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Maintenance Planning and Scheduling 	Planner/Schedulers, Maintenance Supervisors, Maintenance Managers, Operations Coordinators, Storeroom Managers and Purchasing Managers	Apply preventive and predictive maintenance practices. Calculate work measurement. Schedule and coordinate work. Handle common maintenance problems, delays and inefficiencies.	July 23-26, 2018 (CHS) Sept 24-27, 2018 (CU) Nov 5-8, 2018 (OSU) Jan 5-7, 2019 (CHS) May 7-9, 2019 (KU) Jun 18-20, 2019 (CHS) Jul 23-25, 2019 (CHS) Aug 27-29, 2019 (CHS)	4 consecutive days 2.8 CEUs	\$2,495
Materials Management 	Materials Managers, Storeroom Managers, Planner/Schedulers, Maintenance Managers and Operations Managers	Apply sound storeroom operations principles. Manage inventory to optimize investment. Understand the role of purchasing. Implement effective work control processes.	Oct 23-25, 2018 (CHS) Mar 5-7, 2019 (CHS) Jan 29-31, 2019 (CU) April 16-18, 2019 (OSU)	3 consecutive days 2.1 CEUs	\$1,895
Planning for Shutdowns, Turnarounds and Outages	Members of the shutdown or outage teams, planners, plant engineers, maintenance engineers	Save time and money on your next shutdown by learning how to effectively plan for and manage such large projects. Learn processes and strategies for optimal resource allocation.	Aug 7-9, 2018 (CHS) August 6-8, 2019 (CHS)	3 consecutive days 2.1 CEUs	\$1,895
Predictive Maintenance Strategy 	Plant engineers and managers, Maintenance, Industrial and Manufacturing Engineers, Maintenance Supervisors and Managers	Collect and analyze data to assess the actual operating condition. Use vibration monitoring, thermography and tribology to optimize plant operations.	July 31-Aug 2, 2018 (CU) Nov 6-8, 2018 (KU) Apr 2-4, 2019 (CHS) May 21-23, 2019 (OSU) Jul 30-Aug 1, 2019 (CU)	3 consecutive days 2.1 CEUs	\$1,895
Reliability Engineering Excellence 	Reliability Engineers, Maintenance Managers, Reliability Technicians, Plant Managers and Reliability Personnel	Learn how to build and sustain a Reliability Engineering program, investigate reliability tools and problem-solving methods and ways to optimize your reliability program.	Oct 23-25, 2018 (OSU) Feb 26-28, 2019 (KU) Apr 30-May 2, 2019 (CU) Jun 18-20, 2019 (CHS)	3 consecutive days 2.1 CEUs	\$1,895
Reliability Excellence for Managers 	General Managers, Plant Managers, Design Managers, Operations Managers and Maintenance Managers	Build a business case for Reliability Excellence, learn how leadership and culture impact a change initiative and build a plan to strengthen and stabilize the change for reliability. CMRP exam following Session Four.	SESSION 1 DATES: Aug 28-30, 2018 (CHS) Mar 19-21, 2019 (CHS)	12 days total (4, 3-day sessions) 8.4 CEUs	\$7,495
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.	Oct 2-4, 2018 (CHS) Feb 12-14, 2019 (OSU) Mar 26-28, 2019 (CU) Jun 11-13, 2019 (KU)	3 consecutive days 2.1 CEUs	\$1,895
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Contents

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8

THE 5 HABITS OF GREAT RELIABILITY ENGINEERS
Peter Horsburgh

LER Leadership for Reliability

FEATURES

Editorial	5
In the News	6
From a Different Angle: A Perspective	
Nothing Is Wrong, What Are You Going to Do? • By Joel Levitt	58
Q&A with Industry Leader – Dr. Carla Boehl	60
Book Review – <i>THE RELIABILITY LEADERSHIP CONNECTION</i>	
By Jay Shellogg • Review By Joel Levitt	64

ARTICLES

Cr Corporate Responsibility		WEM Work Execution Management	
Bottom Line: Consumers Prefer Companies That Care		Is Wrench Time Worth Measuring?	
Karla Jo Helms	14	Ron Moore	28
Mt Motor Testing		Opx Operational Excellence	
7 Ways to Ensure Better Maintenance of Electric Motors		Back to Leadership Basics	
Jeson Pitt	16	Andrisa Jefferson	32
Rsd Reliability Strategy Development		Ak Asset Knowledge	
How to Optimize Big Data in Factory Maintenance		The Next Industrial Revolution: Transformational IoT	
Jeremy Wright	20	Charles Rathmann	36
Ri Risk Management		Re Reliability Engineering	
Why Is ISO27001 Security Standard Certification So Important?		A Strong Approach to Reliability in the Refinery & Petrochemical Industry	
Tyler Caldwell	24	Marcin Kowalski	40
		AM Asset Management	
		Does Your EAM System Ensure Work Safety?	
		Neeraj Gupta	44



Contents [Continued]

Fa	Fluid Analysis Varnish Mitigation: Effective Fluid Analysis and Varnish Removal Options Riley Mieth and Gene Wagenseller 48
Pi	Performance Indicators Why Maintenance Cost to Asset Value Ratio Is Not a Good Benchmark Binseng Wang 52



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<p>Argo Consulting.....23</p> <p>ARMS ReliabilityInside Back Cover</p> <p>AssetAnalytix 15</p> <p>AssetScan26</p> <p>Banetti27</p> <p>Bentley Systems..... 7, 19</p> <p>Checkfluid*</p> <p>Des-CaseBack Cover</p> <p>Failure Prevention 15</p> <p>Fluke.....47</p> <p>Full Spectrum Diagnostics50</p> <p>Infralogix.....*</p> <p>IRISS..... 1</p> <p>JMS Software 13</p>	<p>Life Cycle Engineers..... 2</p> <p>Lubrication Engineers.....18</p> <p>LUDECA38</p> <p>PinnacleART..... Inside Front Cover</p> <p>PRÜFTECHNIK31</p> <p>Quartic.ai22</p> <p>RelyAssist.....30</p> <p>SDMyers.....51</p> <p>SDT57</p> <p>SKF22</p> <p>Springfield Resources43</p> <p>Technical Associates of Charlotte.....55</p> <p>The UltraSound Institute13</p> <p>Vibration Institute59</p>
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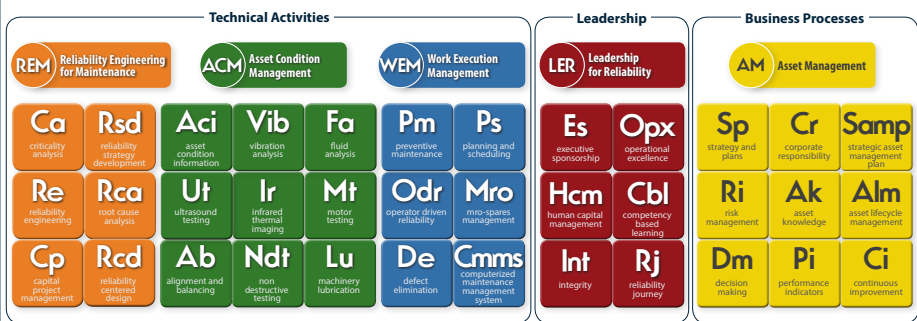
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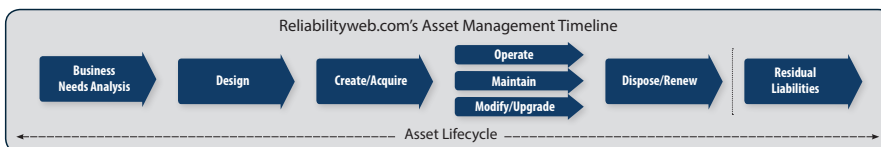
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Uptime® Elements



A Reliability Framework and Asset Management System™



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Uptime® Elements - A Reliability Framework and Asset Management System™ is in use at over 2,500 organizations around the world to engage and empower reliability culture.



IT IS NOT EASY BEING A LEADER, SO GET USED TO IT

TAKE THE
ROAD LESS
TRAVELED
AND LEAD
RELIABILITY.

Summer is one of my favorite times because you can find me hip deep in judging Uptime® Awards. Every year since 2006, *Uptime* magazine has judged over 100 condition monitoring, reliability and asset management programs.

As judges, we learn a tremendous amount about effective leadership, cultural development, competency development, condition monitoring technologies, reliability methods, asset management strategies and, most importantly, people.

Often times, the nominees' reliability leaders tell the story of attending the International Maintenance Conference (IMC) or The RELIABILITY Conference (TRC) for the first time and something inside them changed. That is exactly what Reliabilityweb.com's conferences are designed to achieve.

The common thread shared by each of these programs is the moment when their relationship with reliability was transformed. There was a shift in how they viewed reliability and they "got it." In other words, they saw beyond the technical approaches and got a glimpse of the big picture. At that moment, these leaders took a stand for reliability.

Another way we talk about a stand for reliability is: "What is it that you can be unquestionably counted on for?" What you stand for – that is, what you say your work (or your life) is about and for what you can be unquestionably counted on – is all part of your word.

Within the Uptime® Elements framework, people who give their word, do what they say they will do and are whole and complete are said to have integrity. Performance gains of 100 to 500 percent are possible simply by focusing on promises made and promises kept.

It is not easy being a leader, so get used to it. Being able to choose reliability and stick with your choice is critical to leadership. Start now by being tough on yourself if you find yourself creating reasons or excuses for not really giving your word or saying that it is too hard or not worth it. Those are the marks of non-leaders and people who fail as leaders. This becomes especially challenging during those times when the reliability journey gets difficult or you experience hurdles.

Some people make this reliability journey on their own, however, we find it useful to use a proven framework, like the Uptime® Elements A Reliability Framework and Asset Management System,™ or be part of formal or informal communities of practice, like the Reliability Leadership Institute,® or by attending IMC-2018, December 10-14 in Bonita Springs, Florida, or TRC-2019, May 6-10 in Seattle, Washington. Through these communities, you will discover people who have made the reliability journey, the tools you may need for your own journey and the support network to reinforce your strategy and plan.

Take the road less traveled and lead reliability. We hope you can join us at one of our upcoming face-to-face meetings and that this issue of *Uptime* magazine gets you started on your reliability journey today.

I am grateful,

Terrence O'Hanlon, CMRP
About.me/reliability
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Reliabilityweb.com®
Uptime® Magazine
<http://reliability.rocks>



IN THE NEWS

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Two of Amsterdam's Largest Operations Welcome Reliabilityweb.com

HEINEKEN: #1 Brewer in Europe Opens Its Door to Reliabilityweb.com

Founded in 1864, HEINEKEN® has established itself as the world's most international brewer with over 70 markets globally. Reliabilityweb.com recently had the opportunity to visit with the Global Reliability Team at HEINEKEN's Amsterdam facility. The facility is leading the way with its virtual reality system and using smart technology to monitor their assets. The team is exploring the implementation of the Uptime® Elements Framework into its global reliability journey. Just as one of the business priorities of the company is to "Engage and develop our people," the Uptime Elements allows for an engaged and empowered workforce, providing a common language for reliability.



Learn more about Heineken at www.theHEINEKENcompany.com.

Schiphol Airport Handles Reliability and Asset Management with Care

As one of Europe's busiest airports, Amsterdam Airport Schiphol's reliability team doesn't take their responsibilities lightly. The airport is Europe's top 5 busiest and ranks as the 6th largest in terms of international traffic. With over 65 million passengers in 2017, there is no time for failure or unscheduled downtime in the baggage handling system. Reliabilityweb.com had the opportunity to go behind the scenes to observe how this well-oiled machine operates.



Amsterdam Airport Schiphol 2017 Annual Report: www.annualreportschiphol.com

Reliability and Asset Management Training Symposium a Huge Success!

Reliabilityweb.com hosted the Reliability and Asset Management Training Symposium June 6-7 in Birmingham, United Kingdom, at the National Motorcycle Museum. Over 150 reliability leaders turned out for the 2-day event and enjoyed a special keynote presentation, RAP Talks, short courses and the Certified Reliability Leader workshop. The exhibit hall and reception provided the opportunity for attendees to network and learn about innovative technologies. A special thank you to the event's sponsors: ARMS Reliability, Interloc, IRISS and PRÜFTECHNIK. 2019's event locations and dates will be released in the upcoming months. Visit www.reliabilityweb.com/events for more information.



San Francisco Bay Area AMP Chapter Meeting

The San Francisco Bay Area (SFBA) AMP chapter meeting was held on June 28 at San Jose Water with over 40 participants from many Bay Area companies. The topic was reliability leadership, with special presentations by Nick Jize and several teams from San Jose Water.

The SFBA AMP chapter has been gaining popularity since its July 2016 launch and organizers hope to continue its popularity and growth. The next meeting is scheduled for October 4, 2018, at Lawrence Livermore National Laboratory and the topic is RCM forum.

For more information or to learn how to start your area's local chapter of the Association of Asset Management Professionals (AMP), [contact us](#).

Reliabilityweb.com Launches an Industry First Live Video Streaming Conference

Solutions LIVE streaming leadership conference kicked off its first event June 26th. Sponsored by Women in Reliability and Asset Management (WIRAM), the event featured presentations from women leading the way in reliability and asset management not only in their companies, but the industry, as well. Guest speakers were: Amy Lindblom, Sound Transit; Vestanna McGuinnan, Mars; Laura Phillips, Herbalife; Natalie McMillen, Intel Corporation; Carmen Romero, Bristol-Myers Squibb; Gretchen Gallagher, Interloc; and Jennifer MacKay, Boeing.

These no travel events allow companies and teams to view together, interactively, in work groups without leaving the office. Stay tuned for future dates and times!





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Peter Horsburgh

THE 5 HABITS OF GREAT RELIABILITY ENGINEERS

EDITOR'S NOTE:

The author's fascination with technology dates back to his youth. His father was a blacksmith, an engineer of metal work, and was instrumental in helping the author discover his love of creation through construction. He also passed on his passion for airplanes, which led the author to a career in aeronautical engineering, where he first encountered aspects of reliability. A subsequent career in reliability guided him along a path of confusion, frustration, curiosity, learning and change. Although still going through those stages constantly, they taught the author the five habits presented in this article. Now, those five habits make achieving meaningful change that much easier. They have been so effective, in fact, that it prompted the author to pass them on to *Uptime* readers.



FIRST OFF, THE FIVE DON'TS

The five habits are great successes curated from many failures. However, in order to understand these good habits, you must first understand the bad habits they cancel out.

- 1. DON'T KNOW** – Many problems you are experiencing are ones you aren't even aware of. They're either invisible enough that you don't realize how much time and resources they're costing your plant or organization, or they eventually pop up at the most inopportune times. Good reliability engineers solve problems as they appear, but *great* reliability engineers catch the problems before the problems catch them.
- 2. DON'T UNDERSTAND** – Acknowledging a problem and understanding a problem may sound similar, but they are radically different. Too often, engineers apply a solution without bothering to understand the problem intimately enough to know what would be effective. Just like a bandage won't do much for a venomous snake bite, one has to wonder why some engineers are treating certain issues like minor puncture wounds. Once you think you've solved a problem, it will once again become invisible on your radar, however, when it resurfaces, it could result in greater costs to your company. This is why understanding a problem is so important, because often it will need a custom-made or carefully selected solution.
- 3. DON'T QUESTION** – One noticeable thing about reliability engineers is that they've become too comfortable with the established, unchanging rules. Even if they understand the problem, they'll select a solution from a stale collection. None of the solutions can actually solve the issue, but they've managed to solve everything before, right? Wrong. Reliability engineers must reject routine. The rules in place prevent them from doing their jobs to the best of their ability. They discourage them from searching elsewhere for alternatives that can yield fantastic results.
- 4. DON'T USE DATA** – Businesses are built on data. You've found a problem, you've found a solution and you've found resistance from your superiors and coworkers because you haven't given them a reason to believe that your smashing status quo solution will work. What reason do they have to trust your word? You haven't presented them with facts. You haven't used data.
- 5. DON'T CHANGE** – In any plant or organization, bringing about change is a team effort. It is impossible to achieve change on your own if your changes are going to affect others. Your colleagues might believe your solution could work, but they don't care enough to put in the effort. Passion encourages collaboration, so it is your job to ignite that passion in your workplace to convince them these changes will be positive for everyone involved.



Good reliability engineers **SOLVE PROBLEMS** as they appear, but great reliability engineers **CATCH THE PROBLEMS** before the problems catch them





THE 5 HABITS

Now, let's focus on the five habits that will turn good reliability engineers into great ones.

HABIT 1 – IDENTIFY ISSUES

If you don't identify issues, you might as well be flying an airplane without a compass. Yes, you can look where you are and compare it to a map, but all those green fields look very similar and you will lose your way.

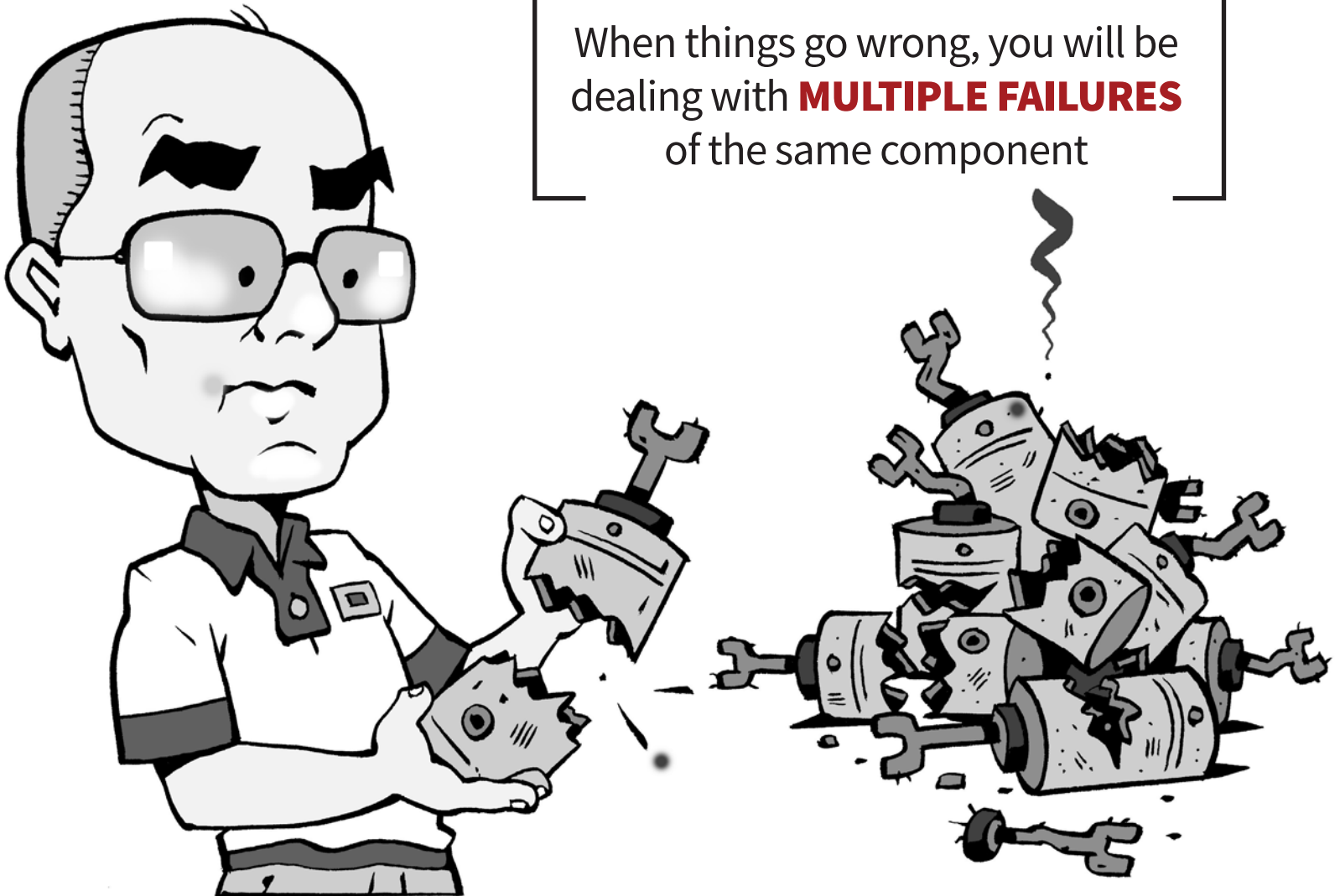
So, why are some issues hard to find? Sometimes, they could be small enough to remain undetected. For example, you don't realize how a small rise in operating temperature that reduces productivity by only two percent each week can add up over a year. Other issues might be apparent, but are seen as natural flaws of the machine. For example, if a machine vibrates itself to bits, you might just think it reached its "best before" date (like how some technology is allegedly designed to break so you'd have to buy a replacement). But really, there's an underlying issue causing the vibration in the first place.

