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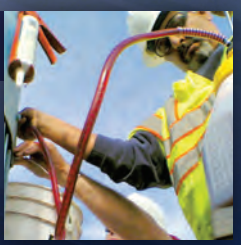

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COURSE	WHO SHOULD ATTEND	YOU WILL LEARN HOW TO	DATES & LOCATION	DAYS/CEUs	COST
Lean Maintenance (Delivered by Joel Levitt)	All levels of maintenance personnel, including Supervisors, Planners, Managers, Engineers and Maintenance Workers	Effectively eliminate waste in maintenance operations and projects, and use tools and processes to create a Lean organization.	Mar 11-13, 2014 (CHS) Aug 5-7, 2014 (CHS)	3 consecutive days 2.1 CEUs	$1,495
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.	Apr 8-10, 2014 (CHS) Sep 30-Oct 2, 2014 (CHS)	3 consecutive days 2.1 CEUs	$1,495
Maintenance Planning and Materials Management	People working in all areas of cross-functional support in a plant	Develop Maintenance Planning and Scheduling and MRO Management objectives and targets to achieve reliability goals.	Aug 19-21, 2014 (CL)	3 consecutive days 2.1 CEUs	$1,495
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.	Mar 31-Apr 4, 2014 (HOU) May 12-16, 2014 (CHS) Jul 21-25, 2014 (CHS) Sep 15-19, 2014 (HOU) Visit website for more dates	5 consecutive days 3.2 CEUs	$2,495
Operator Care (Delivered by Joel Levitt)	Production Supervisors, Operations Managers and Personnel, Maintenance Supervisors and Personnel, Team Leaders, Lean Implementers	Improve production performance and asset reliability with an Operator Care program. Make data-driven decisions to create effective Operator Care tasks and achieve operational stability.	Feb 25-27, 2014 (CHS) Apr 8-10, 2014 (CL) Sept 9-11, 2014 (CHS)	3 consecutive days 2.1 CEUs	$1,495
Planning for Shutdowns, Turnarounds and Outages (Delivered by Joel Levitt)	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.	May 20-22, 2014 (CHS) Oct 21-23, 2014 (CHS)	3 consecutive days 2.1 CEUs	$1,495
Predictive Maintenance Technologies (Delivered by Keith Mobley)	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.	Apr 22-24, 2014 (CHS) Jun 24-26, 2014 (CL) Sep 9-11, 2014 (CHS)	3 consecutive days 2.1 CEUs	$1,495
Problem Solving	Front-line Supervision, Quality Personnel, Team and Business Unit Leaders, Area Managers, Support Staff, Process Operators	Select and apply effective problem-solving methodologies and resolve problems that limit performance using five data analysis tools.	Mar 11-13, 2014 (CHS) Aug 19-21, 2014 (CHS)	3 consecutive days 2.1 CEUs	$1,495
Prosci® Change Management Programs	Executives and Senior Leaders; Managers and Supervisors; Project Teams; HR and Training Groups; Employees	Build internal competency in change management. Deploy change management throughout your organization. Become licensed to use Prosci's change management tools.	Contact us to schedule a private onsite class.	Sponsor: ½-day Coaching: 1-day Orientation: 1-day Certification: 3-day	Contact us for pricing
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.	Mar 11-13, 2014 (CL) Mar 25-27, 2014 (CHS) Aug 19-21, 2014 (CHS)	3 consecutive days 2.1 CEUs	$1,495
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.	SESSION 1 DATES: Mar 25-27, 2014 (CHS) Jun 10-12, 2014 (CHS) Sep 16-18, 2014 (CHS) (Sessions 2-4 dates are available on the website)	12 days total (4, 3-day sessions) 8.4 CEUs	$5,995
Reliability Excellence Fundamentals	Personnel involved in applying or are impacted by Reliability Excellence, and people who influence business process improvement.	Experience the fundamental concepts of Reliability Excellence in order to drive performance improvement efforts within your organization.	Feb 25-27, 2014 (CL)	3 consecutive days 2.1 CEUs	$1,495
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.	Apr 29-May 1, 2014 (HOU) Sep 23-25, 2014 (CL) Nov 4-6, 2014 (CHS)	3 consecutive days 2.1 CEUs	$1,495
Root Cause Analysis	Anyone responsible for problem solving and process improvement	Establish a culture of continuous improvement and create a proactive environment. Manage and be able to effectively use eight RCA tools to eliminate latent roots and stop recurring failures.	Apr 29-May 1, 2014 (CHS) Jul 29-31, 2014 (CL) Oct 7-9, 2014 (HOU)	3 consecutive days 2.1 CEUs	$1,495

***LOCATION CODES:** (CHS) = Charleston, SC | (CL) = Clemson University | (HOU) = Houston, TX | (UA) = University of Alabama

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PERSONAL RELIABILITY WILL TRANSFORM YOUR LIFE

On a scale of 1-10, how would you rate your own personal reliability? Before you answer – take a moment and think about the most reliable people you know. How do they rate? What traits describe them?

Here is how I describe the most reliable people I know:

1. They keep their word.
2. They take responsibility for actions and outcomes in their life.
3. They can be trusted and relied upon.
4. They communicate with respect even when disagreeing.
5. They spend time improving their knowledge and experience.

Reliability does not begin with your spouse. It does not begin with your friends, it does not begin with your co-workers and it does not begin with your boss. Reliability begins with you.

Do you keep the commitments that you make to yourself? Do you take responsibility for your own actions and the outcomes generated in your life? Do you communicate when you see something that needs to be talked about or do you use silence, withholding and withdrawal as a tactic? Do you invest time and energy in developing your own knowledge and experience?

OK – now go ahead and rate your own reliability on a scale of 1-10.

If you score anything under 10, then you can use ***reliability*** to lead transformation in your own life – which will transform ***reliability*** in your relationships and will transform ***reliability*** in your organizations.

Here are some suggestions for improving your personal reliability score:

1. Keep your word.
2. Clean up the mess when you don't keep your word.
3. Take full responsibility for the outcomes in your life.
4. Communicate (with respect) when you know you should.
5. Improve your knowledge and experience.
6. Bring people with you on your journey – they may not travel with you right away, but keep inviting them anyway.

The team at *Uptime Magazine* has the privilege of meeting and learning from hundreds of high reliability people each year, but none more so than the special group of Uptime Award-winning Program. Each and every Uptime Award-winning Program reflects the values and performance of the Association for Maintenance Professionals (AMP) Certified Reliability Leaders who value the triple bottom line of *Economic Prosperity, Environmental Sustainability and Social Responsibility*. You can find out more about these leaders inside this issue or watch for online videos about their programs at Reliabilityweb.com.

Inside this issue you can also read about the new Certified Reliability Leaders (CRLs) who sat for the exam hosted by the Association for Maintenance Professionals (AMP) at IMC-2013. We congratulate each new leader!

The team at Uptime is proud to be contributing members of the maintenance reliability community and we hope we can meet you in person and learn how you are achieving high reliability. We have a number of events planned at the Reliability Leadership Institute in Fort Myers, Florida, as well as RELIABILITY 2.0 Las Vegas, Solutions 2.0 in Bonita Springs, Florida, or IMC-2014 the 29th International Maintenance Conference in Daytona Beach, FL, or at one of the AMP Reliability Leader Tours.

Thanks for reading *Uptime*.

Warmest regards,

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New International Standard for Asset Management Published

Uptime Magazine publisher Terrence O'Hanlon reports that after a three year international development effort that included hundreds of people in 28 countries, ISO has announced the publication of a new series of Asset Management standards. ISO55000:2014 Asset management — Overview, principles and terminology provides an overview of asset management, its principles and terminology, and the expected benefits from adopting asset management. ISO55001:2014 Asset management — Management systems — Requirements specifies requirements for an asset management system within the context of the organization. ISO55002 Asset management — Management systems — Guidelines for the application of ISO 55001 provides guidance for the application of an asset management system, in accordance with the requirements of ISO 55001.

ISO (International Organization for Standardization) is the world's largest developer of voluntary International Standards. International Standards give state of the art specifications for products, services and good practice, helping to make industry more efficient and effective. Developed through global consensus, they help to break down barriers to international trade. "These ISO Asset Management standards will focus organizations and asset owners on delivering value from assets," states O'Hanlon, "and we think that reliability enables asset management. According to the standard, leadership plays a large role in delivering performance and the new Certified Reliability Leaders (CRL) from the Association for Maintenance Professionals is in perfect alignment for teams that plan on making asset management a priority in the future."

You can preview and purchase ISO standards in a number of document formats at **www.iso.org.** For guidance on asset management visit the Association for Maintenance Professionals at **www.maintenance.org.**

Reliabilityweb.com and Uptime Magazine Announce 2014 Events

CRL Workshop & Reliability TOUR
Cincinnati MSD
Cincinnati, Ohio
May 14-15, 2014

CRL Workshop & Reliability TOUR
National Ignition Facility
Livermore, California
June 18-19, 2014

CRL Workshop & Reliability TOUR
TBD
Nashville, Tennessee
October 1-2, 2014

RELIABILITY 2.0
South Point Hotel, Casino & Spa
Las Vegas, Nevada
April 7-11, 2014

Solutions 2.0
Hyatt Regency Coconut Point
Bonita Springs, Florida
July 28 - 31, 2014

IMC-2014
Hilton Daytona Beach
Daytona Beach, Florida
December 8 - 12, 2014

www.maintenanceconference.com

The Certified Reliability Leader Exam Launched at IMC-2013

The Association for Maintenance Professionals (AMP) recently introduced the Certified Reliability Leader (CRL) Exam, an exam and certification based on the Uptime Elements and it's Reliability Leadership system. The first exam was provided at IMC-2013, December 10-13 in Bonita Springs, FL. History was made with sixty-one Reliability Leaders becoming certified, moving AMP closer to its goal of creating 1,000 Certified Reliability Leaders by December 2014.

See page 29 for the list of the first CRLs. To learn more and to become a part of history, visit **www.maintenance.org.**

Certified Reliability Leader Complete Body of Knowledge Now Available

The Certified Reliability Leader System focuses on whole life asset management decisions and whole life value delivery through leadership. The system provides guidance in applying its principles early into the asset's lifecycle, rather than in the typical operate and maintain asset lifecycle phase that most organizations employ. It is a map of theory, to engage and empower every stakeholder in your organization as a Reliability Leader.

The CRL Body of Knowledge is designed to create leaders who focus on delivering value to the triple bottom line of:

- Economic prosperity
- Environmental sustainability
- Social responsibility

The body of knowledge includes:

1. *The Certified Reliability Leader Travel Guide*
2. *The Certified Reliability Leader Passport series*
3. *Don't Just Fix it, Improve It!* by Winston Ledet, Winston J. Ledet and Sherri Abshire
4. *Level 5 Leadership at Work* by Winston Ledet, Michelle Ledet Henley and Sherri Abshire
5. *People: A Reliability Success Story* by Cliff Williams
6. *Clean, Green & Reliable – A Sustainable Reliability Guide for Industrial Plants* by Douglas Plucknette and Chris Colson

Visit www.mro-zone.com to place your order today!

