emerging reliability program of the year for 2014, they also recognized:

- Reduced maintenance spending by 12%
- Safety incident rate nine times better than industry benchmark
- Planned vs. corrective work orders increase from 45% to 64%
- On-time deliveries reaching an all-time high of 95.4%

### Saudi Aramco success

Top-quartile reliability requires more than just technology investments. At Saudi Aramco's Ras Tanura Refinery, the decision and commitment to instilling a reliability culture from the top down netted significant improvements over a short two-year period. Their people-centric, multi-tiered approach included a multi-disciplinary reliability team, roadmaps for improving reliability of problematic rotating equipment, development of key performance indicators (KPIs), and internal "boot camps" focused on the benefits of reliability and continuous improvements. The facility was named Emerson's 2015 Reliability Program of the Year winner based on their program and documented results:

- Total annual savings of over \$10 million
- Reduced preventative maintenance manhours by 24%
- 180% increase in defects identification
- 20% increase to air system efficiency
- Elimination of \$7 million in energy waste

### Corbion success

Shifting from a culture of run-to-failure to why-did-it-fail can have measureable impacts on safety, availability, and profitability. Corbion is a global leader in sustainable ingredients manufacturing for certified compostable PLA, lactic acid and lactic acid derivatives, and their food grade counterparts. They recognized the need for a sustainable reliability program, starting with their Blair, Nebraska facility – a food grade Good Manufacturing Practice (GMP) plant operating 24x7, 365 days a year. By prioritizing an understanding of the root causes of equipment failure, Corbion created a safer, more reliable, and more productive environment resulting in:

- 50% reduction in monthly maintenance expenditures
- Working at 99% planned maintenance tasks
- Emergency work reduced to 3-4 hours per week
- Plant uptime in the 90% range
- Production for 2015 up 70% over 2004



# Improve availability, profitability and safety using Emerson's Reliability Solutions.

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