So, what are the symptoms of underlying problems? How do you find them? Here are some questions to start asking yourself:

- Does your plant have unplanned failures?
- Where is the money spent?
- Are production targets being hit?
- Are there any irregularities in the data around:
 - Cost of production and maintenance;
 - Production downtime;
 - Maintenance overruns;
 - Maintenance schedules?

Following these trends and clues will help you hit a gold mine of issues to dig into.

When things go wrong, you will be dealing with **MULTIPLE FAILURES** of the same component



HABIT 2 – UNDERSTAND ISSUES

A pilot might know what the destination is, but might not automatically know the route to get there. Trying to fly an unmemorized route without a compass or map will, most often, result in getting lost, no matter how sure you are of the direction you're going in. Like an airplane that needs to arrive at its destination, a reliability engineer needs a reliable direction. By understanding the issue, it sets a clear direction on where to go.

But, some problems are difficult to understand and sometimes they're easy to misinterpret. Is it a yellow orange or a round lemon? The only way to find out is by cutting it open before you use the zest in a recipe. Sometimes, there are certain undetectable or unfamiliar nuances surrounding a problem, so they can't be easily categorized. Treating a problem as its own distinct thing is something many aren't accustomed to doing.

To fully understand an issue, the most important aspect is to find the root cause. For this, one form of root cause analysis (RCA) is the 5 Whys. The 5 Whys work by simply asking "Why?" five times. Here's an example:

1. Why is the machine breaking? It's vibrating itself to bits.
2. Why is it vibrating so much? It isn't properly lubricated.
3. Why isn't it lubricated properly? The oil is contaminated.
4. Why is the oil contaminated? Because it has water in it.
5. Why is there water in it? Because the containers storing the oil are exposed to the weather.

The solution for this example is to put the containers indoors.

The aim of dissecting a problem is to understand what triggers the chain of events behind it. If you do not address the trigger of the problem, it will happen again. And again. And again. RCA author Dean L. Gano describes it as a "continuum of causes and effects," meaning for each problem, there is a trigger. Then, that trigger has a trigger that triggers the problem you encounter. Addressing the root cause temporarily solves the issue, but addressing every level of it prevents it from happening again.

HABIT 3 – FIND ALTERNATIVES

While reliability engineers may have found many effective solutions to recurring issues at your plant, you'll often find they are unwilling to find and implement alternatives. This is a real shame because they are fencing themselves off from a range of resources that could make things easier for themselves, their colleagues and their plant.

Why are reliability engineers so unwilling to explore beyond their boundaries? One possible reason is the lack of global communications in a consistent language within the reliability engineer community. There is no sharing of lessons learned by other engineers and different languages, terms and definitions are used from plant to plant to describe the same things. For example, you will find people confusing failure mode and failure cause. Some people argue they are the same, while others say they're different. Generally, failure cause is the reason for the failure mode. However, you need to be aware that people think of them differently. You may need to switch from

"cause" to "mode" to be understood. It doesn't matter how you personally define the words, you need to adapt to another's language.

This communication struggle stands in the way of so much valuable potential. Many years ago, Ron Moore, an internationally recognized authority on reliability, manufacturing and maintenance strategies, taught Industrial Roundtable members the enablers of reliability growth: planning and scheduling of work; root cause and defect elimination; and maintenance strategy implementation. Despite the drastic changes in technology over the years, the information is still invaluable and holds relevance today.

There are many more reasons why engineers resist finding alternatives, like how change takes courage and effort. They often don't realize that the effort it takes to implement a change could save a lot more effort later on. Another worry might be that if they ask for help elsewhere, they will appear incompetent at their job. Finally, it is difficult to implement changes in an environment so used to routine and unwilling to take risks.

Reliability engineers who are open to exploring alternatives should search outside the industry they work in. Talk to engineers from other plants, even in other countries. Also talk to people from other departments or young newbies with fresh ideas. A reliability engineer with experience and a reliability engineer with new ideas can make an excellent team if they are willing to listen to each other. Search various groups online, like Reliabilityweb.com and Maintenance.org, to learn how other people have solved similar issues to yours. See what

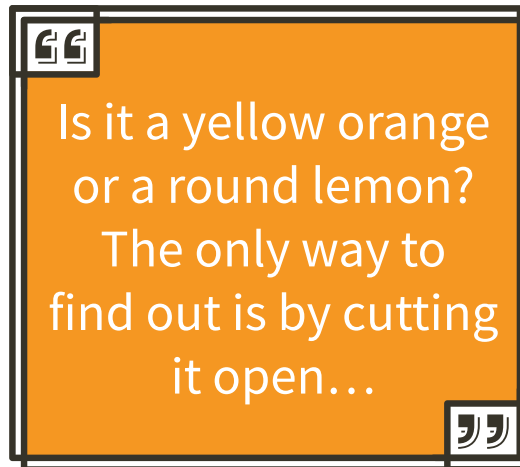
kind of changes people from all around the plant want to see and figure out how to include them within your own agenda.

Alternatives reduce costs and time and effort, encourage innovation and increase efficiency. Given that reliability engineering is becoming a world village, learning from others becomes easier each day. To illustrate, a working tool that automatically formats long text in a computerized maintenance management system was recently developed as a result of two reliability engineers from different organizations discussing a problem and sharing their knowledge. All reliability engineers should be encouraged to learn and form business relationships with others and combine it with their own experiences to become a truly unique force to be reckoned with.

HABIT 4 – DECIDE WITH DATA

Given how integral data is within the reliability field, it is disappointing how many engineers undervalue and ignore it. Data is the most valuable tool at your disposal. It helps you and other people understand an issue and communicate value. Analyzing data helps you find an issue before it finds you. Data justifies the changes and solutions you want to implement to the people who have the power to green light it or work with you. Data also is valuable as a past record to understand a plant's history, which could help solve present issues.

Often times, engineers skip data because it is difficult to find, collect, or interpret. It can take time to gather sufficient data, which seems like it delays the actual solving of the problems. However, launching into an issue without sufficient data to understand it usually results in wasted time and resources. Solutions are found to be ineffective because no one made sure they were the right ones for the job. Without the use of data, a lot of issues pop up without warning and are more complicated to deal with than if they were found and



corrected early on. The absence of data also makes it difficult to justify the actions you want to take to management and/or colleagues.

So, what data should you use to spark change in your workplace? How can you tell an engaging story? Here are some examples for guidance:

- Compare the data to other companies to understand what you are doing better or worse;
- Use past data to show improvements and/or declines at your plant;
- Highlight trends that tie in with what your colleagues have been dealing with;
- Focus on significant events and changes to illustrate the effect they've had on your plant;
- Present a scenario where 50 percent of the issues you experienced went away. Would you have broken a plant record?

HABIT 5 – FACILITATE TO IMPLEMENT

You might have good ideas, but no one else knows how good they are. Having data isn't enough if you can't work with your colleagues to implement changes. You can factually prove that your idea will work, but convincing others to change with you is another story. They're apprehensive, they don't want to be bothered, they're intimidated, they're confused about what role they should play and they are hesitant about asking for help. As the one who wants to implement change, you must not only ignite passion, but provide guidance. Whether it is direct or not, you need to ensure there is a system in place where everyone is confident in their task.

Who do you need to convince to join you on this journey? It depends. Obviously, whoever has the authority to green light the change, but also anyone you need to collaborate with or seek help from in other departments or even potential customers.

Here's an example to illustrate: A company was introducing a new vibration tool that had a live feed. The tool was hooked up to a test rig to measure vibrations. In a meeting, the results were projected on a screen as the presenter described the tool to the audience and suppliers present. When the presenter tapped the test rig, it measured the change and projected it onto the screen. One engineer was so impressed that he asked to give it a try. The presenter agreed and soon others followed in trying out the tool. The conversation quickly turned to how many of these new vibration tools were available and how long it would take to supply this limited stock device to each eager customer. Note how demonstration, engagement and interactivity were the key to success here.

GET IN THE HABIT OF BECOMING A GREAT RELIABILITY ENGINEER

Bad or average habits can be hard to break, but the effort to replace them with good or great habits is a valuable investment of time. No matter how often you catch yourself making the mistakes you were trying to avoid, do not be discouraged. The 5 Habits take many years to perfect, but in the end, you will learn better, faster and smarter.



Peter Horsburgh is Founder and CEO of Reliability Extranet, an online platform providing knowledge, tools, and data for industrial reliability engineers. Mr. Horsburgh has been an engineer for over 20 years, working with plants in the mining, smelting, and power generation industries and has a passion for machine reliability.
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BOTTOM LINE: CONSUMERS PREFER COMPANIES THAT CARE

Karla Jo Helms

In this fast-paced world of meeting deadlines, quotas and targets, one facet of business that can easily get overlooked is corporate social responsibility. (For reference in this article, the corporate responsibility acronym, Cr, from the Uptime® Elements will be used.) It's a corporation's initiative to take responsibility for the environmental and social well-being of the world. Cr generally applies

to efforts that go beyond what may be required by regulators or environmental protection groups.

In a world full of corporations trying to get ahead, there's a social movement toward doing good. Despite tabloids and the entertainment industry portraying the villain of the story as the one who wins, society is actually leaning more and more toward ensuring that the nice guy finishes on top.

Cr has become a major decision point in the purchasing habits of your customers and clients. They want *you* to care about what *they* care about and if you don't seem to care about anything, there's backlash in terms of spending. They'll simply spend their money elsewhere.

Millennials are a wonderful example in showing the importance of Cr for a company. Eighty-five percent of millennials say a company's social re-

sponsibility affects where they shop and buy, and 75 percent of them even donated to a cause within the last year. Before you sneer at the word "millennial," remember that millennials spend over \$200 billion a year, making them a powerhouse in the market. "Participation economy" is something millennials like to witness in the businesses with which they interact.¹ A stellar example of

participation economy is TOMS® shoes, which built its entire business model around social responsibility by matching "every pair of shoes purchased with a pair of new shoes for a child in need." Millennials came running.

Global consumers are keen on Cr, too. Fifty-five percent of global online consumers pay more for products and services provided by companies that are committed to positive social and environmental impact.²

Why are community affairs on a local, regional, national, or even international level an important step in ensuring business viability? Because people *expect* it. It's almost an unspoken moral code within society. The bigger your company gets, the more you're counted on to give back. Consumers want to do business with those companies that are doing good, giving back and enhancing society or the environment.

The real reason for committing to corporate social responsibility is you'll be helping others. (Your company's bottom line will thank you, too).

Aside from attracting more business to your company, there are great benefits to incorporating Cr that go beyond cash value. Common results in companies that put an effort into their Cr include:

- Higher staff engagement;
- Enhanced reputation;
- Competitive advantage among competitors;
- Reduced marketing costs.³

A business can get started on implementing a Cr strategy by first looking at its mission statement. This will often point the way to various nonprofits/charities that align with the statement and lead to a natural progression of aid and support.

Do market research on your clients to find out what they consider to be worthy causes. Anything your clients support will create goodwill if you support it, too, but you must also believe in the cause and legitimately get behind it. Publicize everything you do and grow the human side of your business.

Another approach is surveying your employees to see what they're passionate about—it could be animals, children, the local cancer drive, etc. Inspiring employee involvement is one of the best financially viable actions you can take. This has been proven to increase employee morale, which, in turn, leads to improved customer service, finally culminating in positive brand strength. And, again, publicize *everything* you do—even highlighting your employees in the press goes a long way toward making Cr *everyone's* game.

You can—and should—promote your Cr initiatives via the media. Helping those in need has always been something the media supports and third-party credibility is the acceptable way to promote your good works. But don't forget to also publish your efforts in your own company newsletter. Make it about *who* you're helping, not about *you* helping them. Make whomever you're helping the hero of your story, otherwise, your good works

can take on a self-serving tone. People will always see through non-genuine communication.

While any industry can benefit from Cr programs, certain industries can benefit substantially from such efforts. Any industry where there's a lot of public distrust, low employee engagement and/or high turnover, or reliance on public opinion for their existence can best reap the benefits of Cr programs.

Corporate social responsibility activities strike a chord in the heart of what makes people tick—their ability to help. Those who help are those who lead the human race. Businesses that truly help and then publicize those good works are those businesses that do better than others. It's like business karma and it's a growing trend in the marketplace.

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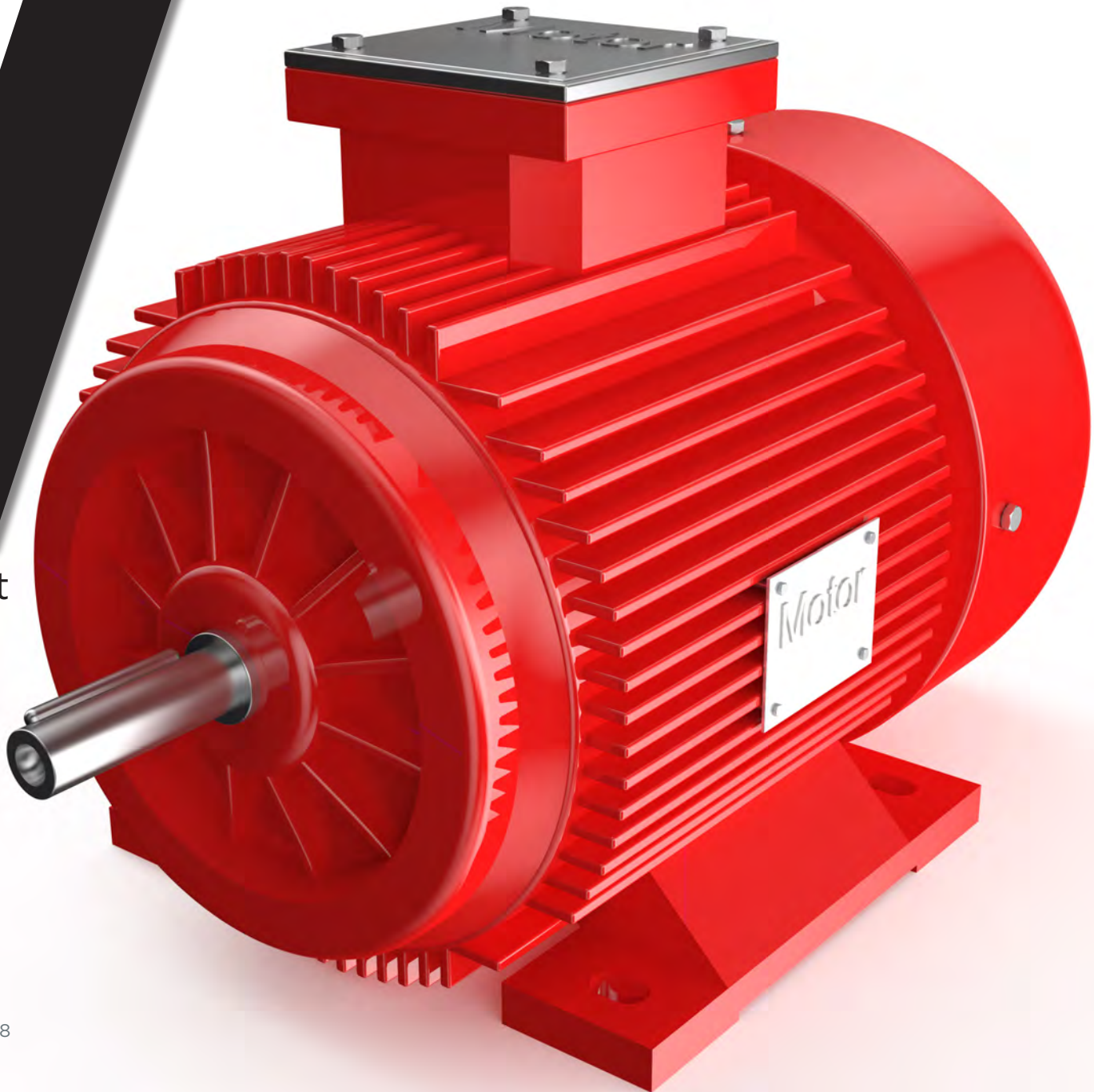
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WAYS TO

ENSURE BETTER MAINTENANCE OF ELECTRIC MOTORS

Jeson Pitt



Electric motors may look like any other electrical component, but they have a massive impact on the company's profitability and productivity. As such, it is critical to perform regular preventive maintenance checks on electric motors¹ to ensure they always perform at their peak.

For starters, prepare a checklist that focuses on examining and monitoring the motor and electrical wiring. This allows you to detect and identify potential problems that the motor may face and lets you address these problems ahead of time. This will drastically bring down unexpected repair expenses.

**HERE ARE SEVEN TIPS FOR BETTER ELECTRIC MOTOR MAINTENANCE.
BE SURE TO ADD THEM TO YOUR CHECKLIST.**

1. PERFORM VISUAL INSPECTIONS

A quick visual inspection can reveal some important details about the electric motor. Take a look at its physical condition and record your observations. If the electric motor operates in a rugged environment, you will see signs of corrosion and dirt buildup on individual components. Observe the motor's windings to detect any hint of overheating, such as a burnt odor. Ensure relays and contacts are dust-free and aren't rusted. All these factors may cause an internal problem as the debris may pose a threat to the efficient performance of the equipment.