Uptime® Awards

Best Maintenance Reliability Programs 2013

Dragan Trivanovic with Zellstoff Celgar Limited Partnership accepts the Uptime Award for Best Operator Driven Reliability Program

Uptime Magazine congratulates the following outstanding programs for their commitment to and execution of high-quality Predictive Maintenance and Condition Monitoring Programs.

To read more about each company, download the Uptime Award Winners' stories at:

uptimeawards.com

Metropolitan Sewer District of Greater Cincinnati

To implement its strategic maintenance reliability plan that supports its mission and vision, MSD's WWT division has shifted towards a team-based approach and created a group of change agents called the positive energy (pE) team. The team is composed of champions (crafts, crew leaders, supervisors and reliability engineers) who have volunteered to participate with positive energy in implementation activities. The implementation activities are carried out through chartered sub-teams composed of selected pE team members and other division staff.

Over the past 1-½ years, the pE team and chartered sub-teams completed two RCM studies, created a centralized predictive maintenance function, purchased and implemented predictive maintenance technologies, including laser alignment, adopted advanced planning and scheduling practices, performed a lubrication practices audit and provided go-live support to a Maximo 7.5 upgrade. The team also created the "Find of the Week" to highlight positive work performed by staff, completed over 20 training workshops and gave numerous program updates at the semi-annual State of Plant Process Maintenance presentation at each treatment plant.

Since 2012 to date across 7 plants, efforts of implementing best practices have increased proactive maintenance hours by 24 percent. Increase in reliability by 33.6 percent, reduced downtime by 23.6 percent, work order cost reduction of over $500 thousand and cost avoidance of $650 thousand due to proactive maintenance activities. Monthly emergency failure rate has decreased by 55 percent including 67 percent scheduling success.

Charlie Becker, Kevin Cunningham, Mike Duffy, John Feist, Jaclyn Gandee, Tom Goodman, Rob Johnson, Rick Meade, Brent Merwin, Brent Miley, Zeno Perry, Bob Smith, Eric Stevens, John Shinn Jr, and not pictured Doug Little and Mike Mueller.

Hibbing Taconite Company: Managed by Cliffs

Driving a sustaining culture of reliability and pushing Hibbing Taconite to achieve new levels of excellence is the leadership within the reliability department and site upper management. This top-down reliability maintenance approach enables site reliability engineers to develop strong competencies in asset management technologies and enhances the development and training of personnel who operate and provide maintenance on the floor.

From left, front row: *Daniel Othoudt, Daniel Mackey, Daniel Lerick, Carissa Butterfield, Nick Maki, Jonathan Eng*
Back row: *Craig Maki, Dana Koth, Chris Rootes, Tony Paleri*

An emphasis on predictive technologies has turned the maintenance organization from reactive to proactive. Training in asset condition monitoring technologies and the continual development of reliability competencies are standard practices for reliability engineers and to develop the craft workforce.

Preventive maintenance is a key metric monitored within all departments. Assets on the site are continually reviewed for opportunities to increase reliability through Cliffs's engineering maintenance tactics process. The workforce is engaged to probe for new ideas on how to gain more value in the process and also build ownership with equipment. The results of the process improve the ability to identify work accurately, increase equipment reliability and enhance throughput/availability/performance of the assets.

Reliability at Hibbing Taconite is a culture that seeks continual improvement of its assets and the workforce. The maintenance reliability team uses a tried and true maintenance system to provide reliable equipment that ensures the safety of employees, protects the environment, meets the production needs of Hibbing Taconite and generates sustainable bottom line results.

TransAlta Corporation Alberta Thermal Power Plants

The condition monitoring program at TransAlta Alberta Coal consists of three parts: excellence in knowledge and skill; communication of the knowledge; and communication of equipment and production loses prevented to show how condition monitoring has and can save money.

The condition monitoring team is responsible for doing the vibration testing and analysis on approximately 1,700 pieces of equipment at the Sundance and Keephills coal-fired power plants, as well as the rotating equipment at a 6,800 gpm water treatment facility and a fly ash sales facility that sells in excess of 350,000 tons of ash annually.

The program also includes taking an average of 2,200 oil samples per year from rotating equipment; thermography on 2,000 pieces of electrical and rotating equipment; electric motor on and off line testing of approximately 300 motors; transformer oil analysis on critical transformers; and ultrasound testing.

The program's motto is: We may lack enough evidence to predict an equipment failure, but we will never predict an equipment failure because of lack of evidence. It is attention to being right all of the time that has helped drive the growth of the condition monitoring group. Very seldom is an equipment call made without using at least one other technology to verify the concern.

The results of the TransAlta condition monitoring program has led to it becoming a very integral part of the maintenance processes.

From left: *Mark Kumar, Dwaine Thomsen, Dale Rowswell, Gilles Martin, Kirby Engelking, Harvey Henke, Darren Hum, Don Beisel*

Zellstoff Celgar Limited Partnership

Zellstoff Celgar's operator driven reliability (ODR) program began in the middle of 2010 with the main objective of involving the operations department in some of the maintenance activities. This would free up maintenance resources to focus on more advanced preventative and predictive maintenance strategies.

The success of the program required full support from the management team and operations department. Both recognized the value of a proactive approach and their support and endorsement was received.

In building the program, no one knows the equipment better than those operating it every day, so involvement of the operations team was fundamental to building the routes, inspection schedules and procedures.

Now three years later, the pilot project on one machine has been expanded to four other areas. Through the ODR schedule, 400 machines are currently inspected per week, with an average of 37 follow-ups resulting. This new inspection process has changed the way maintenance work priorities are defined and how the PdM group functions. Technicians spend much of their time on follow-ups identified through the ODR program and continuous monitoring systems, rather than on standard route-based data collections. The overall result is earlier detection on worn and failing equipment and a high level of operator ownership.

The program's future includes expansion to all mill areas, implementation of ODR through the automated diagnostic system and a target of zero unpredictable failures.

Utilities ODR, from left: *Dave Ingham, Jamie MacDougall, Ken Hunter-Oglow, Perry Parker, Pat Farrell, Steve Torres, Keith Girling, Dragan Trivanovic*

Machines ODR, from left: *Jim Zwick, Ken Johnson, Larry Walker, Dragan Trivanovic, Dave Ingham, Dough Raoul*

Compañia Cervecera de Puerto Rico

Reasonable investments for a greener future at Compañía Cervecera de Puerto Rico brewery started with the development of the company vision in terms of energy management. In developing a strategic plan, five main challenges were identified: (1) Increase of prices of raw material, energy and transportation; (2) Help relieve worldwide shortage of water; (3) Stay competitive; (4) Reduce carbon footprint; (5) Reduce total operational costs.

The approach used to overcome these challenges is based on the beliefs that green power is only truly green if used efficiently; sustainability is not simply about saving the planet, but about the environment, business and society; and energy efficiency is a by-product of reliability.

The successes of the Compañía Cervecera de Puerto Rico green reliability program include: reducing environmental impact by 94 percent; reducing water consumption 67 percent; using only natural refrigerant ammonia for sustainable and environmentally-friendly solutions; reducing waste water discharge by half; reducing thermal energy consumption by 42 percent; and reducing total energy consumption by 40 percent.

The program has also reduced waste water treatment plant maintenance costs by 70 percent and waste water treatment plant power consumption by 35 percent. Through the green reliability program, a multi-technology condition-based maintenance program has been implemented, yielding an 86 percent reduction on total cost for the ammonia system.

From left, back row: *Ramon Vasquez, Marlon Cabrera, Carlos Kelly, Ricardo Jeremias, Carlos Arroyo, Felix Manuel Laboy*
Front row: *Jonathan Ramirez, Wanda Serrano, Miguel Marrero, Maria Contreras*

Ethanol Greenfield Quebec Inc.

Reliability has played a key role in the development of the GreenField Ethanol plant in Varennes, Quebec, which went into operation in February 2007. Predictive technologies were introduced and a CMMS system implemented.

Over time, the foundation of the reliability program has been reinforced by adding numerous elements, such as new predictive tools; a planning and scheduling process; a continuous improvement team based on world-class maintenance practices; precision maintenance; PM and PdM optimization; execution and control of work; failure analysis and prevention; equipment management; CMMS improvement; and employee skills development. Moreover, continuous improvement methodologies have been adopted. The reliability process is also characterized by the elimination of waste and non-added value operations. KPIs and information analysis techniques make it possible to see patterns emerge and take action before problems occur.

From left: *Nelson Kenny, Jonathan Leduc, Georges Duhamel, Jonathan Dion, Mathieu Fyfe-Leblanc, Frederic Laperriere, Martin Hamel, Yvan Dalpe, Patrick Petrin, Frederic Thivierge*

The reliability process is reassessed annually using a rigorous method. The annual business plan is based on the results of the assessment in order to maintain gains and minimize weaknesses. In the last four years, a great improvement in adhering to the scheduling has translated into a significant drop in unplanned shutdowns, as well as a decrease in maintenance costs.

Despite good results achieved, there are still plenty of opportunities for improvement in the maintenance reliability program. The plant strives for excellence, which is not a short adventure, but rather an endless search.

Asset Man

Or, Maintenance Man

The development of PAS55, a British standard for supporting asset management, has had a very positive influence on various maintenance organizations. It's a good document, one which has been slowly evolving into ISO55000, scheduled for issue in early 2014. According to Terrence O'Hanlon, CEO of Reliabilityweb.com and Uptime magazine, and a member of the ISO standards committee for asset management, ISO55000 is a management systems standard for asset management.

Ron Moore

The point he makes is subtle, but critical. ISO55000 is not an asset management standard; it is a management systems standard. It provides nothing on how-to-do asset management, rather it simply provides the what-to-do elements for a management system (i.e., it characterizes a business management system that happens to relate to managing assets), with an emphasis on managing value creation and risk. Clearly, it's a business imperative for companies to manage their assets effectively, including intellectual property, human and physical assets. However, most seem to be focusing their interpretation of PAS55 and ISO55000 on managing physical assets and maintenance, in particular. While maintenance is an essential element in asset management, it is not sufficient and does not appear to be the intent of PAS55 and ISO55000. Indeed, O'Hanlon states emphatically that, "Asset management is not about managing assets. It is about ***delivering value*** to an organization through the ***effective utilization*** of its assets."

