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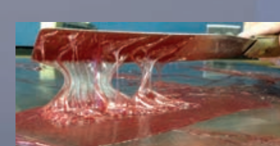

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Risk-Based Asset Management	Project Engineers, Reliability Engineers, Maintenance Managers, Operations Managers, and Engineering Technicians.	Learn to create a strategy for implementing a successful asset management program. Discover how to reduce risk and achieve the greatest asset utilization at the lowest total cost of ownership.	Apr 14-16, 2015 (CL) Sep 15-17, 2015 (CHS)	3 consecutive days 2.1 CEUs	$1,495
Root Cause Analysis	Anyone responsible for problem solving and process improvement	Establish a culture of continuous improvement and create a proactive environment. Manage and be able to effectively use eight RCA tools to eliminate latent roots and stop recurring failures.	April 7-9, 2015 (UT) Aug 18-20, 2015 (CL)	3 consecutive days 2.1 CEUs	$1,495

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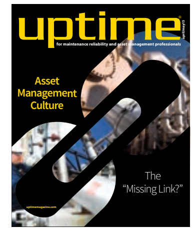

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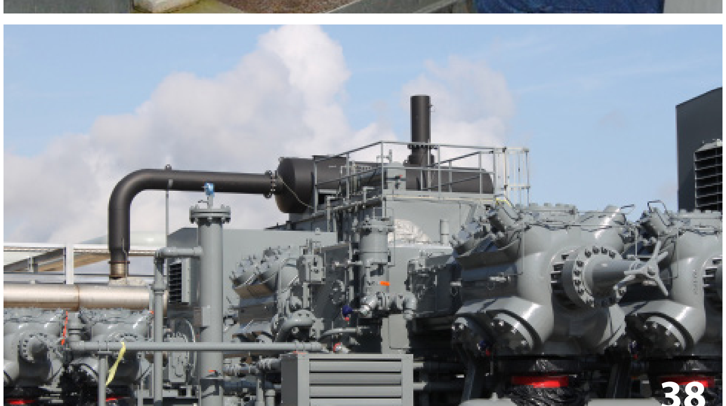
Features



Elements

6 Questions to Check Reliability Leadership in Your Organization

World-class organizations recognize that success is achieved through leadership, however, they also realize that results are only delivered through engagement and empowerment of everyone in the workforce. Leadership does not come from one person; it comes from everyone. This is especially true for reliability.

Here are six questions we use with companies using Uptime Elements that may also serve you as a guidepost or mile marker for your own journey.

Is there a shared vision of AIM in your organization?

Every organization has a reason it exists and a mission it works towards. This is the AIM of the organization and all initiatives and efforts, including reliability leadership, should be aligned in delivery of that AIM.

According to W. Edwards Deming, "It is important that an AIM (of the organization) never be defined in terms of activity or methods. It must always relate directly to how life is better for everyone. The aim of the system must be clear to everyone in the system."

Do you have reliability leaders in place at all levels who are willing to take on challenges with a positive attitude and continuously develop themselves?

There are stakeholders who enable and disable reliability in all areas of your organization. The long-term goal is to have reliability leaders at all levels widely distributed across your organization – not just in the maintenance department. These leaders must understand the holistic nature of reliability leadership and commit to a path of continual self-development.

Are the reliability leaders in your organization embracing their role as teachers, developing other reliability leaders for the future?

Successful reliability leaders are likely to change jobs within the organization or possibly change organizations and even retire. Successful learning is demonstrated by successful teaching. Succession plans are often lacking and most organizations suffer a shortage of reliability leaders. We urge you to embrace teaching as part of your own self-development path.

Are the reliability leaders in your organization using rigorous processes to solve the right problems step-by-step?

We are not just asking if you intellectually understand the Reliability Centered Maintenance Analysis process or the Root Cause Analysis process. We are asking if your reliability leaders actually use rigorous processes like RCM and RCA to solve problems or do they jump to "doing" – because of management's' tendency to value action over planning.

Does your organization have an environment in which aligned targets for reliability improvements are developed and good ideas for achieving those targets are sought from all stakeholders and shared across the organization?

The Uptime Elements Framework is not simply designed to create reliability improvement; it is designed to create a culture of reliability. As reliability leaders engage and empower team members by seeking wide stakeholder input and by using rigorous problem-solving processes – reliability and other business improvement is an outcome and a sustainable reliability culture is developed.

Do you use major challenges from the environment to further strengthen reliability leadership?

Critical equipment fails, budgets get slashed, key team members leave, outside events, impact our reliability and top management changes every few years. It is important to create reliability leaders in your organization who are prepared not only to deal with negative events but to leverage them for maximum long-term, positive impact. By learning and teaching Uptime and by applying rigorous problem solving techniques, you can be prepared to demonstrate leadership during a crisis to strengthen your organization.

Visiting and revisiting these six questions will ensure that you will constantly improve your own performance as a reliability leader, as well as the business results of your organization.

Warmest regards,

Terrence O'Hanlon, CMRP
CEO and Publisher
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uptime®

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First Reliability Leadership Institute Board of Advisors Meeting

Fort Myers, FL – The first Board of Advisors meeting was held on February 4-5, 2015 at the newly remodeled Reliability Leadership Institute (RLI) in Fort Myers, Florida.

RLI has a vision to create a vibrant Community of Practice based on Uptime Elements – A Reliability Framework for Asset Performance and to work with integrity and commitment in order to enable the triple bottom line of economic prosperity, environmental sustainability and social responsibility.

The inaugural meeting included representatives from:

- Bristol Myers Squibb
- Honda North America
- Bentley Systems
- Goodyear
- Siemens
- CBRE
- IBM
- Goldcorp
- Jacobs Engineering
- Lockheed Martin
- Acuren
- Cincinnati MSD
- Kansas City BPU
- Lubrication Engineers
- CH2M Hill

Monthly web meetings are planned throughout the year. The next RLI Board of Advisors Face-to-Face will be held at Solutions 2.0 August 3-7, 2015 at the Westin Galleria in Houston, Texas. More details at www.reliabilityleadership.com.

Reliability Leadership Institute Introduces Mapped Services and Training (MSAT) Providers Program

Does your company provide products, services or training that support the Uptime® Element™ Framework?

This program is designed to:

- Assist potential clients to source approved vendors
- Highlight mapped vendors in the Reliability Leadership Institute MSAT Directory
- Supply referrals of potential clients who require execution support for areas of the Uptime Elements
- Have a profound effect on business outcomes for organizations

Current MSAT Providers:

- Bentley Systems
- Blue Sky Reliability
- Lubrication Engineers
- LUDECA
- Mobius Institute
- People and Processes
- Profit-Ability, LLC
- The Aladon Network
- Uberlytics

For more information, contact Kaitie Sweet:
kaitie@reliabilityweb.com
888.575.1245 • 239.333.2500 ext 114

Trending: Internet of Things (IoT), Analytics, Applications for Drones, Cyber security and the convergence of IT/OT

Reliabilityweb.com CEO, Terrence O'Hanlon, recently participated as keynote speaker, panelist and workshop leader at the following events:

Oracle Value Chain Summit – San Jose, CA
The Institute of Asset Management West Coast Meeting - San Jose, CA
ARC Forum - Orlando, FL
Global Rail Summit – Las Vegas, NV
IBM Interconnect - Las Vegas, NV

From his participation, Mr. O'Hanlon reports that maintenance reliability leaders are beginning to discuss the impact of the "Internet of Things" also known as IoT, the use of analytics for asset management, productive commercial applications for the use of drones, cyber security concerns from sensor networks and the convergence of Information Technology systems and Operational Technology systems. You can count on Uptime Magazine to keep you informed of these important trends in our industry.

IAM USA West Coast Meet and Greet Report

IAM USA Leadership

Terrence O'Hanlon and Reliabilityweb.com hosted an IAM USA West Coast Meet and Greet on January 26, 2015 to expand awareness about the mission of IAM, recruit new IAM members, recruit volunteers from existing IAM members and share knowledge and information about the expanding practice of asset management.

There was vibrant networking and high enthusiasm for IAM USA activities and the outcome of the meeting was positive.

IAM USA Representatives

Terrence O'Hanlon – Reliabilityweb.com
Maura Abad – Reliabilityweb.com
Thomas Smith – University of Wisconsin
Carl Vieth – University of Wisconsin

Attendees from Asset Owner/Operators included:

- Google
- Genetech
- PGE (First US Utility to earn ISO 50001 Certification)
- Bay Area Rapid Transit (BART)
- Lawrence Livermore National Lab (LLNL)
- National Ignition Facility (NIF)
- Kaiser Permanente
- NASA AMES
- Jacobs Engineering
- Denver Airport
- ARUP
- AECOM
- Roll Global

Suppliers included:

- Anil Verma Associates Inc.
- TRM Net
- Ascot Associates
- Sunflower Systems
- Commissioning Agents Inc.

Upcoming Certified Reliability Leader Workshops/Exams

April 13-17, 2015
RELIABILITY 2.0 Las Vegas
Las Vegas, NV

April 23, 2015
CRL Workshop and Exam
Pretoria, South Africa

May 5, 2015
CRL Workshop and Exam
Everett, WA

May 4-8, 2015
Uptime Elements - CRL Workshop
Fort Myers, FL

June 15-19, 2015
Uptime Elements - CRL Workshop
Fort Myers, FL

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CONGRATULATIONS

Asset Management Culture

The "Missing Link?"

by Stuart Grant

With the advances that science, technology and regulation have brought, many companies today have excellent engineering capabilities, a fantastic technical framework and good governance. In theory, these companies should function reliably and also achieve great value. But often, that is not the case. What is going wrong? DuPont took a cultural journey to find the "missing link."

According to the 2013 CEO Challenge study conducted by the Conference Board,[1] operational excellence is one of the top three most important issues for CEOs globally. It is widely recognized as one of the most important contributors to a company's sustainable performance and growth.

Businesses today face global competition and are part of global supply chains. Social and environmental regulations and expectations are becoming ever more stringent. Investors expect companies to pursue lower cost and higher value products with existing assets. To survive, organizations have to adapt rapidly and efficiently to changes in market demand and competitive pressures at plant level. They need to find and pursue synergies to drive productivity and efficiency. All these external drivers exert pressure on companies to improve their overall operations performance. Those that manage to do so reap the benefits of a productive workforce, increased value and sustainable growth.

So, what are the key elements to achieving operational excellence? DuPont found that one of the key steps is to create an aligned and productive culture.

Founded in 1802, DuPont is a chemical-based manufacturing company. Throughout its history, the company has learned many safety and asset management lessons. Over the years, DuPont has come to understand that the often hidden influence on safety performance – the people part – is also key to operational excellence and asset management. By fixing the safety culture and setting the right mind-sets and behaviors for safety, the company found it not only improved its safety performance in the long run, but also its productivity and operations excellence in asset management. This article outlines the main features of this cultural journey, which can be applied to any organization.

Many companies take too narrow an approach when implementing improvement methodologies or become overly dependent on elaborate procedures that do not lead to sustainable results. The clue to extracting maximum value from productivity improvements lies in an integrated approach. Put differently, the key is operational excellence, defined as "the application of principles, systems and tools to engage and focus everyone's efforts on meeting customers' needs and continuously improving process performance."

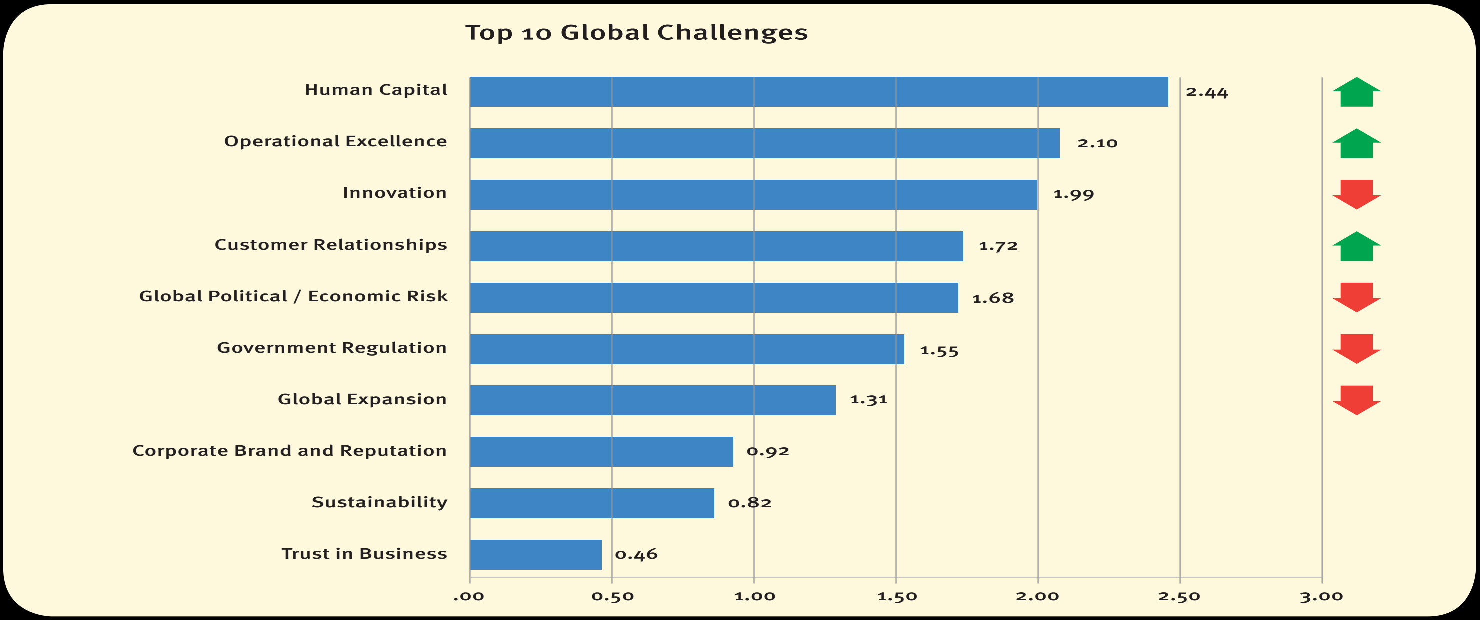

Figure 1: Market Drivers – Operational excellence is one of the most important issues for CEOs globally

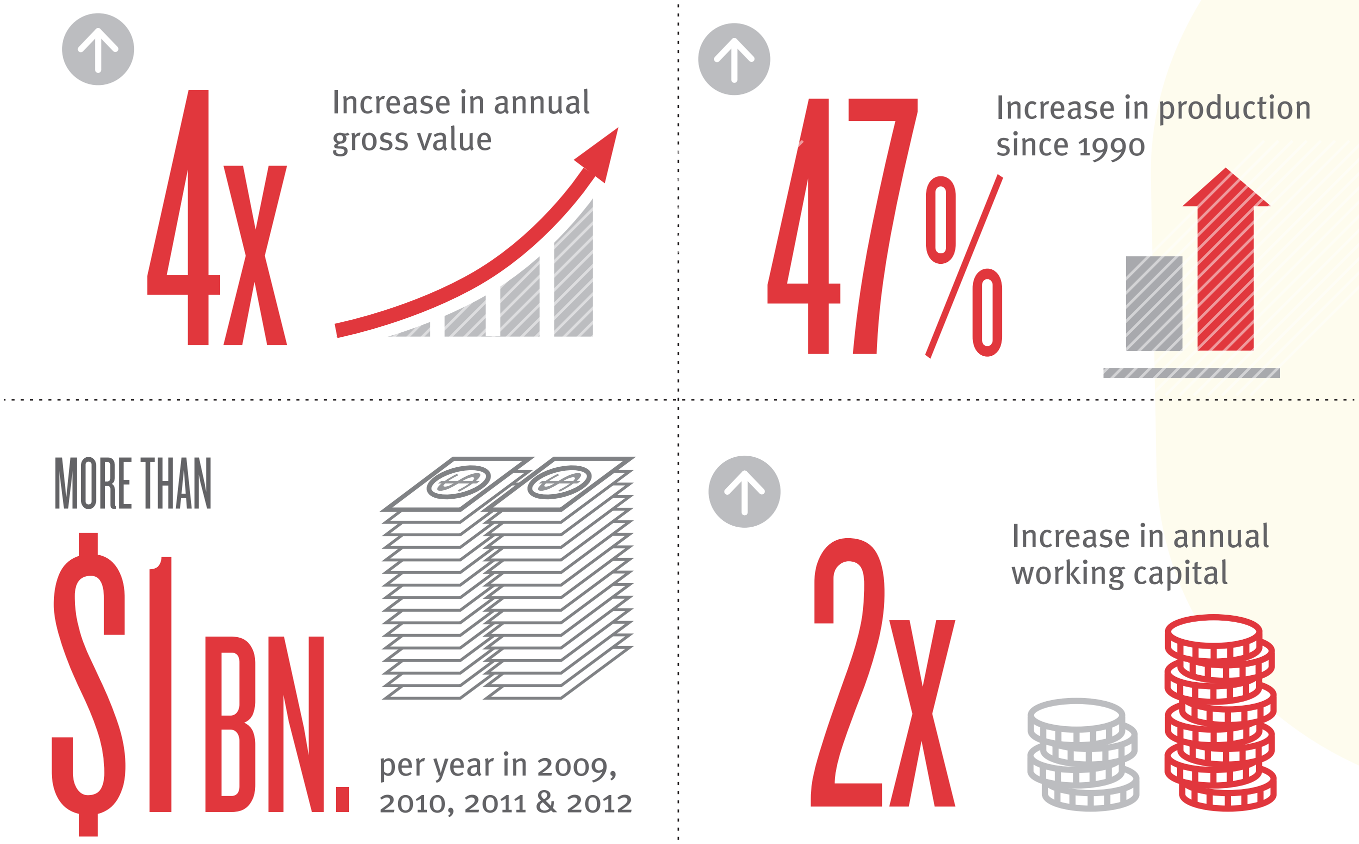

Figure 2: DuPont's business results linked to operational excellence

Getting the Balance Right

All companies want to create value: for society, for the customer and for the stakeholders. As companies strive to create value, they have to strike a delicate balance between risk management and driving profit. There are two main strategies for achieving this. The first is to reduce risk to an acceptable level (protecting the asset). The second is to increase profit in a sustainable way (optimizing the asset). Everything DuPont does in asset management stems from those two clear business imperatives.

The ideal scenario is for a company to mitigate risk while achieving ever-rising profits. That may sound utopian, but is, in fact, linked. DuPont recognized this and, therefore, set out to establish a sustainable model, as shown in quadrant 1 of Figure 3. Profit is balanced by risk mitigation to a tolerable and acceptable level.

So far, so good. But how does a company achieve this status?

Like many other companies, DuPont has worked with numerous systems, from Six Sigma to Lean, and other logical tool sets that support technical models. One of the aims, of course, has been to improve asset productivity and eliminate waste. Many of these are excellent tools and DuPont still uses and establishes competencies in them. However, the trap that is easy to fall into is the illusion that these systems alone will transform asset productivity. The same holds true for PAS55 and now ISO55000 or ISO55000 in conjunction with ISO31000 for risk management. These standards provide an excellent framework for asset management and help companies develop their internal strategies and standards to support value creation from an asset. But, as important as these systems are and however much they appeal to those who are engineers and scientists, they are not enough on their own.

In fact, the recently produced International Association of Oil & Gas Producers (IOGP) report[2] into asset integrity failures across the industry found that among the top causes of incidents were human factors, competencies and failure to establish technical and capability programs in a sustainable way. As will be discovered further on, these company behavior patterns are set at leadership level. Culture and mind-sets are engendered from the top. As another report by Oil & Gas UK[3] in 2009 highlighted, the number one underlying cause for asset management events is poor leadership. Again, culture and mind-sets are engendered from the top.

Figure 3: Business value risk model

Promoting Independence

At DuPont, it is recognized that leadership and other human factors influence outcomes. It is, therefore, people's behavior that is the focus of the company's safety performance, production system and other management models.

Over the years, DuPont has developed a safety assessment tool called the DuPont Bradley Curve,[4] based on the book, *The 7 Habits of Highly Effective People* by Stephen R. Covey. This model allows DuPont to assess where it is in its safety culture. It has become clear that there is a tipping point in an organization when the culture becomes much more effective and develops its own momentum. This critical point of transition lies between the *dependent* and *independent* phases shown on the Bradley Curve in Figure 4. Once employees cross the cultural bridge from compliance (force) to choice, they become supremely motivated, not just for safety, but also for operational excellence.

The reason for this lies in people's innate attitudes and behaviors. The following explains how employees are likely to act and react in the different phases of the Bradley Curve, particularly as it applies to operations, as illustrated in Figure 4.

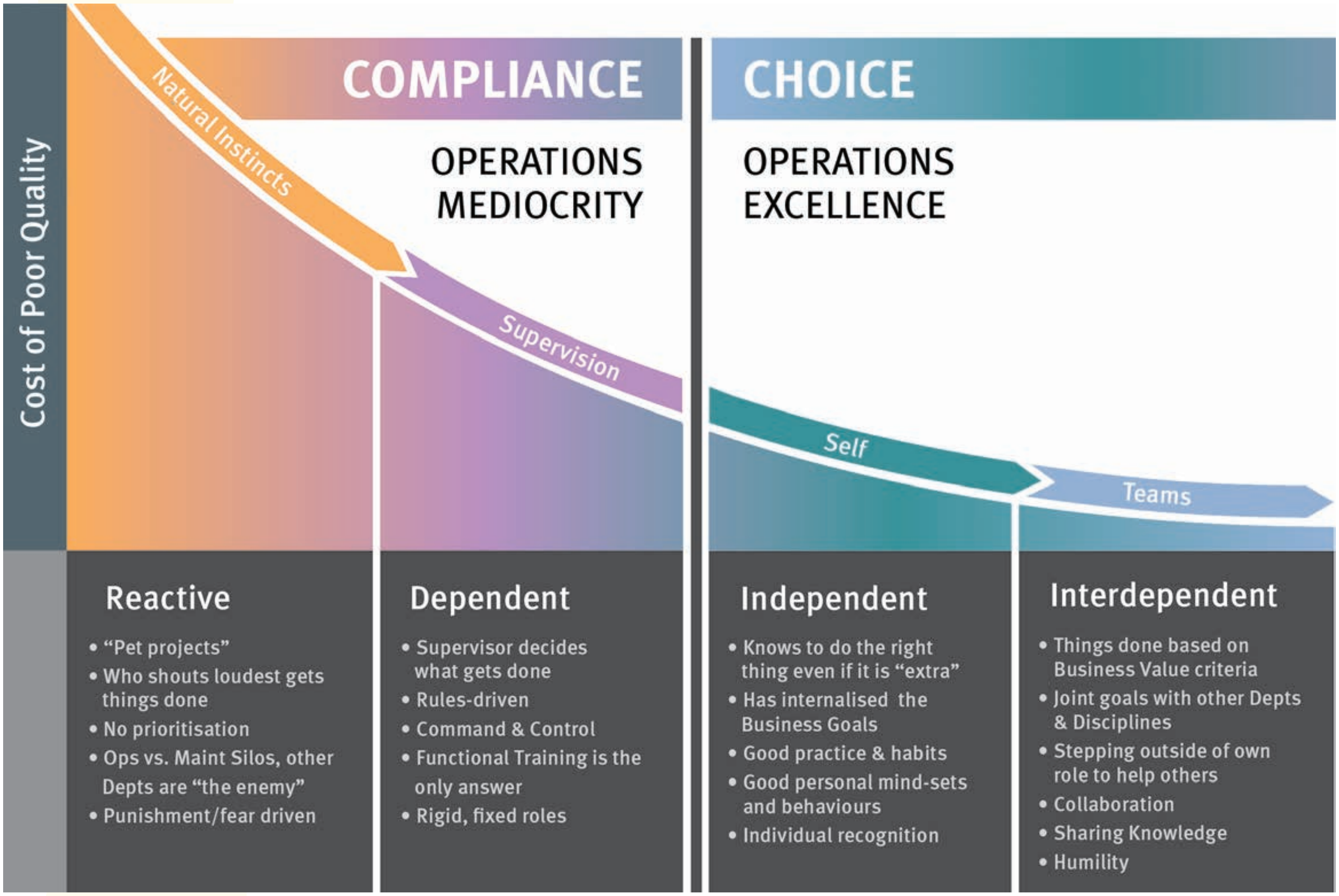

Figure 4: The DuPont Bradley Curve

Reactive culture

An organization that finds itself in the reactive phase is in a vicious cycle of one action resulting in a destructive reaction. Behavior is based on instinct. Compliance is the goal. People follow the rules because they have to. The "law of the jungle" prevails. The attitude is likely to be, "just get the day in;" do whatever it takes to get through it fast and out the other end. Reactive behavior often manifests in people taking shortcuts, schedule busting, little discrimination in prioritizing work (everything is urgent), little or no schedule backlogs, etc. This is where companies encounter "silos" and a notion of "the enemy," whereas operations versus maintenance versus reliability. This is the worst place to be and is often reflected in safety performance, too. It is not a good environment to work in!

Dependent culture

Dependence is a little better, but employees will still do things only because they are told to, or because there is an implied threat. Fear and discipline are the motivators. In this organizational culture, people leave their brains behind in the workplace parking lot and let their bosses decide for them. If the boss gets it wrong, there can be big implications. If the boss is not there, employees tend to slip back into reactive behavior. In this environment, there may be a focus on training, but not necessarily on competence.

Independent culture

In this quadrant, there is a subtle, yet significant mind-set change. People follow the rules because they want to and because they see the sense and benefits in doing so. That makes for a much better place to work. In this environment, people know what the right thing to do is and they do it. They often understand their role is directly linked to business results. Applied to asset management, this means the culture of maintenance reliability leadership has changed from a cost focus to a value focus. As a matter of fact, this aligns with the ISO55000 asset management standard. In an independent behavior phase, you begin to see individual recognitions and the adoption of good and best practices because everyone knows the goal. However, there is still room for improvement.

Interdependent culture

Once organizations attain a culture of interdependence, things are done for the greater good. Organizations are in a virtuous cycle of one action affirming a new, better action. Everyone is aligned with a joint goal. Operations work as equal partners with maintenance reliability. People cross boundaries without being asked to do so and proactively help each other. There is collaboration. Knowledge is codified and shared. Mentoring and coaching is the norm. There is team recognition, but not just for heroic efforts, such as those responding to an after-hours production incident. In this environment, a planner or planning team that quietly and methodically extracts value and eliminates waste by superior planning will be recognized and receive acclaim. Thus, the virtue of proactivity trumps reactivity.

Figure 5: Clean tech- Sulfur Morses Mill (Morses)

The best things about the interdependent quadrant are:

1. It is NOT Utopia, it's attainable;
2. It comes with superior safety results because the attitude is the same for safety, reliability, operations excellence, etc.;
3. It is sustainable.

The same quadrants of the Bradley Curve used at DuPont to monitor and assess safety culture also apply to other management systems. If employees act independently and responsibly because they see the value for themselves and for the business, that not only benefits safety, but also maintenance, reliability, performance, output and quality, all of which contribute to creating value and improving operational excellence.

But what makes people want to become that interdependent? It is quite a leap from reactive behavior to independence and interdependence. DuPont believes the clue is in visibly demonstrating leadership commitment so people see and feel that senior management is doing exactly what it also expects from all employees.