2. PERFORM A BRUSH AND COMMUTATOR INSPECTION

Regular maintenance checks help ensure that electric motors won't experience inconsistencies or stop working abruptly. Look for signs of wear and tear; any hint of excessive wear leads to commutation problems with the motor. This means you need to change the brush in order to regain the integrity of the equipment's function. Also keep a check on the commutator to ensure it doesn't have any dents, grooves, or scratches. These rough spots indicate brush sparking. Additionally, inspect the motor mount, rotor, stator and belts thoroughly. Replace all worn out parts.

3. CONDUCT A MOTOR WINDING TEST

Once you have inspected the various machine components, you need to test the motor's windings. This test helps you identify any anomalies or failures in the windings. If you see any burn marks or cracks or smell a burning odor, conduct a mandatory motor winding test. The test involves disassembling the motor to determine the abnormalities of the motor. If the windings are overheated, the chance of serious damage is higher. Rewinding the motor and testing the wind insulation, which reveals information on the resistance level, are also critical parts of the test.

4. CHECK THE BEARINGS

Check the bearings for noise and vibration as they indicate potential problems, like poor lubrication, dirt buildup, and wear and tear. If the bearing's housing is too hot to touch, it may mean the motor is getting overheated or there is an insufficient amount of grease. The maintenance requirements for bearings may vary, depending on where the equipment is situated. You need to be aware of the different kinds of bearings being used in the plant and what their repair requirements are.

5. PERFORM VIBRATION TESTS

Sometimes, excessive vibrations are difficult to detect manually. But, if not detected on time, vibration can reduce the life span of an electric motor, which then eventually leads to motor bearing failure or failure of windings. In most cases, the cause of vibration is mechanical in nature, such as a faulty sleeve or ball bearings, too much belt tension, or improper balance. The electric motor can be tested by removing the belts or by disconnecting the load and then operating the motor. Sometimes, even electrical problems can give rise to vibrations. A few tests, such as field vibration analysis that is conducted by mobile instruments that measure exact frequency and amplitude of vibrations, can help in detecting the exact cause of vibrations.

6. USE INFRARED THERMOGRAPHY IN PREDICTIVE MAINTENANCE

Recently, this method of inspection has become popular with predictive maintenance due to its desired outcome. With infrared thermography, an infrared camera is used to capture thermal images without interfering with the motor's operation. These images provide a temperature profile of the electric motor by giving heat patterns at several points throughout the motor simultaneously. All mechanical systems produce a particular amount of thermal energy, therefore, they have normal thermal patterns along with a maximal temperature at which the motor can work. In case any problem exists, such as insufficient air flow, insulation failure, or degradation in the stator, the infrared camera will immediately detect the unstable voltage in the form of a thermal image, helping you find its cause and solution.

7. DOCUMENT EVERYTHING

Documentation is extremely important. Keep detailed records of all preventive maintenance schedules, tests performed and their results. Maintain records of all repairs and replacements, as well. Doing so allows you to have a better understanding of the equipment, identify which issues need to be addressed, or determine which parts have to be replaced or repaired. Your records also will be helpful for future audits and inspections.

“...Prepare a checklist that focuses on examining and monitoring the motor and electrical wiring”

DOCUMENTATION IS EXTREMELY IMPORTANT

Precautions to Take While Performing Maintenance Checks

- ✓ Only assign electric motor maintenance tasks to those individuals who are well-trained in handling electrical components. Those who perform this task need to be aware of hazardous situations.
- ✓ Qualified personnel who perform maintenance checks should be equipped with protective gear, along with dielectric tested gloves and approved electrical test devices.
- ✓ Employees must make sure that pulleys and belts are in proper alignment and ensure operating parts are moving easily and without excess friction. Contactors and relays can be checked by hand for binding and sticking parts.
- ✓ Employees must be encouraged to regularly perform a maintenance task that keeps their surrounding environment dust-free and clean to avoid creating an unwanted path for electric current to flow.

To ensure better maintenance of electric motors, all maintenance procedures and tests should be conducted systematically in order to pinpoint potential problems and correct them before they result in undesired downtime.

This approach not only improves the motor's operation, but also increases its life span.

Different electrical materials² have different maintenance requirements, so regular inspections must be scheduled per their needs. With electric motors, it's a matter of understanding what they need and implementing those measures to enhance their productivity and the company's profitability.

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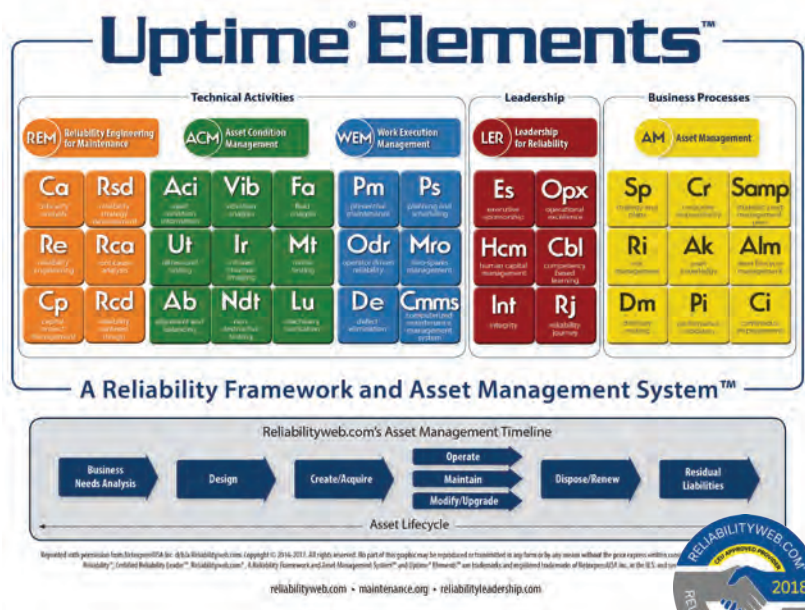
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How to

OPTIMIZE BIG DATA

IN FACTORY MAINTENANCE

Jeremy Wright

If you work in any aspect of manufacturing today, there is no doubt you are aware of a significant revolution underway. It is a new era for the industry, dramatically evident when you take a look around any reasonably maintained and updated manufacturing facility. It no longer reflects the “gritty side” of the industry: dark, dirty and dangerous oversized rust belt garages that are dreary to visit, let alone work in. Instead, most forward-thinking facilities today are clean, bright and efficient workplaces that use, or are starting to use, some of the most cutting-edge technological advances available today in order to get ahead of the competition.

What is driving this revolution, albeit a slow industry shift from a machinery-based environment to an information-based one? Quite simply, it's technology and the big data that results from it.

THE BIG DATA REVOLUTION

In simple terms, big data can be defined as very large quantities of information that can be analyzed. This analysis, in turn, reveals patterns, trends and relationships among processes and can be invaluable as a basis for strategic decision-making moving forward.

When it comes to maintenance, big data can be highly valuable, thanks to the increasingly sophisticated technology tools available that take advantage of the Internet of Things (IoT) and generate those large amounts of data that are so ripe for analysis. Examples of these tools include oil analysis, thermography, motor current analysis, vibration testing, sonics/ultrasonics and highly sophisticated computerized maintenance management systems (CMMS) that involve failure coding and investigative guidance.

The use of these tools to generate valuable data is the foundation of any modern manufacturing organization's predictive maintenance program, which, in turn, paves the way for that organization to reap the significant benefits that a modern approach can bring.

FROM BIG DATA TO PREDICTIVE MAINTENANCE TO BIG REWARDS

Big data facilitates predictive analytics, which then make way for a shift from merely diagnostic maintenance work to activities that are more prognostic in nature. That shift is huge. It moves the needle that much closer to working proactively rather than reactively. That, in turn, leads to improved

reliability, greater efficiencies, increased productivity and a myriad of other advantages that translate into a significantly healthier bottom line for the entire manufacturing organization.

Big data can do all of that. But, it's not easy.

BIG DATA, BUT NOT BIG EASY

At first glance, who can argue with having more data to drive more informed decision-making? No one. But in real life, managing all that data can be challenging and overwhelming, especially in the initial stages of implementation. Modern psychology confirms that the more one learns about a subject, the harder it is to make a decision about it. Some ways to overcome this issue in a predictive maintenance setting include setting criteria for decision-making up front and religiously focusing on only utilizing data that is relevant to that particular decision. Also helpful is implementing systems and programs that make decisions very binary, setting limits for specific actions. Then, all that's left to do is stick to the rules of the program.



Big data facilitates predictive analytics, which then make way for a shift from merely diagnostic maintenance work to activities that are more prognostic in nature



Another challenge to getting the most out of big data is that maintenance organizations tend to be resistant to change. It's a cultural issue and a natural reaction to a relatively new and unknown world: all of this highly sophisticated technology that's coming from who knows where? Convincing longtime workers with ingrained habits and skills to change practices based solely on data derived from a white-collar desk dweller is tough. The good news is maintenance employees, for the most part, tend to be loyal and trust-driven in nature. They want the company to succeed just as much as the leaders at the top do. Over time, when implementing new programs and procedures related to big data and choosing new hires accordingly while upskilling existing maintenance workers to address cultural and procedural shifts, attitudes will adjust and trust will be earned. This is especially true when maintenance teams start seeing and benefiting from massive benefits firsthand.

One of the biggest hurdles to implementing these types of changes is it can be expensive. This bottom-line sticker shock is reflected in the extra resources and up-front investment required to number crunch data and start to use it to analyze how it might best apply to existing practices, all way before any inkling of cost-saving benefits come into play. In today's competitive market, it is extremely hard for most companies to make this kind of time and financial investment when facing only the *promise* of a rosy future where everything's improved. To combat this challenge, organizations should seriously think about and identify what systems and processes are most relevant to their immediate business and customers, and then implement changes that relate to managing and analyzing only that information relevant to those issues. With this focus, big data can begin to be used on a limited basis to im-





...Managing all that data can be challenging and overwhelming...



prove internal processes, from production schedules to standard procedures, then eventually into predictive maintenance.

As the amount of data increases, companies with legacy IT systems will be likely challenged along the way. The good news is that highly attractive solutions in the form of advanced IT systems are continuously becoming available and improved upon. It's just a matter of determining the right time to pull the trigger on implementation to start reaping the rewards.

FOCUS, ATTITUDE, PATIENCE

There's no doubt that technology advancements have ushered in a revolution in the manufacturing industry. Big data and the predictive maintenance

it drives -- and the big rewards that come from all of that -- is evidence that this revolution is only getting started and the smartest companies will get fully on board as the engine gains steam. With a focus on using the right data for the right decision, companies can combat the overwhelming nature of it all. With a nod to cultural implications of technological change and a little assistance with attitude adjustment, companies can overcome any resistance from their teams. And, with a lot of patience toward realizing solid payoff from a significant investment, companies can systematically modernize, improve and streamline their maintenance processes, thus optimizing big data and making their way to the top of the list of world-class manufacturing organizations already happily humming along today.



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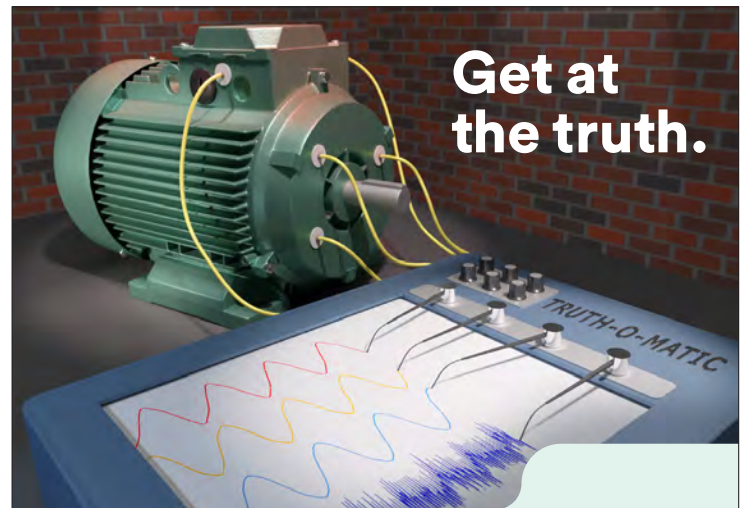


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WHY IS

ISO27001

SECURITY STANDARD CERTIFICATION SO IMPORTANT?

Tyler Caldwell

ISO27001 is a quality standards specification for information security management systems (ISMS). The ISMS is an overall framework that encapsulates business procedures and policies pertaining to the control of a company's information security risk management processes. It covers physical, technical and regulatory controls.

The stated goal of ISO27001 is to "provide a model for establishing, implementing, operating, monitoring, reviewing, maintaining and improving an information security management system."

ISO27001 implements a six-part planning process, as shown in Figure 1.

The ISO27001 specification covers management responsibility, documentation, continual improvement, internal auditing, as well as corrective and proactive action. It is an enterprise-wide specification, with all business units falling under its mandate.



Figure 1: Information security management system planning process



Figure 2: Security issues ISO27001 addresses

“ At all times, companies should adhere to the three key requirements for all customers’ information assets: **CONFIDENTIALITY, INTEGRITY AND AVAILABILITY** ”

Information Security Issues and How ISO27001 Helps

ISO27001 provides a feature-rich specification for solving many common information security issues. Key information security issues addressed by ISO27001 are:

- Compliance to stringent regulations by providing a governing framework for the management of security risks pertaining to information security, thus ensuring compliance.
- Data breach protection by forcing the identification of risks, as well as implementing procedures designed to detect security breaches. This can be accomplished by following an iterative security program that is regularly reviewed and revised to improve the effectiveness of an ISMS.
- Information availability by making data available when it is needed through secure processes that put information security first.
- Improved information security risk management that provides a framework for identifying risks to information assets and implementing the right technical and management controls. Due to the fact it is a risk-based doctrine, information security is achieved in a more efficient way.

- Meeting customers’ expectations by demonstrating a company’s competency in managing information security risks. ISO27001 is a recognized standard specification that will be instantly recognized and understood in tenders and proposals.
- Raising the awareness of information security in the enterprise, as senior management sponsorship demonstrates the seriousness of certification to the workforce. Staff training and awareness is a key facet of certification. Information security management systems are defined and key employees are given specific responsibilities. These responsibilities are monitored and measured to ensure adequate performance at all times.

Why Should Companies Take on the Challenge to Achieve ISO27001 Certification?

Customers expect companies to protect their information in a diligent manner. At all times, companies should adhere to the three key requirements for all customers’ information assets: confidentiality, integrity and availability.

Having full ISO27001 certification demonstrates very clearly to customers that the company

understands the issue of information security and continually strives to prove it is a safe and secure haven for their data assets.

How Does ISO27001 Certification Allow Companies to Better Position Themselves?

Achieving ISO27001 certification delivers a number of benefits to companies with regard to the image they can promote. Certification shows that a company is diligent in matters of security, not simply relating to the internal controls, but also in the management system it has built.

This system encompasses every member of the team, from the CEO on down. Every employee receives awareness training and there are physical and administrative controls in place to ensure policies are followed. The entire company has a role in security within this system.

How Difficult Is It to Achieve ISO27001?

The first year of certification is the most difficult. In the first year, the initial challenge of building controls and developing documentation needs to be overcome. In many cases, companies

“This is the underpinning foundation of ISO27001 – identifying risks and deciding how to treat them”

have a lot of processes in place already that need better structuring and have to be documented.

Companies also may need to tackle the risk management aspects of certification. This is the underpinning foundation of ISO27001 – identifying risks and deciding how to treat them.

How Do Companies Maintain ISO27001 Certification?

The aim of ISO27001 is for a company's security program to not remain stagnant. The standard promotes the constant refinement of the security program, improving upon it year on year.

For example, as part of the initial certification process, a company identifies risks to information security. The company then sets a risk level it feels is acceptable. Going forward, the company's aim is to lower that risk level each year as its security program matures.

The key challenge for companies is to continue to identify new risks, as well as manage those identified risks better, with greater granularity,

while improving its overall security program by adding new controls and developing new security processes. At the same time, companies must make sure employee training and awareness are maintained.

Why Is Security So Important in the Context of Cloud Computing?

Cloud adoption has been a major trend for several years now, however, one issue that is holding back late adopters is the concern of security, especially for those companies who use third-party providers. Companies require their critical operational data to be highly secure and can be apprehensive about moving their data to the Cloud. As such, companies should look for ISO27001 certified third-party providers who can not only meet their requirements, but exceed their expectations.

Most companies typically have their own IT infrastructure and their own security processes. These applications are typically installed within

on-site data centers that are oftentimes mistakenly considered to be highly secure. Many times, they are legacy security systems securing the aged infrastructure. However, companies that become ISO27001 certified have the benefits of a certified security program when moving their information assets to a cloud solution. It is a security program that will mature and become more effective every year and keep up with the latest technology and security threats.



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Tyler's team ensures
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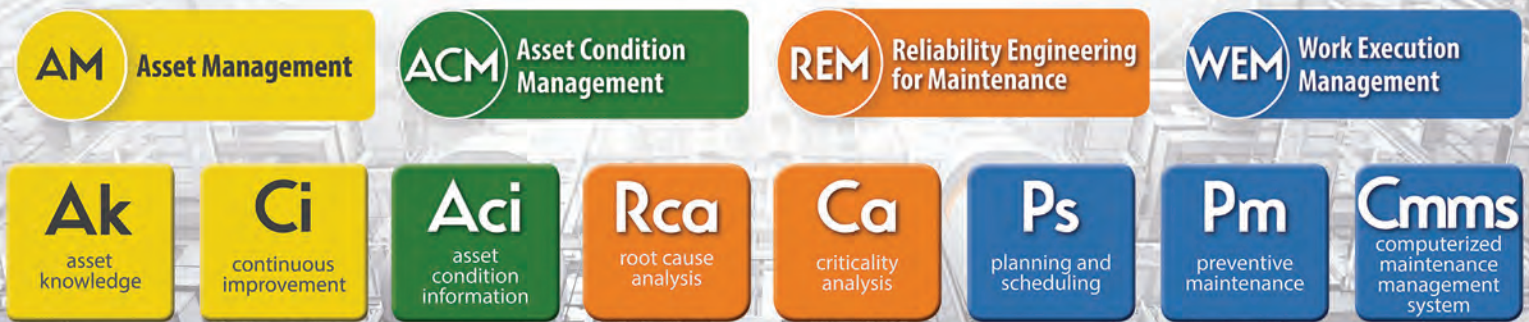


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IS WRENCH **TIME** WORTH MEASURING?

Ron Moore



Wrench time, or tool time as it's called in some countries, is an often touted measure for determining maintenance productivity since it's intended to measure the actual time technicians spend working with their tools at a given job. Typical numbers observed are 25 to 35 percent, meaning technicians typically spend 65 to 75 percent of their time not working or, at least, not getting the work assigned done. Is this a valid measure or conclusion? Is it useful to measure wrench time? The answer is yes, if properly done, as well as a resounding no, if not properly done, which happens more often than not!