Asset management is not about managing assets. It is about delivering value to an organization through the effective utilization of its assets

BACKGROUND

With that introduction in mind, it's been my experience that most asset management strategies give far too much attention to physical asset management and maintenance, in particular, and not nearly enough attention to other issues that are even more critical to asset management, that is, ***delivering value through effective asset utilization.*** These strategies typically appear to be maintenance management strategies that have been "rebranded" as asset management strategies in an apparent attempt to make them more relevant to corporate executives. Asset management just sounds better at the executive level than maintenance management. This is particularly true for manufacturing plants and industrial operations. While maintenance is an essential element in asset management, it is simply not enough. The key questions that should be asked are: Does our asset management strategy substantially improve the performance of our assets in terms of their effective utilization and the value we create (i.e., quality production output)? At the lowest sustainable cost? With excellent environmental performance? At the lowest risk of injury and incidents? And perhaps other issues? The asset management strategies I've read do not answer these questions particularly well. And that is a major concern.

The Institute of Asset Management (IAM) has attempted to address some of these issues by publishing *Asset Management – An Anatomy.* It's a really good document, one I would recommend to anyone with an interest in the topic and in delivering value to the organization. For example, it states: "The tools and technologies may be helpful, but the engagement of the workforce, the clarity of leadership, and the collaboration between different departments and functions are the real differentiators of a leading asset management organization." I couldn't agree more.

agement?

agement, Rebranded?

At the same time, however, it seems the document is maintenance-centric. It states that, "The enduring objectives of the GFMAM (Global Forum on Maintenance and Asset Management) are: To bring together, promote and strengthen the maintenance and asset management community worldwide." The inference here is that maintenance and asset management are very closely linked, perhaps even synonymous. Given the name of the forum, who will attend the forum? Given the enduring objective to promote and strengthen maintenance and asset management, who will help achieve that objective? It's highly likely, as we've often seen, that only maintenance people will take an interest in this issue and this is simply not sufficient! A better name for the forum would be the Global Forum for Asset Management, *with a mission to align marketing, design, procurement, operations and maintenance to deliver value through effective asset utilization*. This would convey, in simple terms, a very comprehensive approach to asset management and express a key objective of ISO55000, to deliver value.

The IAM document also has a section on reliability, availability and maintainability (RAM). Clearly, these are essential to effective asset management. However, a key issue is missing for manufacturing and industrial plants – operability. Without effective operating capability and practices, it will be very difficult for maintenance to effectively manage the assets and provide high reliability and availability. And, these must be designed should be added to create ROAM – reliability in the design, providing for operability, availability and maintainability through the life of the assets.

Reinforcing my concern are all the webinars, workshops, papers and other communications that mostly link ISO55000 to:

a. Using a computerized maintenance management system (CMMS) or an enterprise asset management (EAM) system to do proper asset management;
b. Applying proper maintenance work management, planning and scheduling, preventive and predictive maintenance;
c. Using reliability centered maintenance (RCM) in asset management or a host of other tools for asset management.

Unfortunately, most of these are traditional maintenance management tools and do not address the issues around business requirements, or design and operating practices.

No doubt the formal issue of ISO55000 will be a boon to maintenance consultants. Perhaps this is appropriate. However, it will not achieve what is expected by focusing on maintenance. The defects that result in poor asset management typically come from marketing, design, procurement and operations, and these will overwhelm the ability of the maintenance department to effectively manage the assets for delivering value. At best, organizations will end up doing work they should not be doing in the first place more efficiently; work that could be eliminated with a more comprehensive approach to asset management. What a proper asset management strategy should be is a point of departure for senior executives to align their organizations for the effective utilization of the company's assets to deliver value and mitigate risk.

As noted above, *Asset Management – An Anatomy* states that: "The tools and technologies may be helpful, but the engagement of the workforce, the clarity of leadership, and the collaboration between different departments and functions are the real differentiators of a leading asset management organization." Let's explore how we might do this.

GUIDANCE FOR DEVELOPING AN EFFECTIVE ASSET MANAGEMENT STRATEGY

These suggestions are provided as guidance regarding the aforementioned issues and generally focus on large manufacturing and industrial operations (e.g., refineries, chemical plants, primary metal plants, paper mills, power stations, automotive plants, mining operations, etc.). While they may apply, these suggestions are not necessarily intended for institutional facilities (e.g., airports, hospitals, schools, railroads, etc.). Although ISO55000 describes many phases in developing an asset management strategy (e.g., need, plan, design, create, operate/maintain, renew/dispose), I'd like to give particular attention to the phases related to need, design, operate and maintain.

Business Requirements for the Assets. An asset management strategy begins with the organization's needs and its related strategy and plan for achieving its goals, and then supports delivery of the value associated with the plan. For any asset management strategy to be effective, it must first clearly define the business requirements for the assets in the coming years, that is, in one, five and ten years, and even longer depending on the business situation. This will require input from senior executives of the organization, marketing and sales, and perhaps others. This should be the very first issue that is addressed in any asset management strategy. After all, how can we develop a strategy if we don't first understand the business requirements for the assets? For example, if I plan to shut down an operation in the next two years, it will have a very different asset management strategy than if I plan to run the operation for the next 10 years and double the business volume every five years. All but one of the strategy documents I've read omitted this essential requirement. The latest draft of ISO55000 indicates that the asset management strategy is an input to the organization's strategy and business plan. Later in the section on planning properly, it states that the organization's asset management objectives should be derived from its strategic plan and should translate the organizational objectives into specific asset management objectives. Certainly, it's an input, but I strongly believe that the organization's strategy and business plans should drive the asset management strategy – that's where the asset management strategy begins.

Current Asset Performance vs. Business Requirements. Most of the asset management strategies I've read do not include a requirement to measure and/or analyze current performance against the assets' requirements. This analysis should include a gap analysis and appropriate plans for improving current performance. For example, if asset utilization (AU) or overall equipment effectiveness (OEE) is lacking, it should be improved before any additional capital expenditures are authorized for increasing capacity. The exception to this might be authorizing new capital for improved technology that is more efficient, or manufacturing new products that require a change in design to the equipment. The question is: Are we effectively using the assets we have? Before we authorize additional capital, we must assure excellent performance in existing assets. Manufacturing companies often authorize additional capital for increasing capacity when existing assets, if operated well, would provide for additional capacity requirements.

Capital Projects Role in Asset Management. Moreover, the typical asset management strategy does not include the role of the design and capital projects function in the management of the assets, particularly those that are planned, including the application of lifecycle principles as opposed to the more common approach of having the lowest installed cost. It will be very difficult to effectively manage new assets if they are poorly designed for the intended service and business needs, and fail to consider lifecycle cost and performance implications. This will typically require a new statement of corporate policy and the development and implementation of those standards and practices related to applying lifecycle principles. As previously noted, the business should not be spending money on new assets until the existing assets are performing at a high level.

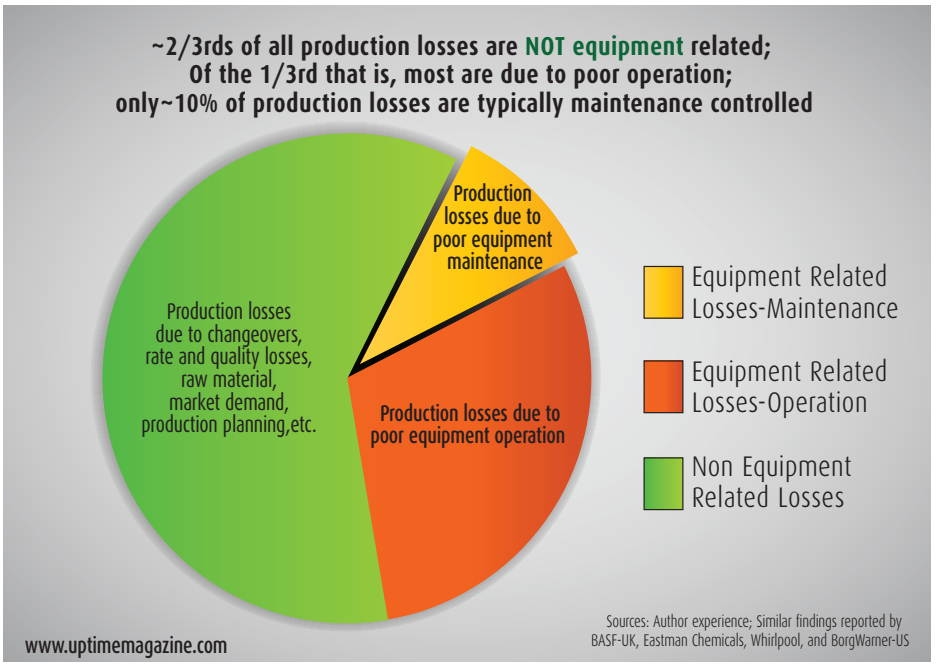


Figure 1: Causes of production losses

Operations Role in Asset Management. Typical asset management strategies mention operations' role only in passing, if at all. But if you don't have strong leadership from operations in managing assets, you will not have good asset management or performance, irrespective of how well maintenance is done. In about 90 percent of the industrial operations

I've seen, some two-thirds of production losses have nothing to do with equipment. These losses relate to other issues, such as product or raw material changeovers, poor production planning, rate and quality losses, short stops, inadequate raw material quantity and quality, and market demand. Of the one-third that is related to equipment failures, some two-thirds of that is caused by poor operating practices. For example, there are typically poor startup and shutdown practices, failure to operate the equipment per the standards required, running the equipment beyond its inherent capability, inconsistencies in operation across shifts, and a general lack of basic care and sense of ownership. Figure 1 illustrates this.

Reinforcing this view is the following data:

- The Japan Institute of Plant Maintenance (JIPM) reports that 70 percent of equipment failures are preventable by operators.
- A Fortune 500 manufacturer did 23 RCM analyses, identifying 1,864 tasks to minimize equipment failures – 1,260 tasks or 68 percent, were done by operators and 237 redesigns of process and/or equipment were required.
- A large chemical company did several failure mode and effects analysis (FMEA) at one of its plants, identifying 475 tasks to minimize equipment failures – 315 tasks or 66 percent were done by operators.

View your people as your most valuable asset

Given this data, how can you have an effective asset management strategy without operations leadership and operational excellence, particularly when maintenance only controls 33 percent of equipment failures and only 10 percent of the asset's total production losses?

Tools for Improving Asset Management. The typical asset management strategy makes little or no mention of the various tools that might be used for improving asset management and performance (e.g., Kaizen, total productive maintenance, RCM, root cause analysis, etc.). While condition monitoring is, at times, identified as an element in managing physical assets, it is not given sufficient prominence. Some 80 to 90 percent of assets have a random failure pattern associated with them, or a constant conditional probability of failure. The best way to manage random failures is to understand the failure modes and consequences of those failures, and then develop a comprehensive condition monitoring or inspection strategy to:

- Detect those pending failures early enough to manage their consequences;
- Improve the design for longer life;
- Design in redundancy so if the failure occurs, you still have functionality;
- Accept run to failure as a valid approach because the consequence of failure is minimal.