Achieving Sustainable Asset Productivity

Driven by an imperative for asset productivity sustainability in a period of intense business challenges, DuPont developed its own DuPont Production System (DPS). This system is based on a four-strand approach:

1. Managing or Governance Process;
2. Technical Model;
3. Capability Model;
4. Mind-sets and Behaviors.

DuPont has transformed its own business model in the past seven years by working with this four-strand approach. DuPont has found from its work with other companies through its consulting business, DuPont Sustainable Solutions, that companies tend to concentrate on the technical, capability, or governance processes. These are very important. However, in order for a business and asset management processes to succeed and thrive, it is equally important to promote the right culture.

Once DuPont applied its Bradley Curve culture assessment learnings, coupled with the right leading indicators, to operations excellence, maintenance, reliability and other capabilities, they began to flourish. Technical and capability models will not work without understanding the true culture of an organization and what needs fixing. And to fix, you start with leadership.

DuPont has found that a sustainable solution to operations excellence, which includes an asset management program, is only viable if the right governance, technical model, capabilities and, critically, a supportive culture are in place. If any one of these elements is weak, the whole program is likely to fail.

As an owner-operator, DuPont is in a unique position to assess and guide other companies through DuPont Sustainable Solutions using real-time experience. With a toolbox of mind-set and behavior resources, DuPont has worked with clients in a variety of industries, including oil and gas, petrochemicals, energy, mining, agriculture and food to assess where they are and to help them move, as DuPont has had to do, to the right side of the Bradley Curve.

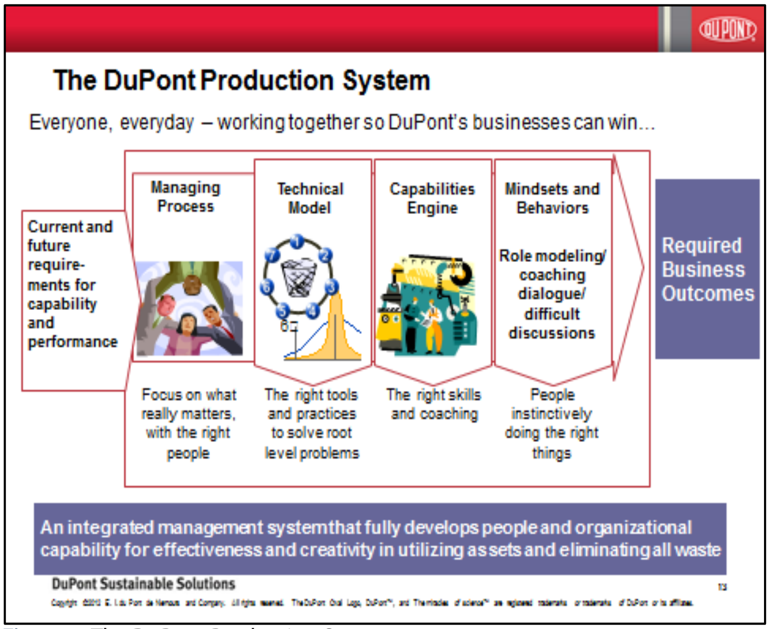

Figure 6: The DuPont Production System

References

1. The Conference Board. *CEO Challenge® 2013: People and Performance*. https://www.conference-board.org/retrievefile.cfm?filename=TCB_R-1523-13-RR_CEO-Challenge-2013-Report1.pdf&type=subsite
2. International Association of Oil & Gas Producers. *Asset Integrity – The Key to Managing Major Incident Risks*. Report No. 415, December 2008. http://www.ogp.org.uk/pubs/415.pdf
3. Oil & Gas UK. *Asset Integrity: An Industry Progress Report*, April 2009. http://www.oilandgasuk.co.uk/publications/viewpub.cfm?frmPubID=306
4. DuPont. *DuPont Helps to Sustainably Improve Safety Performance*. The DuPont Bradley Curve Video: http://www.dupont.com/products-and-services/consulting-services-process-technologies/brands/sustainable-solutions/sub-brands/operational-risk-management/videos bradley-curve-video.html

***Stuart Grant** is a Global Solutions Architect for Asset Management at DuPont Sustainable Solutions based in Maydown, Northern Ireland. He has 26 years of experience in operations roles, including operations, maintenance reliability and utilities. In his current role, Stuart works with companies to design sustainable solutions that will protect and optimize their asset strategies using proven methodologies developed at DuPont, and align them with emerging best practices and new standards. www.sustainablesolutions.dupont.com.*

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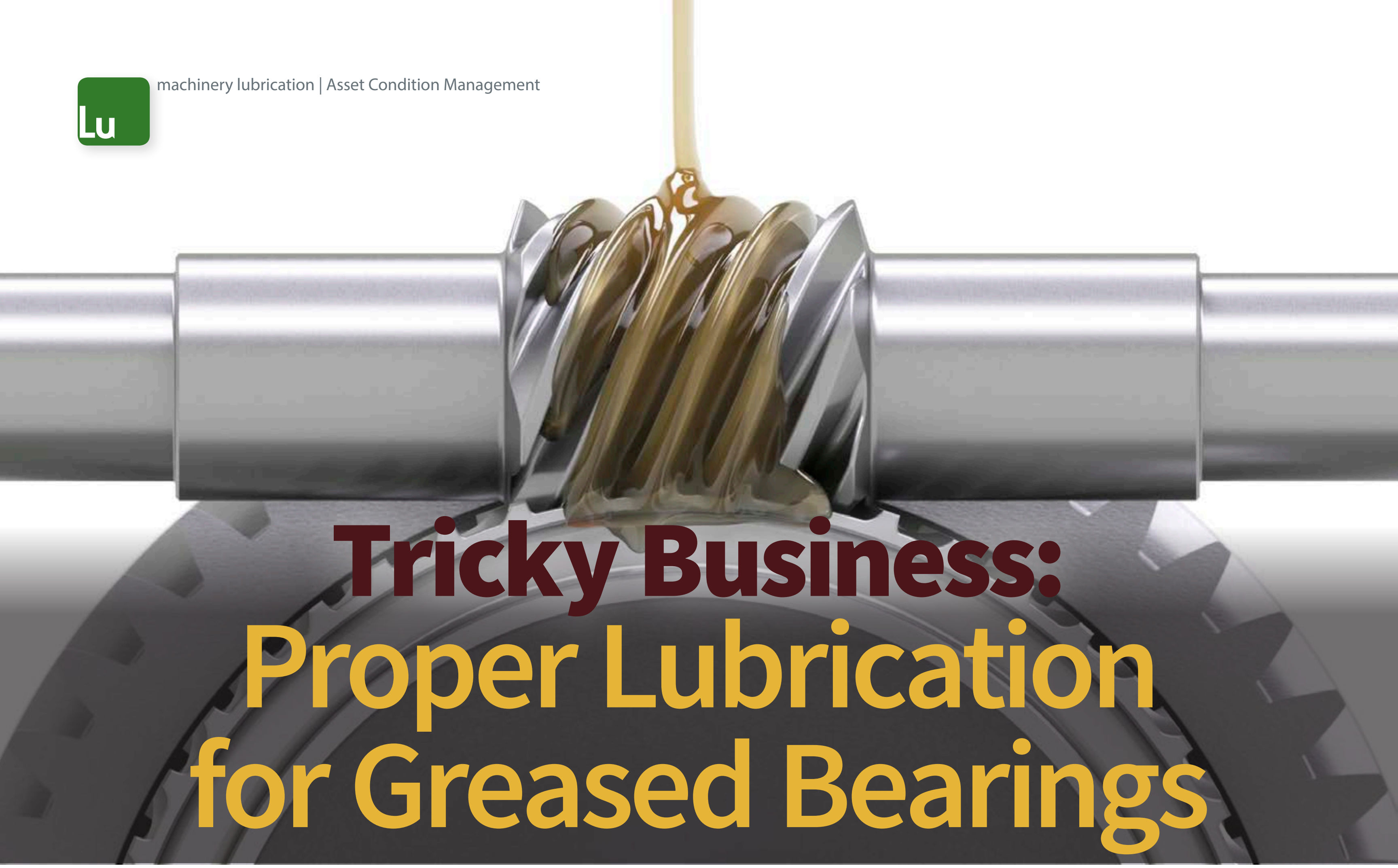


Tricky Business: Proper Lubrication for Greased Bearings

by Jarrod Potteiger

In the average plant, many mistakes are made with respect to grease selection, application amount and application frequency. The key to optimum grease lubrication for bearings is to add the maximum amount of grease without causing harm.

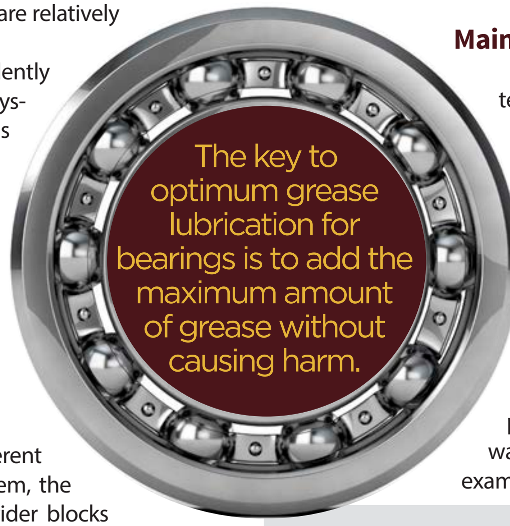
This maximum amount is based on the bearing's size and speed. In most bearings, grease will have a very long service life, thereby maximizing the required interval for reapplication, which, in some cases, could be years. There are, however, many factors that can curtail grease life, such as bearing type, operating temperature, vibration and contamination. When the combined effect of these factors is great enough, grease service life can be reduced to mere days or even hours. In these cases, it makes sense to employ automatic application systems to lessen the burden on lubrication technicians, freeing them up to deal with other issues. There are other situations where automatic application is attractive, such as the sheer number of grease points, accessibility issues and safety. Yet another potential benefit of automatic application is consistency. Assuming a system is designed and tuned correctly, one can be relatively sure that the correct amount of grease will be maintained in each point. Conversely, manual application injects the human factor, which is subject to the opinions and actions of individuals. Regardless of the reasons, once it is determined that automatic application is the right path, the next step is to decide which type of system to install.

While compact, single point lubricators are appropriate in many applications. However, the focus of this article is on centralized, multipoint systems. Centralized application systems are those that lubricate many points from a single system. They can be categorized into three primary categories: single line parallel (non-progressive), single line series (progressive) and dual line parallel systems. Each of these systems has advantages and drawbacks in the areas of cost, versatility, maintainability and durability.

Single Line Parallel (Non-Progressive)

Single line parallel systems are the most simple and inexpensive. In these systems, a pump pressurizes a main supply line and fills a number of injectors, all of which operate independently of one another. Once the injectors have been primed, they utilize a spring to deliver the grease over a short interval. Application rates can be adjusted by changing the pump cycle time or adjusting the stroke of the injector cylinder. The units are well suited for smaller, compact machines where the length of the primary supply line is limited to a relatively small area. However, these systems don't do well with very viscous lubricants over long distances. Major advantages of these systems are they're easy to repair and modifications, such as adding additional lube points or changing delivery volume are relatively simple.

The fact that the injectors operate independently can be a good or bad thing, depending on the system being lubricated. Independent function means an individual failure of one injector doesn't disrupt the rest of the system. On the other hand, there is no central signal that provides an alarm when a failure does occur. This lack of a central signal makes rigorous inspection that much more important. If technicians are vigilant and proper preventive maintenance (PM) inspections are in place, the problem will be neutralized.



Single Line Series (Progressive)

Single line series systems utilize a very different distribution method. In a series progressive system, the pump delivers grease through a network of divider blocks that contain a complex system of interconnected spool valves. As the grease flows through the block, it subsequently fills one cylinder while moving a piston to deliver grease to a lube point. At the end of the stroke, another port is revealed and the flow is redirected to the next cylinder and so on. In this way, grease is delivered to each lube point in succession so that if grease is delivered to the last lube point, it may be assumed that each point received its specific amount. These systems are capable of delivering grease further distances than the non-progressive systems, but they require more extensive engineering up front. It is somewhat difficult to add lube points and adjusting the delivery volume requires either new, larger valves or increasing the cycle rate for the entire system.

With respect to system monitoring and failure isolation, the series system is the opposite of the parallel system. In this case, a central signal can be generated from the end of the system that alerts the user to a failure, thus making fault detection easy. A failure at any point in the system, upstream or in the divider blocks, will be propagated through the rest of the system, allowing for easy monitoring. The downside of this is that a failure at one point will result in lubricant starvation for all subsequent points. If the nature of the lube points is such that a failure to deliver grease could cause immediate harm, this may be a big problem. When this is the case, it is necessary to define the response to a failure accordingly. It is also important to note that one of the most common failure modes of all automatic grease systems is line breakage between the injector and the lube point. In this case, the only way to identify a failure is a complete system walk down, no matter which type of system is installed.

Dual Line Parallel

Dual line systems are the most complex and expensive systems, but they offer several advantages. Dual line systems can accommodate hundreds of lube points and cover large areas. In these systems, the lubricant application rate is determine by the cycle time and the displacement of the valve cylinders.

The dual line system uses two pressurized feed lines to deliver grease to the injectors. Each time the system cycles, one of the lines is pressurized to both fill one side of each injector and deliver grease from the other side to a lube point. When the appropriate pressure is generated at the end of the line, a diverter valve is signaled, which redirects the grease flow to the other side, reversing the process. In this way, half the system's lube points are lubricated with each cycle. These systems typically utilize very powerful pumps and are capable of delivering large volumes of very viscous fluids over long distances, making them a common choice for systems with many large bearings, such as paper machines and many steel mill applications. It is also fairly simple to add lube points to an existing system.

The most significant downside of dual line systems is that they are relatively expensive due to the component's cost, installation and twice the use of tubing and fittings compared to a single line system.

Maintenance of Centralized Grease Systems

The drawback of most automatic lubrication systems is the natural tendency to ignore them. Because they are designed to eliminate work, people tend to install them and consider the problem solved. Although most centralized grease systems are very reliable, they are not maintenance free. They require proper maintenance just like any other critical asset and should be subjected to rigorous inspections with defined corrective actions for abnormal conditions. Proper maintenance for these systems is really quite simple. Daily and monthly inspections should uncover any common problem that would likely arise and provide ample warning to take corrective action. The following is an example of a good grease system PM program.

Daily Inspections

- Inspect the system's pumping station for any alarms.
- Check the grease reservoir level.
- Perform a general inspection of the pumping station and note any abnormalities.

Monthly Inspections

- Perform an entire system walk down to check all grease lines, header lines and grease fitting lines.
- Check doser/injector operation. While performing line checks, note the status of the flags/pins on each injector (e.g., up/down or in/out). Next, energize the system and then make sure each flag or pin has moved to the opposite position.
- Perform a general inspection of the air and electrical supply to the pump and other components to ensure they are in good working order.

Different systems may have unique inspection or maintenance items that apply, but, in general, these are the main steps required to ensure trouble-free operation. The criticality of certain components or the criticality of components receiving timely lubrication may elevate the need for individual line checks, so inspection frequencies should be adjusted accordingly.

Whichever centralized grease application system is ultimately chosen and installed, the reliability of the system and the assets it lubricates will be largely determined by the quality of the inspection and the maintenance process for the system.

Jarrod Potteiger is the Product and Educational Services Manager for Des-Case Corporation. Prior to joining Des-Case, Jarrod was a Director of Services for Noria Corporation. Jarrod holds a Bachelor of Science degree in chemical engineering from the University of South Alabama and is a certified maintenance and reliability professional (CMRP). www.des-case.com

Condition Indicators

Provide Advanced Condition Analysis

by Allan Rienstra

The world of asset condition management needs dependable data to assess machine condition. Useful data empowers Reliability to extend asset lifecycle; Schedule timely intervention in a cost-effective way; Predict and plan for end of lifecycle; and Analyze failure modes to improve future asset integrity.

SDT's Four Condition Indicators (4CI)

In the world of asset condition management, we rely on dependable data to inform us about the condition of our production machines. Useful data empowers reliability in so many ways. We can:

- Achieve whole lifecycle for our assets.
- Schedule timely maintenance intervention in a cost-effective way.
- Predict and plan for the end of an asset's lifecycle.
- Analyze the failure mode to improve the integrity of future assets.

Common sources of condition data are contributed from a basket of reliability technologies: ultrasound, thermography, vibration, oil analysis and motor circuit analysis. Let's take a closer look at ultrasound data to see what is now possible with SDT's innovative ***Four Condition Indicators (4CI)***.

Before ***4CI,*** ultrasound inspectors trended ultrasound data based on a single, static measurement taken at an arbitrary point in time. Capture the measurement at the wrong time and the defect was either missed, or amplified beyond reality. ***4CI*** allows inspectors to set the acquisition time prior to capturing the measurement. The result: a more representative and accurate collection of data.

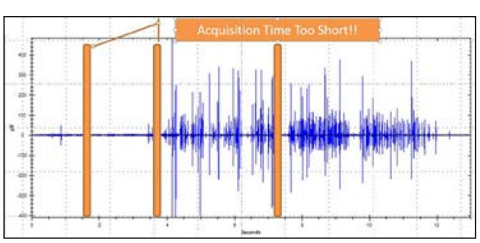


Figure 1: Measure without acquisition time and miss important parts of the signal

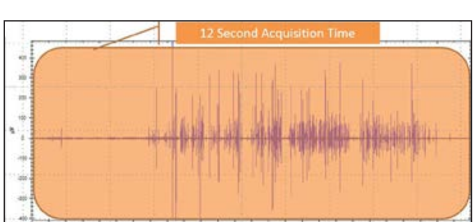


Figure 2: Measure with acquisition time set to 12 seconds and capture the entire signal

The static data in Figure 1 misrepresents actual bearing condition because the acquisition time was too short. Important elements of the signal were missed. In Figure 2, the static data was collected with a 12 second acquisition time. The resulting data was then applied to SDT's Four Condition Indicators.

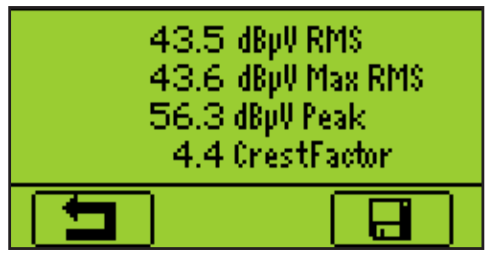


Figure 3: SDT270 returns Four Condition Indicators with each static dB measurement

Condition Indicator 1 – Overall RMS

The SDT270 averages the entire 12 second sample and returns a single RMS decibel value (Example 43.5 dBµV RMS). The overall RMS is useful for producing friction trend graphs over long periods of time.

Condition Indicator 2 – Max RMS

The SDT270 calculates a block of RMS values every 250 milliseconds. A 12 second acquisition time would have 48 RMS blocks. The SDT270 reports the block with the most energy as the Max RMS. (Example 43.6 dBµV Max RMS) The Max RMS, when compared to the overall RMS, gives the inspector an indication about how stable the signal is.

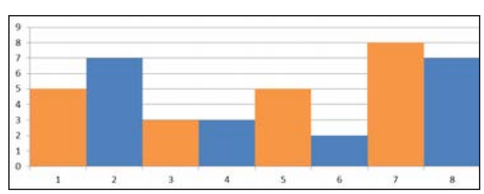


Figure 4: Max RMS is the loudest 0.25 second block of data for the acquisition time. Block #7 is the Max RMS of this 2 second sample

Condition Indicator 3 – Peak Value

The SDT270 captures 8,000 measurements per second. That's 96,000 measurements in our 12 second example above. The peak value condition indicator returns the single loudest measurement. (Example 56.3 dBµV Peak Value). The peak value is an excellent indicator of impacts in a bearing, or worn and broken teeth in a gearbox.

Condition Indicator 4 – Crest Factor (CF)

A ratio between the peak value and the RMS value, CF is useful to estimate the failure severity for bearings and gears. It also helps predict remaining useful lifecycle. When an asset is entering failure mode, the CF value will spike even if the RMS remains moderate. The CF levels drop as failure stage advances because the peak value remains high as the RMS advances.

Ultrasound inspectors using the SDT270 four Condition Indicators have unprecedented insight about the meaning of static dBµV data. This innovative addition is an evolutionary step forward for ultrasound technology. Before ***4CI***, static ultrasound data was useful as a trending tool so long as the acquisition time was long enough to capture all of the signal. With ***4CI***, ultrasound inspectors have valuable analysis data that goes beyond simple trending. Use ***4CI*** to determine if increased friction is a result of poor lubrication, early or advance wear, or both.

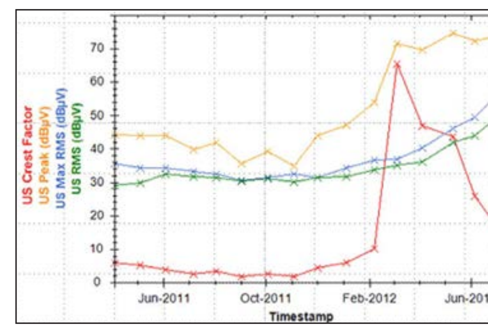


Figure 5: Note the spiking CF in February 2012 followed by a retracement of CF in June as the bearing is entering advanced failure stage. (Trend graph courtesy of SDT's Ultranalysis Suite data management software. Data collected with an SDT270DU Ultrasonic Data Collector)

Ultrasound trends always gave the earliest indication that a bearing had entered failure stage. Now, ***4CI*** empowers inspectors to determine the length of window between early, advanced, and catastrophic. If you're charged with asset condition management and RCM planning and scheduling, adding SDT's Four Condition Indicators to your data set gives you the competitive advantage you need.

Research provided by Reliabilityweb.com's "Asset Management Practices, Investments and Challenges" reports that 70% of companies polled felt an in-house asset management strategy suited them better than outsourcing, yet only 30% of those strategies succeeded. The report cites lack of leadership as a leading cause of project failure.

Ultrasound must be a key element in your asset condition management strategy. The technology provides early detection of asset health issues and affords the opportunity to plan corrective actions at optimal costs. Fully implemented programs enjoy the benefits of lower energy costs, which lends itself to environmental sustainability. World-class ultrasound programs witness an increase in the velocity of culture change between implementation and maintenance milestones.

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HEAR SDT MORE

Doing It "Right" in Maintenance

by John Crossan

Lately, it seems strong, single-minded commitments to beliefs have just about everywhere in the world in some kind of struggling situation. All kinds of groups, on all kinds of issues, taking the absolute position that they're right, the other side is just wrong and there's no common ground where some kind of agreement can be reached. Agreement where there actually might be some work done together to make things better for all.

This is not new to people in the world of maintenance and operations who have struggled with seemingly conflicting objectives, probably since the very first tool of any kind was developed on the planet. There is no doubt there was some pretty violent debate back then about when and how often that tool should be sharpened and the truly dire consequences if it wasn't. (Some might even say the actual sounds of the debate haven't really changed across the eons.)

As a brand new maintenance supervisor too many years ago, I remember being counseled by some older mechanics that we, maintenance, were at war with production. We always had to fight them because trying to be nice to them or working out some accommodations was just showing weakness that they would exploit.

If there was something wrong with a machine, I was advised that, "We should just walk over, shut it down right now and do whatever we had to do to fix it completely and properly, no matter how long it takes."

I remember thanking them for the advice, but pointing out that I had a young family with numerous expenses and a regular paycheck was somewhat important to me. But not entirely disagreeing with their position.

Over the years, and it took quite a few, I eventually realized that this pretty common (sadly, often fostered) conflict, when left unresolved, causes some real roadblocks to improvement in plants and eliminates any chance of getting close to manufacturing excellence.

> I remember being counseled by some older mechanics that we, maintenance, were at war with production. We always had to fight them because trying to be nice to them or working out some accommodations was just showing weakness that they would exploit.

Operations and maintenance, each in their defensive mode, fortified silos, not trusting or communicating well and seemingly just worrying, mostly about building bigger, stronger silos.

There was maintenance demanding downtime or else the world could end and operations saying, "No way. Couldn't be that bad. We don't believe it." And of course, the post-disaster blame fests. I've witnessed some truly great, dramatic role-playing, with both sides performing like they felt they were supposed to. Just like the warring families in "Romeo and Juliet," or the more recent, perhaps somewhat less classy, "Family Feud." Not to say there aren't different viewpoints on issues, but routine, open, respectful, structured teamwork discussions can get to agreement on solutions that will move things forward.

In my years of teaching about maintenance and manufacturing, this issue often comes up in discussion. If it doesn't, I'll bring it up because it's always there and it has to be dealt with, no matter how nicely both parties might talk about each other and their relationship when they're both in the same room.

It usually shows up in discussions about problems and dealing with them on a planned, scheduled basis versus just jumping in and fixing, taking however long it takes. At issue is the morality of putting some patch repair in place, or maybe even just leaving it until a proper repair can be planned and scheduled. I remember one particular group of really solid, well-intentioned, capable maintenance folks who said, "If we have an issue, we're going to deal with it in the best way, right now, because that's the kind of people we are."

"Doing it right" is important to all of us, but especially for craftspeople who take real pride in their work. Anything else just doesn't feel right, lacking in principle and not the way we were raised and trained, and our mothers would be upset with us if they found out.

I had some remodeling work done in a bathroom at home and the tile contractor worked on it all day Saturday. He came back on Monday to finish, but when I went to check on him, he had torn out a bunch of what he did on Saturday and was redoing it. He said, "I thought about this all day yesterday and it just wasn't right. It's my mistake, it won't cost you anything." It had looked just fine to me.

"If we have an issue, we're going to deal with it in the best way, right now, because that's the kind of people we are."

There are many quotes on the subject: "Do it right the first time," "If a job is worth doing, it's worth doing well," and the famous one attributed to John Wooden, the famed UCLA basketball coach and leadership guru, "If you don't have time to do it right, when will you have time to do it over?" These quotes are sometimes thrown out by those in the maintenance silo to those in the operations silo as a way to take the moral high ground in the argument. (What kind of person can live with themselves not giving up enough downtime for us to do it "right," right now?)

But what is doing it right for the organization overall?

It always seems to be a big revelation how inefficient and, worse, ineffective, unplanned and unscheduled maintenance work really is. For many folks, they're working really hard, in the best way they can, fixing it as right as they can and going home late and worn out. So how can that be wrong? And it really can't be that inefficient.

But when we go over jobs in detail talking about the time spent figuring out what to do, looking for parts, figuring out what else to do when we don't have them (cheap company won't stock what we need), trying to get everything together on a hurry-up basis, under pressure, taking shortcuts, (did we do all the safety stuff we're supposed to?), it becomes pretty apparent that a lot of time was just flat out lost. We finally get something done, but most times it's not really done right after all and we'll have to revisit it anyway. So we've taken more operational downtime than we needed to, which cost a bunch of money. We wasted a bunch of maintenance resource time that we never have enough of anyway and, worst of all, we have to do it again.

The numbers usually quoted are staggering. Typically, unplanned work takes four times longer than planned work, costs four to 10 times as much and usually has to be done over again anyway. No organization can afford this. And it's usually not a matter of not having enough staff, but just that you're wasting so much of people's time.