Measurement Techniques

There are two basic ways to measure wrench time. One is work sampling, wherein an analyst with a clipboard and a chart broken into 10 to 15 minute intervals observes technicians and determines whether or not they are working on the job. Not working typically has to do with traveling to and from the job site; waiting for parts, permits, access and tools; waiting for start-up checks; and taking part in other activities, such as receiving assignments and instructions, taking breaks, going to training, closing out work orders, attending administrative meetings, or anything else where actual work on the job is not being done. It's important to understand that most, if not all, of these activities are or can be essential, but the key is to minimize the amount of time on these activities, while maximizing the time for getting a quality job done.

The second technique is a day in the life of (DILO) a maintenance technician or operator. This approach tends to be more enlightening because you spend more time talking with the technician and getting a much better understanding of the day-to-day obstacles and frustrations.

DILO Case Study

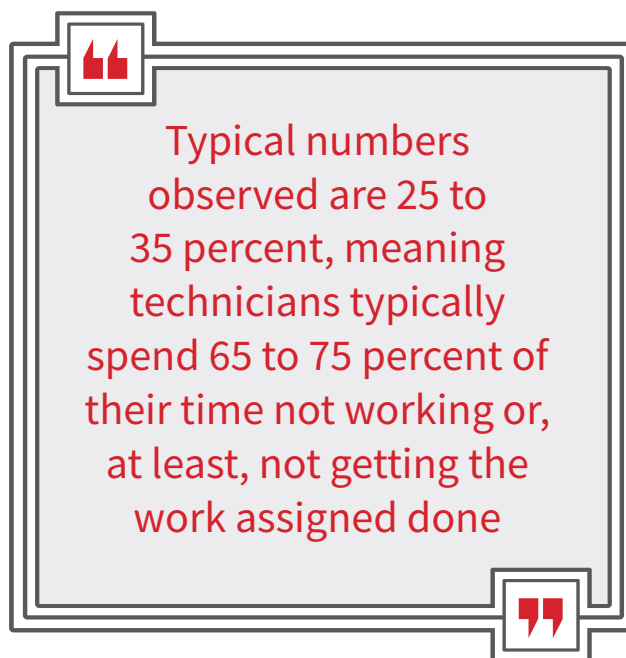
At a power station in the United Kingdom, a reliability consultant planned a DILO with a maintenance technician (called a "fitter" in the UK). Upon introductions, it was clear the fitter was suspicious of the consultant. The fitter asked numerous questions, among them: Why is that? What do you intend to do with your observations? Will I get to see them? The technician was assured that the consultant would NOT be checking to see if he was working, but rather looking for things that were stopping him from working. While the consultant was confident the fitter and all his mates wanted to do a good job, the focus of the DILO was on answering the question: What was preventing that from happening?

This is a critical point in measuring wrench time. If your objective is to see if people are working, they will become very suspicious and not be very cooperative. Indeed, they will be fearful of your objectives. On the other hand, if they view the process as being one to help eliminate their frustrations and obstacles, they will be far more likely to cooperate and be very helpful. Far too many people do work sampling with a view of checking on whether people are working instead of looking for the obstacles that prevent the work from getting done.

At the UK power plant, the maintenance technician stood and waited for about 15 minutes for a work order with his job assignment. He finally received the work order from his supervisor, which directed him to replace the gasket on a filter of a ball mill. Its function is to pulverize coal before it gets blown into the boiler. Of course, the job required a gasket, so the technician, along with the consultant, went to the storeroom, which, fortunately, was nearby. The two stood in line for another 15 minutes. After receiving the gasket, they traveled to the mill, taking another 10 minutes. On arrival, the mill was running, so the gasket couldn't be changed. They then went to the control room and asked about shutting down the mill. This required a permit and the machine to be shut down, locked out and tagged out. This took another 45 minutes. All the while, the fitter and consultant were waiting.

The consultant asked the technician if this happens often. He responded, "Most every day."

When the fitter finally had access to the mill, he proceeded to remove all the bolts holding the gasket in place. The consultant even helped with an extra wrench he had, which was much appreciated. This took about 10 minutes. Unfortunately, the storeroom had given the fitter the wrong gasket, so he and the consultant returned to the storeroom, with measurements in hand, and finally received the correct gasket. Another 30 minutes had passed getting the correct gasket. The maintenance technician then put the correct gasket on the mill. This took about 10 minutes. Next, he and the consultant went to the control room to get the mill restarted, which dictated that an operator had to untag, unlock and restart the mill so the fitter could check the gasket to make sure there were no leaks.



The operator went through the process, but as soon as the mill started, it tripped. He opined that he hadn't started the mill in six months and went to get the start-up procedure. On returning, he observed that he hadn't shut (or opened) a valve that should have been. Once he followed the procedure, the mill started right up and, fortunately, there were no leaks. However, another hour had transpired while waiting for the operator to start up the mill. Finally, the job was over and the fitter and consultant headed back to the supervisory area to close out the work order. Another 15 minutes transpired. Then, they went looking for the supervisor to get another work order, which took another 15 minutes. This time, the work order was to change the gasket on a steam line. Needless to say, the fitter had to go through the same process for this job.

During the DILO, the fitter did 20 minutes of actual work, meaning wrench time or tool time, but about 3 1/2 hours passed getting this done. Wrench time was about 20 minutes divided by 210 minutes total time spent, or about 10 percent. Should the technician be fired for working only 10 percent of the time? Clearly not. What should be done to improve his day? Planning and scheduling would help – assignments are done on the day prior. Planning would include coordination for permits and making sure the right gaskets are specified. Planning that included kitting the gaskets and placing them in a staging area would also help. Having the operator actually use the start-up procedure also would help.


Note that other non-wrench time, such as training, administration, breaks, etc., is not included in this tiny case study.

“ The consultant asked the technician if this happens often. He responded, “Most every day.” ”

Conclusion

Measuring wrench time can be a very effective means of improving productivity if it is done with a focus on removing the obstacles and frustrations that prevent the work from being done efficiently and effectively.

Wrench time should never be used for checking to see if people are working. It's important to assume that people want to do a good job. You have to help them be able to do that and not blame them when they don't. If you want to understand the problems with getting the work done, ask the workers and work with them to resolve or mitigate those problems.



Ron Moore is the Managing Partner of The RM Group, Inc., Knoxville, TN. He is the author of the books, *Making Common Sense Common Practice - Models for Operational Excellence*, 5th edition; *What Tool? When? - A Management Guide for Selecting the Right Improvement Tools*, 2nd edition; *Where Do We Start Our Improvement Program?*; *Business Fables & Foibles*; and *Our Transplant Journey: A Caregiver's Story*, as well as some 70 journal articles.

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BACK TO

LEADERSHIP

BASICS



— Andrisa Jefferson —

With so many advancements in world-class technology, many maintenance leaders have failed to set a strong leadership foundation. All too often, they get distracted with starting predictive maintenance and oil analysis programs because these are the hot topics and buzzwords. Instead, maintenance leaders, prior to doing anything, must first gauge what their organizations need and set goals to achieve them. Everyone in an organization knowing what is expected of them and working toward one goal of success is much more valuable than any latest or greatest program. This article pinpoints the basic leadership skills for establishing a maintenance leadership role. The type of leadership role can vary from manager to reliability engineer to predictive maintenance leader. However, the main focus is to lead others to get results.

STEP 1

OBSERVE YOUR SURROUNDINGS (WHAT'S NEEDED?)

If you start by observing the root of problems to determine what your organization truly needs, it's practically impossible to fail. To determine what's needed, don't start by changing everything and telling everyone about your previous work experience and many accomplishments. Start by observing what currently works and doesn't work. Determine the daily challenges that your team faces. Determine what resources are needed to eliminate or improve those challenges.

Most likely, you will find such problems as a lack of capital investment, a poor safety environment, a shortage of labor, or a lack of leadership and mechanic accountability. Keep in mind that gaining leeway for more manpower or a new large capital investment will be a harder sell during your first year because these things require capital or period investments outside of your current account budget. Large investments are important, but focus initially on smaller issues, such as resolving lack of leadership, poor management and accountability. These areas are where you can easily gain the most respect from your manager and team members, which will make you more trustworthy for receiving large, future return on investments.

Most importantly, you must gauge the ability of your team. How you utilize your talent will make or break your success. Oftentimes, people are placed in roles that aren't a good fit for them, resulting in the task being more challenging and time consuming than it has to be. Some people are extremely hands-on or self-doers, while others are stronger when leading others. Some are highly organized, while some will never be interested in the 5S methodology. Thus, focus on moving people out of wrong areas and getting them in areas where they can succeed.

While observing, keep in mind that feelings aren't facts. Just because someone frequently complains about an issue doesn't mean the issue really exists. For example, if the overall production impression is low maintenance productivity, you have to determine if that's subjective or a fact. You need to know how work requests are gathered and collected. If work orders are requested by shoulder taps, then fix the poor work order processing issue. Or, if your customer relationship management (CRM) system is used to process work requests, but you observe the work is not processed quickly enough, then attempt an adjustment of manpower allocation. Or, if there are numerous work requests resulting in an enormous backlog, it is best to involve production to select the work. Then, at least they know where manpower hours are going, resulting in their knowing what maintenance is servicing. Or, it could be that your mechanics don't have a good preventive maintenance (PM) program and are spending too much time on emergency work. That doesn't mean they're not doing anything, but too much firefighting time can result in too many unprocessed work requests.

These examples result in an unsatisfied production customer and leave a perception that maintenance is unproductive. But, in reality, maintenance teams are working, but not in an efficient work order, processing environment.

Where is most of your workforce time allocated? What percentage of time does the department allocate to emergency versus scheduled work? How are work requests gathered and collected? These questions should be considered to complete your observation.

STEP 2

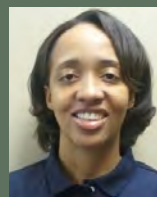
SET GOALS TO GRAB THE LOW-HANGING FRUIT

Some managers think of goal setting as an unnecessary soft skill. Their plan is to just fix everything. This mentality can quickly send the organization down the path of destruction and inefficacy. A maintenance methodology is complex; you can't address everything at once. Just focus on the things that can be easily accomplished. Pick items you're familiar with so you can complete them faster. Set goals for what's reasonable according to your staffing and funding. For example, establish 5S lubrication areas, simplify the work order flow process, hold people accountable, reduce vendor spending, or supervise those who need it. Have at least one safety initiative, such as arc flash protection, personal protective equipment (PPE), lock-tag-try (LTT), lighting, etc.

Have each member of your staff set one to two continuous improvement/project goals that each agrees is reasonable to accomplish within the year. It should be something the person has a special interest in. Most likely, your staff members already have projects they wanted to complete, but just didn't have the time or management support. You can set one goal for you, but most of your time should be spent utilizing your strength in numbers by following up and supporting your team goals. Within the first year, you will be observing a lot, so grabbing the low-hanging fruit at the same time is key.

There is a difference between job responsibilities and goals. As a leader, you must identify employees' job roles first and then determine the remaining available time for projects/goal initiatives. If you don't clearly communicate an employee's job role and what is expected, you will experience confusion and frustration in your work environment. If employees have several daily tasks that occupy their time, avoid giving them a lot of project work. For example, if your planner has numerous backlogged orders, it wouldn't be good to add three new projects. Instead, the planner would be better served with a continuous improvement initiative pertaining to his or her current job, like starting a job kitting station, daily tracking of schedule completion percentage, or updating a bill of materials (BOM) that the planner hasn't been able to complete.

If you observe underutilized mechanic hours, this must be addressed. Mechanics should not be idle because they currently don't have emergency work. You have to schedule their work. If not, this will be the area where you waste the most money from underutilized manpower. If you currently don't have a large number of backlogged work requests, this would be a great opportunity to create continuous improvement work requests. The requests could be focused on the mechanic reviewing and editing equipment BOMs; modifying PMs; creating and editing task lists for PMs; 5S work areas; reading or reviewing equipment manuals for faster troubleshooting; and modifying lockout-tagout tasks.



Andrisa Jefferson has diverse experience with managing projects in quality, energy, maintenance, and production. She worked for Pfizer as a maintenance supervisor and was an energy site leader and maintenance supervisor at the Ohio-based Owens Corning asphalt plant. Andrisa is a certified Level I Machinery Lubrication Technician and has held a certified Six Sigma green belt since 2007.



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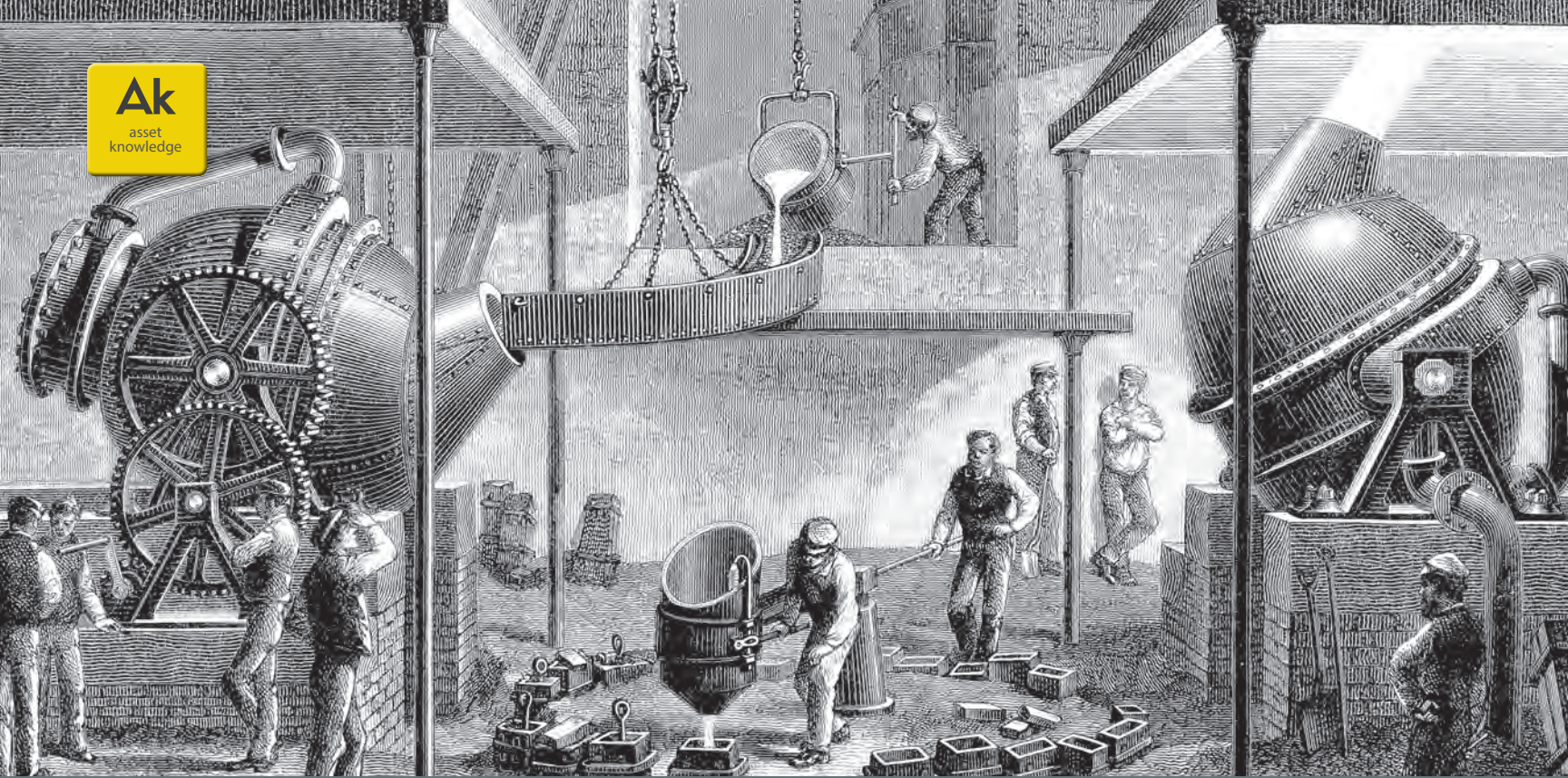
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THE NEXT INDUSTRIAL REVOLUTION:

Charles Rathmann

The Internet of Things (IoT) has its roots in manufacturing and industrial companies. As consumers are just beginning to look for IoT-driven thermostats to turn down the heat when away from home, manufacturers are already moving IoT off the plant floor and into other settings where it can transform their business.

When referring to IoT in a manufacturing context, it often means technology that has been heavily used since the 1970s. Electrical engineer Dick Morley led the revolution toward industrial automation by introducing the programmable logic controller, the core technology on which most modern manufacturing technology is built.

Next Step: Using That Data

Programmable logic controllers (PLCs) and more modern alternatives, such as Ethernet I/O modules or proportional control devices, enable centralized control over machines and communication between one machine and another. This machine-to-machine (M2M) communication is the driving force behind industrial automation. These networked machines are often connected to a centralized system, like supervisory control and data acquisition (SCADA). Apart from sending instructions to the machines, SCADA and other centralized technologies may gather data on machine performance and process faults to enable more proactive maintenance, diagnose problems and drive business intelligence dashboards.

However, with technologies, IoT data is still largely consumed on the plant floor. But, in order to truly transform business, IoT data must be shared outwards beyond just M2M or technicians on the plant floor or in the field. It must be made available to executives to support decisions and trigger business processes in transactional systems, such as enterprise resource planning (ERP), driving automation and efficiency in key processes.



TRANSFORMATIONAL IOT

Lifting IoT From the Plant Floor

According to an IFS primary research study¹ of 200 IoT decision makers within industrial companies, about 85 percent of them collect data from sensors on their equipment or equipment they install at customers' sites. Most use this data for condition-based maintenance (CBM) or industrial automation, but only 16 percent have integrated data from these connected devices with ERP software, the transactional backbone of the company. Only a few more can view IoT data in asset performance management software, which helps executives manage the total value produced by and cost of operating capital assets. The transformative value of IoT is, in many cases, still restricted to the plant floor.

Closing the IoT Enterprise Gap

While industrial automation and smarter maintenance are desirable, the people making decisions about the direction of the company are cut off from real-time data and, therefore, have no ability to use IoT to opera-

tionalize their decisions. So, companies that are intent on using IoT data to influence their operations at a fundamental level, driving significant change through digital transformation, will need to figure out a way to close this IoT enterprise gap.

IoT CBM Already Closing the Gap

Condition-based maintenance, when done right with IoT, has the potential to deliver digital transformation benefits.

According to Ralph Rio, vice president of enterprise software at ARC Advisory Group, "study data suggests that the most common use case for IoT in these industrial settings is condition-based maintenance. The benefits go beyond operational improvements and maintenance cost avoidance. It increases uptime that provides additional capacity for increased revenue. It also avoids unplanned downtime that interrupts production schedules and causes missed shipment dates and customer satisfaction issues. When married to demand and scheduling systems in ERP, IoT becomes a revenue enhancement tool improving the top line."