Of course, once a defect is detected, an excellent work management program, including excellent maintenance planning and scheduling, is needed to manage the consequences of the defect. This last issue is typically well covered by the asset management strategy of a given organization, but it's not nearly sufficient. Typically, more guidance is needed in the strategy document relative to the tools that will be used to assure effective asset management.

Executive Leadership/Sponsorship. Senior executives must play a strong leadership role in the development of the organization's asset management strategy, aligning the organization to its business purposes and providing the necessary resources, strategy and measures of success. What I have seen in most organizations is executives giving permission for asset management and then bowing out, expecting that it will happen. Permission is not the same as sponsorship. Once executives approve the asset management plan, they have an obligation to support it. That is, they must provide adequate resources in the form of money, people and training/skill development to assure the asset management plan can effectively deliver the results and associated value for the organization. These resource requirements and measures of success must be clearly defined in the asset management strategy.

Partnership Agreements. Different functional disciplines (e.g., operations and maintenance, purchasing and maintenance, or other departmental groupings) must develop partnerships that articulate how they are going to work together, along with appropriate measurements to assure assets are well managed and that value is delivered with minimal risk and cost. It also must be recognized that as task interdependence increases, teamwork and collaboration become increasingly critical for organizational effectiveness.

Human Assets/Intellectual Capital. It would be an error not to mention the management of human assets or intellectual capital. ISO55000 and PAS55 have often been interpreted to mostly relate to physical assets. It must be highlighted that ISO55000 deliberately omits the word physical asset to be more broadly applicable to all tangible and intangible assets within the organization. My strong recommendation is that you view your people as your most valuable asset, ones that are trained, developed, brought to maximum capability and routinely engaged in process improvement using periodic, structured improvement time. Doing so will require a strategic training and development plan, an assessment of current capabilities relative to business requirements, a plan for closing the gaps related to assuring superior performance and the measurement of the results. The culture of the organization also must be addressed. People do want to change if given a compelling reason for change, if there's something in it for them and if they participate in creating the changes so they have a sense of ownership, control and purpose. All three "ifs" must be addressed in creating a better organizational culture and more effective asset management.

SUMMARY

Most asset management strategies make a good start at creating an effective strategy, but are insufficient to assure excellence in asset management in a manufacturing plant, even if followed in a very disciplined and rigorous manner. Most asset management strategies are missing or only cover superficially the:

1. Requirements of the assets by the business in the coming years;
2. Current performance or state of the assets;
3. Supporting role of design and capital projects;
4. Leadership role of executives and at the next level of operations and the criticality of excellence in operating practices;
5. Tools for supporting effective asset management;
6. Resources required for implementing the strategy.

How can you effectively manage your assets when these issues are not fully addressed?

Ron Moore is the Managing Partner of The RM Group, Inc., in Knoxville, Tennessee. He is the author of Making Common Sense Common Practice: Models for Manufacturing Excellence, 4th edition and of What Tool? When? A Management Guide for Selecting the Right Improvement Tools, 2nd edition, both from MRO-Zone.com; as well as Business Fables & Foibles and Our Transplant Journey: A Caregiver's Story, and over 50 journal articles.

Reliability:

The Essentials for Eliminating Downtime of Your Electric Motor

Lola L. Williams

Downtime is the nemesis of any reliability manager. Every hour of your shutdown due to motor failure affects not only your internal operations, but your customers, your employees and potentially the community at large. Keeping the motor running safely and efficiently in your operation should be a primary goal. Jim Williams, a nationally recognized motor reliability expert and president of Bradleys, points out that, "Preventative maintenance and regular analysis of your motor's load test performance are essential keys to a reliable motor."

Figure 1: Bradleys ships a recently repaired and tested ultra large motor.

A critical success factor in the operation of your electric motor is to ensure the new or remanufactured motor is designed for the application or load. When a motor is put into an application that it was NOT designed to do, it will cause many kinds of repetitive repair issues that even the best preventative maintenance practices will not correct.

Proper evaluation of environmental conditions under which the motor will be operating reduces operating and capital expenditures on future planned and unplanned repairs. The more hostile the environment, such as the corrosive nature of the geographic region itself (e.g., the highly alkaline Gulf Coast region), the ambient air temperature and the actual corrosive or high particulate nature of the industry and actual plant conditions, greatly impact your motor's long-term reliability. Motors, like you and me, prefer moderate temperatures to operate, such as clean air and a relatively dry climate.

Figure 2: ALCOA windings covered in particulate

Motors breathe and require air free of particulates to reduce the opportunity for clogged inlets. Your motors will run cooler and last longer when they breathe clean air. In high particulate environments, such as mining, recycling and aggregate industries, filtration systems with several filters that step-down from large to small micron pores and have pressure differential gauges to monitor the filter occlusion are highly recommended. "Like a molecular sieve, the filtration systems effectively trap the various sizes of particulate without overwhelming the maintenance department," explains Williams. He suggests you have a particulate sample analyzed for micron size to optimize the efficiency and lifespan of each filter. Root cause failure analysis (RCFA) often finds that motor coil damage is caused by high operating temperatures over extended periods of time. As Williams advises, "An ounce of prevention is worth a pound of cure."

Keeping your critical spare motor in a climate-controlled facility specifically designed for storage of motors and equipment at 50 percent humidity at ambient temperature will assist you in resuming operations quickly.

Motors operating in highly corrosive environments, such as pump motors around cooling towers, require a few preventative measures to extend operating downtime intervals. Two part epoxy coatings on all exposed metal surfaces is recommended to protect the exterior from the highly alkaline and wet environment. Additionally, bearing isolators installed in the bearing housing will protect the bearings. Motor life span is generally five to 10 years with these preventative measures. Without preventative maintenance, they may survive six to 12 months.

Full or partial load testing of a critical motor prior to installation or storage is another preventative measure to verify motor

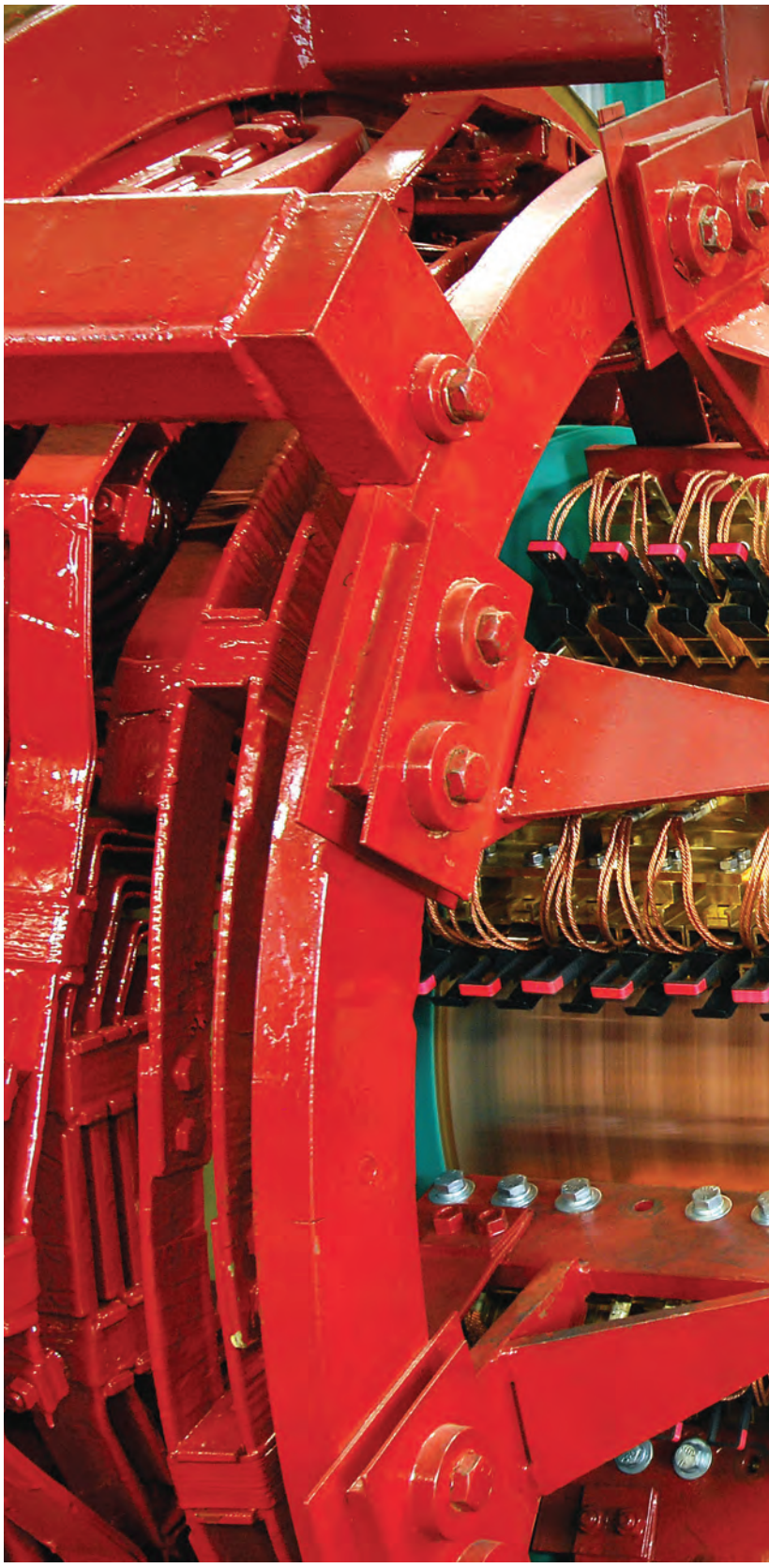


Figure 3a: Load test stand with VFDS

Figure 3b: Load testing monitors in Bradleys' control room

Motors with a history of excessive operating temperatures, high vibration, or an unexplained noise are c ommon driving factors for considering a load test

reliability. Motors with a history of excessive operating temperatures, high vibration, or an unexplained noise are common driving factors for considering a load test. They can be run from four to 24 hours, depending on the customer's specifications. Motors generally stabilize within the first four hours of run time, however, several operating functions of your motor can be analyzed over a 24-hour period. For example, performing a full load test for the motor and drive system up to 7000 HP at 720 RPM provides analysis related to the system's harmonic signature, as well as the impact studies of the motor system on a given distribution system.

A problem-free motor system starts with a good installation. Regardless of whether the motor drives a fan, pump, or compressor, a few basics are necessary to ensure a proper installation. The motor base must be cleaned and inspected for cracks. Oftentimes, motors are returned to the shop by a customer for load and vibration testing when the vibration is caused by a compromised motor base.

The shop's motor removal checklist verifies if the existing motor base is inadequate for the reinstall.