So, is taking this loss doing it right, or is it better to find some workmanlike way to keep things running while we get our act together (provided we're not doing more damage or creating a safety, quality, environmental, etc., issue) so we can do it right on a planned, scheduled basis? And this is not some dishonorable, unprincipled behavior where we should feel badly and wouldn't want our mothers to know about it. This is what I think doing it right is really all about. It's not about values, it's about the time frame. Right now, or when we're ready?

The issue also comes up in discussions of preventive maintenance (PM) work. (Don't you really wish we could redo some maintenance terminology so we don't have to constantly explain the different definitions for the exact same words?) To some folks, "PM-ing" a piece of equipment means taking some downtime, going through inspections and then fixing everything we can find wrong. Seems like an approach, but what usually happens is we find some things wrong and decide to fix them now "since we're here anyway," then find we don't have what we need to fix them right (e.g., parts, resources, information, etc.), but we still try to do it anyway, taking extended time and not getting the rest of our PM done. Then we get upset when operations begins to demand that they need the machine back to fill customers' orders. It's not an emergency breakdown type repair, but it's still unplanned and unscheduled work with the huge inefficiencies that go with it.

Of course, if it's a serious issue that won't last, we have to deal with it right then, but that really speaks to the effectiveness of our PM inspections. If a machine will be out of service for a long period of time, then the first activity is a thorough inspection to find the things going wrong, then planning and scheduling the repair work so we use our resources effectively and efficiently. We can use the analogy of an auto racing pit stop. Do they take however long it takes? Or is it a detailed, planned, highly efficient, scheduled activity done in the shortest possible time using the prior constant communication from the driver and observers for input? Not really a parallel to the industrial situation, but the concept of maintenance and operations both tied into equipment care done in the most effective, efficient way is exactly where we need to get to.

Just don't ever do unplanned work unless there's absolutely no other choice.

So, the key to success is both groups realizing they really have the same objectives and both have responsibilities to achieve them. Operations is responsible for operations and equipment care because that care is vital to good operations and they have a role in it. Maintenance is responsible for equipment care and operations because the purpose of the equipment is providing goods and services to customers in timely, cost-effective ways and they have a role in this.

What are ways to get there?

- Communication and trust are the only ways to break down the silos and they just don't happen by themselves. In fact, we all tend to surround ourselves with people who think like us and stay away from those who don't. How many operations people do you meet at maintenance conferences? And vice versa? One explanation for the upsurge in polarized opinions these days is there are so many channels of information available that we can choose only to see and hear what supports our positions and never even visit the other side. So, the communication has to be forced, with routine, everyday, mandatory, scheduled and structured (blame free) meetings with operations and maintenance to review and discuss current issues and solutions. Informally, it just won't happen consistently, in any way that's close to effective. Once the communication is there and good results begin to happen from it, then the trust will build.

- Effective, structured PM inspections to find pending issues are the key mechanisms to give us the time to plan and schedule effective, efficient repair work. Involving operators in this, since they are the ones closest to the equipment, gets them involved and owning equipment care and improvement. There are always a variety of concerns about this participation by those who have never experienced it. I know I had plenty. But it just really works well when ownership is fostered.

- Operations and maintenance have to agree on some realistic amount of downtime needed for PM inspections and effective efficient repairs. Operations has to commit to this, as well as finding ways to get them as a part of their function. The production scheduler has a responsibility to find time for maintenance, as well as production. A key item for the daily meeting is operations giving maintenance information about downtime opportunities for planned, scheduled work that day.

- Maintenance has to commit to using this downtime well, with properly prepared, planned and scheduled work. But, constantly look for ways to reduce this downtime by doing the work in better ways or finding ways to eliminate it (e.g., looking for ways to get inspections done on uptime versus downtime).

- The maintenance work schedule and PM schedule for the next week are developed and owned by both operations and maintenance to make sure it's the right work from both viewpoints. The status of both PM and schedule compliance are reviewed daily in the meeting as we move through the week and adjustments are made as needed.

- Make sure we avoid unplanned work whenever we can. Or better stated: ***Just don't ever do unplanned work unless there's absolutely no other choice.***

John Crossan *currently works as a consultant. He spent a long career in a wide variety of roles in manufacturing operations, engineering and maintenance. His roles for much of the last 14 years were mainly focused on improving operations by fostering the installation and ongoing implementation of basic manufacturing and maintenance procedural mechanisms across 30 varied plants in the U.S. and Canada. www.johncrossan.com*

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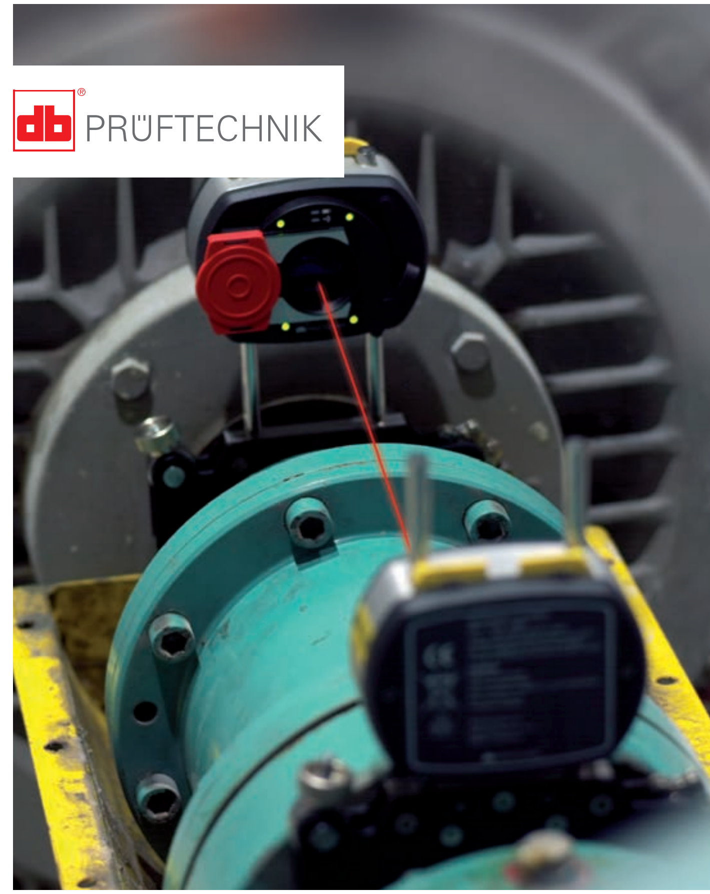

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The Journey to World-Class Pump Reliability

by Phil Beelendorf

What are the essential elements of a world-class pump reliability program? What best practices lower total cost of ownership and which ones create little value? Is mean time between failures (MTBF) the best measure of improved performance?

Roquette America's search for the answers to these questions led the global leader of innovative nutritional ingredients processed from renewable, plant-based raw materials on a journey in search of excellence.

From an initial effort to create written standards for pump design, operation, installation and repair, a fully integrated asset management program slowly emerged. As the program matured, it became apparent there were five essential elements of best class performance.

1. Having a simple, easily understood program.
2. Effective communications of the program's elements to all internal and external stakeholders.
3. Emphasis on training and execution. Like firefighters or first responders, it is important to standardize processes. When variability is minimized, bad actors can be better identified and a defect elimination culture can become firmly established.
4. Development of a continuous improvement culture, where new ideas are incorporated into the low variability processes created through standardization.
5. Development of a formal audit process. This ensures those ideas that lower total cost of ownership are adopted and those that do not are quickly discarded.

Before any journey begins, one must have both a vision and a mission. Roquette's vision for maintaining the pump asset class in all of its plants is simple: All pump failures are avoidable. The two primary failure modes associated with centrifugal pumps are bearings and mechanical seals. In his technical paper series, William McNally of the McNally Institute stated that the L10 life of a radial bearing in a Durco Mark II pump, size 3 x 2 x 10 is 300 years. In his 2014 keynote address at the Society for Maintenance and Reliability Professionals (SMRP) annual conference, Heinz Bloch indicated only 9 percent of bearings reach their L10 life. And ask seal manufacturers how many of their products fail due to complete face wear and they will tell you almost none.

Therefore, like a safety culture built on the premise that all accidents are avoidable, Roquette America believes almost all its pump failures are premature in nature and, therefore, avoidable. The company will change its opinion when MTBF exceeds 10 years! This vision gave birth to the following:

Mission: Roquette America is committed to managing all facets of its pump program to best practice levels, including design, repair, storage, installation, maintenance, and bad actor identification and resolution. It is committed to this mission so that it may increase equipment reliability and reduce the total cost of ownership for this asset class.

But a vision and mission, in and of themselves, do not produce results. Reliability initiatives, such as a pump asset management program, have a greater chance of success if they are strategically designed. Roquette utilized a plan-do-check-act (PDCA) action cycle to develop the scope and sequence of its program. Timing and sequence are critical; getting too many change initiatives started at the same time overwhelm personnel and rolling out actionable steps in the wrong sequence increases the likelihood the initiative will fail. The PDCA action cycle is shown in Figure 1.

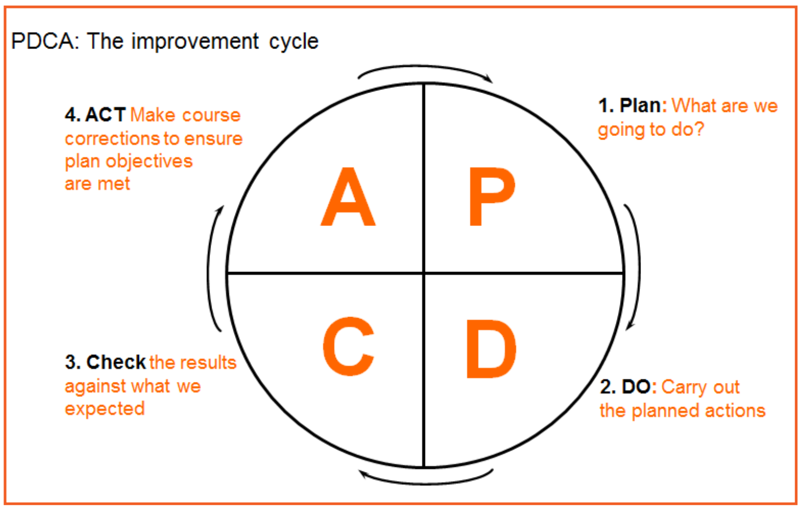


Figure 1: The PDCA action cycle

It cannot be stressed enough the importance of the planning step in the PDCA action cycle. Several questions should be considered:

1. Is the activity well-defined? What scope will be covered under the initiative?
2. What resources will be required to ensure the initiative can be successfully completed? Are the resources committed to the assigned activities and do they have sufficient time to complete them?
3. What is the anticipated payback for the initiative? Based on the required resources (e.g., time and money), will the payback meet company hurdles. Will competing initiatives produce a better return on investment?
4. Is there buy-in from all stakeholders participating in or committing resources to the initiative?
5. What needs to be done before rollout? Should the activity be rolled out in stages or all at once?
6. How will success be measured?

During the planning stage, it became obvious that Roquette America needed to break the program down into smaller, more manageable steps. Defects were found throughout the process. If the company was committed to creating a defect elimination culture, it had to eat the elephant one small bite at a time. There were too many areas in which the pump program was not performing at best practice levels and the data necessary to make informed decisions did not exist. The company concentrated its initial efforts on standard development and the creation of measures that captured the current state of the program. This required meaningful key performance indicators (KPIs) and standardized failure modes. It was at this time that Roquette created the KPI, $ per pump type/per year, adopting it in place of MTBF. In an effort to maximize MTBF, the company was, at times, running pumps to catastrophic failure. The cost of the collateral damage, which occurred in the last few weeks of the asset's lifecycle, far outweighed the extra lifetime gained. This concept is illustrated in Figure 2. Letting a seal or bearing go beyond incipient failure results in higher repair costs. The company's own research indicated that total cost of ownership was minimized somewhere around 90 percent of useful asset life.

Development of best practices standards was a collaborative effort between internal and external stakeholders. Representatives from maintenance reliability, storeroom, purchasing and partner repair facilities were involved. Emphasis was placed on partnerships that were built on value instead of low cost. Shop audits were performed to ensure Roquette partnered with repair facilities that were aligned with its mission. It was important to select shops that provided more than repair services. The company sought partners who could help it identify opportunities to consolidate inventory, provide robust failure analysis capability and provide engineering services capable of identifying and eliminating defects. Price was only used as a deciding factor between best practice shops that were in alignment with Roquette's vision for asset class management.

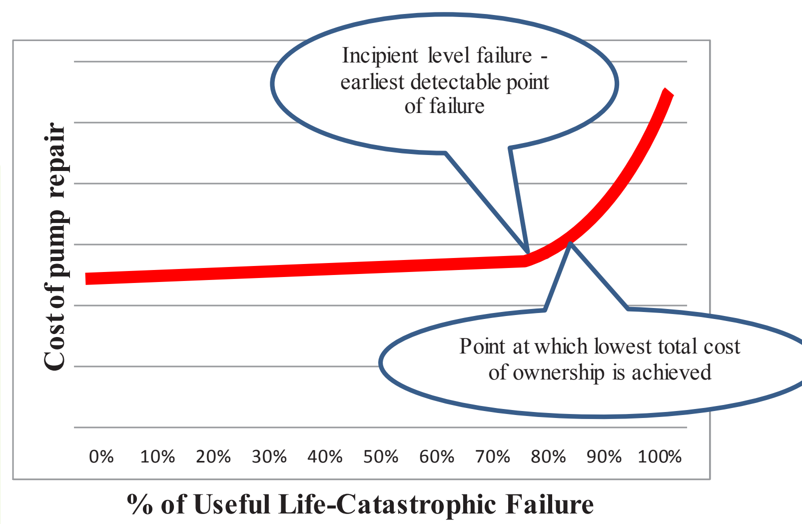


Figure 2: Cost of pump repair as a percent of useful life

The next two focus areas were storeroom inventory consolidation and best practice storage. Inventory consolidation turned out to be one of the most lucrative opportunities since over the years, Roquette America had acquired a veritable museum of different types and vintages of pumps. Several examples of pumps with spare overstock existed due to the practice of removing pumps from service and keeping them for spares. New material codes were created as pumps were upgraded, even though, in many cases, the models were dimensionally equivalent to those they replaced. Many times, one-off pumps were installed by engineers on projects, rather than purchasing a more common pump found in the plant.

2014 Asset Class Program Management Savings						
	Inventory Reduction-# of parts	Inventory Reduction-$ value	Cash Flow savings	Maintenance Savings	Capitalized Maintenance Savings	Alliant Energy Rebate Savings
Pumps	42	$16,331.68	$0.00	$188,387.34	$19,934.70	$0.00
Motors	37	$19,524.51	$0.00	$127,800.57	$108,748.83	$3,110.00
Seals	1	$3,780.00	$0.00	$43,051.53	$0.00	
Total	80	$39,636.19	$0.00	$359,239.44	$128,683.53	$3,110.00
Total Savings			$491,032.97			
Total Savings (includes pump optimization)			$542,784.30			
Projected 2014 savings			$689,569.95			

Program start date	1/1/2014
Todays date	10/9/2014
	1/1/2015
	281
	365

Figure 3: 2014 program management savings YTD through October 9

Many of these one-off designs had one-to-one field to spare ratios. Standardization to preferred pump types provided additional consolidation opportunities.

Cumulatively, these initiatives resulted in a tremendous cost savings opportunity. Consolidation and targeted obsolescence allowed Roquette to forego repairs as pumps failed. It is said that simplicity is the mother of invention and, in this case, simplifying inventory led to better cycle turns and improved storage practices. Roquette had to clean up the clutter to see the forest through the trees. Its optimization efforts removed 102 pumps from its storeroom inventory over a three-year period, saving over $1 million in the three asset classes managed with this approach – pumps, motors and mechanical seals. Figure 3 shows 2014 year-to-date savings through early October.

Using a first in, first out (FIFO) inventory management system and a just in time (JIT) inventory management approach ensured pump cycle turns were optimized and no pump accidently sat in a corner unused and forgotten. A FIFO staging area made it easier for craftspeople to check out the oldest pump first.

Once standardized repair and storage procedures were in place, the focus switched to bad actor resolution and defect elimination. Data indicated that many of the company's pumps followed a typical bathtub curve failure pattern. Chronic bad actors and human error contributed to a high infant mortality rate. Resolving bad actors and eliminating defects significantly increased aggregate MTBF and reduced total cost of pump ownership. A unique process was developed by which the root cause of chronic pump failures was identified. Primary failure mode data helped in creating this process. Figure 5 shows a Pareto analysis of pump failure modes since the program's inception.

Forty-five percent of Roquette's pump failures were from mechanical seal leaks. Mechanical seals leak for a variety of reasons. If the mechanical and operational issues causing the seal leaks were eliminated, the root cause of the majority of remaining issues would be inadequate seal water back pressure or the quality (cleanliness) of the flush fluid. A failure analysis spreadsheet was developed to identify the root cause of seal leaks, the primary failure mode. As bad actors were identified, the lead vibration analyst was dispatched to complete a comprehensive machine assessment, identifying mechanical issues, such as base deterioration, looseness, misalignment, or excessive pipe strain. If issues were found, the cost of corrective actions was estimated to determine whether eliminating these defects would pay for themselves through increased reliability.

Once the machine assessment was completed, the pump's design and its fitness for duty were assessed. The importance of this step cannot be emphasized enough. Most pump designers will tell you the overwhelming majority of pumps are oversized. Many of Roquette America's bad actors ran far left or far right

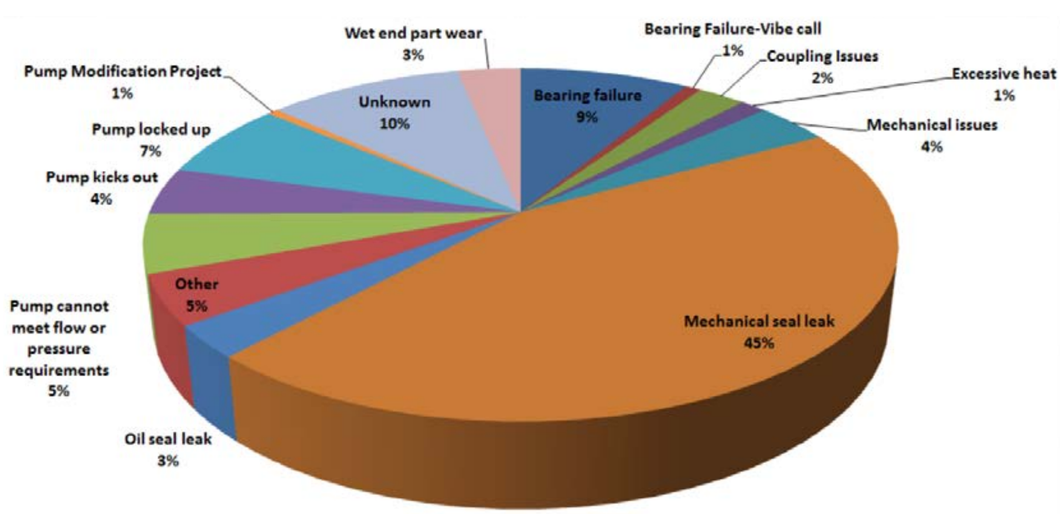
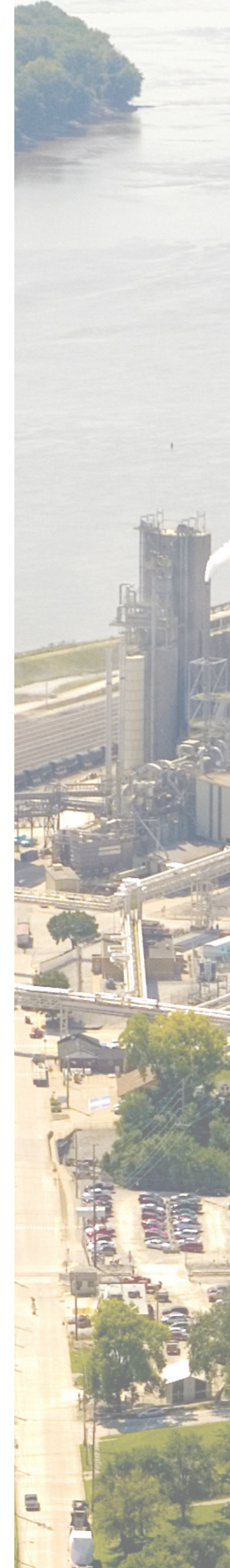


Figure 4: Pareto analysis of pump failure modes



of the pump's best efficiency point (BEP). Radial forces are minimal at BEP. Operating off BEP increases radial forces, causing premature seal and bearing failure. Pump efficiency greatly improves as you operate closer to BEP. Often, the energy savings, utility rebates and the increased pump MTBF will pay for the cost of pump replacement.

If a pump passed through the first two assessments without triggering a corrective action, seal water pressure or flush fluid quality issues were investigated. The plant is very old and the city's water pressure fluctuates in many areas. Over the years, Roquette's API Plan 54 water system has not been upgraded as the company added pumps to the loop. It has found that Plan 53A (seal pots) is an effective solution in many cases to address inconsistent water pressure. In each case, bad actor improvement projects were cost justified. Lifecycle cost (LCC) analysis was used to determine which solutions offered the lowest total cost of ownership. An example of an LCC analysis that was completed to resolve a bad actor is shown in Figure 5.

LCC cost analysis spreadsheet				
	Option 1	Option 2	Option 3	Option 4
	Do nothing	3180 no VFD	3180 with VFD	Recycle line back to tank to keep flow above low continuous flow.
Lead Time				
Life cycle cost (NPV)	$302,395	$311,790	$238,466	$290,395
Life cycle cost (useful life aggregate)	$615,847	$560,808	$411,570	$575,712
Useful life (yrs.)	12	12	12	12
Installed cost (total cost of project)	$0	$81,465	$91,333	$25,700
Alliant Energy rebate	$0	$9,000	$11,000	$0
Maintenance costs-NPV	$59,868	$34,782	$20,148	$22,168
Maintenance costs-Aggregate over useful life	$119,880	$70,050	$49,045	$54,046

Figure 5: LCC analysis for Waste Tank E pump project

Failure mode and effects analysis (FMEA) identified substandard work practices that contributed to infant mortality. Targeted operator and craft training, as well as an operator basic care checklist for pumps and seals, were developed from the primary human error failure modes. The individual initiatives of Roquette's holistic program fit together like pieces of a puzzle to form the improved picture that is the company's current asset management program. The results have been quite satisfying.

Total cost of ownership, as measured by the $ per pump type/per year metric, indicates Roquette America has reduced the overall cost of ownership for its most common pump (Goulds 3196) by approximately 22 percent year-to-date as compared to the 2011-2012 baseline. Figure 6 shows year-to-date results for the 3196 ST, MT and LT series pumps.

"The journey to reliability excellence is long and hard, and it is not for the faint of heart."

Developing a best in class asset management program involves many things. First, using a strategic approach where all facets of the program are considered before rollout will produce better results than a less systematic one. Always remember the importance of employee engagement. Creating a vision of excellence and passionately communicating it to all stakeholders energizes your team and makes them want to be part of a best in class program.

The journey to reliability excellence is long and hard, and it is not for the faint of heart. Great leaders embrace the challenge and assume the mantle of leadership with zeal. The fact that you read *Uptime* magazine demonstrates your commitment to excellence. Adopt the best practices found in this magazine at your plant and become the type of leader who can transform a culture.

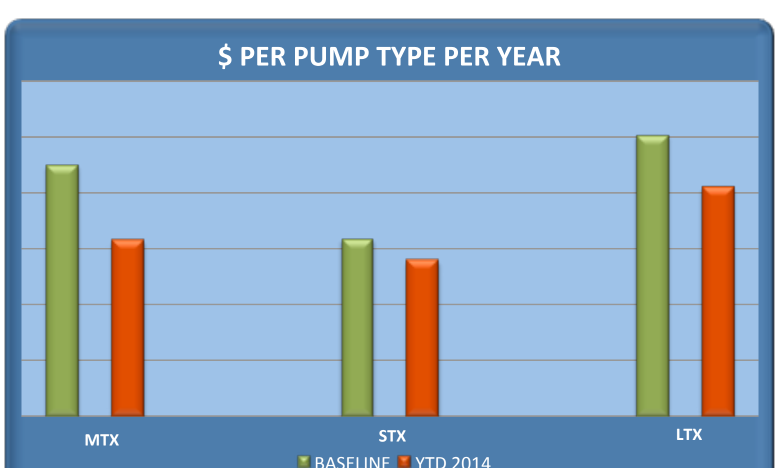
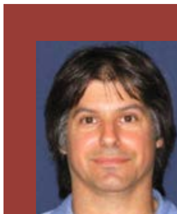


Figure 6: Roquette's $ per pump type, per year



Phil Beelendorf is the Maintenance Technology Senior Manager for Roquette America Inc, located in Keokuk, Iowa. Phil is responsible for the creation and execution of the Roquette America reliability excellence strategy. He is passionately committed to leading a team of talented individuals in pursuit of best in class performance. www.roquetteamerica.com

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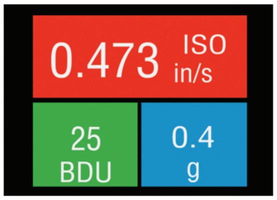
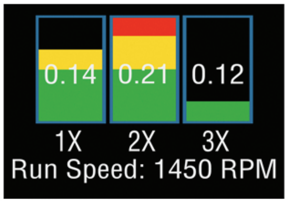
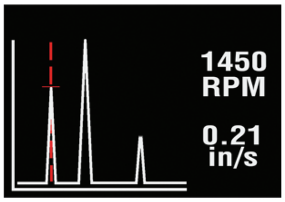


Color coded to ISO alarm levels
› Overall velocity
› Bearing damage
› Acceleration



Diagnose
› Unbalance
› Looseness
› Misalignment



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RCM Providing the Line of Sight for ISO55000 Compliance

by Tim Allen

The buzz at the 2014 International Maintenance Conference (IMC) in Daytona Beach, Florida, was the establishment of the ISO55000 asset management standard. Many reliability professionals who have been in the trenches for a long time gave enlightening presentations on just what this standard will do for our industry and most seminars were overflowing with attendees.

Also at IMC, another significant milestone was being celebrated by those who recently updated the "Reliability Centered Maintenance Project Manager's Guide," published by Reliabilityweb.com. This valuable guide was originated by Jack Nicholas, Jr., 10 years ago with the assistance of participants at the Reliability Centered Maintenance Managers' Forum in Clearwater Beach, Florida, the very first conference ever devoted strictly to reliability centered maintenance (RCM). This author commented at the IMC RCM presentation that one would be wise to pay the same attention to the project manager's guide that was being paid to the ISO55000 tracks. While the presentation was well attended, the gathering should have overflowed to the hallways.

Here is why.

We now have an international standard, which if adopted by any organization, requires that activities associated with the management of assets be **risk based** and that these risks be thoroughly evaluated and documented in the context of the **significance** of the asset and how it relates in realizing (or not) the higher level strategic business requirements of the organization. In other words, there must be a transparent line of sight (another term introduced at the conference) from all asset management activities right up to the decisions, policies and objectives made in the boardroom. This article suggests that RCM is a vehicle to provide that line of sight.