“ Machine-to-machine (M2M) communication is the driving force behind industrial automation ”

Taking CBM to the Next Level: Analysis Going Forward

In addition to monitoring the performance of individual pieces of IoT-enabled equipment, manufacturers can collect data from all their equipment to produce large data sets that can be aggregated, analyzed and modeled. This accumulation of performance and reliability data enables comparisons of individual pieces of equipment with others of the same model and type.

Comparative data helps service providers identify individual units that are operating outside the norm so corrective action can be taken proactively. The accumulation of this data allows engineering, manufacturing and service providers to identify product quality issues that can be corrected in future versions of the product or corrected for existing equipment through the creation of field upgrades and engineering changes.

A predictive maintenance strategy needs software that facilitates the analytics and modeling of all the data gathered from IoT devices. The new generation of ERP software solutions are designed with this level of device connectivity and future technology in mind, making it possible for organizations to implement predictive maintenance and improve efficiency – ultimately benefiting a manufacturer’s bottom line.

Taking Transformational Steps: Witness IoT and Field Service Management

The IFS survey had a weighty sample of industrial manufacturers, HVAC contractors and automation companies, some of whom are monitoring equipment they sell to their customers to support aftermarket services. According to the study, they are focusing these efforts on individual components in a machine that may be mission critical or prone to failure, or the equipment health of an individual machine rather than an entire installed system or asset.

Relatively few used IoT to capture data from service vehicles or devices carried by technicians, suggesting a disconnect between condition monitoring and service execution. Only by taking the next step and integrating with enterprise software will these service organizations be able to reap the real benefits of IoT and automate response to equipment fault data or provide to customers an analysis of system performance against service level agreements (SLAs).

Gaining the Competitive Edge With Digital Transformation

In the IFS survey, between 30 to 40 percent of digital transformation and IoT leaders reported that IoT data was already making it into supporting business software, compared to only 10 percent of digital transformation laggards.

IoT is moving up the bell curve and away from the early adoption stage, but only by elevating IoT from just a transactional tool to a strategic enabler will manufacturers be able to start reaping the rewards of the latest industrial revolution.

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Charles Rathmann is Senior Marketing Communications Analyst, North America, IFS. Charles has more than 25 years of experience in business-to-business journalism, primary research, industrial product marketing, media relations, and sales and business development. www.ifsworld.com

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PKN ORLEN's mission has been to discover and process natural resources to fuel the future

Marcin Kowalski

PKN ORLEN operates six refineries (daily crude oil processing 728,000 barrels) and the region's largest network of service stations located in Poland, Czech Republic, Germany and Lithuania. Crude oil is processed into gasolines, diesel oil, fuel oil and aviation fuel. PKN ORLEN is also a leading producer of petrochemicals, with its products used as basic feedstocks by a large number of chemical companies.

Recently, PKN ORLEN embarked on a new strategy that puts a major emphasis on reliability. It is a strategy that reflects the company's past achievements while looking toward the future and how it can better serve its customers.

Incorporating the Past

The starting point of the petroleum oil industry in Poland and one of the starting points in the world is credited to Polish engineer, pharmacist and inventor Ignacy Łukasiewicz, who improved upon British physician Abraham Gesner's method of refining kerosene by using the more readily available "rock oil," thus creating the kerosene lamp.

In 1854, Łukasiewicz and his business partners founded the first oil company in the world, which began production and use of oil in Bóbrka, a village

in the town of Krosno, Poland. In 1856, he launched the first crude oil distillery in Ulaszowice, Poland.

Since then, PKN ORLEN's mission has been to discover and process natural resources to fuel the future. For years now, PKN ORLEN has led the list of the largest Polish companies in rankings published by the Polish weekly and daily magazines, and was recently awarded the prestigious title of "World's Most Ethical Company" by an international panel of experts at the U.S. Ethisphere Institute.

Rankings recently published by the British financial magazine, *Euromoney*, show PKN ORLEN as being the best managed oil company in the region. The company also has been named the most valuable Polish brand and the best employer.

Fueling the Future: Strategy vs. Reliability

PKN ORLEN established a new strategy for 2017-2021 that focuses on three key pillars of growth:

1. Value creation;
2. People;
3. Financial strength.



Figure 1: PKN ORLEN's production plant in Plock, Poland

The vision for growth set out in this new strategy fits well with global trends in energy sources, technological progress and social shifts, which are bound to create new consumer behaviors and expectations.

PKN ORLEN aims to focus on strengthening its market position, becoming more customer-oriented, exploiting the integrated value chain with a growing role of its petrochemical business, and continuing cautiously with upstream projects. A strong focus on innovation with value creating potential is another vital element of the strategy.

Reliability fits into the first two pillars of PKN ORLEN's new strategy.

VALUE CREATION: Reliability will be achieved mainly by having strong downstream market position. To fulfill this goal, the company needs to be highly competitive by ensuring high availability of its production units.

PEOPLE: Reliability is one of PKN ORLEN's values.

The new strategy of the company also fits in completely with the internal strategy of the Technical Office, which is responsible for maintenance of the production units. Reliability and availability are the main pillars of the Technical Office's strategy for 2017-2021.

Addressing Challenges

PKN ORLEN will use many different tools to ensure an appropriate and as high as possible level of availability. To identify weak points in pressure equipment, the company has introduced risk-based inspection (RBI), which considers a probability and consequence to planned inspections. This is the opposite of the company's traditional approach to inspections, which used prescriptive or time-based requirements for inspection. RBI undoubtedly will help the company identify problems before they occur.

Additionally, through cooperation with the Polish Technical Inspection Authority, PKN ORLEN obtained permission to extend periods between turnarounds (TAs).

In the area of maintenance management of its production units, PKN ORLEN will use reliability-centered maintenance (RCM) to help it focus on its main systems and provide continuity of production in common cases.

Production at PKN ORLEN is strongly focused on reliability. That is why the company has its own machinery diagnostic department, process safety team, reliability team and corrosion analysis team. The 2016 Solomon RAM Study confirms that these efforts are profitable, with the company leading Q1 Non-Turnaround Maintenance Downtime (for Western Europe). What is important to emphasize is this result was achieved during an increase in production efficiency.

“ In aspiring toward operational excellence, a standard of using root cause analysis (RCA) has been established to deal with the what ifs ”

Dealing With What Ifs

Like other companies, PKN ORLEN experiences unplanned events that affect production and, of course, reliability results. In aspiring toward operational excellence, a standard of using root cause analysis (RCA) has been established to deal with the what ifs. Effective RCA is already giving the company a huge advantage by avoiding repeated events. Toward this point, PKN ORLEN is focusing on creating a strong group of the best RCA specialists from its internal engineers who have experience in the refinery & petrochemical industry. The company is certain this will enhance the RCA advantage even more.

Innovating RCA Management With the CMMS System

Companies with a wide scope of production or expanded structures of production and maintenance that have a lot of events affecting continuity or result in a reduction of production require effective RCA management methods that include investigation processes and implementation of corrective actions.

The main problem with this, however, is that not everyone knows what is happening in other units and how they are trying to deal with their problems.

Furthermore, reliability departments need to efficiently manage those events.

The challenge is to build a useful and approachable reliability knowledge database. Although creating this database requires a lot of work, it may significantly make management of events easier and more effective, which undoubtedly will improve PKN ORLEN's reliability.

PKN ORLEN also discovered a simple solution that can be applied without a high cost: the computerized maintenance management system (CMMS) tool. The only task is to create a dedicated module in the system, which could be done by a CMMS provider or the company's IT department. Before doing so, however, it is important to discuss predicted functionality of the projected module with future users. Users' comments could be very useful at this stage before creation.

For the RCA database module to be useful, it must contain:

- Description of event;
- Result of RCA;
- Corrective actions (what is the most important) with people responsible and terms of implementation;
- Full RCA analysis as an attachment.

To manage the punctuality of recommendations, a separate module will be created to contain all corrective actions. In this module, everyone can check the recommendations for which they are responsible.

To facilitate the work of the reliability department, which is to remind and appoint people responsible for each recommendation, reminders will be set and sent automatically to the responsible person. Management can decide whether they want to get information of delays or lack of execution of recommendations, which could improve managing in those areas.

Of course, some solutions will need internal regulations, so the recommendations would describe who is responsible for each step of managing

Numer zlecenia pracy	opis zlecenia	instalacja	data zlecenia	zakończona	termin realizacji	odpowiedzialy	szef/zadawca	wyposażenie	IŁE ANULOWANYCH	IŁE ODRZUCONYCH	IŁE OPÓŹNIONYCH	IŁE W REALIZACJI
590319	1MC-Q2C - uszkodzenie silnika	HRK	2015-02-20 04:40		2015-05-29 00:00	NOVAKOWSKI	KOWALSKIMARCI	1MCQ2C	0	0	0	0
501472	F-201 wyłączenie pieca	HN1	2016-03-03 12:16		2016-04-30 00:00		KOWALSKIMARCI	F201	0	0	0	0
501472	F-201 wyłączenie pieca	HN1	2015-03-03 12:15		2015-03-03 00:00		KOWALSKIMARCI	F201	0	1	0	0
501526	C104A - wyłączenie kompresora	WW	2016-03-24 16:41		2016-04-24 00:00	ZYGADLINSKI	KOWALSKIMARCI	C104A	0	0	0	0
501526	C104A - wyłączenie kompresora	WW	2016-03-24 16:41		2016-06-30 00:00	TOMASZEWSKI	KOWALSKIMARCI	C104A	0	0	0	0
502372	X-011-X-015 zanik napięcia	ASFD	2015-03-03 12:20		2015-06-30 00:00	SZARUGAA	KOWALSKIMARCI	X-011	0	0	0	0
502372	X-011-X-015 zanik napięcia	ASFD	2015-03-03 12:20		2015-05-29 00:00	SZARUGAA	KOWALSKIMARCI	X-011	0	0	0	0
502372	X-011-X-015 zanik napięcia	ASFD	2015-03-03 12:20		2016-02-29 00:00	SZARUGAA	KOWALSKIMARCI	X-011	0	0	0	0
502408	Wystąpienie pożaru w obszarze podłogi	HRK	2015-03-24 15:40		2015-05-30 00:00	ZYGADLINSKI	KOWALSKIMARCI	HRK	0	0	0	0
502408	Wystąpienie pożaru w obszarze podłogi	HRK	2015-03-24 15:40		2015-09-30 00:00	JEDRZEJCZYKA	KOWALSKIMARCI	HRK	0	0	0	0
502408	Wystąpienie pożaru w obszarze podłogi	HRK	2015-03-24 15:40		2015-05-29 00:00	JEDRZEJCZYKA	KOWALSKIMARCI	HRK	0	0	0	0

Figure 2: Corrective actions monitoring system

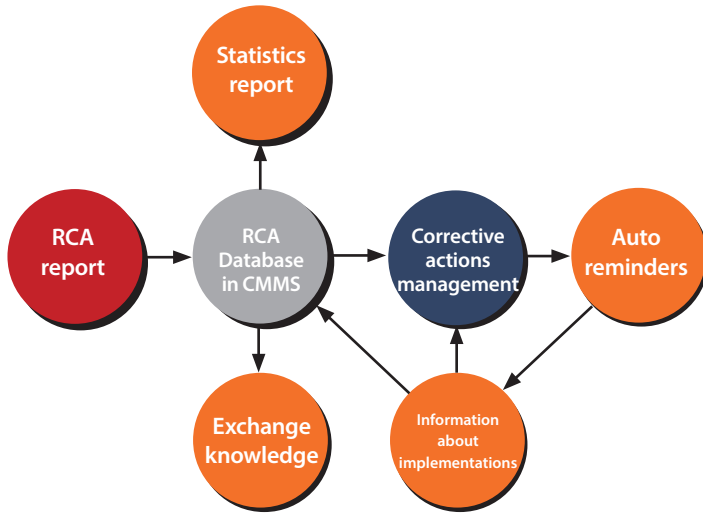


Figure 3: RCA management process

RCA issues. This could be in the form of either an event notification put in by the RCA or exporting the information in a dedicated CMMS module.

The challenge for start-up of an RCA database in a CMMS:

- A lot of work has to be done before starting the project.

The advantages of an RCA database in a CMMS include:

- Exchange of knowledge;
- Increase awareness by PKN ORLEN specialists about what happened, why and how to avoid it;
- No forgotten recommendations since every corrective action is monitored;
- Less work to manage reliability processes because the system will automatically supply the data.

The hazard for the right functionality of an RCA database in a CMMS:

- Lack of regularity of an RCA database filling in.

Results

With the implemented tool, RCA management significantly facilitated work and communication in many areas of the production division (production, maintenance, technology, reliability). Knowledge about the identified hazards that occurred on a specified production unit is spread to other areas, which allows PKN ORLEN to eliminate weak points that may have an impact on the potential loss of production on other units.



Marcin Kowalski is the Reliability Engineer responsible for all reliability processes in the refinery section of PKN ORLEN S.A. (Poland). Marcin has more than 8 years' experience at PKN ORLEN and specializes primarily in RCA during the investigation process of failures and RCM projects for the refinery & petrochemistry industry. www.orn.pl

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DOES YOUR EAM SYSTEM ENSURE WORK SAFETY?

Neeraj Gupta

Most enterprise asset management (EAM) systems just touch upon the safety aspect by registering hazards involved or precautions to be taken while working in a risky environment. But, how do they enforce work safety? There are still so many accidents and incidents in the industry and all investigation findings point to missing safety measures, ignorance, or bypassing safety rules or procedures. What can be done to ensure a safe work environment for everyone? How can a company enforce control of work? One single accident is enough to do away with all financial benefits received through optimized asset management or predictive maintenance to increase asset availability. Asset availability is important, but not at the cost of safety!

Most EAM systems are implemented more as a transactional system, focusing on asset registry and work management to schedule and execute

work, including preventive maintenance, reactive maintenance and emergency or breakdown maintenance. Though computerized maintenance management systems (CMMS) and EAM systems have been in existence for quite some time now, health, safety and environment (HSE) are still seen in isolation and managed manually or in disparate systems. CMMS/EAM integrate with external systems, like financial, supply chain, geographic information systems (GIS), supervisory control and data acquisition (SCADA), etc., but should HSE be an integral part of an EAM system?

Let's take a look at some of the International Labour Organization's facts and figures concerning health and safety at work:

EVERY YEAR...

- ▶ 321,000 people die from occupational accidents
- ▶ 317 million nonfatal occupational accidents occur

THIS MEANS THAT:

EVERY 15 SECONDS

- ▶ 1 worker dies from a work-related accident or disease
- ▶ 151 workers have a work-related accident



Figure 1: Deepwater Horizon oil spill - Gulf of Mexico

The obvious question arises: Who is responsible for work safety? The answer depends on to whom this question is being asked. Employers say each employee is responsible for his or her own safety, while they enable them by providing training, etc. Employees say their employer should make all necessary safety arrangements as they should know the risk involved. They are just workers following instructions.

The reality is that everyone involved in work execution is responsible for overall safety in the workplace, regardless of their role, direct or indirect.



Figure 2: Piper Alpha - North Sea production platform

People also relate work safety to specific industries. Is work safety required in all industries or is it applicable only to oil and gas, transportation, construction and electric utility? It must be understood that work safety is required in all industries, although the degree of risk and its consequences might vary.

More than likely, you have heard about multiple incidents in different industries. One example that comes to mind is the Deepwater Horizon oil spill in the Gulf of Mexico. On April 20, 2010, this explosion killed 11 people and resulted in the owner paying approximately \$20 billion in fines.

Another example is the Piper Alpha disaster. The July 6, 1988, explosion on the North Sea oil-producing platform killed 167 people. Findings indicated inadequate maintenance and safety procedures.

There are numerous other examples throughout various industries, with all of them having one thing in common: some work safety aspect was ignored. Most of the disasters could have been averted with proper work safety management in place.

So, the next question that comes to mind is: Why don't people use a work safety management system? Actually, many have so-called safety man-

WHO IS RESPONSIBLE FOR WORK SAFETY?

agement systems in place, but they are lacking in their effectiveness due to poor process integration with asset and work management systems.

The ISO55000 series puts a lot of emphasis on work safety as an integral part of an asset management system. Several factors can be taken care of by an asset management systems. According to the standard:

“A factor of successful asset management is the ability to integrate asset management processes, activities and data with those of other organizational functions, e.g., quality, accounting, safety, risk and human resources. Where possible, existing business processes should be leveraged to avoid unnecessary new work and duplication of existing work and data.”

Risk management is another factor that must be considered for individual asset or activity and it has to be tied back to the work order management system to ensure adherence to compliance. This is mentioned in ISO55000 as:

“When addressing risks in the asset management system, the organization should determine the risk assessment criteria (e.g., likelihood and consequence, and risk attitude) within asset management decision-making for its asset management system. A risk matrix may be used as part of this process.”

Competence management is another important factor to be considered as part of an asset management system, as it is paramount for ensuring the right skilled person is doing the job in addition to following all other safety procedures. ISO55000 provides clear guidelines to follow. The organization shall:

“Determine the necessary competence of person(s) doing work. Ensure that these persons are competent on the basis of appropriate education,



Figure 3: Metro rail and electric utility



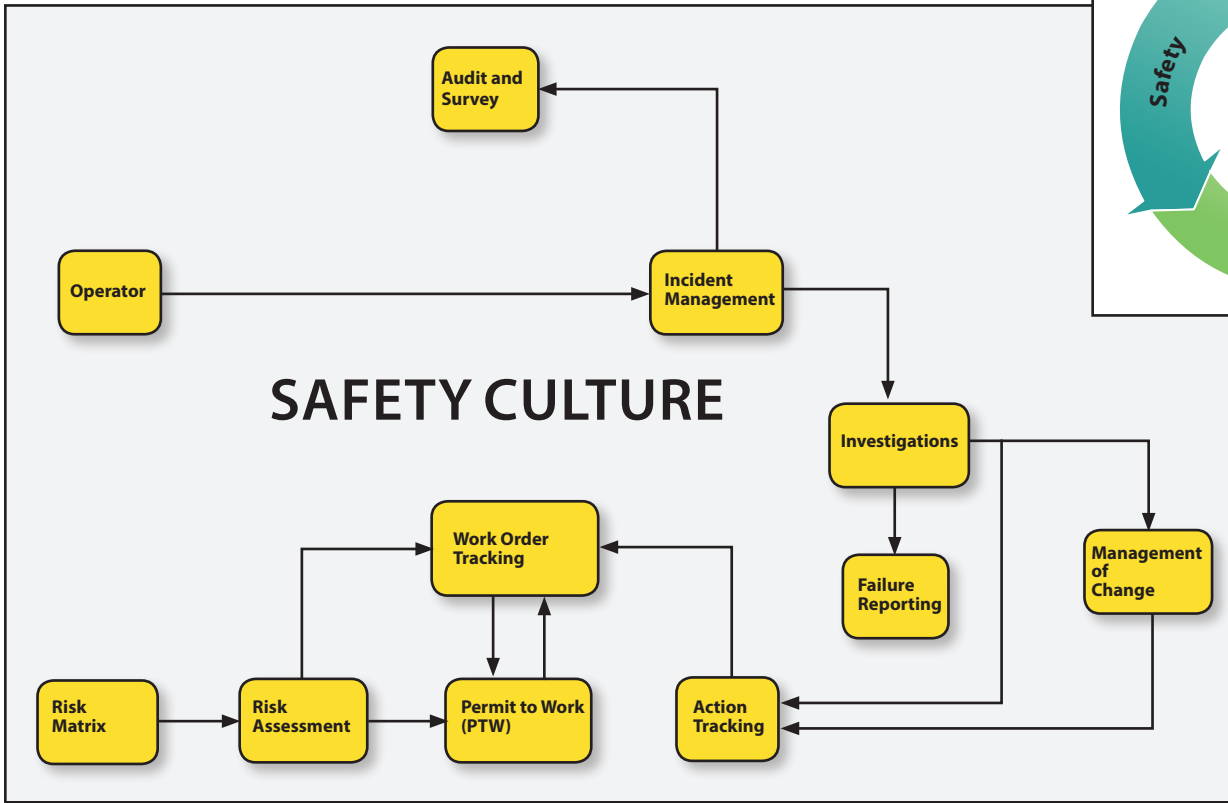


Figure 4: Safety culture



Figure 5: Balance between safety, compliance, quality

training, or experience. Retain appropriate documented information as evidence of competence."