Once the motor is set on the base, the soft foot is adjusted to the industrial standard of 0.002 inches. The motor is then test run to verify rotation and the baseline vibration data is collected. The laser alignment is completed and the motor system is rerun to verify the loaded vibration. The final loaded motor system vibration test can be run from 30 minutes to several hours based on vibration history. Improper alignment causes vibration and short bearing life of both the motor and the driven equipment. Most problems originate with inadequate attention to shims and soft foot. The motor foot and base mounting surface must be clean.

The condition and the number of shims are critical. The rule of thumb is to use no more than five shims to reduce the sponginess of the shim stack. Be aware that between the base and the motor foot, toe and heel problems may exist, requiring partial shims or possible re-machining of the base and/or motor feet. Improper soft procedures can cause distortion of the motor frame, resulting in bearing misalignment and vibration.

A good monthly preventative maintenance program is the vital component to a healthy and happy motor. Based on the motor size and environmental conditions around the motor, the monthly program can change, but the three essentials are lubrication, vibration testing and changing filters. Five to 10 year preventative maintenance programs can include on-site services, such as dry ice blasting to remove heavy particulate loading of the intake vents and other components.

A good monthly preventative maintenance program is the vital component to a healthy and happy motor

The largest cause of failures of a motor in the right application is lubrication, which results in bearing failures. Several studies over the last 50 years have all revealed that a high percentage of motor failures are in the bearings due to lubrication issues. Bearings that never get lubricated account for most failures. Some of the subsequent issues are improper lubrication, incompatible lubrication and contamination of the lubrication. One of the highest returns for your maintenance dollars is to implement a comprehensive lubrication program for ALL of your rotating equipment, especially your motors.

Lola Williams is the Special Projects/Marketing Manager for Bradleys, Inc., a large electric motor repair, rewinding, load testing and field service maintenance company. Bradley's Inc. has served the nation's petroleum, petrochemical, manufacturing and mining industry giants for over 80 years. Her career has spanned two decades in industrial sales and marketing. She lives in Portland, Texas.

Cincinnati's Metropolitan Sewer District's

Maintenance Reliability Program Delivers Results

John Shinn, Jr. and Sam Paske

The Metropolitan Sewer District of Greater Cincinnati (MSDGC), Ohio, serves 800,000 customers and has approximately 600 employees who work at facilities located throughout Hamilton County, Ohio. The MSD Wastewater Treatment Division operates and maintains seven major treatment plants and more than 100 smaller treatment facilities that process an average of 180 million gallons of raw sewage per day. Most of the major treatment facilities were built in the 1950s and contain over 16,000 total discrete assets that are critical to meeting MSD's mission of protecting public health and the environment through water reclamation and watershed management.

THE CHALLENGE

MSD faces many of the same challenges other organizations face – tighter budgets, increasing regulatory requirements, retiring workforce (disappearing knowledge) and aging/degrading infrastructure. Like many asset-based organizations, MSD has a long history of operating and maintaining a complex, capital-intensive infrastructure. While MSD has a strong preventive maintenance program, the amount of corrective maintenance (CM), defined as repair work due to unexpected failures and associated system downtime, was undermining efforts for advanced operational strategies through automation and energy savings.

In 2007, MSD's Wastewater Treatment Division had put the initial elements of a modern asset management program in place, with an updated asset hierarchy, equipment strategies, modern planning and scheduling practices, and maintenance key performance metrics. The proactive work ratio had improved close to 50 percent, reliability was holding steady and predictive maintenance was being applied to critical assets. But the metrics showed that gains from the overall program had leveled off. MSD had made substantial progress by laying the foundation for improvement and was ready to take efforts to the next level.

THE SOLUTION

MSD resolved to refocus its efforts and started with its most important assets – its people. In late 2011, using an employee involvement process, MSD leadership engaged operations, maintenance and engineering staff to define the division's mission, vision, core values and strategic areas for improvement. The process identified five desired maintenance reliability outcomes:

- Increase proactive maintenance to shift from a reactive to a more proactive culture;
- Improve system availability/reliability and avoid forced outages;
- Reduce downtime by building internal predictive maintenance skills and improving the planning and scheduling process;
- Improve safety;
- Reduce reactive maintenance costs.

These desired outcomes became six strategic goal areas in which MSD focused improvement efforts: Focus on Core Business, Communication, Training, Reliability, Maintainability, and Maintenance Planning and Scheduling.

The mission, vision and strategic goal areas were then used to launch the implementation process through additional staff involvement. They are used constantly throughout the organization to help link the MSD's overall purpose to daily activities and changes to practices.

MSD uses a team-based improvement approach centered on a group of change agents called the positive energy (pE) team

MSD uses a team-based improvement approach centered on a group of change agents called the positive energy (pE) team. The team is composed of champions (crafts, crew leaders, supervisors and reliability engineers) who had volunteered to participate with positive energy in implementation activities. Chartered sub-teams made up of selected pE team members and other division staff carry out implementation activities. Over the past 1-½ years, the pE team and chartered sub-teams have:

- Completed two RCM studies;
- Created a centralized predictive maintenance function;
- Purchased and implemented predictive maintenance technologies, including laser alignment;
- Adopted advanced planning and scheduling practices;
- Performed a lubrication practices audit and go-live support of an upgrade to Maximo 7.5.

In addition, the team has created the "Find of the Week" communication to highlight positive work performed by the staff, completed more than 20 training workshops and presented numerous program updates at the semiannual State of Plant Process Maintenance presentations at each treatment plant.

At the onset of the program in 2011, MSD hired internationally-recognized experts Anthony "Mac" Smith, P.E., CMRP, Jack Nicholas, Jr., P.E., CMRP and Doc Palmer, P.E., CMRP, among others, to help take the living reliability program, predictive maintenance (PdM) program, and planning and scheduling practices to the next level. MSD brought Smith, Nicholas and Palmer to Cincinnati in November 2011 to perform a gap analysis that set the stage for a two-year maintenance reliability program implementation plan with the staff. They also helped MSD set an ambitious goal to reduce the 2011 level of corrective maintenance by 50 percent in two years through the successful implementation of best practices. MSD utilized a program management consultant to coordinate and support the overall effort.

The program focused on the core business by encouraging and practicing open and frequent communication with training operations, maintenance and engineering staffs at all levels in maintenance best practices, improving the reliability engineering function, building an internal predictive maintenance capability, and implementing advanced planning and scheduling.

MISSION Preserve process functions so we protect the health of the citizens and the quality of our environment

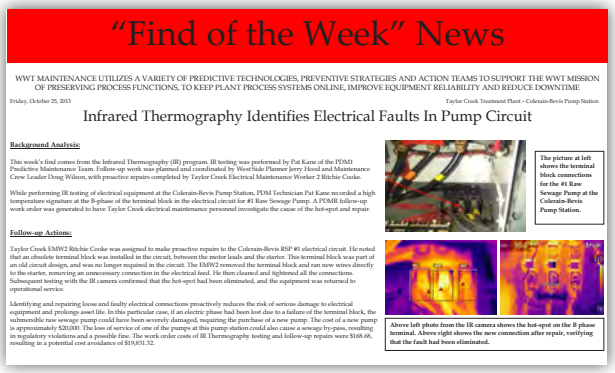
VISION Maximize plant throughput – treatment, at the most effective cost

VALUES Honesty, Accountability, Integrity and Respect

2012-2013 Strategic Maintenance & Reliability Plan

GOALS AND OBJECTIVES:

- FOCUS ON CORE BUSINESS Prevent and correct failures. Reduce special projects.
- TRAINING Invest in maintenance and reliability program and specialized training.
- COMMUNICATION Increase involvement and awareness through leadership listening.
- RELIABILITY Generate proactive work through improved maintenance strategies and a living program to improve uptime.
- MAINTAINABILITY Reduce downtime through centralized and decentralized predictive maintenance program.
- PLAN AND SCHEDULE Planner/Scheduler are focused on future work and capturing work history.



"Find of the Week" News

WWT MAINTENANCE UTILIZES A VARIETY OF PREDICTIVE TECHNOLOGIES, PREVENTIVE STRATEGIES AND ACTION TEAMS TO SUPPORT THE WWT MISSION OF PRESERVING PROCESS FUNCTIONS, TO KEEP PLANT PROCESS SYSTEMS ONLINE, IMPROVE EQUIPMENT RELIABILITY AND REDUCE DOWNTIME

Friday, October 25, 2013 — Taylor Creek Treatment Plant – Colerain-Bevis Pump Station

Infrared Thermography Identifies Electrical Faults In Pump Circuit

Background Analysis:

This week's find comes from the Infrared Thermography (IR) program. IR testing was performed by Pat Kane of the PDM1 Predictive Maintenance Team. Follow-up work was planned and coordinated by West Side Planner Jerry Hood and Maintenance Crew Leader Doug Wilson, with proactive repairs completed by Taylor Creek Electrical Maintenance Worker 2 Ritchie Cooke.

While performing IR testing of electrical equipment at the Colerain-Bevis Pump Station, PDM Technician Pat Kane recorded a high temperature signature at the B-phase of the terminal block in the electrical circuit for #1 Raw Sewage Pump. A PDMR follow-up work order was generated to have Taylor Creek electrical maintenance personnel investigate the cause of the hot-spot and repair.

Follow-up Actions:

Taylor Creek EMW2 Ritchie Cooke was assigned to make proactive repairs to the Colerain-Bevis RSP #1 electrical circuit. He noted that an obsolete terminal block was installed in the circuit, between the motor leads and the starter. This terminal block was part of an old circuit design, and was no longer required in the circuit. The EMW2 removed the terminal block and ran new wires directly to the starter, removing an unnecessary connection in the electrical feed. He then cleaned and tightened all the connections. Subsequent testing with the IR camera confirmed that the hot-spot had been eliminated, and the equipment was returned to operational service.

Identifying and repairing loose and faulty electrical connections proactively reduces the risk of serious damage to electrical equipment and prolongs asset life. In this particular case, if an electric phase had been lost due to a failure of the terminal block, the submersible raw sewage pump could have been severely damaged, requiring the purchase of a new pump. The cost of a new pump is approximately $20,000. The loss of service of one of the pumps at this pump station could also cause a sewage by-pass, resulting in regulatory violations and a possible fine. The work order costs of IR Thermography testing and follow-up repairs were $168.68, resulting in a potential cost avoidance of $19,831.32.

The picture at left shows the terminal block connections for the #1 Raw Sewage Pump at the Colerain-Bevis Pump Station.

Above left photo from the IR camera shows the hot-spot on the B phase terminal. Above right shows the new connection after repair, verifying that the fault had been eliminated.

Figure 1: MSD's Wastewater Treatment Division's "Find of the Week"

The pE team immediately established the "State of Maintenance" presentation to communicate changes and progress across the division. Maintenance management, supervisors, crew leaders and craft persons together presented the "State of Maintenance" twice yearly to all plant operations and maintenance (O&M) staff at each of the seven treatment plants. The maintenance group also sends out weekly results using the "Find of the Week" (Figure 1) to share how maintenance preserves plant process functions and helps avoid reactive costs.