In a white paper entitled, "RCM Method and Means," presented at the 2010 RCM conference in Fort Lauderdale, Florida, this author and Eric Stevens wrote that, "RCM is a technical accounting system that details the functions and functional failures of a system and methodically leads an analyst through a series of decisions to prescribe maintenance tasks to prevent or mitigate the occurrence of functional failure. When implemented, one can trace back just why a maintenance task exists and the intended benefit." We went on to say, "If we fully expect that all expenditures of a company be thoroughly documented by sound accounting standards for future audit, then why would we expect less for documenting the purpose of a company's assets and the strategy in preserving their need?" And so, in RCM training sessions conducted by this author, the questions typically posed to the audience are, "Why does this asset exist?" "Why was it purchased and why is it maintained? The answers are not always clear.

Figure 1 provides the line of sight from components to critical system functions for the Central Arizona Project. Noted RCM author Anthony "Mac" Smith, who devised this matrix, refers to this relationship as the connecting tissue between component and system. The value of assets lies not in the asset itself, but in the interrelationship the assets have within a family of assets - a system - to *create* value. Preserving the owner's needs of the system through effective asset activities is the most efficient policy.

ViewReport1

ViewReport2

Step 5-1

Equipment - Functional Failure Matrix

Rev No: Date:

Comp #	Comp ID	Component Description	FF #	FF Description
01		Waddell Forebay	01.2	Unable to convey sufficient flow capacity – flow below 3000 CFS

Comp # / ID	Component Desc.	01.1	01.2	01.3	01.4	02.1	02.2	02.3	03.1	03.2	03.3	04.1	04.2	04.3	04.4	05.1	05.2	05.3	06.1	07.1
01	Waddell Forebay	x	x	x	x	x	x		x	x	x			x						
02	Culvert Pipe 66" 1BBL 153.281W (beneath Forebay)	x	x	x	x	x	x		x	x	x	x	x	x		x	x	x		
03	New Waddell Wasteway 153.225 (Canal Overflow East to					x		x						x						
04	Waddell Siphon North and South Inlet/Outlet 153.225 W																			
05	Waddell Siphon	x	x	x	x	x	x		x	x	x			x						
06	Waddell Canal (Pool Waddell)	x	x	x	x	x	x	x	x	x	x			x						
07	Culvert Pipe 36" 1BBL 152.558W	x	x	x	x	x	x		x	x	x	x	x	x		x	x	x		
08	Phoenix Lake Pleasant Turnout 152.484W - 4 Trash Racks - 2			x																

Figure 1: Functional failure matrix for RCM equipment for the Central Arizona Project diversion canal

Many have reacted through the years that wide scale RCM efforts are impractical. However, the benefits of a comprehensive RCM program have long been proven. Stevens and his colleagues at the Metropolitan Sewer District of Greater Cincinnati recognized this benefit, stayed the course and demonstrated with evidence how they managed to control critical systems through the RCM process. They are now proud recipients of two prestigious Uptime Awards.

ISO55001 requires an organization to determine "actions to address risks and opportunities associated with managing assets – taking into account how these risks and opportunities can change with time by establishing processes for:

- identification of risks and opportunities;
- assessment of risks and opportunities;
- determining the significance of assets in achieving asset management objectives; and
- implementation of the appropriate treatment and monitoring of risks and opportunities."

This article proposes that for these "risks" to be *identified* in any practical manner, they should come in the form of probable and possible asset failure modes and *assessed* in the context of a failure mode and effects analysis (FMEA), thereby enabling determination of those most consequential. Of course, to be relevant in the eyes of the ISO standard, these asset failure modes must be identified to specific system or asset functional failures that compromise the purpose of the system, as well as to strategic objectives of the organization. In other words, there is no better method and decision-making criteria for meeting procedural step 4.2 of the ISO requirements than the RCM process itself. The RCM logic tree to evaluate the applicability and effectiveness of a maintenance requirement was invented over 50 years ago by United Airlines.

"Why does this asset exist?"

"Why was it purchased and why is it maintained?

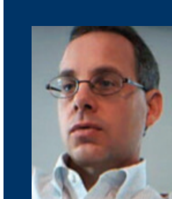
The answers are not always clear.

To fully comply with the standard, one would need to take the RCM process a few steps further than traditional RCM and link asset or system functions to organizational business objectives, with such objectives documented in a strategic asset management plan. Take it one step further and envision RCM system functional statements transforming to include corporate priorities, such as energy efficiency, stakeholder values and other strategic objectives vital to the success of the company.

ISO55000 clearly states that the organization should establish a method with decision-making criteria to determine the risks and opportunities that must be addressed with asset activities to prevent or reduce undesired effects, and that these activities and resources be prioritized. It further says, "Asset management translates the organization's objectives into asset-related decisions, plans and activities using a risk based approach." Therefore, asset criticality ranking systems without detailed documentation as to why such rankings have been assigned would not meet such criteria. The standard clearly looks for assessment, determinations and documentation of such to connect the dots. Preventive maintenance (PM) optimization does not do this. Original equipment manufacturer (OEM) maintenance recommendations do not do this and neither does PM templating. It is RCM that maintains the line of sight right from the applicability and effectiveness of PM tasks to maintaining the organizational need for the asset or system.

ISO55000 is silent to the words reliability centered maintenance and its acronym, RCM. However, if RCM didn't already exist, wouldn't we now have to invent it to comply with the standard?

The Reliability Centered Maintenance Project Manager's Guide is available at no cost
www.reliabilityweb.com



***Tim Allen** is the Reliability Engineering Supervisor at Central Arizona Project in Phoenix. As the former RCM program manager for the U.S. Navy's submarine group, he participated in the original creation of the "Reliability Centered Maintenance Project Manager's Guide" in 2005 and helped review it for the 2014 update. He has over 20 years of experience implementing RCM programs.*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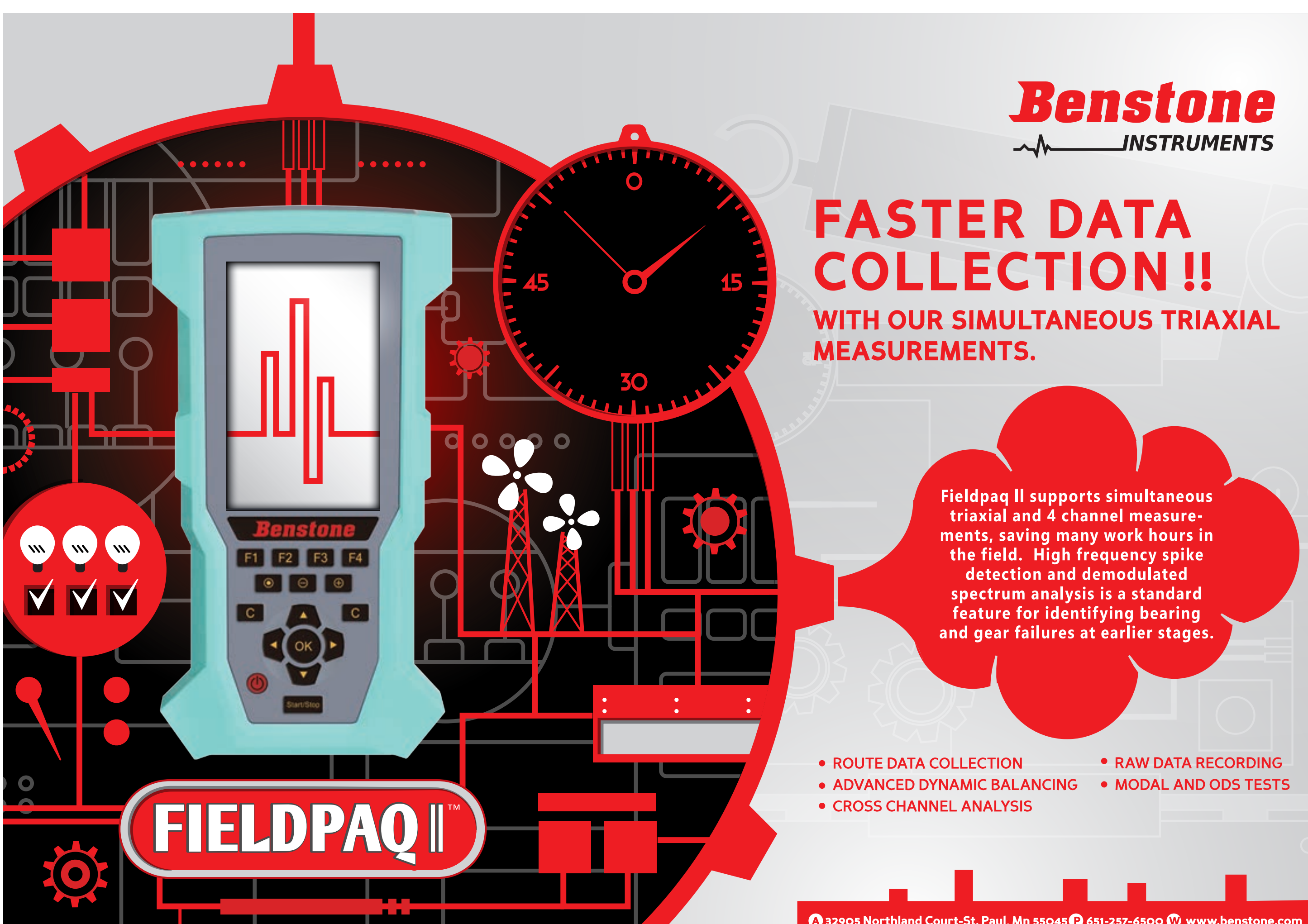
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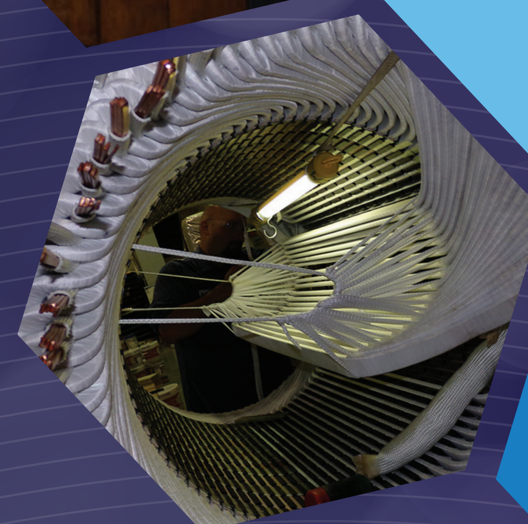

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Uptime Award in Work Execution Management:

LOOP was honored to receive the 2014 Uptime Award for Best Work Execution Management, which was presented at the International Maintenance Conference on December 12, 2014 in Daytona, Florida. Our reliability group worked in concert with maintenance and operations to create a proactive culture by setting and achieving asset and work management goals. Thanks to our owner representatives from Marathon, Shell and Valero, executives, the management team and administrative support; this was truly received as a company-wide award for LOOP recognizing the accomplishments of the entire organization.

LOOP's 5-Year Successes in Repair Cost Reduction and Uptime

- Repair cost and equipment uptime are two metrics used to measure the effectiveness of reliability centered maintenance and related asset and work management programs and procedures.
- LOOP realized a 4-year low in repair cost in 2013, ending the year over $2 million less than 2012. Related expenditures dropped again by nearly 50 percent in 2014.
- Less reactive work allowed for more proactive work, reducing the maintenance work order backlog while improving our main oil line (MOL) uptime to 99.75 percent.
- LOOP's MOL uptime has exceeded 98 percent for over 5 years.
- Results are proving to be sustainable.

The Journey to Operational Excellence (OpEx):

LOOP LLC is a crude oil pipeline and storage company, with onshore and offshore facilities in southeastern Louisiana serving as a vital energy hub with pipeline connections to a significant portion of our nation's refineries. The majority of our operating facilities were designed in 1978 and placed in operation by 1981, so most of our MOL assets have been in operation for over 30 years. We can store over 60 million barrels of crude in below ground caverns and an additional 9 million barrels in above ground tanks. Our unique pumping systems can transport crude at rates in excess of 100,000 barrels per hour on multiple, interconnected pipelines.

Since 2011, LOOP has created and followed a new vision of becoming market driven and operationally excellent. Related strategies and tactical objectives were developed and implemented. The uptime, or availability of assets, is a key performance indicator (KPI) for LOOP and considered a critical component of our business performance to our customers. Uptime, therefore, aligns with our vision. Our proactive asset and work management programs have changed our culture through the implementation of reliability centered maintenance (RCM) best practices. A work and asset management application for our computerized maintenance management system (CMMS) was implemented in 1999. Predictive technologies and condition-based monitoring initiatives have been phased in and enhanced since then, and we're now funding additional planned improvements.

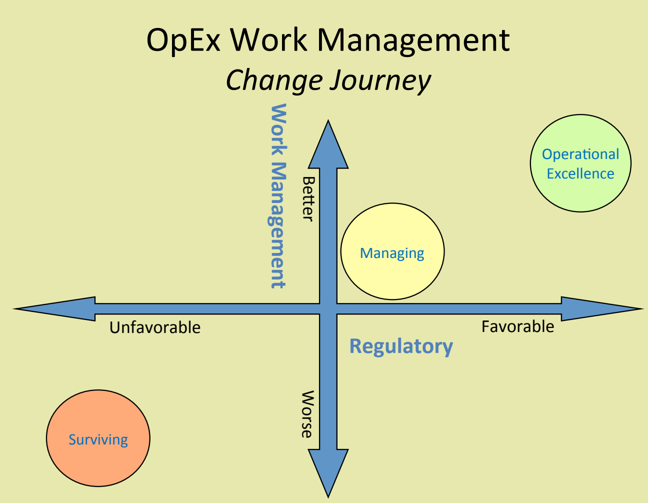


Figure 1: Did you know that if your company is not in regulatory compliance, you could be one audit away from a fine, or one incident away from going out of business?

Work management guidance is documented and implemented through LOOP's maintenance policies and procedures manual. This manual includes high level and detailed roles and responsibilities of the organization, as well as instructions for our maintenance and reliability processes. This guidance document also covers the regulatory requirements and details of our facility management of change process.

We've come to realize that we must reach above and beyond regulatory compliance requirements to achieve OpEx in work management, as depicted in the Figure 1 graph.

Our operator care program consists of a detailed checklist which field operators use to document actual versus expected readings and a plan of action if values are not within tolerance. Our operators take pride in our facilities, as all of our employees do, and are viewed as our first line of defense in asset care.

Maintenance planners and schedulers plan 100 percent of available maintenance crew manhours. Weekly and daily schedules are created with stakeholder input on priority, then distributed for execution. LOOP's preventive maintenance (PM) procedures address asset failure modes, defect detection and elimination. They provide guidance to maintenance technicians for ensuring desired outcomes and repeatability. Reliability technicians and specialists are responsible for our predictive maintenance (PdM) program. KPIs and metrics are used for monitoring and managing asset health.

The following proactive programs and processes have assisted LOOP in becoming successful in our work and asset management objectives.

Condition-Based Monitoring & Predictive Technologies

- Operator Care
- Vibration
- Thermography
- Oil Analysis
- Motor Testing
- Ultrasound
- RCM Practices
- Metrics / Reports to the Organization (Weekly & Monthly)
- Others (Battery Testing, Partial Discharge, B-Probe, SNAP, etc.)

Preventive Maintenance & Critical Spares

- Planning & Scheduling
- CMMS
- PM Compliance / Work Flow / Redline Process
- Work Order / Backlog Management
- Work Execution & Innovation
- Defect Elimination / Failure Reporting, Analysis and Corrective Action System (FRACAS)
- Critical Spares / Warehousing / Off-Site Storage

To help set our strategy and tactical objectives in an effort to sustain our proactive cultural shift, we created a "one pager," providing our office and field personnel with a succinct guideline and mission.

Figure 2: N.J. Lefort, LOOP reliability technician, performing predictive PdMs

Figure 3: Jason Rogers, LOOP reliability technician, performing predictive PdMs

Reliability & Maintenance Planning

Mission:

Analyze and improve the uptime of our equipment through reliability centered maintenance while helping to prepare our assets for a wider variety of crudes

Why Change?

- To sustain our uptime and continue to meet or exceed customer expectations
- To know when assets will fail before they fail using predictive tools and address problems before they occur
- To minimize repair cost and reduce our breakeven throughput requirement
- To address the accuracy of our backlog and reduce the aging backlog of work by priority and asset criticality
- Our *market driven* initiatives may lead to reassessments of our system design parameters
- We must monitor our asset performance and related impacts when new crude types are accepted

If We Do Not Change:

- We may become more reactive and less proactive than our current metric indicates, moving us in the wrong direction, costing us more in repairs and negatively impacting our breakeven throughput requirement
- The accurate, aging backlog may keep us from managing our assets at an *operationally excellent* pace
- We could see more frequent equipment failures reducing our uptime % significantly

Where Are We Going?

- A *market driven*, *operationally excellent* organization that proactively manages our asset health in a safe and efficient manner through reliability centered maintenance best practices
- Promote the Clovelly Hub with proven uptime and theoretical capacity metrics, minimized break even cost requirements and sound confidence in our asset health and capabilities; (flow assurance)

How Do We Get There?

- Establish a strategic collaboration between reliability, maintenance and operations skillsets
- Execute work management with standardized and refined programs and procedures
- Become disciplined in our tactics to address our ever-changing world of asset health management

Related Strategic Process Improvement Goals:

- Increase equipment uptime, availability and reliability
- Improve operating performance
- Reduce repair cost
- Administer the work order process in a disciplined, consistent manner
- Avoid unplanned downtime
- Extend equipment lifespan and secure critical spares
- Prepare our assets to receive a wider variety of crudes

Figure 4: LOOP Leadership Team photo taken after a safety and environmental roundtable meeting in Larose, La.; not all members are present due to other obligations

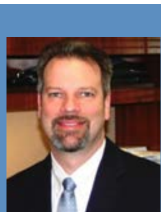
When the one pager was introduced over two years ago to the reliability group after a Leadership Conference, we actually targeted an Uptime Award, which was later realized in December 2014. Thus, we view the award as a pertinent milestone in our quest for OpEx.

While we appreciate receiving this prestigious award, we've already begun striving to achieve goals we've set for 2015 and beyond. Recognizing that 2014 was a historic year of successes for LOOP, we've made a commitment not to camp out at success and will continue to improve our performance through enhanced condition monitoring, asset management and reliability centered maintenance best practices.

Figure 5: 2014 Uptime Award for Best Work Execution Management Program presented to LOOP during IMC-2014

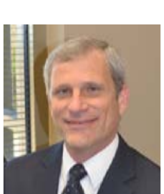
Continuous Improvement

- There is always room for improvement!
- We continue to learn, every day and on every job
- We're learning from successes and failures alike
- We're keeping our priorities in check:
  - Safety
  - Quality
  - Schedule
- We think of OpEx in Work Execution Management as a journey and a vision, more so than a final destination.
- With an embedded culture, a clear focus on getting it right and a passion for continuous improvement, LOOP continues its journey towards operational excellence.



Brian J. Pertuit*, CMRP, is the Manager of Reliability & Maintenance Planning for the Louisiana Offshore Oil Port (LOOP LLC). Brian has over 26 years in the energy industry, both oil and gas, and power. He served in the U.S. Army and later worked in consulting engineering as a co-op student while attending the University of New Orleans, where he obtained a bachelor of science degree in electrical engineering.*

Special recognition to Chris Labat for providing the proactive and timeline perspectives for the article, as well as a final review.



Chris A. Labat*, CMRP, is the Vice President of Engineering & Technology at LOOP LLC, where he once served as the reliability superintendent and helped set up the department and related proactive work practices. Chris has over 27 years in the oil and gas industry and obtained a bachelor of science degree in mechanical engineering from Louisiana State University.*

It's Time to
LOOK AT RELIABIL

Top performing companies have revolutionized their reliability practices, shortening both scheduled and unscheduled unproductive time of their machinery. The combination of predictive intelligence and visionary reliability program can drive down maintenance costs, while improving safety and availability.

Reliability means...

SAFETY

1/2

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.

PROFITABILITY

50% MORE

REPAIR COSTS

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

$8.4 Million

PER YEAR

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

- Doug White, Emerson Industry Expert – Based on Current Refinery Economics.

AVAILABILITY

5%

PRODUCTION **CAPACITY LOST**

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.

43%

DOWNTIME

As much as 43% of unplanned downtime is caused by equipment failure.

- Large Property Damage Losses in the Hydrocarbon-Chemical Industries, 17th Edition.

ITY DIFFERENTLY

Improve Your Reliability to Achieve Bottom Line Results

Studies* show that companies reach the top-performing quartile when they have less than 3 percent unplanned downtime and maintenance costs less than 2 percent of plant replacement value (PRV). For example, a $1 billion top-performing plant spends $12 to $20 million per year on maintenance expense. By contrast, poor performers spend two to four times more per year.

Taking on what may be the greatest cause of excessive operational cost and unrealized profit, Emerson Process Management's reliability consulting guides leaders on how to better manage maintenance costs, improve reliability, and increase profitability. Emerson experts advises global customers on enterprise-wide reliability management programs that leverage technology solutions such as pervasive sensing to connect the millions of data points collected in a plant, providing actionable information to trigger maintenance activities before equipment fails. Just as importantly, Emerson helps companies minimize resistance to change and make a culture shift toward more proactive, cooperative behavior.

> **By reducing scheduled and unscheduled downtime, companies can reduce their maintenance spend by 50 percent or more.**
>
> *– Solomon Associates*

Emerson's success stories include Corbion, a global food and biochemical company. Corbion implemented standardized best practices of reliability over several years and reduced its global maintenance expense by one third while dramatically increasing availability. These actions enabled the company to capture millions of euros in increased profits and sustained increases in capacity and production.

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

Make the cultural shift in reliability
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Preparing for a Root Cause Analysis

by Michael W. Blanchard

The effectiveness of a root cause investigation is predicated on several elements, but the time spent preparing for the subsequent analysis is the most important. Performing a thorough preliminary investigation, identifying the right team members and anticipating problems at the analysis meeting could mean the difference between a highly reliable asset and recurring failures. To demonstrate this point, consider the analogy of assembling a puzzle. You would start with a box of puzzle pieces and then proceed with placing the pieces together until complete. An experienced puzzle builder can develop many tricks and techniques to complete the puzzle efficiently, but someone who has never built a puzzle will likely struggle. However, even the most skilled puzzle builders cannot complete the puzzle if pieces are missing or the facilities don't accommodate this activity. The same holds true for a root cause analysis (RCA). The team cannot complete the analysis if critical evidence is missing, key team members are absent, or the facilitator is unable to follow the agenda because of inadequate equipment or other resources in the meeting facilities. This article will discuss practical ways to anticipate these problems and provide ways to contain their negative impact on RCA effectiveness.

Collecting Evidence - Strike While the Fire Is Hot

Although every investigation is unique, there is critical evidence that must be collected, some with a sense of urgency. You need to strike while the fire is hot, so to speak. Unplanned events sometimes occur on weekends and at night when most support staff are off-site. You must make yourself available for callouts or train operators and maintenance craft to collect time-sensitive evidence. Eyewitness testimonies, failed parts, process data stored in short-term memory and environmental conditions at the time of the incident may be lost forever if they're not gathered in a timely manner.

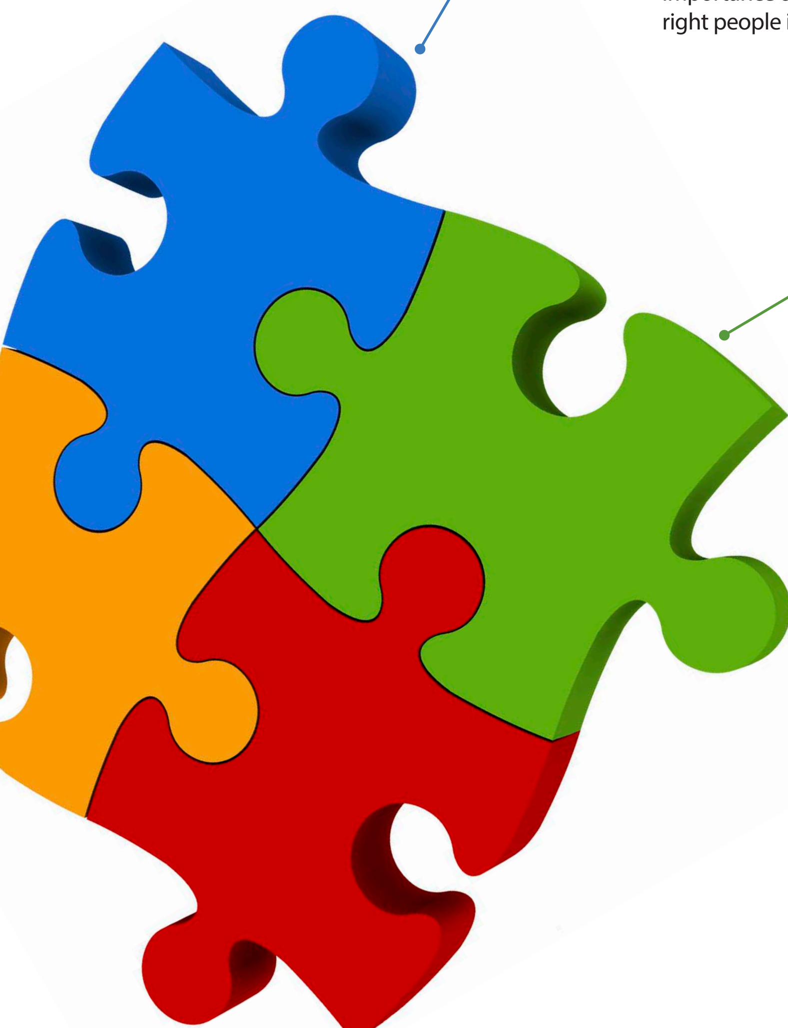
These actions will help you collect the necessary evidence:

- Take pictures of the asset before, during and after repairs are complete.
- Evaluate failed components and send them to applicable subject matter experts (SMEs) for analysis.
- Mine your computerized maintenance management system (CMMS) for equipment history of repair, and preventive and predictive maintenance.
- Search the equipment library for installation documentation, operational and maintenance manuals, drawings and records of the asset's lifecycle.
- Review operational logbooks, either electronic or hard copy, for additional details of long-term and short-term history.
- Include standard operating procedures for the asset and ancillary equipment in the evidence package.
- Record a snapshot of process control screens that reveal the failure through key parameters. This will be the basis for developing the timeline of events, a prerequisite for the subsequent analysis.

Even the most skilled puzzle builders cannot complete the puzzle if pieces are missing or the facilities don't accommodate this activity.

The RCA Team – Identifying Key Players

The effectiveness of the RCA in mitigating or eliminating unplanned events also depends on having the right roles present at the analysis. Too many people at the RCA may pose a problem, but the absence of key players will likely result in a stalled or ineffective analysis. The RCA team should consist of a trained and unbiased facilitator, those directly involved in the incident, equipment and process specialists, operators and maintenance craft, a maintenance reliability engineer and, possibly, an environmental and safety specialist. Additional team members may be named based on the data and evidence collected. The process owner should be included as an ad hoc member to gain support in the solutions and implementation phases. The process owner will likely possess expertise, historic perspective, or knowledge of the specific event. The report generated from experts analyzing failed components also requires interpretation. This may be done by the author of the report or local SMEs. Communicate the importance of attending team meetings to each team member. Building an RCA team consisting of the right people is critical to the outcome of the analysis.