Among other important factors stated in ISO5500 are management of change, an internal audit and processes for the investigation of asset-related incidents.

Putting together a comprehensive list or a kind of process tool kit can help ensure work safety and regulatory compliance. This list of elements might be very useful:

- Identify hazards;
- Prepare risk matrix;
- Perform risk assessment;
- Use permit to work;
- Report incidents, including near misses;
- Investigate incidents;
- Manage improvements;
- Manage competency;
- Conduct audits;
- Management of change (MoC);
- Develop a safety culture.

The most important of all is developing a safety culture, as the complexity of different integrated processes/systems poses a threat of an incident taking place at any time. Hence, it is important to have seamless integration with no possibility of even a near miss going unnoticed and not acted upon. Knowing the root cause is very important, followed by an action plan to ensure nonrecurrence of safety issues.

Organizations always need to strike a balance between safety, compliance and quality while executing work in any industrial situation.

With advancement in technology, it has become simpler to monitor and manage safety issues. Many industries are experimenting with the Internet of Things (IoT) to improve safety through the use of wearable smart sensors to monitor the condition of both the asset's and worker's health to avoid or reduce safety incidents. Hopefully, new technology can bring down the rate of accidents and make industries a safer workplace.

The risks of not solving this problem are having an inefficient and unsafe EAM system, looking at other non-cohesive systems to fill this gap, an increased risk of work incidents and the inability to make right decisions, analysis and risk assessment on time.

It is recommended to evaluate leading EAM systems in the market with an eye on integrated safety management that complies with ISO55000 and other regulatory requirements in your industry.

It is also important to have your HSE domain expert on the team to help design the right system to achieve the objective.

AFTER ALL, SAFETY IS EVERYONE'S RESPONSIBILITY.

Disclaimer: The views and statements made in this document are based on the experience and opinions of the author and do not represent IBM's views.



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VARNISH MITIGATION: EFFECTIVE FLUID ANALYSIS AND VARNISH REMOVAL OPTIONS

Riley Mieth and Gene Wagenseller

One of the most difficult aspects of dealing with lubrication systems is that you can't see what is happening inside of them. Taking an oil sample allows you to gather information about the trace amounts of wear metals, oxidation deposits, additive chemicals and other contaminants that tell you about the system. Just like blood tests don't always tell a doctor the whole story, traditional oil analysis testing doesn't give the entire story when it comes to varnish.

The ASTM International standard, ASTM D7843, defines varnish as "a thin, hard, oil-insoluble deposit, composed primarily of organic residue and most readily definable by color intensity. It is not easily removed by wiping with a clean, dry, soft, lint-free wiping material and is resistant to saturated solvents. Its color may vary, but it usually appears in gray, brown, or amber hues."

More importantly, varnish is a degradation by-product and a potential problem for any moving machinery components. Varnish buildup reduces heat transfer and increases stiction of valves and seals. Varnish buildup on bearings results in reduced clearance and traps abrasive particles, increasing wear and reducing component life. As the buildup gets brittle, it can break apart and cause catastrophic damage to pumps, bearings, valves and other moving components. The potential problems that varnish causes makes minimizing oxidation and varnish formation critical.

The dangers of varnish make it crucial to have fluid analysis tools that can identify potential issues. The best fluid analysis tools for varnish testing today are a combination of the membrane patch colorimetry (MPC) test, as indicated by ASTM D7843 and the remaining useful life evaluation routine (RULER™) test, as directed by ASTM D6971.

TABLE 1 – EFFECTS OF VARNISH ON SYSTEM COMPONENTS

PROBLEM	RESULT
Servo Valve Sticking	System trip and system outage, resulting in production loss
Heat Exchange Plate Out	Reduced heat exchange and higher operating temperature and increased oxidation
Varnish Buildup on Bearings	Varnish captures abrasive particles, creating a sandpaper effect that increases bearing wear and reduces component life
Additive Depletion	The base oil is left unprotected and oxidation occurs, accelerating the formation of degradation by-products
Seal Failure	Oil leaks and cylinder problems
Filter and Strainer Clogging	Oil starvation, resulting in damage to components, such as pumps and bearings

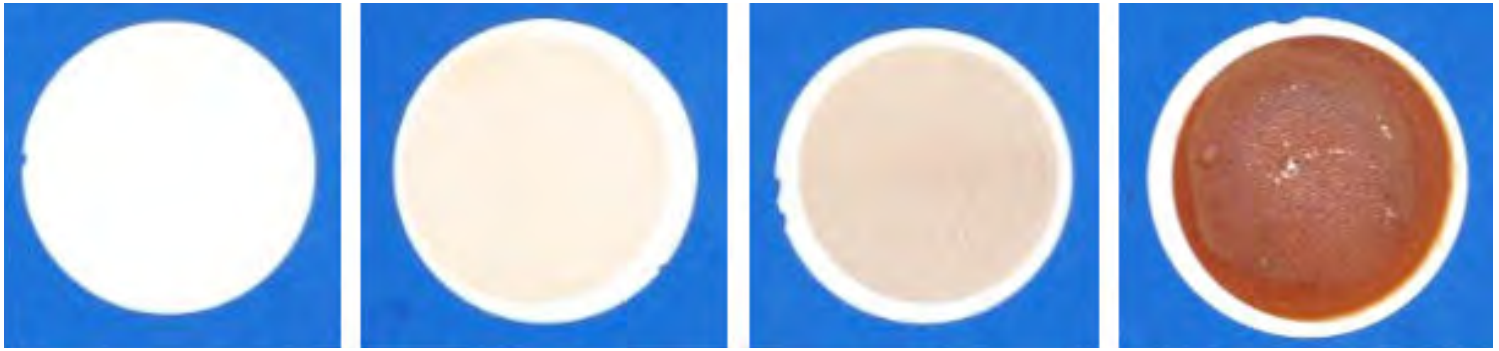


Figure 1: MPC patches from an injection molding machine which, left unchecked, the varnish level increases until it reaches a critical level, resulting in downtime and loss of revenue

MPC Test

The MPC test provides a visual indication of insoluble oxidation products or varnish precursors that are currently suspended in the lubricant. The higher the MPC value, the more severe the potential is for varnish buildup in the system.

RULER™ Test

With the RULER test, antioxidants are measured relative to the new oil. The test is an alternative to the rotating pressure vessel oxidation test (RPVOT), which has been the accepted method for estimating lubricant service life. However, ASTM D7348 has been updated to recommend RULER over RPVOT for current oil formulations. The amount of additive present is reported relative to the amount of additive in the new oil.

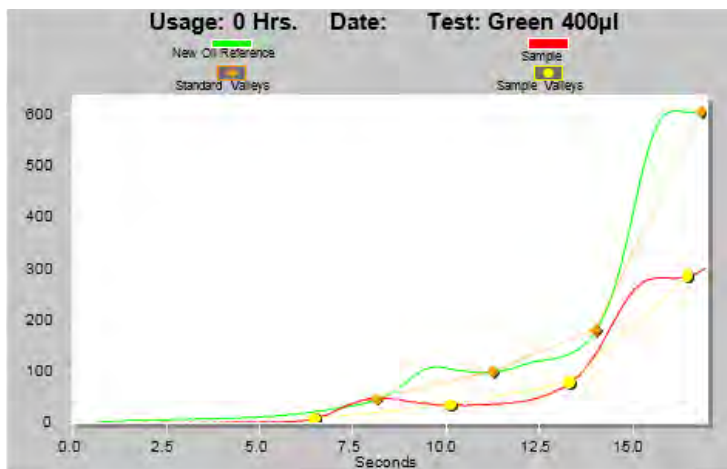


Figure 2: Overlay of new reference oil with the in-service oil

Testing Challenges

Among the challenges of varnish testing is that the MPC and RULER tests are not part of a standard lube oil analysis package. Consequently, the first varnish test performed on a system is typically after someone already suspects varnish. This poses a problem because, like most sample analysis, a single test can only tell you so much. While it can indicate poor or good health of your system, it doesn't tell the story of how your system got to that point. With varnish, the story is critical for root cause diagnosis and pinpointing the corrective action needed to prevent equipment failure.

Varnish Mitigation Solutions

Preventive Measures

Understanding lubricant degradation can help you address some of the underlying causes of varnish formation. Lubricants degrade by two pathways: thermal and oxidative degradation. Thermal degradation occurs when the fluid encounters hot metal surfaces, electrostatic discharge (ESD), or air entrainment leading to micro-dieseling. ESD occurs when the oil passes through filters. Many manufacturers sell antistatic filters to address this problem. Entrained air may be the result of low oil levels, return lines above the oil level, or insufficient dwell time. Performing an air release test, as indicated in ASTM D3427, may be useful. The air release time will increase if the oil is contaminated or degraded.

Specialty Filtration

A variety of specialty filtration options are available that claim to address varnish with a slipstream filtration skid. Balance charged agglomeration, electrostatic precipitator, cellulose depth media and ion exchange resins are some of them. Each has applications that have shown success, while each has also encountered varnish that is resistant to its specific approach. When selecting a filtration media, it is recommended to consult with a vendor that is experienced with the various varnish mitigation and filtration technologies. This approach, regardless of type, is an active way to manage the amount of oxidation products or varnish precursors in the lubricant. If varnish precursors are kept out of the lubricant, they cannot plate out on pumps, bearings,



Just like blood tests don't always tell a doctor the whole story, traditional oil analysis testing doesn't give the entire story when it comes to varnish



valves, etc. Depending on the severity of the varnish buildup on the internals of a system and the amount of oxidation by-products in the oil, this approach can be very effective. The specialty filtration method has the advantage of no machine downtime while it is performed.

Oil Change Out

Performing an oil change is a tried-and-true method for many maintenance personnel. By removing oil that is contaminated and replacing it with new lubricant, you are typically adding good oil to the system and buying time to find a root cause or a more permanent solution. However, if this is the only action taken, the root cause will never be addressed and, over time, a lot of healthy lubricant will be wasted. In fact, if varnish has built up on the components in the system, oil will degrade more quickly than if it was placed into a system that had been cleaned. Oil change outs are a necessary practice, but not the total solution.

Chemical Cleaning

The most aggressive option for removing varnish deposits inside oil systems is the use of a chemical cleaning process. This approach uses a variety of chemicals, solvents, detergents and acids to aggressively break down and dissolve any oil oxidation products throughout the system.

This process can be performed two ways:

- 1. Brief Downtime:** Adding the chemical solvent or detergent while the system is still running at a prescribed percent by volume and allowing the solvent or detergent to interact with all parts of the system. The system continues to operate for two to three days, followed by a drain out, rinse, or flush to get the chemical out of the system prior to adding fresh lubricants.
- 2. Extensive Downtime:** Shutting the system down completely and using either an aqueous solution with acid or an oil solution with solvents and detergents while performing an oil flush on the system.

Both techniques are the most aggressive, expensive and time-consuming compared to oil change outs, filtration and filtration with chemicals. However, when the criticality of the equipment is paramount, these approaches are used to help ensure that varnish is not the eventual cause of major failures and additional downtime.

“ As long as lubricants are the lifeblood of systems, varnish will not vanish! ”

Solutions Summary and Long-Term Management

Varnish is an extreme danger to your system. Understanding your system and the available testing options can ensure a long, healthy equipment life. The operating conditions of your machinery are key to choosing a solution for your application. Once a solution has been selected, it is critical to establish a routine oil analysis program that includes the MPC and RULER™ tests on a semiannual or annual basis. Testing needs to be performed more frequently if test results indicate a potential problem.

Along with oil analysis, contamination control methods should be evaluated to prevent contaminants from getting into the oil. Generally, the cleaner the oil, the fewer opportunities for oxidation to occur that lead to varnish. Lastly, established baselines for oil analysis reporting and actions to take upon reaching those baselines should be implemented.

As long as lubricants are the lifeblood of systems, varnish will not vanish! However, you can do your best to keep your systems from failing as a result of varnish.



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WHY MAINTENANCE COST TO ASSET VALUE RATIO IS NOT A GOOD BENCHMARK

Binseng Wang

A commonly used benchmark for maintenance activities is the ratio of maintenance cost to asset value (MC/AV).^{1,2} Some medical equipment maintenance professionals also claim MC/AV to be the best or most reliable benchmark.^{3,4} Maintenance cost includes both scheduled (often erroneously called preventive maintenance) and nonscheduled (i.e., repairs) maintenance costs, whereas asset value has various interpretations. This article challenges the validity of MC/AV as a benchmark or even a key performance indicator for maintenance activities in most, if not all, industries.

To be clear, the usefulness of the ratio of repair cost to asset replacement value is not being questioned. Whenever a significant or catastrophic failure happens to a piece of equipment and the related repair cost exceeds a significant fraction—as defined by each organization—of the replacement cost (minus resale or salvage value), maintenance leaders should evaluate the wisdom of repair and discuss it with the executive team. Caution should be taken in using replacement cost and not the depreciated book value, as the latter is nothing but an accounting exercise.

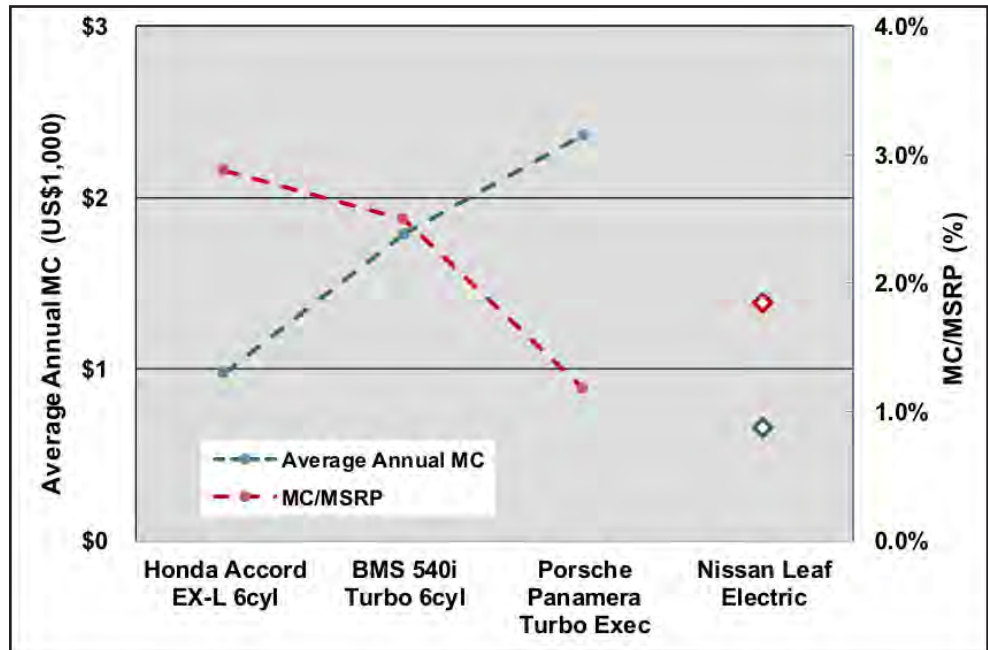


Figure 1: Average annual MC and ratio of MC to respective MSRP for three gasoline-fueled automobiles of different brands and models and an electric vehicle; MC was obtained by averaging the sum of maintenance and repair costs for the first 5 years after acquisition (Data collected from Edmunds.com)

“ Maintenance cost includes both scheduled and nonscheduled maintenance costs, whereas asset value has various interpretations ”

On the other hand, it is unclear why one should use MC/AV for benchmarking maintenance. Implicit in this ratio is the assumption that an asset with higher value will demand a higher maintenance expenditure. While it is intuitive that the MC for a moped is lower than that of an automobile, which in turn has a lower MC than an

aircraft, the assumption that the MC/AV ratio is constant for transportation equipment doesn't appear reasonable under scrutiny.

As an example, let's examine a single class of transportation equipment: automobiles. In order to have significantly different asset values, let's consider automobiles in three different categories:

standard, luxury and ultra-luxury. Figure 1 shows the MC/AV for three such vehicles computed with data collected from Edmunds.com.⁵ While MC does increase with the car's manufacturer's suggested retail price (MSRP)—most likely due to higher costs of replacement parts for the more luxurious vehicles produced at lower volume—MC/AV actually decreases as MSRP increases. Therefore, the maintenance team of a fleet of luxury vehicles cannot claim to be better performers than other teams that maintain standard vehicles. Hopefully, you are not rushing out to buy ultra-luxury cars because of their lower MC/AV!

To make the automobile example more interesting, a purely electric vehicle was added to Figure 1. The annual MC of this vehicle is obviously lower than those with an internal combustion engine. Furthermore, its MC/AV is also lower than the others, except for the ultra-luxury car, although this ratio is likely to increase with future reductions of battery cost and, thus, MSRP. The lesson here is that it is not enough to consider AV; MC is also significantly impacted by technology evolution. This has been most evident in the last half century with the transition of vacuum tubes to transistors, integrated circuits and microprocessors.