MSD also hired its first reliability engineer (RE) in 2011 and began building a sustainable internal maintenance reliability function. MSD integrated reliability functions with work execution, planning and scheduling, and other business processes using a continuous improvement philosophy based on measurement, best practices and cross-functional teams. This required a mind-set change in the culture to shift from preserving equipment to preserving system functions.

Based on lessons learned from prior reliability improvement efforts and guidance from Smith (author of *RCM – Gateway to World Class Maintenance*), MSD implemented defect elimination; root cause analysis; classical reliability centered maintenance (RCM); experience centered maintenance (ECM), a form of maintenance task analysis; and a new comprehensive risk threshold identification procedure to prioritize non-bad actor systems for ECM. The reliability program is based on the plan-do-check-act model of deliberate continuous improvement, as shown in Figure 2.

MSD also refined its reporting tools to track key reliability metrics, including failure count/rate, mean time between failures, mean time to repair, mean time to restore and system availability.

In 2011, many of MSD's PdM activities were conducted by outside contractors. Lubrication sample collection, ultrasonic analysis and low-voltage offline and online motor circuit analysis (MCA) were conducted in-house by maintenance crew personnel with varying results. With guidance from Nicholas (author of *Predictive Maintenance Management* and other authoritative guides), MSD developed a five-year PdM master plan that includes a centralized and decentralized approach. MSD created a centralized PdM team from the maintenance crews to increase the effectiveness and cost efficiency of predictive maintenance. Decentralized plant crews ensure PdM-generated repairs are timely addressed before functional failure.

The five-year PdM master plan includes roles and processes, such as data collection, post-maintenance and baseline testing, and data management/communications; safety, training and certification requirements; initial capital and periodic investments in equipment; calibration services; consumables; and software. Budgets are projected five years out for all anticipated PdM program expenses.

MSD identified and built predictive maintenance key performance indicators, including PdM cost avoidance, PdM generated work trend and equipment health status.

MSD had implemented maintenance job planning and weekly scheduling practices in the past with dedicated planners and schedulers, but the benefits had leveled off short of expectations. Palmer (author of *The Main-*

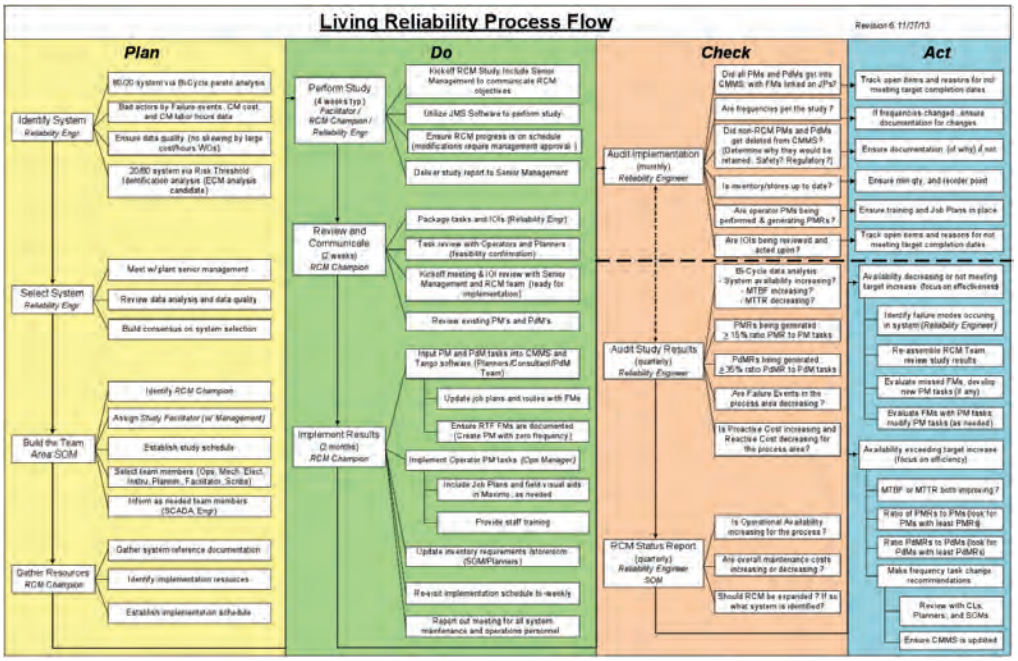


Figure 2: Living reliability process flow used at MSD's Wastewater Treatment Division

	Months-Days	Scheduled Work Orders # Scheduled	# Completed	# Incomplete	% Success	# Break-In Work Orders Pr 1,2,3	Pr 4,5
⊞	Feb 13	49	43	6	87.8%	3	6
⊞	Mar 13	301	286	15	95.0%	9	11
⊞	Apr 13	186	126	60	67.7%	39	3
⊞	May 13	112	63	49	56.3%	119	3
⊞	Jun 13	312	157	155	50.3%	0	13
⊞	Jul 13	277	243	34	87.7%	1	9
⊞	Aug 13	237	186	51	78.5%	1	3
⊟	Sep 13	153	143	10	93.5%	0	5
	1	42	39	3	92.9%	0	4
	8	50	48	2	96.0%	0	0
	15	61	56	5	91.8%	0	1
	Total	**1,627**	**1,247**	**380**	**76.6%**	**172**	**53**

Figure 3: The "red, green, blue report"

tenance Planning & Scheduling Handbook) evaluated existing practices in 2011 and made recommendations to increase awareness of planning and scheduling benefits, continuous improvement philosophy and coordination/communication requirements.

Several key planning and scheduling recommendations made by Palmer have helped the staff improve work order business processes to increase plant availability and manage cost. The staff implemented a deficiency tagging process to help communicate repair needs more effectively. Operations and maintenance worked together to improve the work order priority system and make it time-based (e.g., need it today, within a week, or within a month) rather than subjectively based on level of urgency (e.g., emergent vs. urgent vs. routine). Adding clear definition to the priority system (1-5) addressed MSD's ability to get the right work done at the right time. Planners also focused on continuous improvement of job plans through work order feedback from craft persons in the field. And finally, weekly scheduling became goal-driven by matching a batch of work to 100 percent of a crew's weekly available manpower a week in advance for each crew. A schedule performance report is used to follow through on the success of each weekly schedule by measuring how many scheduled work orders were completed and how many low and high priority work orders broke the schedule.

MSD identified and built key performance indicators to improve planning and scheduling, as well as productivity, including the "red, green, blue report" shown in Figure 3. Other planning and scheduling key performance indicators include schedule success, work backlog, work order priority success, work orders completed per month and percentage break-in work.

RESULTS

In the nearly two years since the program began, MSD's Wastewater Treatment Division has made tremendous progress building teams, making improvements and producing results, which are measured using the division's business intelligence software. MSD's exceptional staff delivered results in 2012 and 2013 that included:

- Maintenance work order cost reduction of over $500,000 in 2012, with similar results in 2013.
- Increase to 70 percent proactive labor today from 46 percent in 2011.
- Monthly emergency failure rate decreased by 55 percent.
- Increase in reliability by 33.6 percent across all equipment at all seven plants.
- Improvement in maintainability (reduction in downtime due to forced outage) by 23.6 percent across all equipment at all seven plants.
- Documented cost avoidance over $650,000 due to proactive maintenance activities.

MSD has made great strides implementing its strategic plan to meet workforce, service level and financial needs, establishing a leadership position in advanced business practices among its peers. In 2013, MSD was recognized for the "Best Emerging Maintenance Reliability Program" by Uptime Magazine. MSD's positive, energetic staff are eager to continue increasing performance beyond current levels. The empowered team approach, combined with proven best practices, promises to be a successful foundation for sustained success.

John Shinn Jr., P.E., CRL, Maintenance Manager, Metropolitan Sewer District of Greater Cincinnati. John has over 28 years of maintenance and reliability management experience. John is responsible for managing process maintenance and reliability of seven wastewater treatment plants.

Sam Paske, P.E.,CRL, works with a team of management and operations practitioners for international engineering firm CH2M HILL, providing innovative services to public and private organizations. Sam has 17 years of asset/maintenance management and technology implementation experience.

Acuren Group Takes Its Clients to **Next Step in Reliability**

Dean Stephens and Forrest Pardue

Reliability service companies, such as Acuren Group in New Brunswick, Canada (formerly Bretech Engineering), are adopting reliability information management systems as a way to lower repair costs, increase equipment reliability, measure performance and enhance customer satisfaction.

Service company customers, such as Richardson Oilseed Holdings and Cargill Grain & Oilseed Supply Chain North America (Cargill GOSC-NA), benefit not only from improved performance, but the software also improves their visibility into the condition of their own equipment and the effectiveness of services being provided.

IMMEDIATE BENEFITS

Acuren is a provider of specialized engineering and technical services, including a full range of condition monitoring services. In 2006, the company replaced word processor document reporting processes with a reliability information management solution. The software is primarily used for the company's condition monitoring services and as a communication tool between its on-site analysts and clientele.

Acuren manages nine different client databases, with approximately 4,400 assets in total. These are mostly rotating assets, such as motors, gearboxes, pumps, mixers, bearings and fans, in addition to electrical components, such as motor control center buckets, switchgears and transformers. Its largest client is also using software for reliability, along with a computerized maintenance management system (CMMS) as a bill of materials to keep track of equipment details.

Richardson Oilseed is leveraging the benefits of the software. "We did not have a functional means of tracking equipment prior to implementing the reliability information management system. Any cost analysis or failure analysis was done manually using the work order history," says Richard Pfeifer, maintenance planner at Richardson Oilseed's canola processing facility in Yorkton, Saskatchewan.

The Winnipeg, Canada-based agribusiness has the majority of its process pumps and fans in the system, as well as specific process equipment, such as conveyors, bucket elevators, seed cleaning equipment, seed flaking equipment, seed presses, oil separator/centrifuges, hammer mills and pellet mills. A total of 283 assets are tracked.

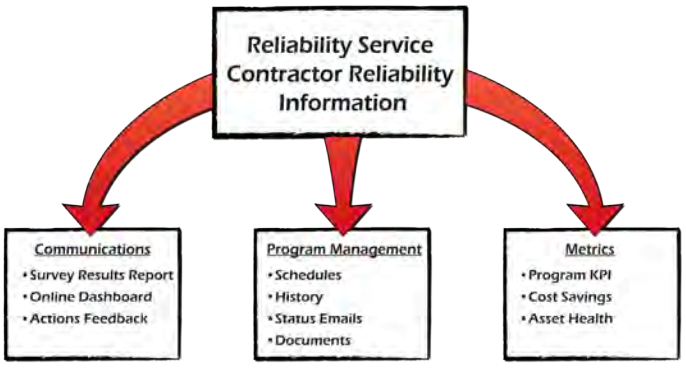


Figure 1: Real-time knowledge enhances the partnership between service companies and their clients

Figure 2: Richardson Oilseed's canola processing facility in Yorkton, Saskatchewan, is benefiting from reliability information management software.