RCA Meeting Logistics – Prepare for the Unexpected

It would be unfortunate, to say the least, to invest precious time and resources preparing a thorough preliminary investigation and forming an RCA team only to have the analysis fail because of poor planning of meeting logistics. As reminded by Murphy's law, anything that can go wrong, will go wrong.

Here are some tips to ensure RCA team attendance and effective use of meeting time:

- Develop and stick to an agenda that doesn't last more than two hours.
- Reserve a centrally located meeting room with sufficient seating and IT equipment. Team members and ad hoc resources off-site may need to attend the meeting remotely, so provide conference call numbers and online meeting information.
- Schedule the RCA at a time when attendees are free or flexible. Team members on shift may need to come in on overtime to accommodate the majority of schedules and others may need to reschedule lower priority meetings.
- Send an e-mail one or two days prior to the RCA, emphasizing the importance of attending the meeting.
- If a follow-up meeting is required, schedule it at the end of this meeting.

Taking the time to develop contingencies for what could go wrong at the analysis meeting will help ensure efficient use of everyone's time and create an environment for success.

Summary

Reliable organizations make it a part of their daily work to prepare for the unexpected. The same holds true for root cause investigations. The analysis is unlikely to produce solutions capable of preventing event recurrence if preparation isn't given due diligence. Thorough preparation for the unexpected will set the stage for a successful analysis phase.

The practices detailed in this article cover basic problems based on personal experiences. You will need to assess your own investigation to ensure you collect sufficient evidence, form the right team, and properly plan meeting logistics and format.

Michael W. Blanchard, *CRE, PE, is a reliability engineering subject matter expert with Life Cycle Engineering (LCE). He has more than 25 years of experience as a reliability leader in a variety of industries. Mike is a licensed Professional Engineer, a Certified Reliability Engineer and a Certified Lean Six Sigma Master Black Belt. www.lce.com*

THE CHALLENGE OF CHANGE

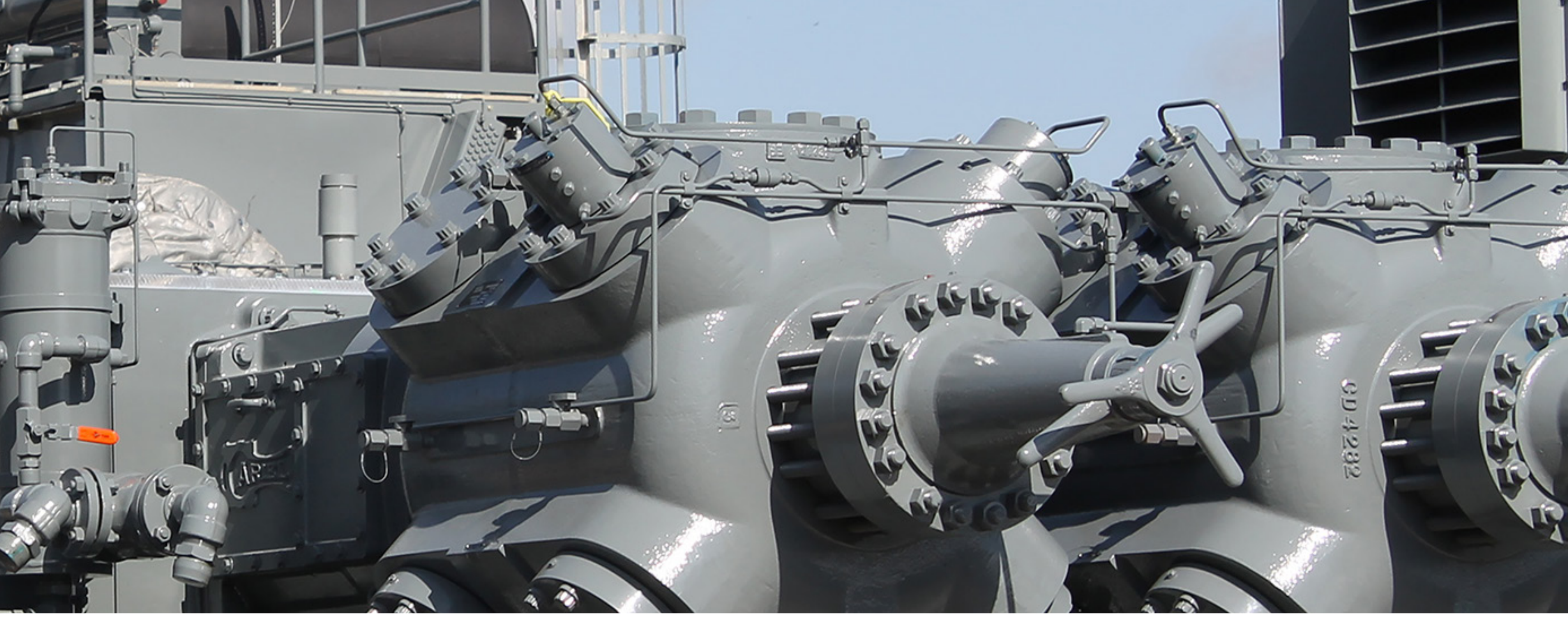
by Kelly Ballew

For much of the past 30 years, the electrical field has seen little change in the way testing is done for industrial electrical equipment, mainly electrical motors, until the last 10 years.

The new trend for an already established maintenance program proposes the great challenge of change. For much of the past 30 years, the electrical field has seen little change in the way testing is done for industrial electrical equipment, mainly electrical motors, until the last 10 years. Recent advances in technology have provided industry with equipment capable of looking inside an electrical motor for early signs of anomalies that could lead to failure. There are numerous manufacturers of this type of motor testing equipment. Subsequently, the inception of these testers has changed the way maintenance is performed on electrical motors. Now, you can trend mechanical and electrical conditions of a motor starting with a baseline, testing every year to observe changes to the motor.

The old standard of testing a motor once a year with a megger and pulling the motor out of service to inspect the internals every three years can be eliminated with this new technology. But, with any new technology, there comes the challenge of change and education. Teaching this new technology to an already established maintenance program using the standards of testing that have been in place for many years through the Institute of Electrical and Electronics Engineers (IEEE) and the InterNational Electrical Testing Association (NETA) is an ongoing challenge for the technician. Although the standards are effective, there is a better and more cost saving way of performing maintenance.

As stated earlier, trending is one of the tools used in predicting how long a motor should be in use before being sent to a motor shop for reconditioning. With current standard practices, trending is not plausible, yet missing the chance to save a motor from failure also is not likely, thus the need for change. By trending, you can, with very good precision, determine how productive a motor will



be by tracking and trending the changes in resistance to ground (RTG) and capacitance to ground (CTG).

By using the new technologies, the technician can observe and trend six fault zones – power quality, power circuit, rotor, stator, air gap and insulation – with not much more than a push of a button. Time is money and the time savings using this equipment not only saves the technician's time, but equipment as well, which is big money.

All of the fault zones are very important to test, but for the sake of this article, the focus will be on two areas of fault zones, insulation and rotor fault zone.

Insulation integrity is one of the biggest issues concerning motor failure. Testing and trending insulation degradation should be done every year. The tests monitored very closely are the polarization index (PI) and the polarization index profile (PIP), along with the RTG.

In the area of PIP, there has not been very much attention paid, but a much closer look should be given to this. A PI of two is ideal; a little more is good, but less is not and is an indication of how clean the windings are. Or is it? There are many times when the PI is two or greater, which would indicate no issues with the windings. But by observing the PIP, you can see if this is a true statement. There are many times when the PI is good, but the PIP is not. In other words, you can have contaminated motor windings with a good PI.

Rotor faults are more common than one might believe. Yes, you can find rotor bar issues using vibration detection, but by using a specialized tester, you can see rotor bar issues before they become catastrophic.

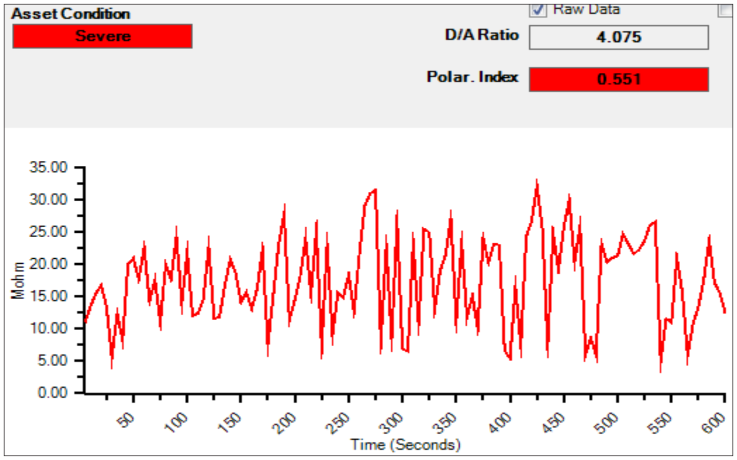


Figure 1: 4160 volt motor showing both PI and PIP

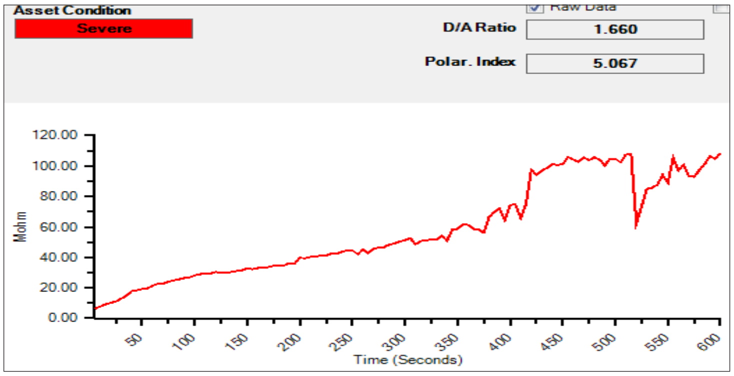


Figure 2: 4160 volt motor showing a good PI

Technology has come a long way and by using the testers of today, you can save your company from premature failures. Using this technology can save thousands of dollars per year in unnecessary motor repair and unplanned downtime.

Currently, Texas-based Energy Transfer is working toward this new way of maintenance by using these new testers, along with infrared and vibration. As with all maintenance programs, change does not come overnight, but Energy Transfer is leading the way with this type of electrical testing in the oil and gas industry to ensure a more reliable future for the company and to keep its competitive edge.

Figure 1 shows a 4160 volt motor at one of Energy Transfer's locations. The PI and PIP are shown. The windings are very contaminated with oil and dirt. This motor will be pulled and sent to a motor shop for reconditioning. If left in service, the motor would fail and cause interruption to the flow process of the natural gas.

Figure 2 is another 4160 volt motor at Energy Transfer showing a good PI, but the PIP is showing contamination of the windings. If the PI alone was considered, this motor would have been left in service and failed, but due to the PIP and low RTG, this motor is being sent out for reconditioning.

Using this technology can save thousands of dollars per year in unnecessary motor repair and unplanned downtime.

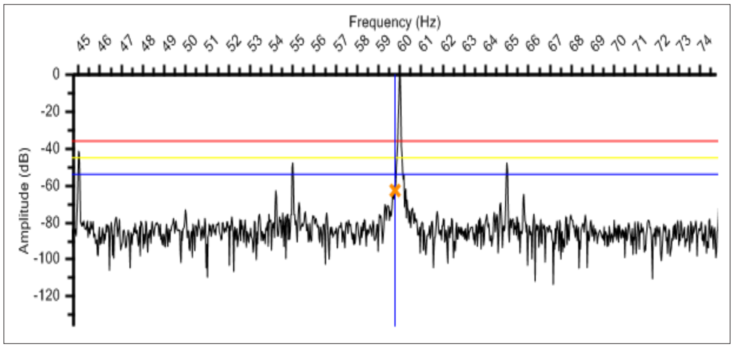


Figure 3: 4160 volt motor showing unusual sidebands on the rotor evaluation

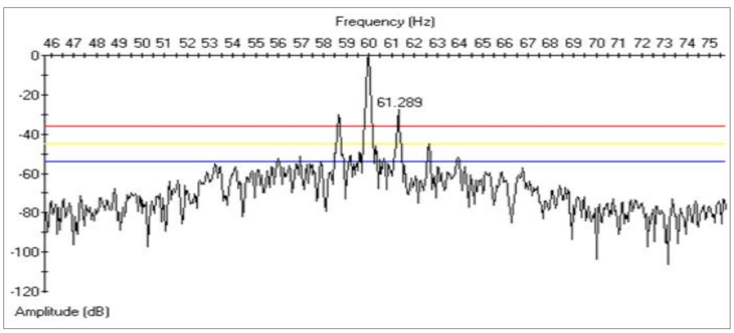


Figure 4: A rotor evaluation spectrum showing an example of a broken rotor bar

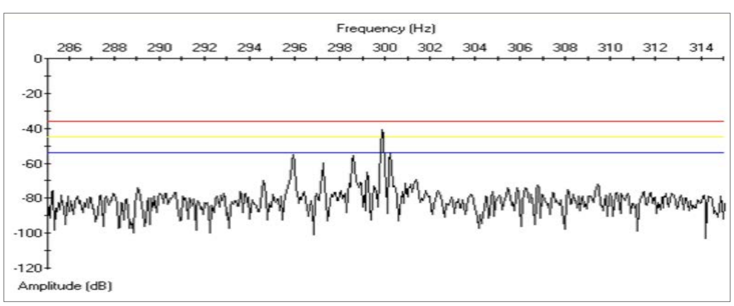


Figure 5: A rotor evaluation spectrum confirming a broken rotor bar

Figure 3 is an example of one of Energy Transfer's 4160 volt motors showing unusual sidebands on the rotor evaluation. Although this is not a rotor bar issue, this is where you would find rotor bar signatures. The lower spectrum is showing sidebands at 55Hz and 65Hz, which is a false positive signal of the air ducts in the rotor.

Figure 4 is an example of a rotor evaluation spectrum showing what a broken rotor bar would look like. It is confirmed by the swirl effect shown in Figure 5.

The reason for the swirl effect is due to the fact that a damage rotor will modulate the stator current at the same frequency at two different vectors. Simple to say, but difficult to understand without a very sound understanding of the mathematics involved in fast Fourier transforms (FFTs).

As the snapshots of motor insulation and rotor evaluation spectrums clearly indicate, there is no need to disassemble a motor every three years because with the tester, you can see contaminated windings or rotor issues without ever popping the end bell off a motor.

With Energy Transfer, as with most companies, the untimely failure of a critical motor will cost the company in lost production. The loss of production usually costs the company a large amount of money and, in some cases, the wait time to have another motor in place can be very lengthy. To avoid this at Energy Transfer, a move to a reliability/predictive maintenance program is being introduced.

Although preventive maintenance will always be part of the maintenance program at Energy Transfer, reactive maintenance will not. This change will allow the company to be very reliable and cost-effective, and ensure on time delivery of product to its customers.

***Kelly Ballew** is currently working on developing strategies for predictive maintenance and improving the reliability on high voltage equipment for Energy Transfer, a natural gas pipeline company. Mr. Ballew has worked in the high voltage field for over 30 years in the power distribution field. He has developed motor testing procedures along with cost savings through predictive maintenance for large companies.*
www.EnergyTransfer.com

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Part 1

Reliability through Optimized Setup and Changeovers

by Dan Miller

When Shigeo Shingo began his work in reducing changeover times for Toyota in the 1960s, the motivation was to reduce inventory in a densely populated Japan. If Toyota could change their production lines over from one model to another very quickly, they could better respond to market demands. Through careful planning and innovative engineering, Shingo was able to reduce changeover times from 30 hours to less than 10 minutes.

Changeover greatly affects the reliability of the asset and its impact is often neglected when improving changeover times. Today's changeovers in manufacturing have followed the same formula as Shingo and Toyota, and many industries have benefited with an increase in uptime and production line capacity, as well as a reduction in finished goods inventory. Equipment manufacturers have successfully added versatility to their product lines; many machines are able to produce dozens of sizes and shapes of products for their customers' needs. Operational driven initiatives by Six Sigma, 5S and Visual Factory methodologies have refined the changeover process on the production floor to help keep conversion times to a minimum. Additionally, original equipment manufacturer (OEM) designers and aftermarket businesses have eliminated many of the assembly fasteners, replacing them with revolutionary clamps, slides and twist locks.

However, efforts to reduce changeover times can conflict with setup consistency and repeatability. Achieving a goal of two hours for a filler changeover, for instance, may be cause for celebration, but if the accomplishment is infrequent or, worse yet, based on unique shortcuts, the increase in variability can lead to hours of line adjustments and associated reduced line speeds and throughput.

The focus of this article is on the effects of setup and changeovers on asset reliability. From the impact of flexible OEM designs on endurance to the details of properly written setup and changeover standard operating procedures (SOPs), the "trauma" of changing over a perfectly running production line to produce the next stock keeping unit (SKU) on the production schedule can lead to premature failures, in-

DEFINITIONS

Reliability: The probability that an item will perform its intended function for a specific interval, under stated conditions. – MIL-STD-721C

Failure Mode and Effects Analysis (FMEA): A technique used to examine an asset, process, or design in order to determine potential ways it can fail and the potential effects of that failure, and subsequently identify appropriate mitigation tasks for the highest priority risks.

Changeover: The total process of converting a machine, line, or process from running one product to running another.

The focus of this article is on the effects of setup and changeovers on asset reliability.

creased quality defects, exposure to safety risks and even operator fatigue. No organization seeking to have a world-class enterprise asset management (EAM) program can succeed without fully understanding and refining their setup and changeover process.

Achieving Changeover Sustainability

Equipment reliability during each production run begins with a consistently executable and sustainable changeover method. Since reliability is so dependent on highly successful changeovers, the reliability team needs to drive the proper development of each step, the step sequence, equipment modifications, support systems, comprehensive training and the deployment of associated world-class best practices.

Changeover is a reliability function directly affecting overall equipment effectiveness (OEE):

Availability – Improved changeover techniques (e.g., single-minute exchange of die (SMED) approach) will reduce actual changeover times and increase the time equipment is available.

Performance – When changeovers are sustainably consistent, higher throughput is attainable.

Quality – Properly executed changeovers reduce/eliminate initial start-up "running" adjustments and lead to less scrap and out-of-spec quality issues.

Changeover Effects on Reliability

There are six elements that influence how well or how poorly a changeover program will succeed. They are: degree of intrusion; environmental impact; transformational impact; equipment design; SOP or written procedure content; and training.

Degree of Intrusion

Changeovers are intrusive and traumatic to any piece of equipment being converted from running one product to running the next product on the production schedule. Well performing equipment is suddenly shut down, cleaned, stripped down, cleaned again, new changeover parts installed or parts reinstalled and the equipment is then started up. Hopefully, there are few running adjustments. Most of the time, however, numerous adjustments are made until the system regains its normal operating throughput.

Environmental Impact

Environmental factors, such as temperature (e.g., cooldowns), moisture (e.g., cleaning with water and chemicals) and air speed (e.g., drying with plant air), change how the equipment behaves. In the changeover transition, these factors need to be accounted for and compensation for their effects needs to be an integral part of the changeover process.

Transformational Impact

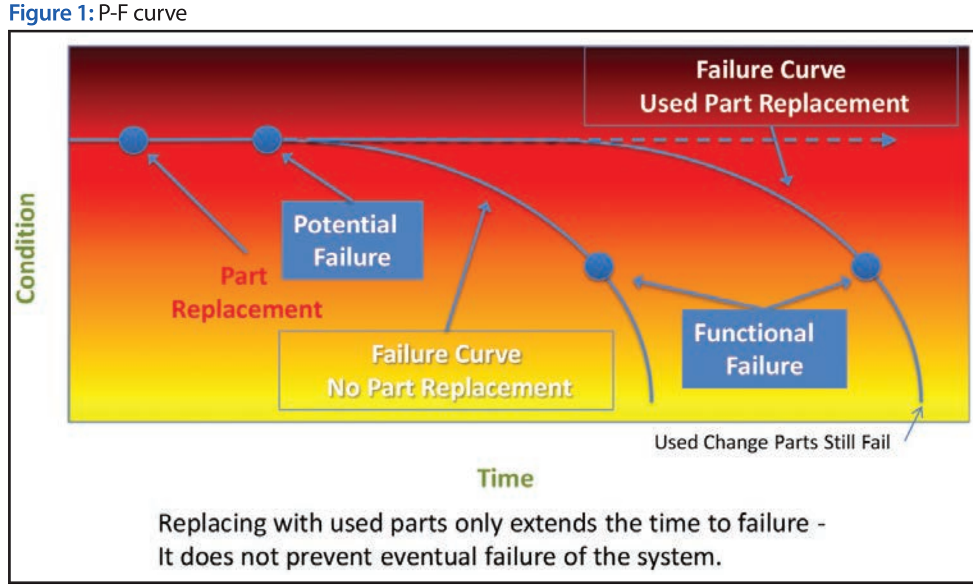
When a product's specific changeover parts are exchanged with parts specific to the previous product, a transformation of the equipment occurs. The new setup can give the asset a different personality. In a normal maintenance event (e.g., corrective or preventive maintenance) where old, worn and broken parts (e.g., wear strips, bearings, etc.) are replaced with new parts, the asset is restored to like new status. The asset regains its intended performance characteristics, which are maintained until the next scheduled maintenance.

But change parts are not usually new parts; they are most likely used parts that are swapped out over and over again. A changeover requires the meticulous removal of the previous change parts, to be used again the next time the product is run, and installation of previously used parts to run the new product. Three factors affect transformational impact: mean time between failure, dimensional diminishment and availability components.

Mean Time Between Failures (MTBF): MTBF is normally calculated based on total run time of the equipment. Seldom, if ever, are separate MTBF calculations performed based on which product is being run. Because of the variability in change parts' construction and design, each set (designed for a specific product) will behave and fail differently. Therefore, any key performance indicator (KPI) tied to a given asset should be tracked by product run on the asset. Product subcategories are then averaged to reflect the total MTBF for that asset. In most industries, the production/manufacturing departments already track and evaluate each product's throughput for performance and budgeting improvements. It only makes sense, then, for the reliability team to track MTBF by product to help identify changeover improvement opportunities.

Dimensional Diminishment or tolerance degradation: Unlike a new part replacement where a dimensional reset on the equipment (like new) occurs, change parts are removed and installed numerous times over their life. There are three types of wear affecting dimensions and performance on a changed part: Normal Running Wear, which

Figure 1: P-F curve



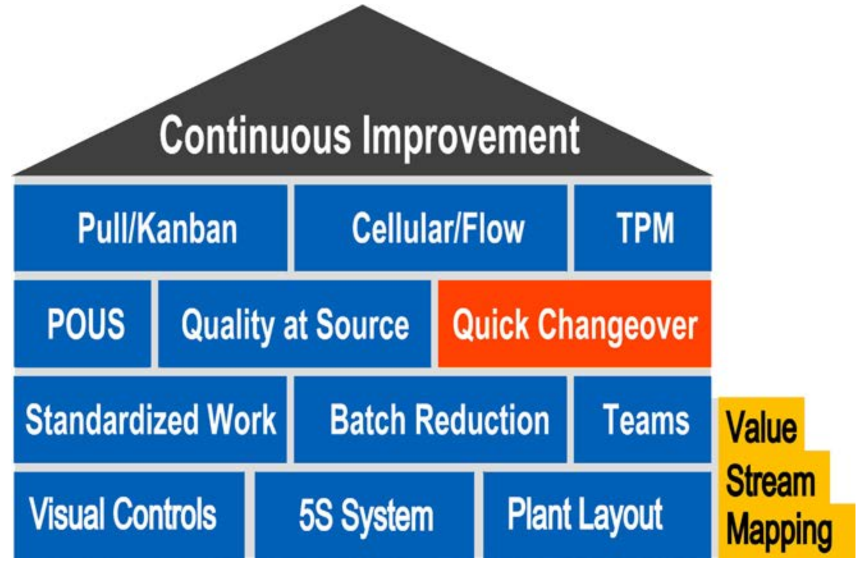


Figure 2: Continuous improvement

is predictable and based on run time of the equipment with applicable change parts installed; Replacement Wear, which is nearly unpredictable and based on the frictional factors of sliding a part into and out of place, bore wear for alignment pins, thread wear for bolts and fasteners, and widening of slots over time; and Handling Wear, which is unpredictable and preventable wear and damage due to transport, storage and cleaning of change parts.

Availability Components: Availability is defined as the probability that an asset is capable of performing its intended function satisfactorily when needed and in a stated environment. Availability is affected by the ability to precisely replicate the performance-related conditions achieved during the last run of the product now to be run. The factors include dimensional adjustments, parameter setup and warm-up/break-in time.

Equipment Design

Equipment design must factor in the flexibility of the equipment to run a wide variety of products. Size, raw materials and ingredients, process and cure times, scrap factors and post-process requirements (e.g., embossing, coding, etc.) are all taken into account. To construct production equipment meeting multi-product applications, the OEM must optimize all the dimensions and build change parts that fit within those dimensions. The end result, even under perfect conditions, is a machine that runs a lot of different products, but sacrifices throughput and possibly yield when compared to a one size, one product version of the equipment.

SOP Content

Changeover consistency needs to be maintained through guidance found in well-written SOPs. The changeover SOP not only needs to be detailed enough for the newest member of the changeover team, but also relevant enough to the most seasoned participant. Steps are written to the level of detail necessary for first-time readers, but simultaneously crafted to allow effective perusing when familiarity is attained. Consistent SOP execution leads to sustainable and repeatable outcomes.

Training

The biggest influence to consistent changeovers is the training program. Training establishes the basis by which participants align their perspectives to accomplish the task at hand. Proper indoctrination for new members allows them to contribute to the team without an interruption in momentum. Once aligned, all participants achieve sustainability in changeover execution.

Failure Mode and Effects Analysis and Its Application in Changeover

In addition to the normal component failure analysis, such as drive motor failure, coupling degradation, gear wear, backlash, etc., the equipment also needs to be evaluated. This entails each product's setup and its impact on non-changing components; the probability of failure for each change part and the impact of any positional factors (e.g., installed backwards or upside down, clamping force variance, loose parts, etc.) affecting them; the probability of failure based on fastening mechanisms (e.g., bolts, clamps, alignment pins, etc.); and the probability of failure due to non-extracted setup tools, alignment jigs, bridges, go/no-go gauges, etc.

Each task/step in the changeover process needs to be evaluated to determine its risk factors relating to functional failure or its potential impact on product quality or throughput. For example, if the adjustment of the discharge rail is too high for the next product, the discharge transfer/conveyor can be damaged or easily cause a jam. A potential solution may be to add a flexible or self-adjusting rail that would then eliminate an adjustment step. Where critical parameters are identified or the failure risk is higher than acceptable, inspection techniques and fail-safes must be included in the process.

In the next issue of *Uptime* magazine, this topic continues with a more detailed look at:

- How reliability centered maintenance (RCM) principles relate to changeover activities.
- The changeover process and steps and sequence factors.
- Applying SMED concepts to continuously improve changeovers.