Aside from the conceptual challenge, MC/AV also has significant practical challenges with the determination of AV summarized as:

- Purchase Price as AV:** Unlike the MSRP for automobiles, most industrial and professional assets do not have list prices. Even when a list price exists, discounts are typically offered by vendors to buyers with large purchasing power (i.e., bargaining power) or high prestige (i.e., for future sales reference). In this case, MC/AV would favor organizations that pay more for the same asset without any relationship to performance. Furthermore, few organizations keep accurate records of purchase price, with details on optional accessories, extended warranty, freight and installation costs.
- Replacement Cost as AV:** Like purchase price, the replacement cost varies from one organization to another due to bargaining power and marketing considerations. While easier to obtain compared to original purchase price, it is laborious to keep updating this cost every year and often difficult to find exact replacement for older equipment, as technology is evolving rapidly and new features are constantly being introduced.
- Standardized Price at Purchase or Replacement as AV:** In lieu of list price, some proponents of MC/AV have suggested adopting standardized prices at purchase or replacement. While this is an improvement over individual purchase or replacement cost,

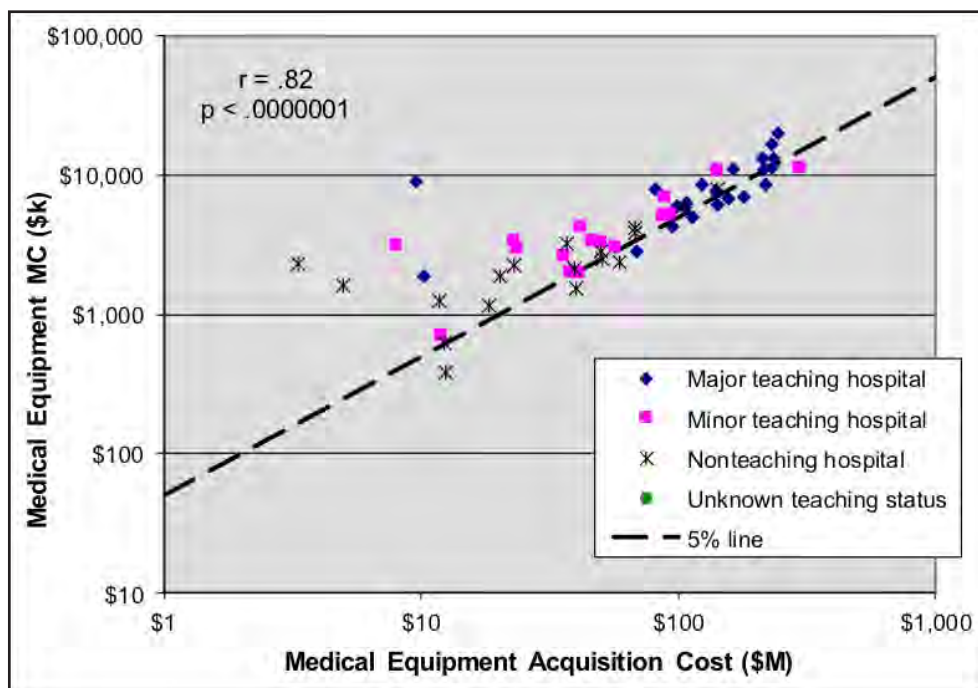


Figure 2: Relationship between medical equipment MC and its acquisition cost

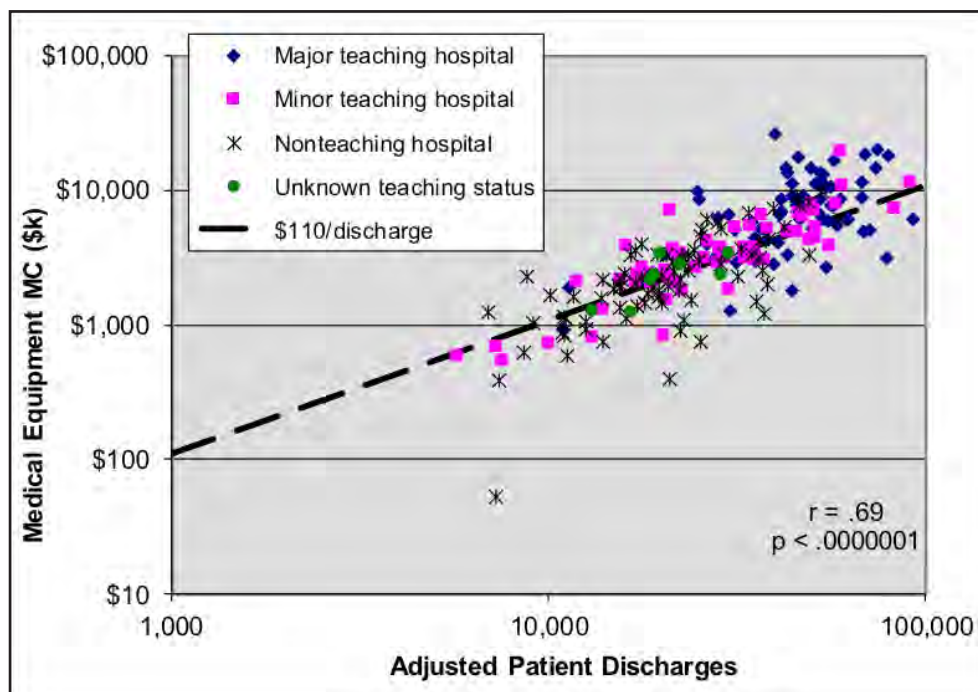


Figure 3: Relationship between medical equipment MC and adjusted patient discharges

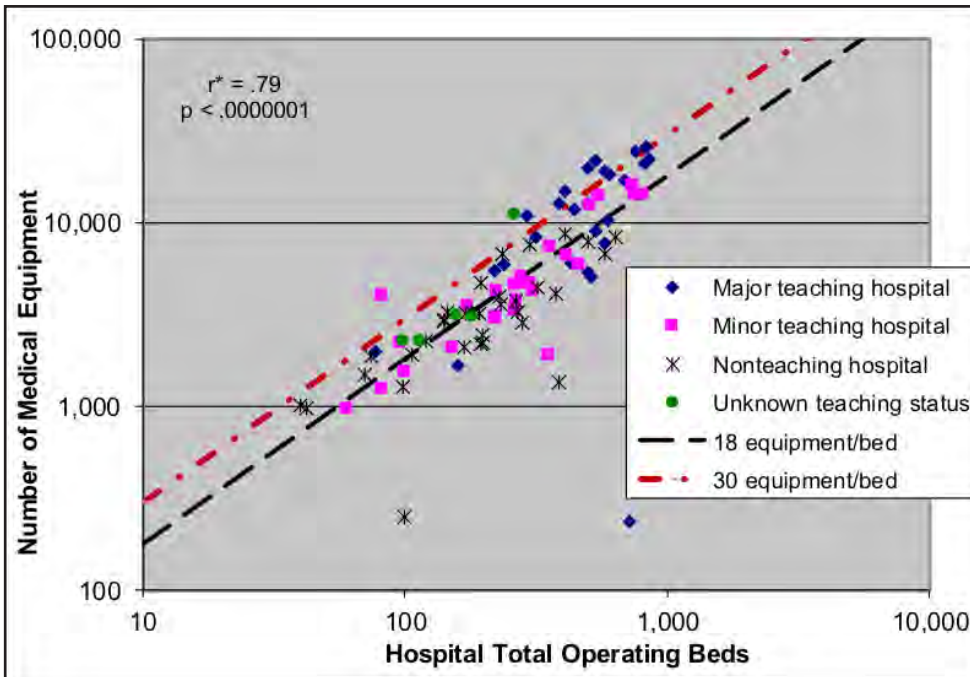


Figure 4: Relationship between the number of medical equipment and the number of beds actually in use by each hospital (known as operating beds); note that major teaching hospitals are better fitted with 30 capital devices (equipment) per bed versus 18 for the others

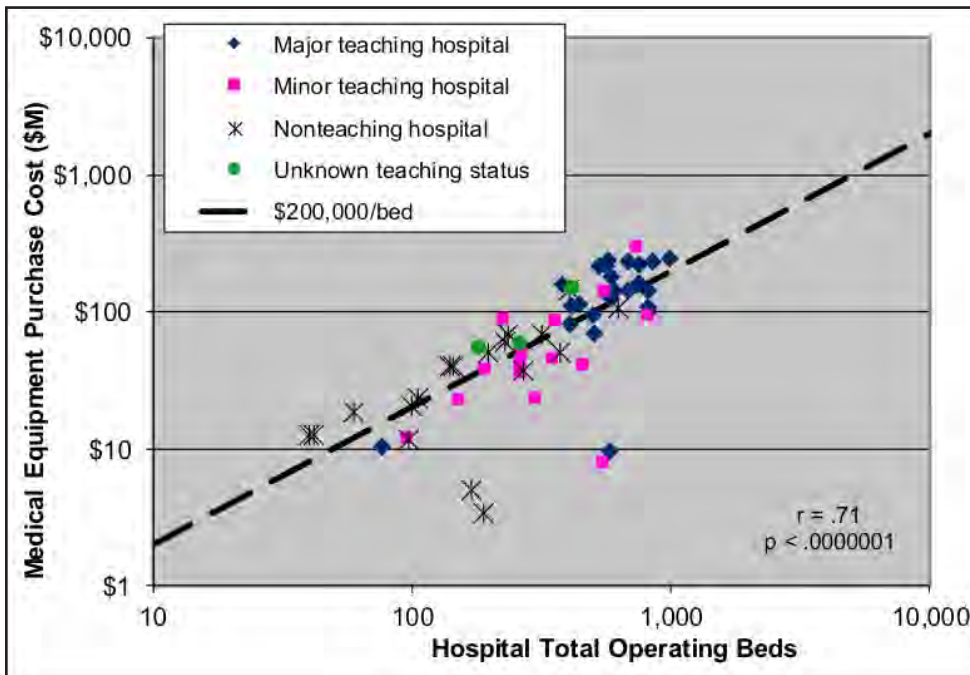


Figure 5: Relationship between medical equipment purchase cost and the number of operating beds

it is challenging to establish industry-wide standardization. Until standardized prices are widely available and adopted, this interpretation is not likely to be useful.

To illustrate how MC/AV can be misleading, let's consider the cost to maintain medical equip-

ment in acute care hospitals. For Figures 2-6, data were collected in 2013 from about 300 American hospitals of different sizes and teaching characteristics (major >400 beds, minor, nonteaching and unknown) by Truven Health Analytics through its ActionOI® program.⁶ Since not every hospital provided data on all the metrics, each graph has

a different number of data points. Note the logarithmic scales on both axis. The dashed lines in the graphs are visual guides for readers based on the author's experience instead of statistical fits due to the high number of obvious outliers. Verification of data accuracy is not possible because hospital identities are protected by Truven.

Figure 2 shows MC/AV (with purchase price as AV) for hospitals of different sizes and teaching characteristics. It appears that major teaching hospitals are just as cost-effective as smaller and nonteaching hospitals, except perhaps for a few very large ones.

However, when an output metric is used as the denominator, one can see that most larger and teaching hospitals are actually not as cost-effective as the rest. One output often used for health-care is adjusted patient discharges,⁷ where the actual patient discharge is adjusted by the ratio between total revenue and inpatient revenue in order to account for outpatient care. Figure 3 shows most major teaching hospitals generally spend more on MC than the rest.

It is not difficult to understand why major teaching hospitals have higher MC. These organizations typically have more equipment—in quantity, variety and sophistication—than the rest due to their educational needs (see Figure 4). This leads to higher equipment MC. The fact that they enjoy discounts on a few high-end, “show-case” equipment does not significantly reduce their total equipment purchase cost (see Figure 5), as they still have to pay near normal price for the remainder of equipment. In addition, most major teaching hospitals offer higher employee compensation than others, especially those located in expensive major metropolitan areas on both coasts.

“...Every benchmark has its own imperfections”

Therefore, it is not surprising that major teaching hospitals have MC/AV comparable to smaller and nonteaching hospitals. Their higher MC is compensated by higher AV. However, this does not justify using MC/AV as a benchmark. Like the classical statistics lesson, “correlation does not imply causation,” one should not take the fortuitous coincidence of comparable MC/AV among hospitals of different sizes and teaching characteristics as proof of it being a good benchmark. To blindly follow MC/AV would lead hospitals to

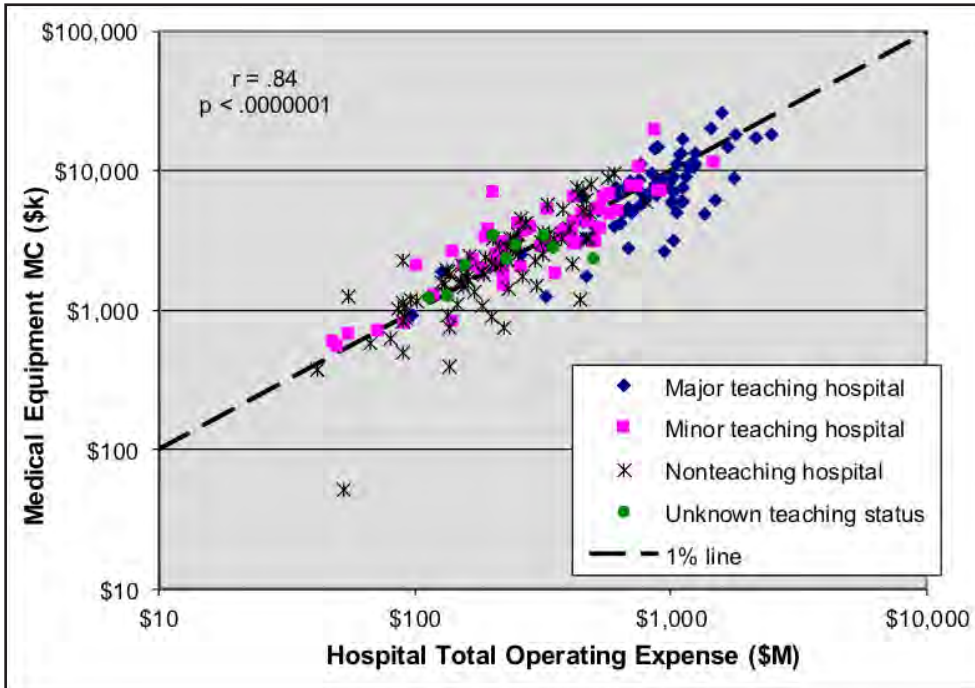


Figure 6: Relationship between medical equipment MC and a hospital's total operating expense

spend more in MC than truly necessary for good patient care.

MC/AV could be a reasonable benchmark if the organizations being compared have exactly the same assets (e.g., brands and models of equipment), with only difference in quantities. This scenario, however, is very unlikely. Even car rental companies are likely to have vehicles of different brands, models, sizes and luxury levels.

From this analysis, it is not surprising that some industries have developed their own financial benchmarks. For example, facility maintenance professionals use square feet as the denominator,⁸ while commercial airlines use flight hours.⁹

For those who prefer to benchmark in the form of a ratio or percentage, the cost of goods sold (or services) sold (COGS) seems to be a reasonable alternative denominator, as long as the benchmarking is made within the same industry and includes cost of living adjustments for regional salary differences. Figure 6 shows MC as a function of a hospital's total operating expense. Most hospitals, including the major teaching ones, have MC/COGS in the range of 0.5 to 2 percent. Notice in Figure 6 that some hospitals have much higher operating expenses than others (i.e., data points

TABLE I - ILLUSTRATED VIBRATION DIAGNOSTIC CHART			
PROBLEM SOURCE	TYPICAL SPECTRUM	PHASE RELATIONSHIP	REMARKS
BASE IMBALANCE A. TONIC IMBALANCE			...
ROTOR RIB A. TONIC RIB			...
JOINT BEARINGS A. WEAR CLEARANCE PROBLEMS			...
UL WHEEL A. WEAR			...
UL SHIP A. METABOLISM			...
HYDRAULIC AND AERODYNAMIC FORCES A. BLAKE PUMP & VANE PUMP			...
GEARS A. NORMAL SPECTRUM			...
BEARING A. BEARING SPECTRUM			...
SEAL DRIVE PROBLEMS A. WORK, LOOSE OR MISALIGNMENT			...

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shifted to the right). These are typically prestigious, major teaching hospitals that can afford to have consistently negative annual operating incomes due to significant donations and endowments they receive.

As MC/COGS shows, every benchmark has its own imperfections. Therefore, it is recommended that benchmarking attempts be made with as many benchmarks as possible, including dissecting MC into internal labor, replacement parts, external labor and material, service contracts, etc. This would be analogous to improving location accuracy of a global positioning system (GPS) with more satellites. In fact, a multidimensional model has been proven to work fairly well in comparing or predicting hospital equipment MC.¹⁰

In essence, maintenance professionals should consider abandoning MC/AV or at least supplement it with additional benchmarks. There is no irrefutable reason that MC should be related to AV, be it purchasing or replacement cost. Experience has demonstrated that MC depends primarily on the main building components (e.g., mechanical, electrical, electronic, etc.) of deployed assets, as well as how often these assets are used and how well they are cared for by the

users. Adopting MC/AV as a financial benchmark or key performance indicator for measuring and comparing cost-effectiveness of maintenance teams—especially if used alone or as the primary indicator—would discourage improvements in financial performance.

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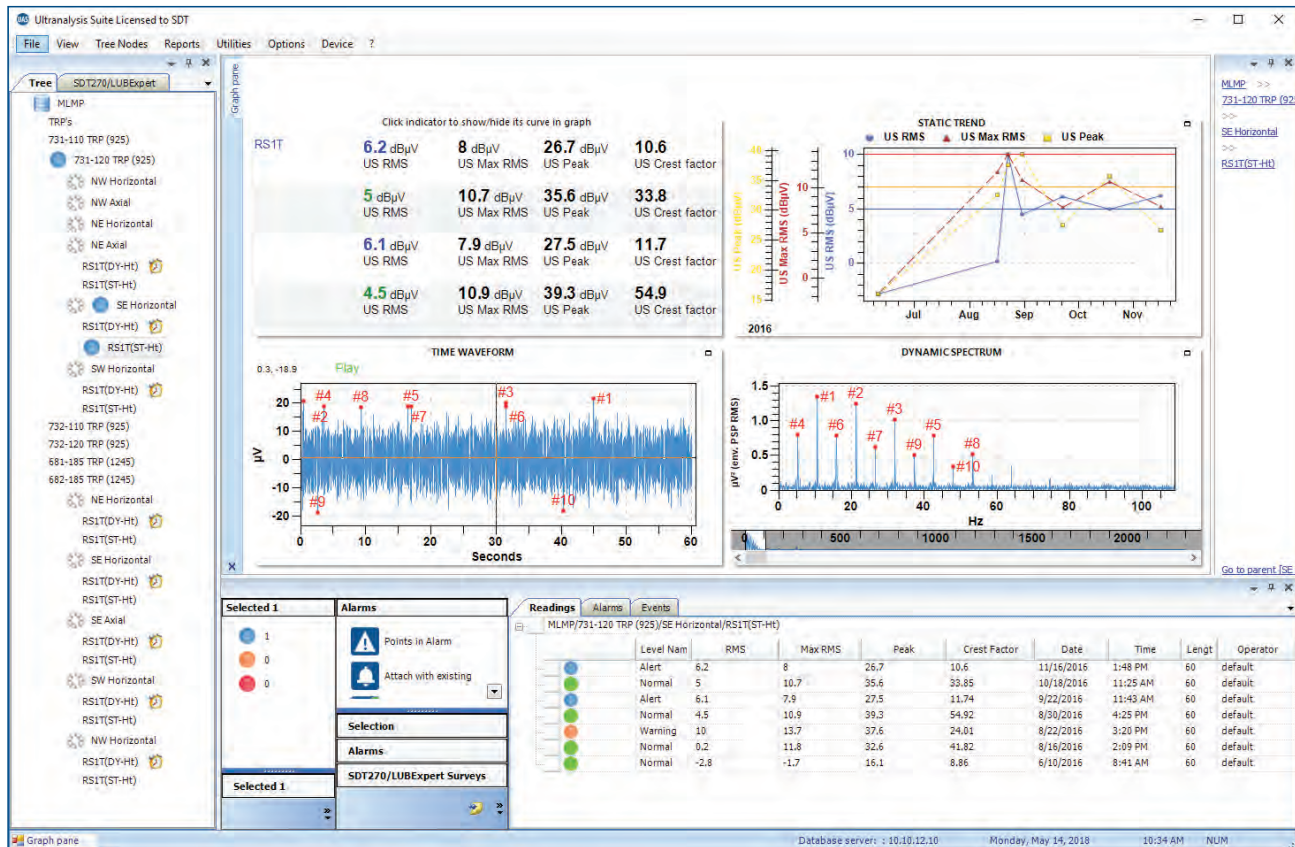
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NOTHING IS WRONG, WHAT ARE YOU GOING TO DO?