Cargill GOSCNA has improved its equipment visibility with the reliability information management software. Prior to software implementation, a CMMS was the primary asset tracking system at the canola processing plant in Saskatchewan, Canada. Now, the reliability software is used to track 813 total assets at the plant, including fans and blowers, conveyors, pumps, electrical switching, motors, gearboxes and process equipment.

PROCESS AND COST SAVINGS

Timing is everything when it comes to condition monitoring. A reliability information management system that generates e-mail notifications when conditions warrant enables corrective actions to occur before the equipment fails. Web-based delivery allows access to the information from any location or device with Internet access. Real-time knowledge enhances the partnership between service companies and their clients by allowing better communication and coordination of efforts and the ability to measure and optimize performance.

A reliability information management system that generates e-mail notifications when conditions warrant enables corrective actions to occur before the equipment fails

For service providers like Acuren, the reliability software provides efficiency and structure. It does a lot of the grunt work automatically with its template reporting structure, e-mail notifications, self-generating key performance indicators (KPIs) and other features.

By studying some of the system's KPIs, the company can evaluate how its condition monitoring programs are performing and determine whether the client's or Acuren's need improvement. E-mail notifications and recommendations derived from its analysts keep the company in touch with each facility so it is aware of the most recent concerns.

The reliability information system is now integrated as part of Acuren's full-time condition monitoring agreements. The software is included in the price and its use is promoted at each new business opportunity. The benefits are equally shared between the company and its clients.

For end users like Richardson Oilseed, reliability software allows the company to easily show the overall condition of its assets to all departments in the plant. It also permits users to easily track and trend the overall condition of assets. "This lets us take care of

"We simply don't spend as much as we would with uninformed decisions," says Richard Pfeifer, maintenance planner at Richardson Oilseed.

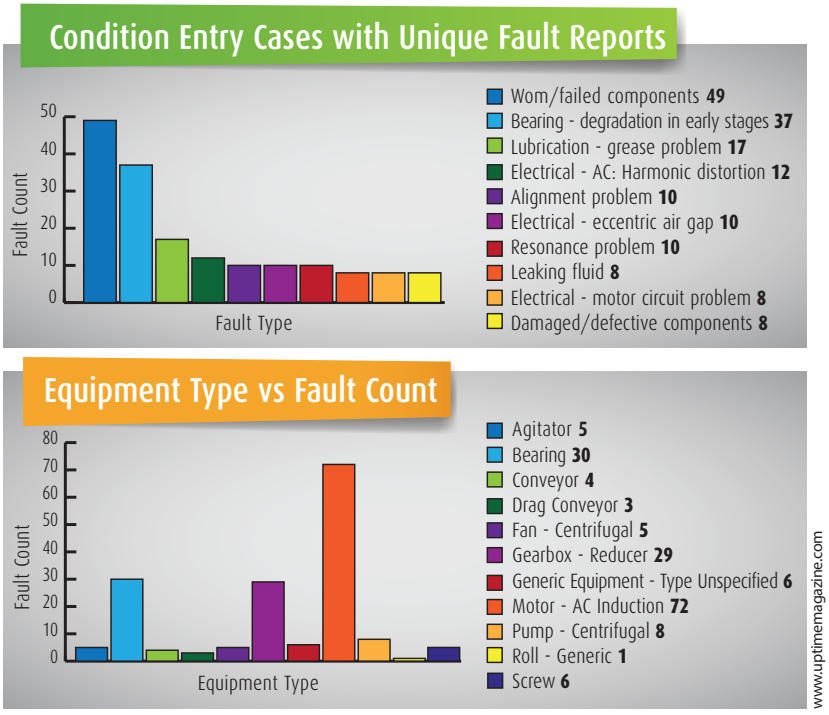


Figure 3: Software is used to measure overall asset health trends, the time to repair defects and repeat issues

issues by priority and allows us to make more informed decisions on how our assets are maintained," says Pfeifer.

"The software also allows us to oversee Acuren's performance by easily seeing its fault findings and the findings by technology. It trends cost avoidance, which we in the maintenance department can use to justify the cost of having Acuren on-site as a maintenance provider," adds Pfeifer.

Cargill GOSCNA takes a slightly different approach. "We don't use this software to oversee Acuren, but internally it is used to measure overall asset health trends, the time to repair defects and repeat issues," says Jerome Simonson, reliability supervisor at Cargill GOSCNA. "The software has improved our communicating and asset tracking with all reliability technologies using the same system," he adds.

Information security is another benefit. User-level security settings restrict access to specific screens and functionality. "The Web-based system is very convenient when working with different outside contractors because there is no need to give them access to our internal CMMS database," says Simonson.

RETURN ON INVESTMENT

With a reliability information system, service providers and equipment owners alike save time and reduce costs. More importantly, it furthers their shared goal of improving equipment reliability and uptime.

Reporting time is easily cut in half at Acuren, which allows analysts to spend more time at the machine doing inspections. Additionally, reliability service managers spend 50 percent less time on month-end reports, KPIs and special requests for the client that the software can automatically produce.

Richardson Oilseed has realized operations and labor improvements as a result of the software. "We've seen production time savings due to the equipment being more reliable. Management saves time by not having to trend and review work orders manually. Technicians save time by not performing duplicate or redundant repairs on machines that are not due for maintenance," says Pfeifer.

"The software has improved our communicating and asset tracking with all reliability technologies using the same system"

Direct economic benefits are also being achieved. "Cost savings result from the increase in productivity, as well as savings on asset-specific maintenance. We simply don't spend as much as we would with uninformed decisions," explains Pfeifer. "Our equipment reliability overall has and will continue to increase based on the statistics in these trends," he adds.

USABILITY DRIVES RESULTS

The best technologies and software won't live up to their full potential if the users have difficulty learning or applying them. Reliability information management systems complement asset management software, which tends to be highly functionally rich and complex, by providing

Figure 4: The reliability software is primarily used for Acuren's condition monitoring services and as a communication tool between its on-site analysts and clientele.

a cohesive and focused view of equipment and component reliability information. Having a Web-based architecture, simplified user interface and standard navigation allows anyone familiar with Internet applications to quickly develop competence in the software and pursue the promise of condition monitoring.

"The software is quite user-friendly. Really, a matter of a few hours of use allows a new user to transition to an experienced user," says Pfeifer.

Dean Stephens is the regional director for Acuren Group in Saskatchewan, Canada. He was the first reliability services technician for Acuren in the province and has 13 years of predictive maintenance experience in potash mining, oil and gas, oilseeds crushing and uranium industries. www.acuren.com

Forrest Pardue co-founded 24/7 Systems in 1998 following years of experience in vibration analysis and production maintenance. He is based in Louisville, Tennessee. www.tf7.com

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Will you be a part of history?

The Quest of the Two Questions

A Basic View of Industrial Reliability and 2 Qs the Things that Hold Programs Back

Peter Chalich

PART I – How Is the Equipment Failing?

This is the first of a two-part series. Part 1 covers value and methods for understanding how our equipment is failing. Part 2 will address the value and methods for understanding the services that we may or may not be providing our equipment.

VISION AND PURPOSE

Imagine a chaotic industrial setting where the equipment rules over humans through untimely breakdowns. The results are huge losses to the bottom line and much human energy and toil being expended on inefficient and inconvenient emergency repairs. If this sounds uncomfortably familiar, then perhaps you should read on.

After 25 years of working within a variety of industrial settings, I have concluded that most people facing an extremely reactionary industrial maintenance setting realize that things could be and should be better. They can visualize a world where everything, including organized outages, runs without interruption. They can visualize a world where operations hands over equipment at the agreed upon time and maintenance returns the equipment at the agreed upon time. This is the vision, but how do you get there? Most people can understand where they are and most can understand the vision. However, understanding how to get from one to the other is not so easy.

So how do we plot a course to the visionary state? I have come to believe that clues to this are within our ability to answer two seemingly simple questions: How is the equipment failing? and What are we doing to the equipment? It has been my experience that, outside of industries such as aviation, pharmaceutical and anything nuclear (where the cost of equipment failures are extraordinarily high), many, if not most, organizations cannot really answer either of those two questions.

You see, it's all about the equipment. The fulfillment of our vision depends on how well we understand what our equipment is experiencing, both in terms of application and the service we provide. Through this understanding, we can work to reduce the likelihood of unanticipated failures, thereby increasing the likelihood of an uninterrupted run to the next planned outage. This can be expressed by the single verb – reliability. And the result can be expressed by the single noun - reliability.

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THE FIRST QUESTION – HOW IS THE EQUIPMENT FAILING?

If your business is process constrained, the first and most pressing question is: How and why is your equipment failing? This is because failures go straight to the bottom line through production shortfalls, makeup, or rework. Fortunately, there are several tools available that help address the question of how the equipment is failing. Most notable are delay tracking and analysis, breakdown work order history, root cause analysis and condition monitoring.

DELAY TRACKING AND ANALYSIS

Delay tracking and analysis is where we look at how the process has failed. The dominant data coming out of delay analysis is time or production units lost and the number of process interruptions. Next is the type of interruptions. Some delays are caused by operations issues, others by equipment issues. The more robust systems may even be able to provide some insight into equipment failure detail. It is clearly a retroactive look, but we can learn a lot by studying how the process failed.

Most organizations have some form of delay tracking mechanism where information about process delays is entered. However, it has been my experience that this information is rarely looked at. There are several reasons for this. Firstly, it's a tedious, boring task that is viewed by most with the same zeal as filling out one's tax returns. Secondly, while important, it is never urgent. All urgent tasks supersede all important tasks and the workplace is full of urgent tasks. Thirdly, the data is always suspect. This should come as no surprise. When people realize that nobody ever looks at the data, they soon find the path of least resistance, which usually involves either entering crap or nothing at all. Lastly, the coding used to capture this information is usually poorly thought out and is often a mixture of causes, effects and remedies. As such, on those rare occasions when analysis is actually performed, the result is a Pareto chart showing "blank" and "other" as the top two columns.

The fulfillment of our vision depends on how well we understand what our equipment is experiencing, both in terms of application and the service we provide

Delay analysis is a big topic and there are all kinds of analysis tools out there. The important thing is to get started, use whatever data is available, act on the findings and make all this as visible as possible. As stated earlier, most organizations have some form of delay data and it has been my experience that every data set has a story. It's your job to find the story. Locate whatever data is available, brew yourself a pot of coffee and lock yourself away so you can have some uninterrupted time to find the story. This is somewhat like turning over rocks. Most rocks have nothing under them, some may have clues that lead to other rocks, but a few will have jewels of opportunity.