References

1. Singo, Shigeo, translated by Dillon, Andrew P. *A Revolution in Manufacturing: The SMED System*. New York: Productivity Press, 1985.
2. Henry, John. *Achieving Lean Changeover: Putting SMED to Work*. New York: Productivity Press, 2013.
3. Deka, Amalesh. *Single Minute Exchange of Dies (SMED)*. January 30, 2012 <http://www.slideshare.net/amaleshdeka/smed-11331527>
4. Gulati, Ramesh. *Maintenance and Reliability Best Practices, Second Edition*. South Norwalk: Industrial Press, August 2012.
5. Moubray, John. *Reliability-Centered Maintenance, Second Edition*. South Norwalk: Industrial Press, January 1997.

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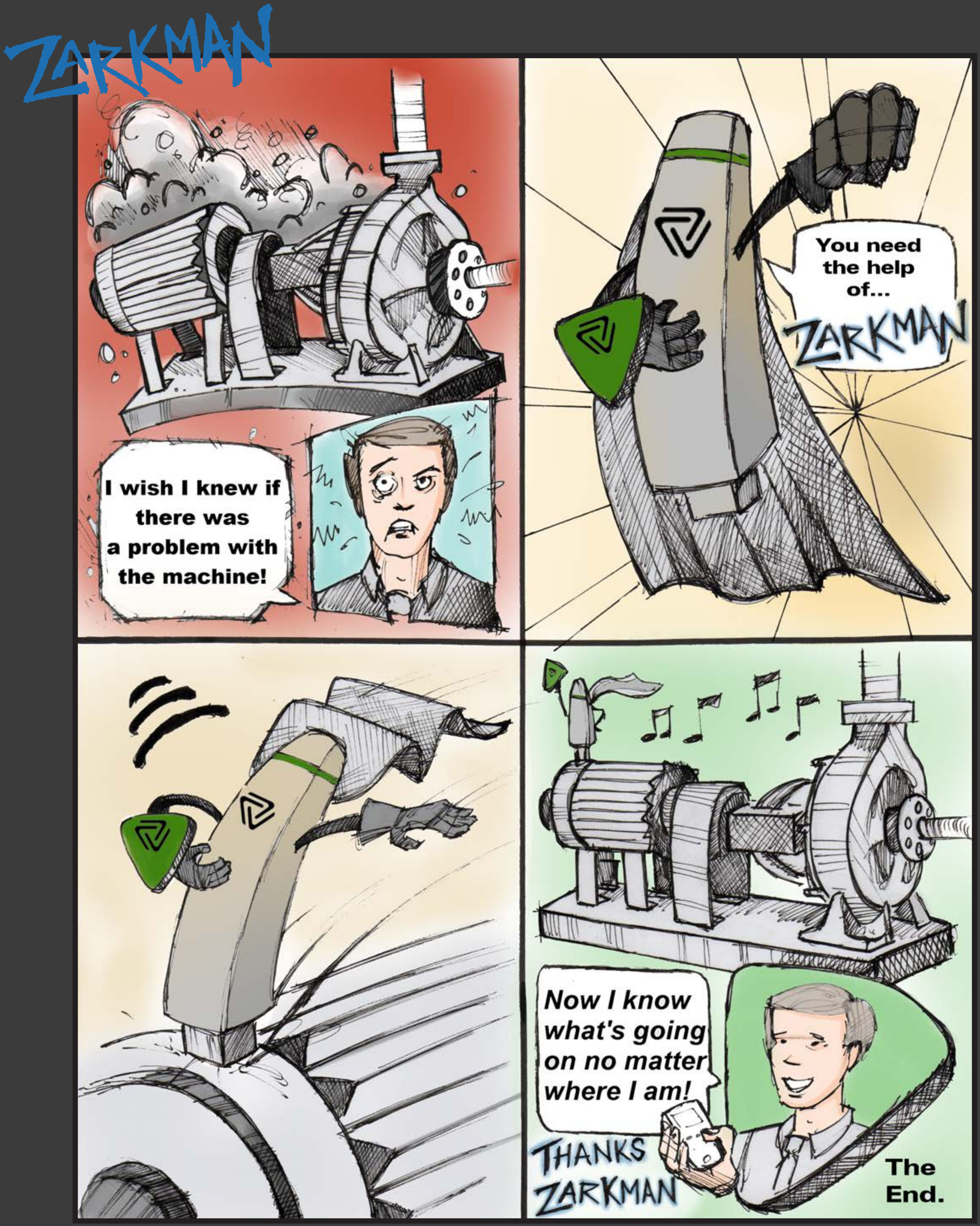

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Bearing Scraper

Where Have All the Bearing Scrapers Gone?

by William Hillman

A 2013 paper titled, *The Surprisingly Swift Decline of U.S. Manufacturing Employment,* by Justin R. Pierce, an economist at the Board of Governors of the Federal Reserve System, and Peter K. Schott, Yale School of Management and the National Bureau of Economic Research, suggests that the sharp decline in U.S. manufacturing jobs is a result of imports from China.[1] Regardless of the cause, the fact is that U.S. manufacturing has declined over the past several years. Along with the decline in jobs, there has been a decline in the technical skills needed for performing manufacturing jobs. The loss of technical skills is largely due to the fact that as manufacturing jobs declined, job training refocused to other areas, such as service sector jobs. This all happened at a time when baby boomers, who were the backbone of American manufacturing, began leaving the workplace in droves due to retirement. The age of the baby boomers is rapidly coming to an end, but due to the decline in manufacturing, there's been no concerted effort to replace them.

Finding people with the required technical skills has long been a problem, even before the decline in manufacturing. This author recalls a conversation some years ago with a vocational/technical school director in Pennsylvania. When asked to name the biggest problem facing vocational/technical schools, the director was quick to respond, "Difficulty in finding quality students." The director continued by saying his own students referred to the school as "sped school." "Sped" is a derogatory term referring to special education.

This conversation and conversations with other vo-tech administrators indicate that quality students are difficult to find because of the stigma placed on vo-tech training in general. Young people have been conditioned to believe vo-tech training is for people who can't make the grade in college. This is puzzling because many jobs requiring vo-tech training are actually better paying jobs than some white-collar jobs. A solution to the problem would need to include a heightened effort by educators to change attitudes toward vo-tech training. This isn't likely to happen because many educators see lending support to vo-tech training as downplaying the importance of college. This situation is most unfortunate because there are many college graduates who are employed in sub-level service jobs. If they had the proper technical skills, perhaps they could find employment in more lucrative skilled trades jobs.

Our educational system provides a solid foundation in basic content, but does a poor job in matching education to the jobs that are available. The paradigm in the U.S. is to complete high school and go to college without really assessing the aptitudes of students. Most students have no idea what jobs will best suit them. Aptitude testing in the United States is willy-nilly at best. The training paradigm is slow to change direction in meeting training needs. To reverse declining enrollments in career and technical education, schools need to restructure their programs and rebuild their image. Traditional vocational programs provide students with job specific skills that many parents view as too narrow for their children.

Until those needs are met, companies are still faced with the challenge of finding skilled people to fill technical positions. Even in times of economic downturns with many people looking for work, thousands of technical jobs go unfilled because qualified people can't be found.[2]

> The age of the baby boomers is rapidly coming to an end, but due to the decline in manufacturing, there's been **no concerted effort to replace them.**

Another reason for the difficulty in replacing baby boomers is that some of their skills are so specialized that there is little or no formal training for those skills. The scraping of plain bearings is an example. Large rotors, such as those found in the turbines of power plants, are supported in plain bearings. Large plain bearings consist of a soft metal (Babbitt) that is bonded onto a steel housing. The soft metal is intended to protect the harder rotor shaft from damage during times of boundary lubrication or loss of lubrication. In order for these bearings to operate properly, the surface of the Babbitt must be precisely shaped. The proper shape is obtained by scraping away some of the Babbitt. Science

Finding Skilled Craftspeople in the Post Baby Boomer World

and art are involved in obtaining the proper shape. A highly trained individual with an art for this work is required to do the scraping. This author recalls a plain bearing failure on a mill drive motor in a steel mill. The bearing was replaced only to fail soon after start-up. Another bearing was installed which also failed in short order. The company called the bearing manufacturer requesting help. The manufacturer sent in an elderly gentleman who appeared to be in his 70s. The old gent's hands shook whenever he picked up one of his scraping tools. However, when he was finished, the mill was up and running and that bearing did not fail again. That old fellow is long gone. Over the years, this author has met several craftspeople who possessed bearing scraping skills. They are all gone. It is probable that there are no good estimates on how many bearing scrapers are present in the U.S. today. This is all reminiscent of a NASA statement concerning manned lunar landings where a spokesperson declared, "If we wanted to land a person on the moon today, considerable time would be required because all of those who knew how to do the job are now retired."

"If we wanted to land a person on the moon today, considerable time would be required because all of those who knew how to do the job are now retired."

In a conversation with a contractor who supplies craftspeople for various companies in Gulf Coast states, the supplier confided that his most perplexing problem was not being able to fill all the requests from companies needing qualified craftspeople. The contractor went on to say that when a company orders a length of pipe, it is simply a matter of knowing its specifications and acquiring the piece of pipe. He said the same should be true for craftspeople. However, that isn't the case. For example, all electricians don't have the same specifications or abilities. The contractor stated that he has no easy way of determining an electrician's qualifications. He's selling a product that he hasn't been able to measure. This makes his job extremely difficult.

What is the best process a company can use to fill the skills vacancies left by the exodus of baby boomers? There is probably no one best answer, but there are a few options to consider. Keep in mind there is a best answer for each individual company, but because there are large differences in companies' sizes and needs, there is no one-size-fits-all solution. Finding the proper craftspeople is a process that should begin with a plan. The first step in this plan is to accurately assess needs and determine which skills are required to meet company goals. The hiring process should not begin until the required skills are known. After the required skills are determined, measures should be developed to determine if prospective craftspeople do, indeed, possess those skills. An interview process has long been the standard for determining if craftspeople possess the proper skills. However, a major drawback to the interview process is that it can be too subjective. Before any interviews are conducted, there should be an objective set of requirements defined for the interview. The interview process should be highly structured and documented. Nothing should be left to chance. Requirements for interviewees should consist of portfolios, resumes, schooling, degrees, certification, experience, skills performance demonstrations, testing, prior work experience, recommendations and any other items that will help ensure the hiring of the proper person. Skills requirements can be filled by hiring or contracting electricians, millwrights, pipe fitters, etc., or by obtaining craftspeople who are multi-crafted. There are several advantages to having multi-crafted personnel, but these individuals are also more difficult to find.

A decision should be made to either perform the work in-house or contract it out. Many times, a company will use both options. There are pros and cons to both solutions and the answer will depend on several factors. Such factors may include: Are people with the needed skills available in the area? Are there any contracting companies nearby that can provide skilled people? Will contracting out the work be more cost-effective than hiring in-house employees? Are the required skills rarely needed?

A thorough assessment should be made in order to determine which avenue will meet company goals and provide the highest return on investment. If a decision is made to contract the work out, a company should have written specifications detailing what is expected from the employment agency in regards to the skill levels of the craftspeople provided. Certifications and licenses are examples of what may be required. Prestigious certifications do not guarantee a craftsperson has the required skills, but is a good indicator of skill levels.

Some companies have determined that it is more cost-effective to have in-house craftspeople performing technical work. One advantage of an in-house workforce is it is easier to instill a sense of ownership in the employee. Companies can partner with local technical colleges to ensure the craftspeople they hire will have the proper skills. Vo-tech schools can tailor classes to meet the skills requirements of their partnered companies.

Apprenticeships work well for training craftspeople. Companies can draw from their existing employee base, ensuring their employees will have the required skills. There are long-term costs associated with developing and managing apprenticeship programs, so all factors should be thoroughly explored before any decision is made to enter into such a process.

Pay-per-skills programs are another good way for companies to ensure their workers have the needed skills. In these programs, workers are given incremental raises as they acquire new skills. If done properly, pay-per-skills is an excellent way of assuring the needed skills will be present in the company. As with apprenticeships, there are considerable costs and efforts associated with developing and managing a proper pay-per-skills process. In order for such a process to be sustainable, a long-term commitment is required. If administered fairly, pay-per-skills programs are also wonderful morale builders.

Although obtaining craftspeople with the necessary skills may not be easy, it can be managed if treated as a process. This is one area where doing it right the first time is critical for success. Bringing the wrong person on board results in several losses. The initial effort and cost in hiring that person, as well as having to do the rework of finding the right person, are all expenses. Some companies compound the error by hiring two people to do the work of one.

Companies consist of capital assets, physical assets and people. Basically, people are the company because they manage all the assets. Therefore, no process is more important than the process used to bring people into a company. This process needs to be well-defined and fully documented. Since all company goals are directly determined by the hiring process, the basic directive is not to "take who you can get, but to get who you need."

References

1. http://economics.yale.edu/sites/default/files/schott-09-oct-2013.pdf
2. http://moneymorning.com/2013/07/29/u-s-unemployment-three-million-jobs-in-america-are-waiting-to-be-filled/

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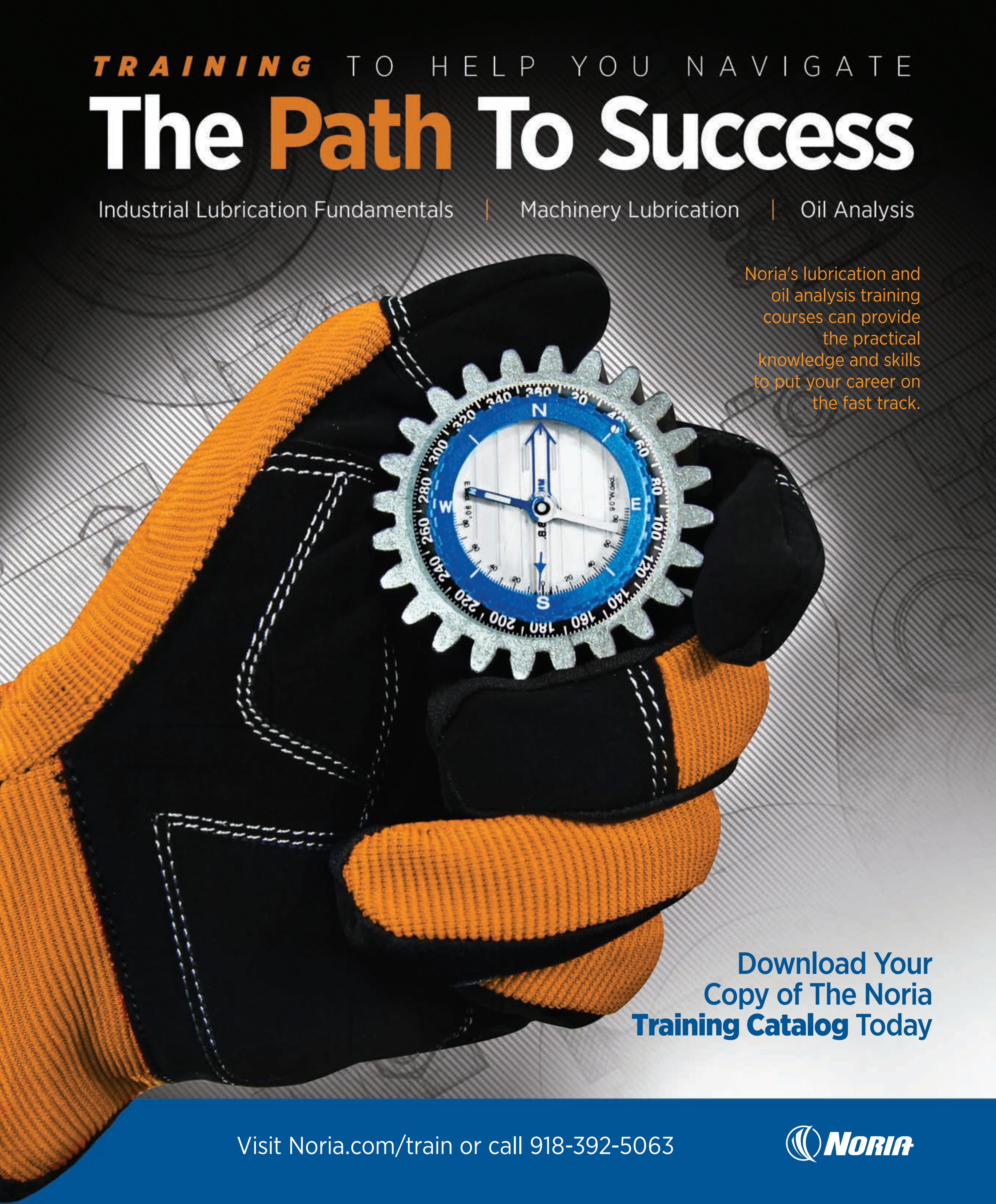
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Alarm Management of Permanent Vibration Monitoring on a Slow Speed Gearbox

by Han-Chian Gee

In any modern plant, condition monitoring is essential for allocating limited resources for repair when necessary and convenient to curtail downtime. Among the many available technologies, vibration is one of the leading measurements for rotating equipment reliability.

A permanent system, which covers 108 pieces of equipment, ranging from 174 to 15930 RPM, using 412 accelerometers and 48 proximity probes is discussed in this article, and the majority is on slow speed trains.

Slow speed gearboxes handle pelletizing which is the final manufacturing step in polymer extrusion. As a critical process in introducing additives or modifiers to enhance or distinguish the products by customized recipes, pelletizing is always accompanied with a heavy and fluctuating process.

Mechanical faults on slow speed pelletizing gearboxes typically have a low response. Despite their slow speed; its failure is never sweet, most of the time, it is silent without early warning and violent with extended consequences. There are a lot of myths worth discussion about this unique creature.

Consistency – The Basic Requirement for Slow Speed Gearbox Monitoring

For detection, numerous guidelines are advocated and are only limited to general rotating; they are absolute in concept and may not agree with each other. Unfortunately, no benchmark is available for slow speed gearboxes to begin with, and experts keep quiet about this topic.

Relative trending provides another option; how far and how fast the pattern is climbing which is easy and self-explained. However, consistency is essential.

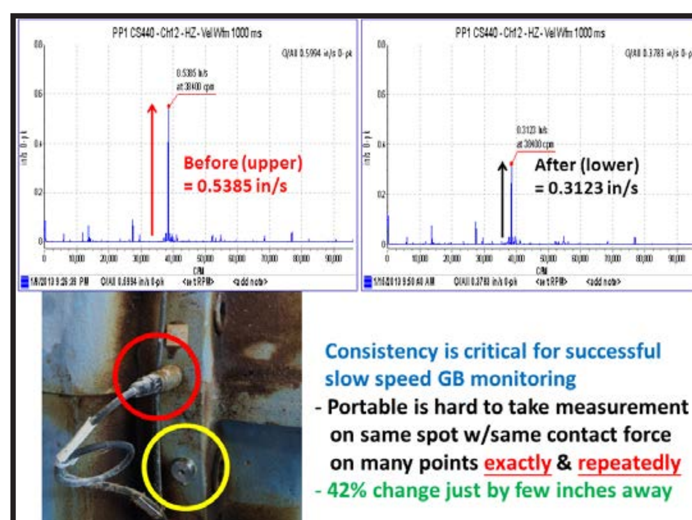

Figure 1

Figure 1 demonstrates a 42 percent variation between readings taken a few inches away, which happens likely by using a portable meter during a monthly cycle. The next walk-through might be collected by a substitute, and the result unpredicable. Without consistency, it is tough to differentiate among human factors, process load, rotating speed, or mechanical defects.

The first case study occurred just after commissioning an online system; its last portrait was launched remotely before it tripped. The second case study validates the lessons learned from the first case study.

The First Case Study – "How High Is Too High"?

Without an existing reference, the only way to gain experience is after the fact. Figure 2 illustrates a trend on the output shaft (174 RPM) from a gearbox with three shafts, three rotating speeds and three gear mesh configurations. It is around 0.04 in/s change, ranging from damaged bearings, cracked gears, broken teeth, an egg-shaped bore housing, and loose shaft to bearing fitness, etc. As a general rule of thumb, level 0.3 in/s is roaming on the severity margin between tolerable and rough, which was five times higher than the last 0.06 in/s, and proved to be a catastrophic failure.

One popular myth for abnormal detection is: "how high is too high?" For slow speed gearboxes, the question becomes the opposite: "how low is too low?" Where should the proper threshold be: 0.05? 0.04? or 0.03 in/s? Intuition is expensive, but it can be inferred - every one thousand is counted for slow speed gearboxes. However, this only can be achieved by using a permanent system.

More than detection, time waveform and spectrum analysis are informative for diagnostics, but in their own way. Periodic spikes at 174 cpm in Figure 2 (upper left) identify that the defects originated from the output shaft.

Spectral analysis is sophisticated for gearboxes; fortunately, it is an exception here and makes it an easier precursor for the comprehensive second case study. In Figure 2, a resonance haystack (about 3000 cpm and < 0.02 in/s) is stimulated by the impacts between broken teeth. Although not related to any rotating speed or gear mesh, its 174 cpm sidebands (after zoom in) still spotlight the output shaft and match the clues from the time waveform.

To wrap up the first case study, it can be concluded that data in Figure 2 provides detection function. However, time waveform offers further insight that not only indicates the footprint (174 cpm) from the broken teeth on the output shaft, but also its impact in nature, which is valuable for severity evaluation.

Now, this learning can be deployed and elaborated in the second case study.

	1st event	2nd event	3rd event
Location	Input shaft outboard end bearing A		Intermediate shaft motor end bearing B
Event date	Nov-26-2013	Mar-21-2014	Apr-11-2014
Shaft 1xRPM	1200		650
Bearing Rollers	14x rollers		26x rollers
Damage	Inner race crack	Outer race crack	Inner race pitting
Spectrum	600, 1200 cpm sidebands wide distribution	6780 cpm 1x outer race faulty peak	20280 cpm 2x inner race (10140 cpm) faulty peak
Band trend	600-4900 cpm band trend jump	3900-7900 cpm band trend burst	14680 - 22680 cpm band trend burst
Timewaveform Peak-Peak trend	Timewaveform P-P trend jump	Timewaveform P-P trend burst	Timewaveform P-P trend not conclusive & dumb

Bearing A (inner & outer race) - Peak-Peak trend and spike on waveform, band trend & spectrum, all work together for detection & analysis, from infant to last stage

Bearing B (inner race) - Peak-Peak trend on waveform is not very conclusive, however, band trend has responsive burst & spectrum shows 2x inner race harmonics

Table 1

	1x	2x	3x	4x	5x	6x	7x	8x	9x	10x	11x	12x	13x	14x	15x	16x
Input (1200)	1200	2400	3600	4800	6000	7200	8400	9600	10800	12000	13200	14400	15600	16800	18000	19200
Intermediate (650)	650	1300	1950	2600	3250	3900	4550	5200	5850	6500	7150	7800	8450	9100	9750	10400
Output (226)	226	452	678	904	1130	1356	1582	1808	2034	2260	2486	2712	2938	3164	3390	3616
GM#1	38400	76800														
GM#2	13680	27360	41040	54720	68400	82080	95760									
GM#3	5900	11800	17700	23600	29500	35400	41300	47200	53100	59000	64900	70800	76700	82600	88500	94400
Input Inner Race (14x)	10942	21884	32826	43768	54710	65652	76594	87536								
Input Outer Race (14x)	6780	13560	20340	27120	33900	40680	47460	54240	60480	67800	74580	81360	88140	94920		
Inter Inner Race (26x)	10140	20280	30420	40560	50700	60840	70980	81120								

Vertical columns (categorize all frequencies into three groups)

- up for three shaft rotating speeds, middle for three gear mesh families & bottom for three bearings defects

Horizontal rows

- list associated harmonics for each group

Table 2

The Second Case Study – Detection at Early Stage

Figure 3 is a derivative from the first case with minor modifications: rotating speed, gear teeth and bearing models, etc. Three damages occurred: the first two are on the same bearing A (red, input shaft outboard end), and the third one on bearing B (green, intermediate shaft motor end). Each spectrum is posted next to its damaged image.

Figure 4 is a traditional overall trend over 20 months; scan around every 15 minutes since the online system was commissioned. Before the first ignition (bearing A inner race, November 26, 2013 and circled red), it was buried by an overwhelming data mine (variable load, stop and start up, etc.). Why is this specific date singled out? Waveform Peak-Peak is another trending, although a few times a week, do provide more sensitive warning, a jump on the same date explains the reason.

Figures 5 through Figure 7 illustrates comparison before and after each event with its associated time domain on the right and frequency domain on the left. 96000 cpm is sliced into ten (10x) bands with 1600 lines and 60 cpm resolution. Those bands are categorized as gear mesh and non-gear mesh, with non-gear mesh bands inserted among gear mesh without a gap. Only the most representative band trending is selected (left lower). All related information is summarized in Table 1.

The Second Case Study – Analysis to Identify the Defects

Trending within a narrower frequency zone is sensitive to minor change for early detection and can focus on nominated targets like bearing defects as long as you know where they are. For example, higher thresholds can be assigned to gear mesh, which fluctuate with load, and false alarm can be eliminated by process variation.

Table 2 is a matrix for diagnosing. Shaft rotating and gear mesh frequency are generated as long as the machine is running, then defects are added if they occur - new, adjacent or exactly aligned with normal operation footprints (shaft rotating, gear mesh or one of their harmonics). On vertical direction, shaft speeds, gear mesh and defects are categorized into three groups (up, middle and bottom). All associated harmonics are listed along horizontal direction.