Joel Levitt

Reflecting on April's The RELIABILITY Conference 2018, it was a very intense (kind of like drinking from a fire hose) four days devoted to all things tech in maintenance. The presentations were on sensors related to the Industrial Internet of Things (IIoT), artificial intelligence (AI), the Cloud, analytics and a few even spoke about good maintenance practices. Like all Reliabilityweb.com conferences, it was congenial, fun and worthwhile.

Terrence O'Hanlon opened one of the daylong events. It was a conference within a conference summarizing the state of AI, IIoT and analytics. He said something that stopped numerous attendees in their tracks and started them thinking very hard!

“When you achieve reliability, then all your sensors, all of your AI, all of your analytics will detect nothing and prescribe no actions,” he stated.

Imagine spending tons of money, sweating the details for a couple of years, eliminating the defects and the result is nothing happens. That is a bit sobering.

It would be like if you exercised, had a great diet, used a bunch of tech and that ensured immortality. You can just see all the doctors and nurses picketing, throwing rocks and chanting slogans like, “Let’s go back to when healthcare was great (and 13 percent of our economy).”

Where Would that Leave You?

Jobless? Don't worry, this is a mental exercise, there's probably nothing to worry about. But really, where would that leave you? You have a certain set of skills and knowledge. What would be your best use to your organization?

Actually, if you do a bit of homework, the answer to the question is pretty simple. It's how you can best serve the mission, vision and values of your organization. In certified reliability leader (CRL) speak, it's called serving the

organization's *aim*. Your homework is to find out what that is. It is usually on or linked to the home page of the organization's official website.

Remember, you have a certain set of skills and knowledge. Now, given that the need to be fixing breakdowns and such has been eliminated, how do you best serve the mission?

Consider if it is in the mission to:

- Reduce the number of defects flowing into your system;
- Make your place safer;
- Reduce takt time;
- Increase yield;
- Reduce impact on the environment;
- Optimize production settings;
- Improve quality.

You must redesign your job. Evaluate your mission and figure out how you can serve it better.

You better get moving with your planning. With all the tech, it seems like only a short time before sensors can sense pre-problems that are even thinking about going down the P-F curve. Then, AI tells you what to do and is really good at it.

HAVE FUN WITH ALL THE GEAR AND GOOD LUCK!



Joel Levitt, CRL, CPMM, is the President of Laser Focused Training. Mr. Levitt has 30 years of experience in many facets of maintenance, including process control design, source equipment inspector, electrician, field service technician, maritime operations and property management. He is a leading trainer of maintenance professionals and has trained more than 17,000 maintenance leaders from 3,000 organizations in 25 countries in over 500 sessions.
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This course helps prepare attendees to perform a range of simple, single channel machinery vibration condition monitoring and diagnostic activities, is recommended for individuals as an introduction to machinery vibrations

Basic Machinery Vibration - CAT II

This course helps prepare attendees to perform basic machinery vibration analysis on industrial machinery using single-channel measurements, with or without triggers signals, according to established and recognized procedures.

Machinery Vibration Analysis - CAT III

This course provides more in-depth discussions of single-channel time waveform, FFT, and phase analysis techniques for the evaluation of industrial machinery. It includes acceptance testing, machine severity assessment, basic rotor dynamics and much more.

Balancing of Rotating Machinery - CAT III & CAT IV

This course covers single-plane balancing techniques for both rigid and flexible rotors. It includes both field balancing and shop (balancing machine) balancing. Topics such as pre-balance checks, influence coefficients and case histories are included.

Practical Rotor Dynamics & Modeling - CAT IV

This course teaches both practical and theoretical modeling of rotating systems using journal and rolling element bearings.

Advanced Vibration Analysis - CAT IV

This course is targeted to solving complex vibration problems involving transient and forced vibrations, resonance, isolation and damping, advanced signal processing analysis, and torsional vibration analysis.

Advanced Vibration Control - CAT IV

This course is targeted at solving complex vibration problems involving transient and forced vibrations; resonance, isolation and damping; and field and shop balancing in both structural dynamic and rotor dynamic systems.

Dates & Locations

Introduction To Machinery Vibrations - CAT I

- March 5-8, 2018
Oak Brook, IL
- August 6-9, 2018
Indianapolis
- December 10-13, 2018
San Diego
- May 7-10, 2018
New Orleans
- October 2-5, 2018
Orlando, FL

Basic Machinery Vibration - CAT II

- February 5-9, 2018
Tempe, AZ
- June 18-22, 2018
Oak Brook, IL
- September 24-28, 2018
San Antonio, TX
- April 9-13, 2018
Knoxville, TN
- July 16-20, 2018
New Orleans
- November 5-9, 2018
Indianapolis

Machinery Vibration Analysis - CAT III

- March 19-23, 2018
Oak Brook, IL
- August 6-10, 2018
Indianapolis
- December 10-14
San Diego
- May 7-11, 2018
New Orleans
- October 1-5
Orlando, FL

Balancing of Rotating Machinery - CAT III & CAT IV

- February 5-9, 2018
Tempe, AZ
- October 15-19, 2018
Oak Brook, IL

Practical Rotor Dynamics & Modeling - CAT IV

- April 9-13, 2018
Knoxville, TN

Advanced Vibration Analysis - CAT IV

- November 5-9, 2018
Indianapolis

Advanced Vibration Control - CAT IV

- September 24-28, 2018
San Antonio, TX



Q&A



Dr. Carla Boehl
Principal Consultant, Digital Asset Management and Innovation
SNC-Lavalin/ Atkins

Dr. Boehl, Portuguese Australian, is a Chartered Engineer Fellow of Engineers Australia and asset management professional with over 20 years' experience within rail, utilities and mining industries. Dr. Boehl recently shared her thoughts and experience on strategic asset management, machine learning and automation with *Uptime* magazine.

SNC-Lavalin is a global fully integrated professional services and project management company and a major player in the ownership of infrastructure. SNC-Lavalin recently acquired Atkins, one of the world's most respected design, engineering and project management consultancies.

Q. Dr. Boehl, how would you describe asset management?

It is a management system that focuses organizations on their purpose and what their priorities must be. It also enables to better create assets in line with stakeholder and business requirements so optimized investment decisions for the life of an asset can be made. As a system, it becomes an enabler for the critical line of sight of communicating direction, priorities, risk management and outcome focus between executive management, middle management and the workforce as a two-way street. It creates the environment that fosters cooperation and specific collaboration across all functions in an organization that are involved in the development, creation, sustainment and optimization of assets and their value to the stakeholders.

Q. Why is asset management important to organizations and the market(s) they serve?

The intrinsic focus on business and stakeholder critical outcomes creates the common framework for responsive decision-making during the useful lifecycle of assets. This enables the reliable provision of services or products at optimum unit cost. Managing assets in this way creates not only a stronger competitive position and potentially increases market share, it also gives investors incentives to support such organizations.

Q. With asset management playing such a critical role in today's industry, why was this not in practice long before now?

Assets were managed successfully over the last couple of millennia. The Industrial Revolution of the 19th century created a different dynamic within industry. This trend has accelerated through the ever-increasing speed of changing demands in a global market and now through new technology. Today's larger organizations serving the larger markets require better structures to remain profitable and effectively deliver the goods and services stakeholders and consumers require.

Q. What is new in the area of asset management? What changes have you experienced?

What is new is that the ISO55000 series describes what asset management is all about and provides common reference for the constituent parts of asset management and the asset management system. It is through this standard and the competencies defined in the asset management landscape that publicly accountable organizations, in particular, have started to look at their long-term vision and planning. It is notable that the power, water and transport industries have begun to transform their ways of managing current assets and how to justify investment.

Q. The Industrial Internet of Things (IIoT) and artificial intelligence are making significant breakthroughs in the industry. How has this affected asset management in the organizations that are utilizing this technology?

Through the rapidly increasing computing power, there is greater tendency to use and emphasize analytics and analytical interpretation of data. New sensor technologies enable more and better collection of data that should be fully aligned to business needs and provide the basis for the analytical aggregation of the raw data. Asset management potentially receives a boost through this technology as the considered data analytics enable the creation of a better foundation for decision-making across the business and asset lifecycle. OPEX, as well as CAPEX, optimization should result, as well as greater transparency in asset governance and management.



Q. What is the relationship between competitiveness and profitability in asset management?

An organization can be competitive, but at the same time, may not be profitable. A well-defined and designed asset management system enables the creation of a balanced outcome in respect to both competitiveness and profitability. It enables the optimization of strategic, organizational and tactical activities through the strategic asset management plan (competitiveness) and the asset management plan (profitability). One describes the business direction and, therefore, identifies objectives for assets and their management. The other identifies the cost of operations and managing the assets, directly influencing asset and organizational performance and, through that, the profit margins.



Q. How is that relationship related to risk management?

All activities undertaken in business bear inherent risk. Managing risk could be seen as the key requirements in managing any business. The statement of competitiveness an organization may wish to adapt in the market, therefore, requires careful identification and appropriate management. On the other hand, profitability is directly influenced by this vision for the competitive place, hence, the decisions taken to boost one or the other can lead to undesired outcomes. Balancing the competitiveness versus the profitability desired can be positively influenced by a well allied asset management system.

Q. In 10 years, where do you see asset management? What benefits will result from the present-day asset management strategy?

Reflecting on today's uptake of an ISO55000 based asset management system, I think infrastructure and public utilities are on the forefront of asset management expertise and success in the future. It should provide full transparency of spending public funds that ratepayers and taxpayers desire and enable justified investment in these assets and services according to public need. In private business, a similar benefit could be achieved through a change from short-term planning to a strategic view of the business, fostering adaptive thinking in management to consistently improve outcomes based on the foundation of the asset management system.

Q. How has the Internet of Things (IoT) changed modern asset management strategies?

IoT devices could have a profound impact on the development and implementation of asset management strategies. It allows asset managers to move away from a sole reliance on inspection based modeling techniques to the use of real-time data to support real-time decision-making. The same accurate, real-time data can be used to support the development of accurate asset investment and renewal plans through regular updates of asset degradation models. Asset management strategies need to take into account how IoT devices can be integrated into major infrastructure assets and how the capacity of IoT devices to add unprecedented levels of accuracy can be integrated into maintenance strategies.

Q. How could a utility or company in the infrastructure industry benefit from using IoT techniques?

Implementing IoT devices within existing or new infrastructure assets will allow owners and operators to continually enhance asset performance. Reliability, availability and the cost of maintenance can be all improved through the use of data generated by IoT devices. IoT devices, providing real-time information on asset performance, allow owners and operators to optimize maintenance practices, aligning activities to the demands of



the asset. Owners and operators are also well placed to continually adjust maintenance practices to support optimal reliability, availability and cost outcomes as the asset ages.

Q. What challenges do companies most often face with integrating IoT techniques?

The implementation of IoT devices into new and existing assets is often a complex engineering task. However, the greater challenge is the ability of the asset owner to adopt existing asset management and maintenance practices to utilize the data created by the IoT devices. Data is useless if it is not utilized. Utilizing data means a reengineering of the internal business processes to support the effective use of data to drive asset performance outcomes. If asset owners and managers cannot make effective use of the data created by IoT devices, they risk overcapitalizing from investing in technology that does not deliver a return.

Q. Could you explain the concept of a digital twin and why it's important for businesses?

The digital twin or 3-D platform is used to analyze/interpret data that are captured by digital tools. By doing so, you are transforming data into information and then creating knowledge and identifying insights that are essential to business decisions.

Here at SNC-Lavalin and Atkins, digital means using new technology, combined with our engineering expertise and deep industry knowledge, to deliver greater insights to our clients. As a result, we are driving step change improvements for our clients and ourselves. We combine engineering expertise, deep industry knowledge, digital technology and data across the entire asset lifecycle to improve and consolidate the design, planning, construction, operation and maintenance of physical assets. This results in the transformation of data into insight, which drives:

- Enhanced engagement, decision-making and planning;
- Improved uptime, security and safety;
- De-risked projects and reduced CAPEX/OPEX.

Through a data-centric digital twin, we can provide greater insights about your assets, enabling us to test critical paths for the construction, installation, modification, or decommissioning of projects and scenario plans and models. For example, digital scanning creates a highly accurate 3-D environment of an asset through data capture. The generated digital twin can be used to understand the existing asset's condition, improve the design approach, verify the as-built situation and provide a digital snapshot for future works. Digital scanning includes a variety of technologies, each suitable for particular uses:

- Drones, which can be used for localized aerial surveying;
- 3-D sonar, a radiation tolerant underwater 3-D surveying technique with a seven to 20m range for general use where underwater 3-D mapping is required;
- Light detection and ranging (LIDAR) for high resolution mapping;
- Laser scanning and photogrammetry for the generation of 2-D and 3-D digital models;
- Thermal imagery for when contrasts are best exemplified outside the visible light spectrum.



Q. What emerging IoT trends and innovations should organizations follow most closely?

As developers, owners and operators integrate IoT devices within their assets, so there is a need to be very cognoscente of the direction and development of the market. Indeed, the IoT devices themselves need to be considered as part of the long-term asset management strategy. IoT devices will need replacing during the life of the asset, so technology obsolescence is a significant risk. As such, organizations implementing IoT devices need to carefully track the retirement of aging technologies. Likewise, new technologies will present opportunities to further enhance asset performance outcomes and how these new technologies are implemented will bring their own integration challenges.

Q. One of your passions is mentoring young female professionals in this field. Why is this important to you and what legacy do you want to leave with them?

It is important to me that we are communicating our experience in the business world to the upcoming generations. As a successful person in my field, I want to make sure that females see the way they can make a difference in the marketplace. Our challenges in the business world seem to be greater than for our male counterparts and it is through the success examples my colleagues and I can offer that we can strengthen our position and achieve the balance in gender involvement in industry and public service.

Q. Is there a book related to asset management that you would recommend? What is on your reading list?

From a long list of related topics in the wider field of asset management, there are, besides texts on economics and strategy, a small selection of books challenging critical thinking. A seminal reference book on asset management is "Physical Asset Management" by Nicholas Hastings. Of similar importance are "Creating Public Value" and "Recognizing Public Value," both by Mark H. Moore. Another related reading of significance is "Reinventing Prosperity" by Graeme Maxton and Jorgen Randers.



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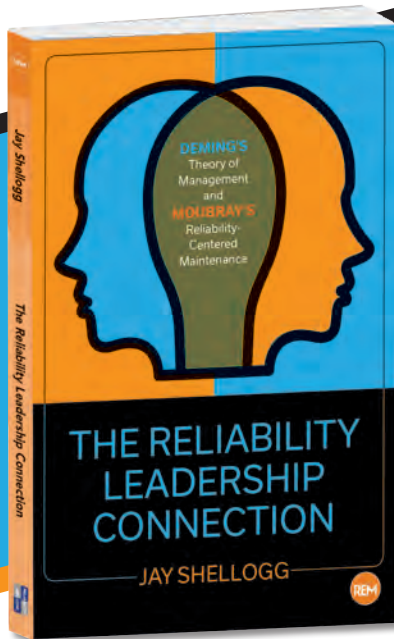


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THE RELIABILITY LEADERSHIP CONNECTION

BY JAY SHELLOGG • REVIEW BY JOEL LEVITT

Failure isn't just an option, it is inevitable. You design, build, install, operate and maintain your assets, but they still fail. The only things you can do are mitigate the consequence of failure, postpone the failure, or detect that the failure has begun. In *The Reliability Leadership Connection*, Jay Shellogg's point is to be realistic from the conception of an asset to its disposal.

Shellogg is clearly a fan of W. Edwards Deming and John Moubray. *The Reliability Leadership Connection* is a great review of the work of Deming and its relevance to maintenance today. The book also weaves in the work of Moubray and his RCM II.

The 14 principles of Deming are well worth restudying because it looks to me like we have not learned much since 1950 when he first published them. Shellogg has a great handle on reliability-centered maintenance (RCM) and introduces several ideas that go well beyond the seven questions of RCM and were new to me.

He distinguishes between two types of failure cause development. This is useful because, depending on the cause development, there are two paths to pursue. Normal wear and tear would require analysis of the P-F curve to look for a usable interval (or a sensor that could detect it in time). If the failure is sudden, from say, misoperation, then mitigation might involve policy, procedure, or a poka-yoke approach.

A couple of ideas that Shellogg mentions stand out. Human senses are capable of detecting 80 percent of the failed state and 80 percent of failures are random as to time (not related to elapsed time). His concept that reliability requires a strategic vision and cannot be achieved by picking and choosing tactics from the RCM tool belt has resonance.

The idea that started me thinking the most is that the criticality of the machine has nothing to do with the frequency of preventive maintenance (PM), but has everything to do with answering the question of whether PM is worth doing in the first place.

Much of the book concerns culture change. Shellogg goes deeper into culture change with a set of provocative questions. I think these questions are at the core of some of the intractable maintenance problems we face:

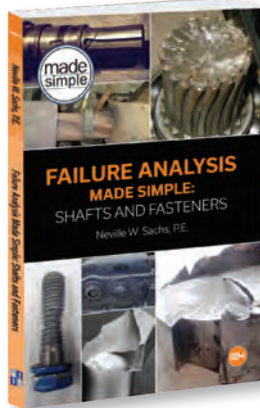
1. What do you want your asset to do? Seems simple, but it is important to pin down. Many times, the expectations are what get us into trouble. Shellogg goes on to say that you should consider what you wanted from the asset when you bought it.

2. What are the assets capable of providing? The issue here is if you are realistic, the gap between the answers to both questions may be the source of the need to change.

Shellogg's approach to reliability leadership, supplemented with clear examples, provides for some easy reading and thought-provoking ideas. I highly recommend the book to anyone who wants to discover why organizations fail to meet their goals and what has to change in order for them to do so. All levels, from management to craftspeople, and all departmental staff, from marketing to shipping to accounting and HR, will benefit from the information contained in this book.

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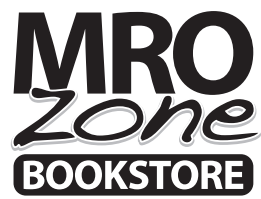
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