Figures 2-7 are located on page 52

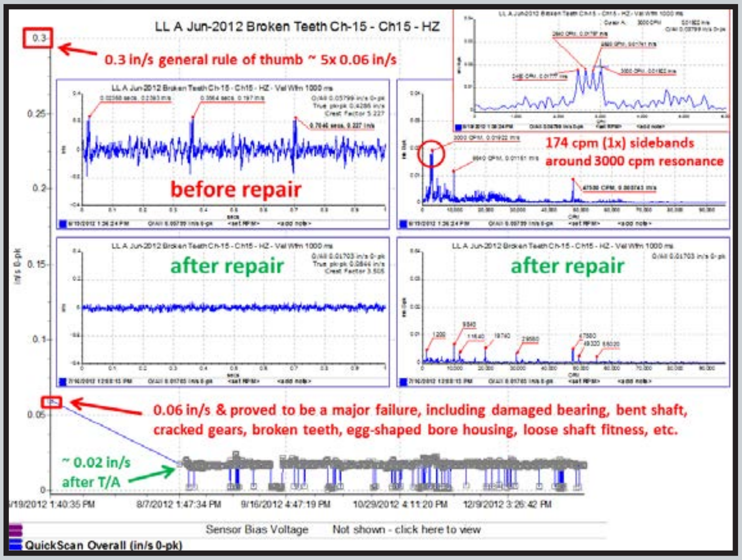

Figure 2

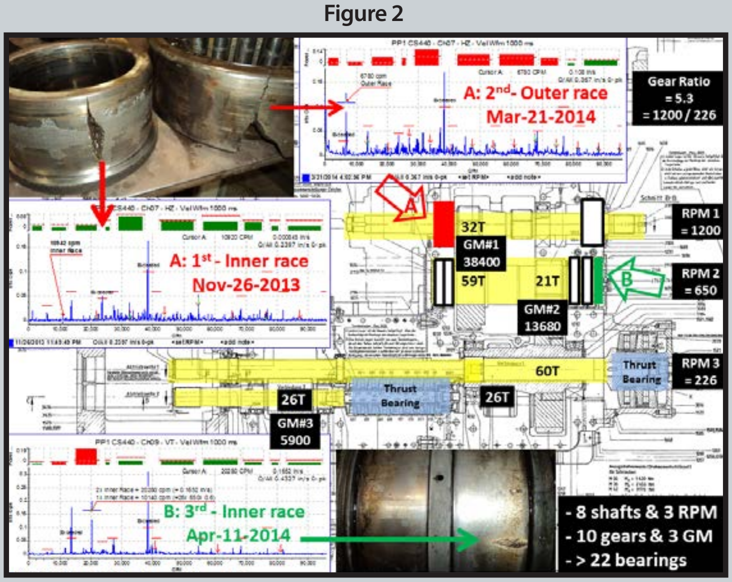

Figure 3

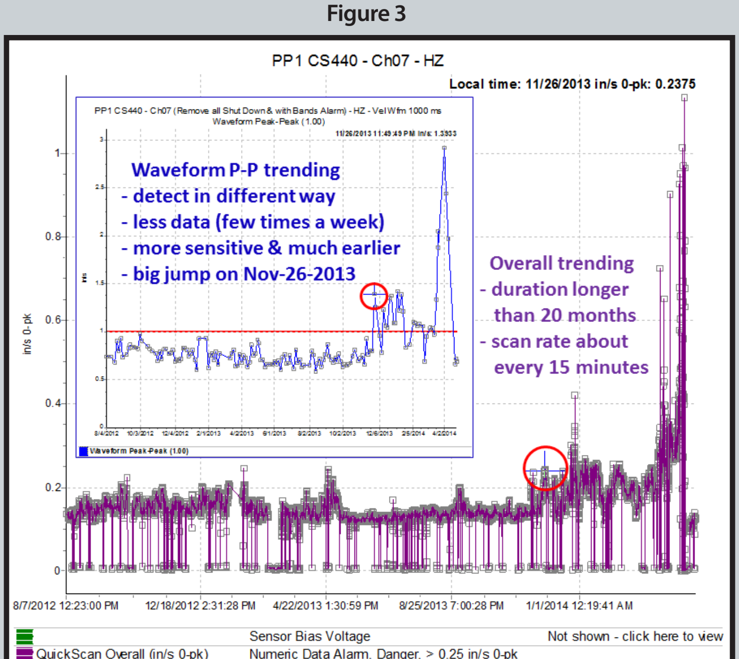

Figure 4

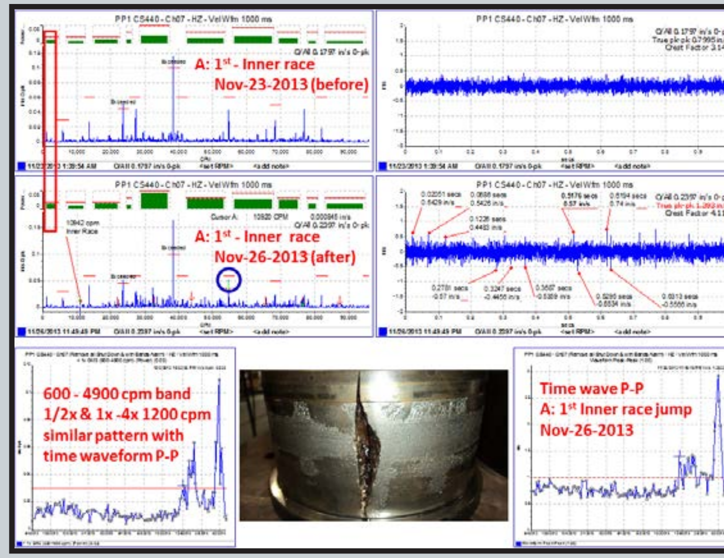

Figure 5

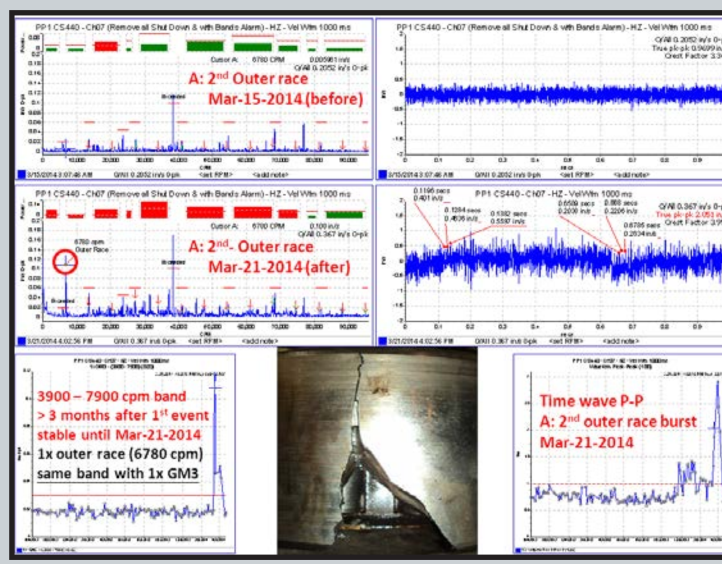

Figure 6

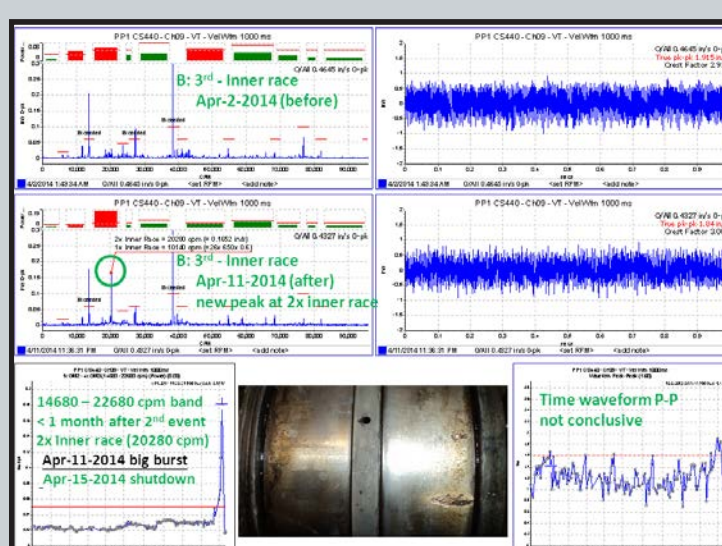

Figure 7

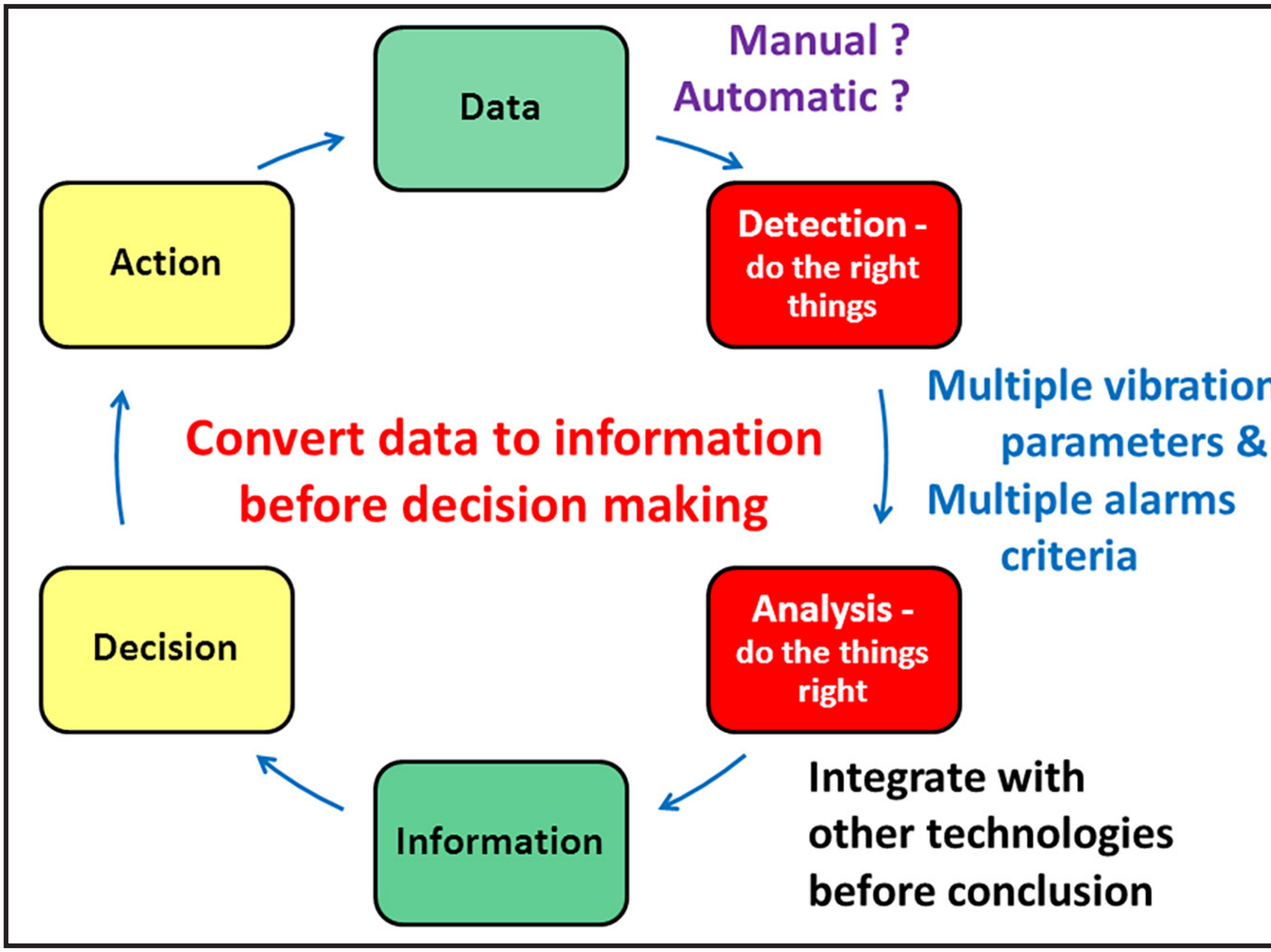

Figure 8

The challenges of each event are:

1. For the first event (bearing A inner race), 600 – 4900 cpm band (Figure 5, lower left) simulates time waveform trending well (Figure 5, lower right). Both 1/2x and 1x 1200 cpm spikes in the time domain (right middle) and 1/2x and 1x 1200 cpm sidebands in the frequency domain (with inner race 10942 cpm at infant) are conspicuous and complement each other.

   To identify developing bearing defects from gear mesh is tough. Referring to Table 2 (bottom and blue filled), 5x inner race (54710 cpm) is 10 cpm from 4x GM2 (54720 cpm), which is also blue circled in Figure 5 spectrum. Coincidentally, 7x inner race (76594 cpm) is less than 4x resolution lines from 2x GM1 (76800 cpm) and both are marked in yellow.

2. For the 2nd event (bearing A outer race), 3900 – 7900 cpm band is assigned for 1x GM1 (5900 cpm), however, the outer race burst (6780 cpm) falls into the same zone. In Table 2 (bottom and black filled), all even 6780 cpm families (2x, 4x, 6x, 8x, 10x, 12x and 14x) are urgently next to each GM2 harmonic, which make the Figure 6 spectrum quite noisy.

3. For the 3rd event (bearing B inner race), the major peak at 2x inner race (20280 cpm) falls into a non-gear mesh band, however it is close to the 2x inner race (21884 cpm) of bearing A, both are green filled and hard to distinguish.

Lessons for Detection

No trend is equal. Traditional overall trending (colored purple) in Figure 4 is not responsive. On the other hand, time waveform P-P tracking (colored blue) is proactive. Either prediction with a three months grace period or protection at the last stage, or ideally both, just depends upon your setup.

Today, there is no isolated information island; messages can be shared within seconds, no matter when or where you are.

Predictive maintenance (PdM) incites a concern. However, if nothing happens immediately or the booming market does not allow for service, the next question an analyst might face is: How long can it last? One of the many requests by unit operations is to shorten the current cycle from monthly to biweekly to weekly and eventually to the utmost, daily, which is a definite penalty with stressful side effects for portable route checks if the detection is too early. Rather than moving people, streaming data updates gives permanent online vibration monitoring another scenario.

Lessons for Analysis

Detection just notifies personnel that something is going wrong. When more information for the reason behind it is desired, analysis is not easy on the slow speed gearboxes.

The aforementioned discussions are based on what is already known and might not actually be available in many other plants. The machine design information is complicated in nature. Accordingly, the matrix composed of permutation and combined with numerous shafts, gear mesh and bearings is amazingly intimidating. It is frustrating to make an assumption, or try to align calculated faulty frequencies with peaks in the spectrum while several defects develop simultaneously and compete with each other. Nobody can predict which component is the weak link this far in advance.

Back to Basics

Economics is both the propulsion and the destination for condition monitoring. Fortunately, many technologies are available (vibration, lubrication, ultrasound, infrared, etc.), however, a permanent online system is unique in its kind.

Machinery wear mechanisms (e.g., ISO15243:2004 for rolling bearings) are dynamic. Spectrum and time waveform are just two in this article, yet there are still many other tools (e.g., stress wave, envelop demodulation, etc.), that have their own strengths and all can work together to aim at the moving targets from infancy and developing to the last stage.

Information is important for decision making, however, without proper interpretation, more data means more confusion (Figure 8). Today, there is no isolated information island; messages can be shared within seconds, no matter when or where you are. However, digital devices only broadcast the repeated messages without judgment. How the system is set up to initiate the first meaningful attention is the key.

Whether it is a portable or a permanent online system, detection to do the right thing and analysis to do the thing right should always be on the list and can never be missed. Both are the core for vibration condition monitoring and also the contribution by industrious professionals.

Acknowledgement

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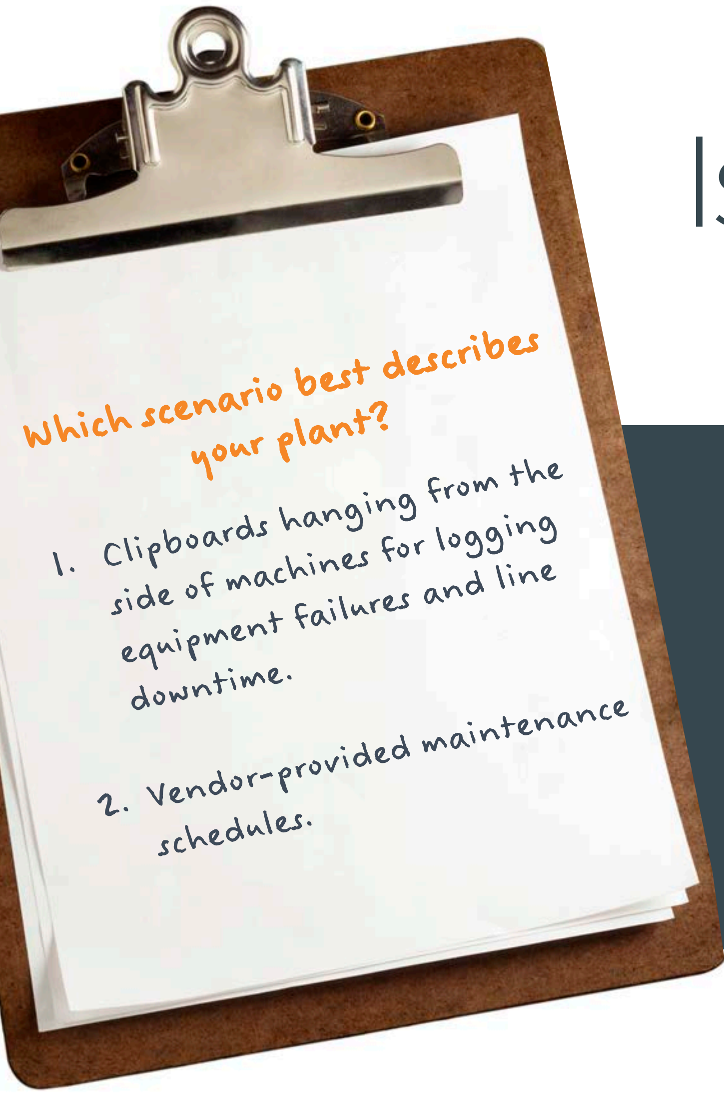

Is Your Equipment Telling You When It Needs PM?

by Lisa Sobkow

When it comes to preventative maintenance (PM), which scenario best describes your plant: Clipboards hanging from the side of machines for logging equipment failures and line downtime, or vendor-provided maintenance schedules? Both are actually a good start! But unfortunately, operator-collected data carries the intrinsic risk of bias and error, and maintenance schedules can't possibly correlate directly to a plant's unique production cycles. The best way to create a PM schedule that minimizes downtime is to base it on actual historical data.

Manufacturers know they have the raw equipment data; they just need a way to capture it and convert it into useful equipment health monitoring information. A manufacturing execution system (MES) provides that vehicle. Rather than rely on a vendor-provided maintenance schedule or a manual log, an MES creates a PM program based on historical cycle counts. Data is collected through plant floor controls and incorporated into a database. Rules are then created based on actual tool and equipment wear patterns, and maintenance work orders are generated.

An MES can be self-contained or customized around a plant's existing software. For example, a global automaker uses real-time production counts and time in the cycling state to feed its off-the-shelf maintenance scheduling software. In the past, the company had to perform its most labor-intensive maintenance operations during shutdown periods. Equipment failed between shutdowns and downtime resulted. Today, the PM schedule for even its most complex machines is based on actual use and wear patterns, allowing production and maintenance schedules to work together to minimize downtime.

In another example, a large engine manufacturer has a self-contained equipment health monitoring MES. Its rate of tool failure was creating unacceptable levels of downtime and scrap. A system was developed to collect usage data from each individual tool and define maximum tool life. A line-side human-machine interface (HMI) was provided to allow the tool's anticipat-

Figure 1: Example of line-side MES HMI

Figure 2: Equipment health can be broadcasted plant-wide

ed life to be viewed by operators. Today, when a tool approaches 90 percent of its maximum expected life, the system alarms, notifying the operator and the maintenance staff. As a result, not only have downtime and scrap decreased, but the overall cost of tools is lower because purchasing can identify and buy the tools that last the longest.

Once equipment health monitoring systems are in place, an expanded MES can identify and prevent bottlenecks, guide overall process design and facilitate line changes. For example, a plant wanted to increase its line speed from 17 jobs per hour (JPH) to 23 JPH. The plant used its MES to understand operator cycle times by shift. One of its shifts had limited over cycles, while another shift had a much larger occurrence of over cycles. Was there a variation in training, or a lack of parts? Or, if both shifts were identical in those aspects, was there a process issue at fault? The MES allowed the industrial engineering team to determine whether an operator or process issue was the root cause, correct it and bring line speed up to the target of 23 JPH.

Once equipment health monitoring systems are in place, an expanded MES can identify and prevent bottlenecks, guide overall process design and facilitate line changes.

Plants running multiple assembly lines can use data from one line to prevent problems in another. When an equipment issue is creating problems on Line A, maintenance staff can take action to prevent the issue from occurring on Line B. When a new process or machine is added to multiple lines, the MES can compare and contrast equipment health on each line to quickly head off problems across all lines.

An effective MES equipment health monitoring system should increase uptime, reduce scrap and tool costs, and provide the foundation for a complete process management system.

What Is a Control System Integrator?

A control system integrator is a person who designs and implements sophisticated control systems for manufacturing, process and other industrial facilities. Applying engineering, information technology and business knowledge, system integrators integrate plant equipment to automate manufacturing and processes from the plant floor to the enterprise level. Automation helps manufacturers and processors reduce cost, increase production, use less energy and lower environmental impact.

What Does a Control System Integrator Do?

Control system integrators design, program, test, commission and service electrical and electronic systems in industrial applications. They integrate hardware, software and equipment from multiple suppliers into fully functional systems for optimum plant control, automation and information. Their scope of supply includes all requirements from the plant floor to the enterprise level.

What Is the Control System Integrators Association (CSIA)?

The Control System Integrators Association (CSIA) seeks to enable industries everywhere to have access to low risk, safe and successful applications of automation technology by advancing the business practices of the system integration industry. CSIA helps its members improve their business skills, provides a forum to share industry expertise and promotes best practices for business management.

Founded in 1994, CSIA is a not-for-profit, global trade association for system integration companies. CSIA has more than 400 member firms in 27 countries.

What Does It Mean to Be CSIA Certified?

CSIA certification is the gold seal mark of a professionally managed system integration business. Certification reassures clients that the control system integrator is an established and successful professional services firm that wants to develop a successful, long-term partnership with clients.

CSIA certification is similar to the International Organization for Standardization (ISO) certification, but there are important differences. ISO certification offers quality management to make sure operations are consistent for your business. CSIA delivers that same consistency, but expands the concept to include business management, financial management, human resources, project management capabilities and more. Audit criteria for achieving CSIA certification derive from the CSIA Best Practices and Benchmarks Manual.

How Do I Find a Certified Control System Integrator?

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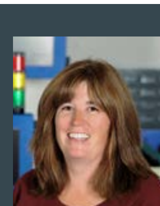

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criticality analysis • risk-based inspection • reliability centered maintenance • failure mode effects analysis • cost risk optimization

Integral Asset Care

by Edwin Gutiérrez

Integral asset care (IAC) is the result of the optimum combination of other methodologies, such as criticality analysis, risk-based inspection, reliability centered maintenance, failure mode and effects analysis, and cost risk optimization, that integrates all together for the design of care activities for dynamic, fixed and electrical equipment and instruments. This article presents the generation and application of IAC for the design of asset care integral maintenance plans.

Table 1 – Risk Ranking Matrix

		A	B	C	D	E
		Negligible	Minor	Moderate	Significant	Severe
E	Very Likely	Low Med	Medium	Med Hi	High	High
D	Likely	Low	Low/Med	Medium	Med Hi	High
C	Possible	Low	Low/Med	Medium	Med Hi	Med Hi
B	Unlikely	Low	Low/Med	Low Med	Medium	Med Hi
A	Very Unlikely	Low	Low	Low Med	Medium	Medium

INTRODUCTION

Aiming to improve the profitability of productive processes, huge efforts are made daily that focus on visualizing, identifying, analyzing, implementing and executing activities to solve problems effectively, make successful decisions involving high impact areas like safety, environment, production goals, operation and maintenance costs, and guarantee a good corporate image and customer and staff satisfaction.

Maintenance or asset care plans represent one of these efforts. Due to their high costs in design, elaboration and implementation, the establishment of asset care plans must adhere to the belief that through these you will get better levels of performance and profitability throughout the value chain.

The proper selection of methods and tools used during preparation significantly affect the processing time and cost of the plans.

CONCEPTUAL FRAMEWORK

Risk

In the decision-making process, risk is used as a tool for optimizing asset care plans, directing more resources and efforts to equipment that presents a high risk and less to low risk equipment, to allow a justified expenditure of resources directed to maintenance items.[1]

To evaluate the risk through the probability of occurrence and its respective consequences, risk relatively is estimated using a qualitative matrix[1] as shown in Table 1.

Equipment Group

Hierarchical level characterization of all equipment supports functions or a group of functions for which they have been selected (Figure 1).

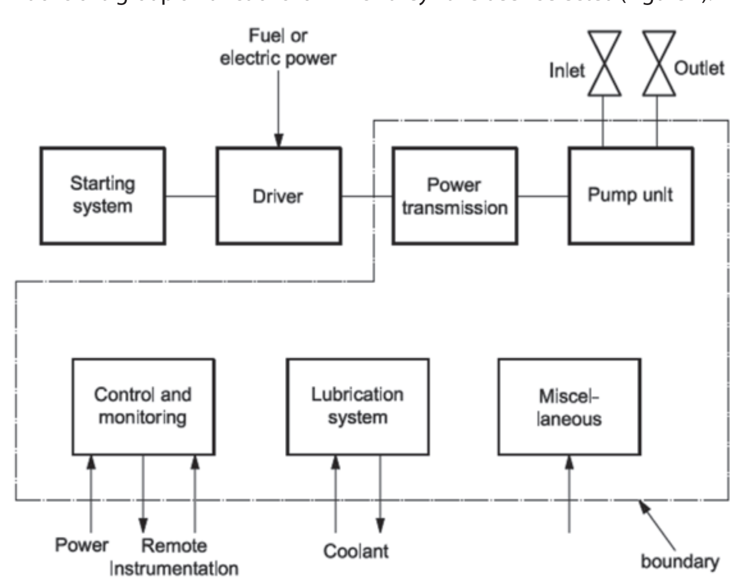

Figure 1: Equipment group[2]

Criticality Analysis

This methodology establishes a facilities, systems, equipment and devices hierarchy or priorities according to a figure of merit called criticality. Proportional to risk, criticality creates a structure that facilitates decision-making and steers effort and resources in areas and situations that have the greatest impact on business.

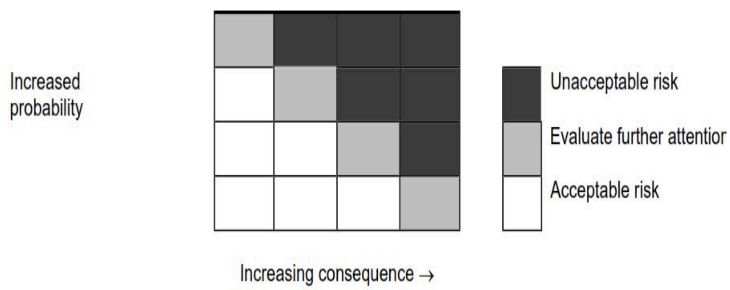

Figure 2: Criticality matrix[3]

Figure 2 is a typical arrangement of a semi-quantitative 4x4 risk matrix. It shows that the likelihood or frequency axis is divided into high, medium, low and remote classifications, and consequences are equally divided into ranges as grave, substantial, marginal, or negligible. These ranges should be associated with numerical values for quantitative studies and/or clear descriptions in case of semi-quantitative or qualitative studies.

Three risk regions can be identified in the matrix: unacceptable, acceptable and a region between the two that requires detailed assessment activities, risk management and monitoring.

Risk-Based Inspection (RBI)

An RBI study is based on the implementation of American Petroleum Institute (API) standards, API580 and API581, and establishes frequency and scope of inspections based on historical behavior, damage or deterioration modes, design features, operating conditions, maintenance, inspection and management policies, the quality and effectiveness of inspections, and the consequences associated with the occurrence of potential faults.

Graphically, this methodology allows for the identification or location of equipment under analysis risk level in a 5x5 matrix (Figure 3) that has four levels of risk classification: low (white or green), medium (yellow), medium high (orange) and high (red).

The result of this methodology is a hierarchical list of equipment based on risk calculated to determine the types of inspection and the appropriate frequencies.

Reliability Centered Maintenance (RCM)

It is an analytical and systematic process based on understanding the system's role (functional analysis) and functional and components failures that aims to identify company policies to handle the failure modes that can cause functional failure to any physical asset within an operational context.

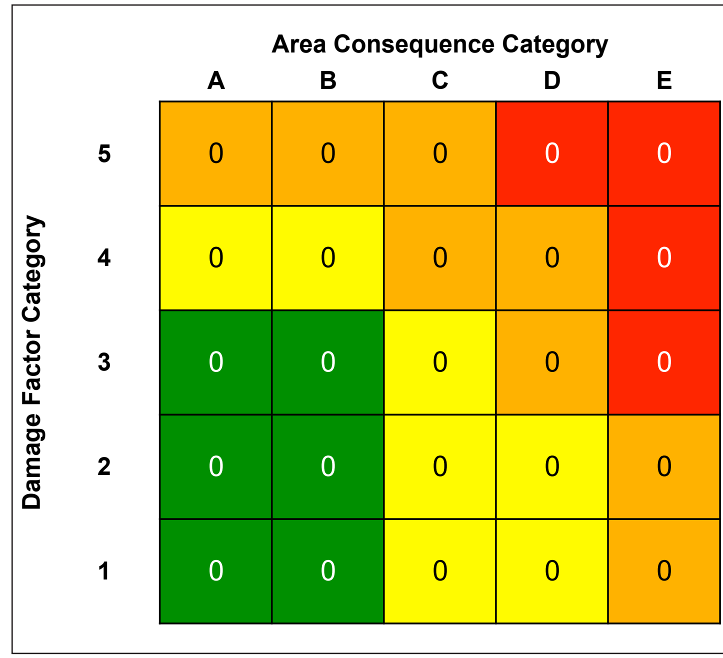

Figure 3: Risk-based inspection risk matrix[4]

The objective of an RCM analysis is to generate the appropriate maintenance tasks to minimize the recurrence of failure modes and/or mitigate the consequences of its occurrence.

Failure Modes and Effect Analysis (FMEA)

At the heart of the RCM process is FMEA, a systematic methodology that might occur in specific equipment, evaluated in its operational context. This analysis shows the possible causes and failure mechanisms and, therefore, can be inferred preventive, predictive, detective and/or corrective actions required to avoid failure and/or mitigate their consequences using a maintenance task selection diagram, as shown in Figure 4.

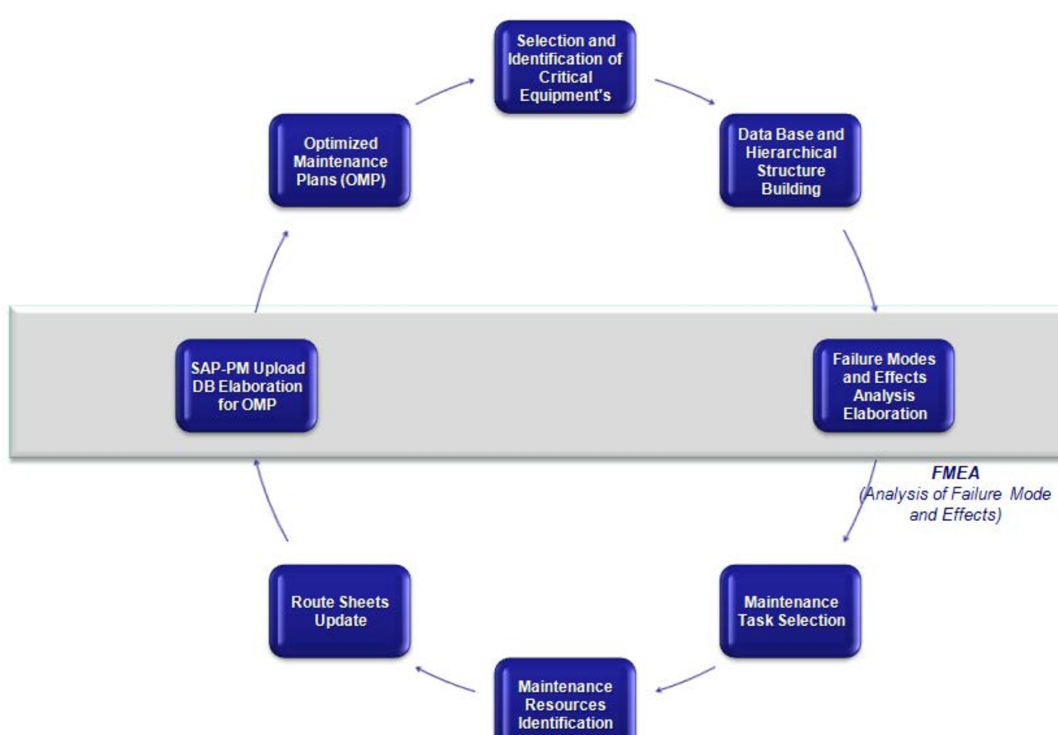

Figure 4: Reliability centered maintenance process using FMEA methodology[5]

Cost Risk Optimization

Cost risk optimization is a model to determine the optimal risk level and the appropriate amount of maintenance to get the most benefit or minimal impact on business. Figure 5 shows graphically the model; three curves are highlighted and may vary over time:

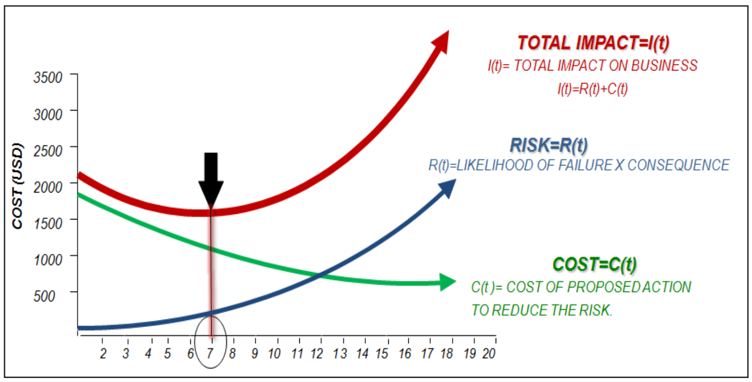

Figure 5: Maintenance frequency optimization[2]

- Risk level curve (risk = probability of failure x consequence).
- Risk mitigation action costs curve - simulates the costs of different frequencies for the proposed action.
- Total impact curve - results from the sum of the risk curve and the cost curve, point to point. The "minimum" of this curve represents the "minimal impact on the business" and is located on the value that can be translated as the period or optimal frequency for the implementation of the mitigation activity, a shift to the right of this point would mean "taking a high risk" and a shift to the left would mean "spending too much money." It is important to highlight that each of these curves represent probability distributions based on the fact that the level of uncertainty of the input variables has been considered.

INTEGRAL ASSET CARE METHODOLOGY

IAC was developed to meet the requirements of integral asset care, such as dynamic, electrical, fixed and instruments, both primary and secondary. Additionally, this methodology directly involves the operator as principal in the design and implementation of different asset care activities.

IAC is based on the combination of the criticality analysis methodologies, Level I of RBI, RCM, FMEA and cost risk optimization, in order to design integral plans for asset care (Figure 6).

The application of this methodology is developed in the following steps:

1. Establish system boundaries that will design the integral asset care plan.
2. Define care policies for all asset types.
3. Search and analysis of: databases of main and secondary equipment, maintenance plans and policies of current support, maintenance indicators, operational philosophy, process and instruments diagram (P&ID), Process Flow Diagram (PFDs), current equipment conditions equipment and technical features, technology used, etc.
4. Perform criticality analysis for each system's assets based on known methods, such as integral criticality analysis; functional analysis; criticality based on maintenance and reliability management indicators (e.g., mean time between failures, mean time to repair, etc.) and risk-based inspection.

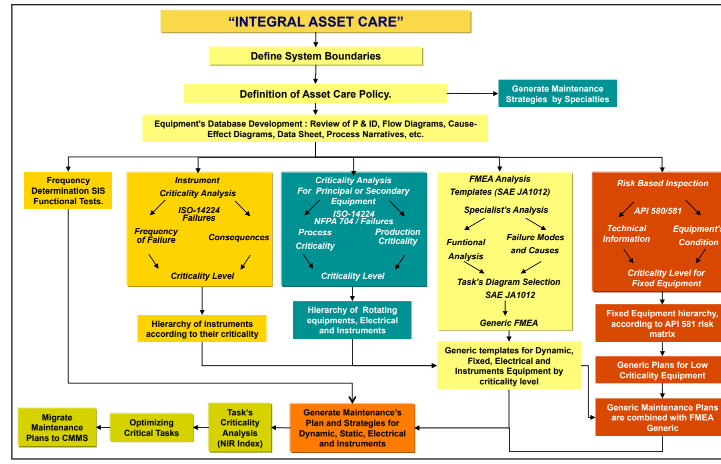

Figure 6: Integral asset care methodology[5]

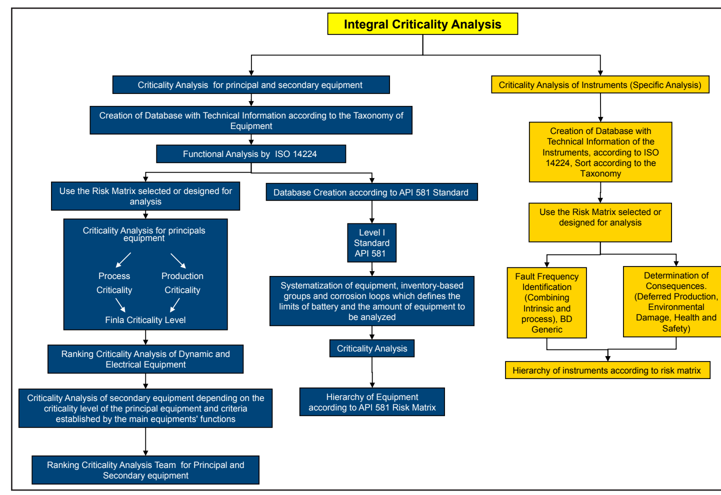

Figure 7: Integral asset criticality analysis methodology.[5]

An integral asset criticality analysis application can be developed according to the flowchart in Figure 7.

The flowchart shows how the integral criticality assets analysis methodology is divided into two branches. The principal and secondary equipment hierarchy includes the instrumentation critical analysis that depends on the type of instruments and the resulting level of criticality of the principal equipment for which the instrument is providing its functions. The other branch is the critical analysis for specific instrumentation, where the level of risk is determined according to failure probabilities and their consequences. The type of methodology used depends on the time and resources available.

Phases of Integral Asset Criticality Analysis Methodology

1. *Determination of criticality level for principal equipment in an equipment group (dynamic and electric according to the risk matrix of the system under analysis)* – Based on the probability and consequence level from health, safety, environment (HSE) and process analysis using the risk matrix defined for the specific business.

   The analysis should be developed with personnel from maintenance and operations, or with any other personnel that has knowledge of risks associated to the safety of the unit or equipment under analysis. The highest level of criticality resulting from the hierarchy of the HSE and process analysis is selected.

2. *Determination of criticality level of secondary equipment in an equipment group* – Based on the level of criticality of the principal equipment and the established criteria, including whether the secondary equipment assists or supports the principal equipment's function performance.

   Once the process impact and HSE level for the secondary equipment are determined, the highest level of criticality resulting from both criteria is selected to determine the real risk level of assets from the HSE and process perspective.

3. *Conduct Phase I RBI to determine the level of criticality of fixed equipment in an equipment group using Level I of API580 and API581 standards* – Level I corresponds to a qualitative analysis that determines the level of risk for assets of a working installation, ranking each unit based on both elements of risk: probability and consequence (Figure 8).

   To apply this methodology, it is necessary to treat the technical, historical and operating conditions data that was used to obtain the first product of the analysis. In addition, a qualitative risk mapping of the units of installation to study is developed to rank the units to determine the level of analysis, classify the level of risk of the units in the installation and place them on the risk matrix, and identify areas inside the plant that require special attention and perhaps special inspection programs.

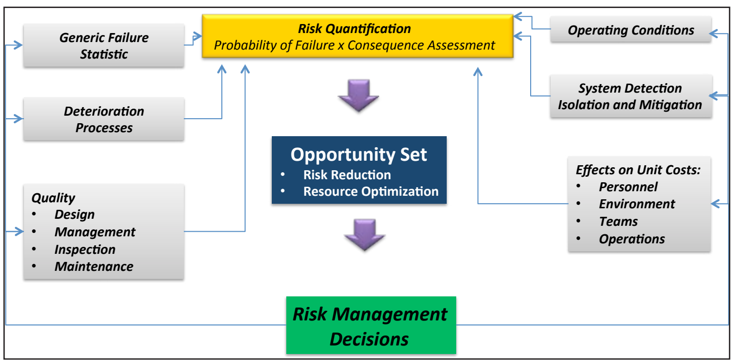

Figure 8: Criticality analysis methodology for fixed equipments[4,5,6]

4. *Design a generic inspection plan* – Applies to equipment with a low criticality level.
5. *Create FMEA or generic templates* – These are procedures taken for asset healthcare and generated for equipment that operates under similar technical characteristics and policies.

   One of the most important steps in the development of a FMEA is the risk index number (RIN), determined by arranging the level of risk associated to each of the failure modes in a qualitative way (Table 2).

RANKING			
	BY FREQUENCY OF OCCURRENCE	BY SEVERITY	BY DETECTION
1	REMOTE PROBABILITY	NO IMPACT	VERY HIGH
2 - 3	LOW RATE OF OCCURRENCE	LOW SEVERITY	HIGH
4 - 6	OCCURRENCE MODERATE	MODERATE SEVERITY	MODERATE
7 - 9	HIGH RATE OF OCCURRENCE	HIGH SEVERITY	LOW
10	VERY HIGH RATE OF OCCURRENCE	VERY HIGH SEVERITY	UNLIKELY

Table 2 – Components of the Risk Index Number

   One of the final and very important requirements for completing the FMEA is the selection of mitigation strategies for each failure mode by applying the decision diagram and task selection of SAE International's JA1012, "A Guide to the Reliability Centered Maintenance Standard." This diagram allows the identification of hidden failures, the determination of consequences and has some criteria of technical feasibility that contributes to the assertiveness on the selection mitigation strategies.

6. *Generate asset healthcare programs for the remaining equipment families* – Includes dynamics, electrics and instrumentation according to their criticality levels and technical characteristics.
7. *Store assets' healthcare programs in a dynamic database* – This allows for the sharing of all information among administrative and managing systems.

Tips for Designing a Successful
Integral Asset Care Plan

- Dedicate time in the design and development of the assets' database since this is one of the foundations for this methodology.
- Form teams to clearly define policies designed for the assets' healthcare in the system.
- Reinforce the level of importance of the culture of the data, in terms of registration, administration and analysis.
- Train all personnel involved in the use and application of this methodology.
- Review and revise accordingly the application of this methodology in a period of 3 to 5 years after the asset healthcare programs' implementation.
- Secure managerial involvement in the development and implementation of the integral assets healthcare programs.

CONCLUSION

The optimal combination of criticality analysis, risk-based inspections, reliability centered maintenance, FMEA and cost-risk benefit analysis methodologies allow for the development of asset healthcare integral policies.

In comparison to traditional methods, the development and application of integral asset care reduces the time and resources used in the design of asset healthcare programs by more than 50 percent.

When applying this methodology, the operator plays an important, proactive role in the healthcare program activities and migration of such programs to the managing system guarantees the success of their implementation.

This methodology facilities the decision-making and resource allocation process by basing it on risk levels and aversion, which allows for a more profitable business.

REFERENCES

1. Yañez Medardo, Gómez de la Vega, Hernando, Valbuena Genebelin. *Reliability Engineering and Probabilistic Risk Analysis.* Venezuela, June 2003. ISBN 980-12-0116-9.
2. International Organization for Standardization (ISO). *ISO/DIS 14224 Petroleum and Natural Gas Industries — Collection and Exchange of Reliability and Maintenance Data for Equipment*. London: ISO, May 2005 (draft).
3. Norwegian Petroleum Industry. *Norzok Standard Z-013, Risk and emergency preparedness analysis.* Rev. 2, 2001-09-01. http://www.standard.no/pagefiles/955/z-013.pdf
4. American Petroleum Institute (API). *Risk-Based Inspection, API Recommended Practice 580 First Edition.* Washington, D.C.: API, May 2002.
5. Fuente R2M S.A Reliability and Risk Management.
6. SAE International. *SAE-JA1011/SAE-JA1012: Guide for the Reliability Centered Maintenance Methodology (RCM).* Warrendale: SAE, 2002.
7. Materan, E; Aranguren, J; Bravo, J; Medina, R. *Generation of Optimal Inspection Plans for Fixed Equipment in the Oil and Gas Industry.* Venezuela: Reliability and Risk Management, 2006. American Petroleum Institute (API). *Risk-Based Inspection Base Resource Document, First Edition*. Washington, D.C.: API Publication 581, May 2000.
8. Calixto Ivaneska, Bahoque Evila, Gutierrez Edwin. *Develop of a Methodology for the Design of the Asset Health Care Policies.* Venezuela. January 2006.

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Q&A


Scott Morris

Uptime Magazine recently caught up with Scott Morris, Associate Director at Genzyme, A Sanofi Company. Mr. Morris played a critical role in the development of the ISO55000 standards. Uptime had the opportunity to sit down with Scott and dive deeper into his role and involvement in the development of ISO55000 and other related standards.


Figure 1: Table Mountain, Cape Town, South Africa

Q: How did you get started in your career?

My career started in nuclear power. I was in the U.S. Navy for eight years and then transitioned to biotech/pharmaceutical for the last 20 plus years.

Q: What are your current roles and responsibilities?

I work in the global engineering group of Genzyme, a Sanofi Company. My role is system administrator for our enterprise asset management system and I am the business process owner for processes used for asset management in the company.

Q: You were part of the U.S. Technical Advisory Group for ISO/PC251. How did that come about?

Our organization was looking at PAS55 as a way to manage assets more effectively. During our research, we found that the PC251 committee had formed to create an ISO standard for a management system for asset management. Being in a regulated industry, we realized that any time you can get in on the development of a process, the more understanding you will have. Being a part of the PC251 committee was a great opportunity.

Q: What did you enjoy most about being part of the development of ISO55000?

I got the most enjoyment from the diverse views and culture of the committee membership. It allowed me to grow professionally and personally.

Q: What was your favorite city visited during the meetings for the ISO process?

It wasn't really the city, but the country – South Africa. The people were warm and very friendly. The hosts for the meeting arranged for early arrivals to go on a safari and we also visited the city of Cape Town, which was beautiful. Another good thing about the South African meeting was all committee members were basically on a level playing field. There was no home field advantage like there was when we were in Washington, D.C., or Australia.

Q: In addition to the ISO55000 standard development, did you participate in the development of any additional requirements related to ISO55000?

Yes, the 17021-5 document, which specifies the knowledge requirements for third-party certification for ISO55001. I chaired the committee and worked with ISO to guide the document through the process. It took almost eight months to produce the 17021-5 document.

Q: What advice would you give companies that are just starting to investigate the ISO55000 standard?

For companies just getting started, they should do a gap analysis between where they are currently and where they will need to be to comply with the standard. They will likely find that they only have to "tweak" many of their existing practices to be in compliance with ISO55000. However, one of the biggest obstacles for most companies is learning to overcome many of the silos they have in their existing organizations. The ISO55000 standard will help break down these silos and ensure all members of the organization work together to maximize the value derived from their assets.

Figure 2: ISO PC251 committee members with representatives from South Africa, United States, Australia, United Kingdom, the Netherlands and Sweden

Q: What advice would you give maintenance reliability or asset management professionals who are just getting started in their career?

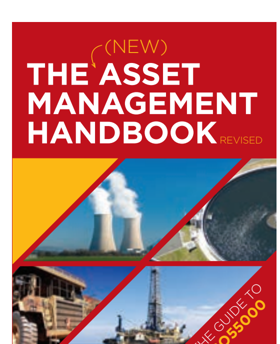
I think it would be to build a reference library and also network as much as they can. No one has all the answers, but in a good network, someone does.

Q: There is an Institute of Asset Management (IAM) USA chapter being formed. Do you have any comments related to this organization?

Until I got involved in asset management and ISO55000, I never realized the level of interest that existed in the U.S. It was surprising to see how many people were looking for asset management knowledge. Based on this, a chapter of the IAM is being formed, IAM-USA, to address the needs of asset managers in the U.S. The IAM-USA organization is going to quickly build a network that will address the need for this knowledge. It would be beneficial for anyone working in the asset management field to investigate joining this network.

Q: What do you see as the next step forward for the ISO55000 standard?

Eventually, like other ISO standards, ISO55000 will be revised. It would be good for other practitioners to get involved as part of the committee that undertakes that task. Having fresh sets of eyes to look at the standard, particularly if they are involved in asset management, will further advance the field. We built the foundation for the standard, others will need to be involved to make it blossom.



Scott Morris was a contributing author to *The (New) Asset Management Handbook* available at www.mro-zone.com.

Refinery Strike 2015

Heinz Bloch

The U.S. oil refineries labor dispute of 2015 will undoubtedly develop in interesting ways. While that's perhaps the understatement of the day, those who have full access to the facts are reluctant to share them with technical journals. If we have access to the facts, we may be pestered with demands to tell people which side we're on, even though some of us don't want to take sides.

Let me just say that some major oil exploration and refining corporations epitomize a culture of risk-taking. Some of that take risks and be rewarded behavior is passed on to the next generation. It goes without saying that certain types of risk-taking cannot be defended by rational people. Take pipelines, for example. I believe certain pipelines were designed by engineers who affixed their stamp of approval with the clear (and usually written) understanding that the pipeline has a design life of, say, 25 years. If, or more likely when, that pipeline leaks after 65 years of service, you will not be able to find the individuals who decided to run it for 30 years, or those who said let's give it another 5 years, and another 5 years, and so forth. The owners proffer explanations about pigging (sending an instrumented balloon down the pipe) and related predictive maintenance actions. The pigging explanation will satisfy many people. To them, it is manna from heaven. They have long ago decided to perceive pigging as good news—good news for folks who long ago have decided never to bite the hand that feeds them.

Cultural changes are critically important at some refineries and these changes aren't optional. They must be made, but making changes will take time. The rate at which such changes can progress is linked to an industrial society's willingness and ability to make very drastic adjustments. On an individual basis, it may be likened to an unprincipled, excessively fast driver on I-95. We, as rational people, know that driver can affect many lives, but the driver may not have the mentality, or desire, to understand this. Likewise, compare the unprincipled and fast driver with another, abnormally slow driver on I-95. The slow driver also can affect many lives, but may not have the mental capacity, or willingness, to either concede or understand his actions.

Anyway, during a labor strife at refineries, hundreds of salaried employees are assigned to one of their refinery's many process units. Some leave for work at 4 p.m. and return home at 6 a.m. the next day and do this seven days a week. They try to get a few hours of sleep during the day and, whether at work or at home, do their utmost to add value instead of dissension. Because their coveralls have decals identifying their employer, many wear neutral clothing over their fire-resistant suits so as not to be accosted by some of their fellow citizens. Their fellow citizens proclaim having intense empathy for the strikers. And, by the way, the strikers' union decal and national flag are also on the salaried employees' coveralls as they do their jobs inside the refinery gates.

I am certain historians will dissect the present dispute years from today. Their writings will explain that some of the salaried employees did a better job than the strikers they replaced, showed exactly the same proficiency, but didn't do as good a job as the strikers whose jobs they had to do for some time. We can all rest assured that the historians' analyses will conclude how and why following checklists and sound work procedures is the best way to live.

Meanwhile, there is intense polarization and many people whose knowledge and allegiance is entirely shaped by the polarizers. Some of them will be surprised when they finally hear the unvarnished truth. And some couldn't care less---not today, not ever.

The opinions expressed herein are not necessarily those of Uptime Magazine and Reliabilityweb.com.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to have your
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take longer
than your
IMPROVEMENT
PROJECT.
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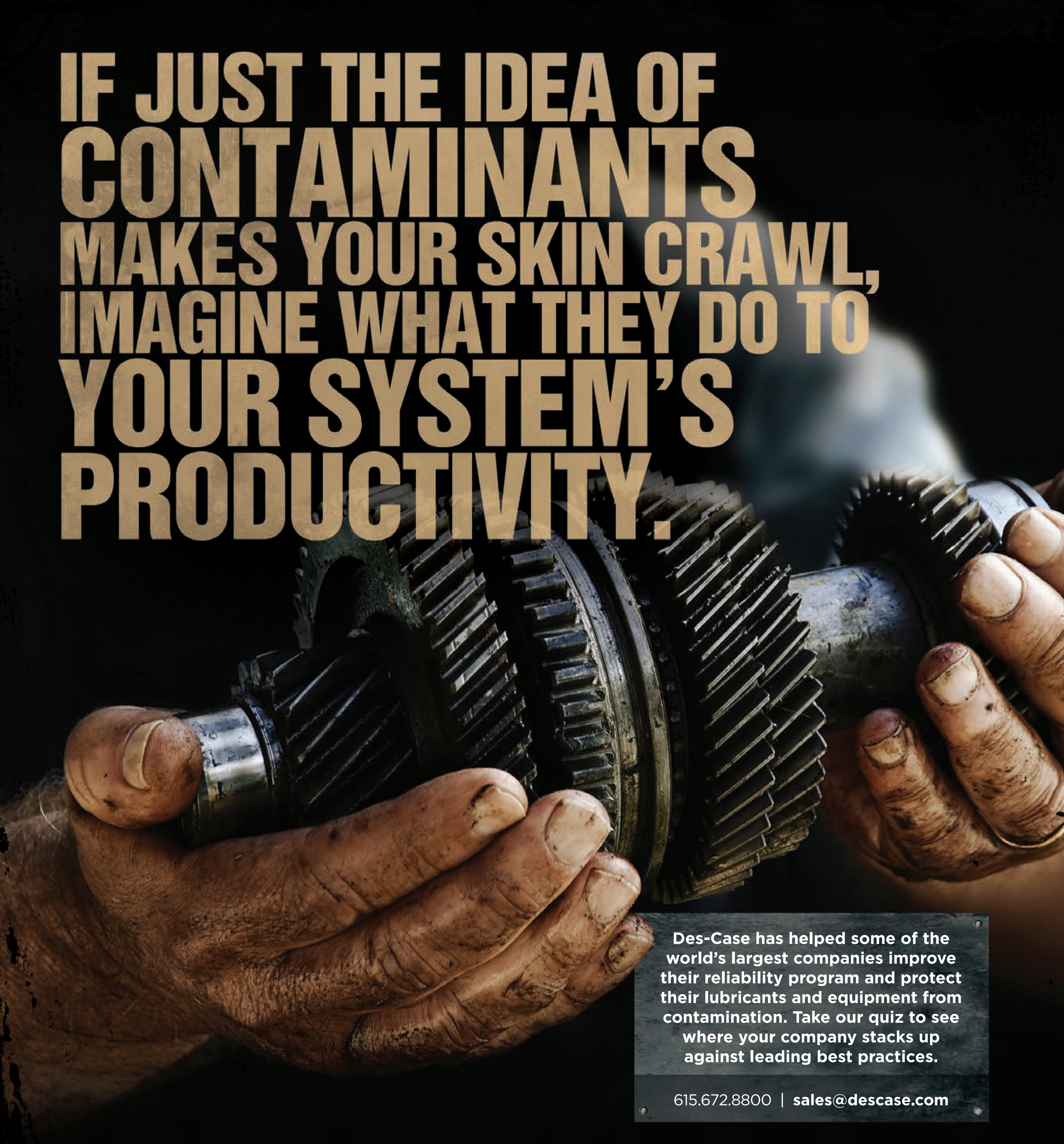

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