For me, basic analysis usually includes building a pivot chart in a spreadsheet program that includes all the pertinent data in the data set. I like to start with six to nine months worth of data. This tends to smooth out some of the special causes. It is important to remember that we are primarily interested in systemic issues rather than one-offs. If possible, create Pareto charts for the number of occurrences by equipment, the losses (hours, minutes, tons, units, etc.) by equipment and the loss per occurrence by equipment. The number of occurrences by equipment is a measure of unreliability and offers clues as to where efforts at preventing failures might add the most value. Losses by equipment are a mixture of unreliability and the consequence of each occurrence. When this is combined with the loss per occurrence information, we often have clues as to where efforts in the area of maintainability might add the most value.

In any case, cover the results with those closest to the equipment. There is no substitute for face-to-face discussion with the people that operate and maintain the equipment. This communication serves two purposes; it validates or invalidates the results and it shows people that the data is being used. Used data is data that is more likely to be inputted and outputted correctly. Do not allow yourself to completely discount the value of the data. Doing nothing because the data is perceived as being inaccurate does not advance anything. Remember, there is always a story in the data, even if the story is that the data systems have to be repaired. As with condition monitoring, act on the findings and then broadcast the value.

BREAKDOWN WORK ORDER ANALYSIS

Breakdown work order analysis is another tool for taking a retroactive look at how things went wrong. We should be able to look up what was done, when it was done and what it cost. If the system is robust enough, we may have some information on failure modes and frequency. The problem, however, is that breakdown work is often performed without a work order or against a blanket work order. In both cases, the useful information is lost. As with delay tracking, there are several reasons for this. Firstly, while posting work against work orders is important, it is not urgent. Getting the process up and running is urgent. The "important" can never quite compete with the "urgent." Secondly, entering and closing work orders with proper detail and coding is tedious and boring. Additionally, we usually depend on the same folks to fill out work orders that we have groomed into adrenaline junkies through years of recognition for putting out fires and saving the day. Lastly, as with delay analysis, we rarely look at this data and when we do, it is not visible to the people entering the data.

ROOT CAUSE ANALYSIS

There are many tools available for performing root cause analysis (RCA). With RCA, we take an in-depth look at the details of individual equipment failures to hopefully identify the most basic causes. If we do this correctly and properly act on the causes, we can either prevent recurrence or at least mitigate the future effects of the failure in question. Furthermore, these root causes often serve as enablers for other potential failures. This means if we truly rectify the causes of the failure in question, we are likely to reduce the risk of potential failures for those of which we may not even be aware.

Some key points to RCA are to know when to conduct an analysis and preserve the evidence, when to use an organized approach to the analysis and, most importantly, when to act on the findings. However, many organizations suffer from shortfalls in all these key points. For example, timing is everything with RCA, but many organizations don't know when to perform a RCA. Usually RCAs are invoked as an emotional response to the sting of a significant failure event. Sometimes, they are actually used as a form of punishment for "allowing" this failure to occur. This triggering mechanism, while bad enough on its own merit, suffers further by the lag time involved. By the time the decision is made to conduct an analysis, much of the evidence has been lost. This is exacerbated by the urgency to get the process up and running. Again, we have the competition between the important and the urgent. RCA may be viewed as important, but not urgent. Mixed in with this is the fear that the analysis will assign blame for the failure. Given all this, evidence disappears and weakens the analysis. Even if there is the intention to preserve evidence, there is often no means to do so. Evidence preservation is much more effective with some up-front work. Having a designated and commonly understood place to take and store evidence, as well as commonly

understood evidence collection procedures, goes a long way towards preserving evidence.

The analysis methodology is useful in keeping the analysis organized. There are many good, off-the-shelf methodologies available and many of these offer software tools that help with organization and perform much of the administrative work. The key points are to identify a methodology, install the tools, train a core group and then put this stuff to use. Many organizations either don't have a methodology identified or they are not competent in its use. It's okay to have more than one methodology if different purposes are truly served, but as a general rule, discourage excursions from the methodology. Competency with the methodology comes only with use and translates into analysis speed and accuracy.

Acting on the findings is probably the weakest area for many organizations. This is because many root causes are systemic or organizational in nature, thus requiring working across department lines. Shortcomings in this area are exacerbated by the RCA trigger likely being an emotional reaction to the failure event. By the time the analysis is complete and the recommendations identified, much of the emotion has subsided and other urgent matters have taken over. Organizational understanding, vision and commitment to improvement are required to get the most out of RCA efforts.

CONDITION MONITORING

In this context, condition monitoring is used to detect when a failure has begun, but the part, component, equipment, process, etc., is still functional. This concept has been well illustrated in John Moubray's now famous P-F curve. In this instance, we are talking primarily about predictive maintenance (PdM) technologies, such as vibration analysis, fluid analysis and thermography. Also included in this realm is sensorial inspection, where issues can be seen, felt, or heard. Condition monitoring is different from the previously discussed tools because it is a real time look, not a retroactive one. With a real time process, we can act on condition monitoring findings soon enough to mitigate some of the effects of the ensuing failure. Here there should be a sense of urgency. However, this urgency is often diluted by issues of faith in either the technology or those deploying it. This is often the case when the use of technology is new to the organization. It also happens when contractors are used to perform the analysis and the results are presented to an organization without enough internal knowledge to engage in any meaningful dialogue on the analysis or its conclusions. Furthermore, there is inherent reluctance within the human species to remove something from service while it still has some life in it. This is because we tend to apply the same logic to things that we apply to ourselves and nobody wants to be removed from service prematurely.

The two best ways that I have found to combat the reluctance to act on findings are competency and visibility. The more competent an organization is in the use of condition monitoring tools, the more likely it is to understand the nature of the risks and opportunities the findings present. This understanding increases the probability of action. Just as competency builds faith in a given technology, visibility builds faith in the overall condition monitoring program. Findings should be tracked, published and discussed whenever possible. It is imperative to keep this information out in front of the organization. In short, make findings difficult to ignore.

Peter Chalich, CRL is a Professional Engineer and Owner of Equipment in Motion, LLC and Senior Associate of Caravel Solutions, LLC. He has over 25 years of experience in industrial process reliability, including 7 years as Director of Equipment Reliability at Cliffs Natural Resources. Mr. Chalich also served as a Maintenance and Reliability Systems Consultant for 12 years with The Sinclair Group, Global Performance, Day & Zimmerman and Fluor.

Leadership for Reliability — Hcm human capital management

How to Get People to Do What You Want Them to Do

RELIABILITY 2.0 Las Vegas Presenter

Garrison Wynn

If this article title pulled you in, maybe you've recently realized that having a better tactic or using your (seemingly imaginary) charisma is not producing the influence you would have hoped. You've read the leadership and negotiation books and you've witnessed some disturbing YouTube videos that appear to prove you no longer need talent or a point to be in front of a camera. However, your all-consuming problems still remain: Your employees just can't get the job done, your boss is a low-IQ narcissist and your 22-year-old kid has just told you, "I don't, like, see myself as, like, working every day at a job and stuff."

Could it be that what works for others in the area of influence will not work for you? Over the years, Wynn Solutions has done anonymous surveys with thousands of extremely influential people who have a proven track record of motivating people to do what needs to be done. From them, we found that some foundational (I can't say "basic" for fear of offending a sensitive expert) ideas that we often deem irrelevant are the root of influence. Here are those things:

Are you proving to people that you see them as valuable? Have you told them that you appreciate their talent and could not have done so well without them? That's very different from just saying "Good job!" And it's not as ridiculous as saying "You'll have a job here as long as you want one," which seems to indicate that they will definitely quit – it's just a question of when.

Are you being sincere but emphatic with your adult child who still lives at home? These days, over 50 percent of all adults 18-26 years old live with their parents. If you have an adult child still living at home, wearing your bathrobe, and wanting to know when more food will be arriving, you need to be forthright. You might say something loving but pointed, like this: "The only way other people will appreciate you as much as we do and offer you opportunities is if they see you as self-sufficient. So getting out on your own (which will involve you leaving this house, by the way) will cause the good things in life to come your way." Letting them stay sends the message "We love you so much that we're willing to sacrifice your ability to be a functional adult." Being 32 and still living at Mom and Dad's house is more than just pathetic; it's creepy.

Are you proving to people that you see them as valuable? Have you told them that you appreciate their talent and could not have done so well without them?

Do you have extreme clarity? Intelligence is not enough. The average IQ for an executive is 104, which is lower than the average for middle management. If you've ever been to a Mensa meeting (the Genius IQ Club), you might have noticed a disturbing number of grownups wearing backpacks and a lot of crummy cars in the parking lot. Intelligence is just a small part of influence. Additionally, as supervisor or manager, you may have employees or work crews whose first language is not English. That means you might go down in history as a misunderstood genius or, more likely, you'll just be remembered as "jefe loco"!

As for tried-and-true solutions, it all comes down to value.

1. *If you want to be influential, you must be able to* ***clearly state your value (or the value of whatever you're proposing).*** Clarity is the foundation of value. People buy into what they grasp quickly. Simply stated, good ideas just aren't good enough. Case in point: It took 40 years to get seatbelts in cars, but they green-lighted the Pet Rock at the first meeting. Spray cheese caught on pretty quickly too.

We are influenced by things that sound good instantly, and nothing sounds better than what we already believe. Making things very *clear* makes them familiar. When we hear something clearly stated, we will often say, "Oh, I know. Yes. That's common sense." But the

truth is we did not think of it until it was very clearly stated. Clarity makes the stated value *make sense.* So if you think this paragraph has told you something that you already knew, then you are right and enlightened at the same time.

2. *With successful business models being driven by search engine optimization and social media,* ***attracting young employees is not just important – it's necessary.*** Our research (5,371 top performers anonymously interviewed over 10 years) showed that Internet marketing is a crucial component of success and that you must have young, talented people to be successful.

   To attract and retain these crucial younger employees, you must show the value of your organization and environment. Flexible work hours, dropping the dress code, and praising younger workers along the way to the goal have a proven track record for success. Having employees who are spoiled and barefooted is a lot better than not being competitive.

3. *To influence people under 30 years old, what you propose* ***must make sense at a very basic level.*** This younger generation grew up with so much information thrown at them that you've got to be able to show them why you're doing something. If it doesn't make relevant sense to them *today,* they will question it and have difficulty taking action on it. If you want young people to come to work early, you need a real business reason – not just that you like to get to work at 7:30 a.m. but don't particularly care for loneliness.

4. *The key to getting people to do what you want them to do is* ***understanding what they value.*** In its clearest and simplest form, what they value is love, money, and prestige. If they can get *that* from you, they're willing to listen and take action. Unfortunately, most people believe they need to outsmart people to get them to take action. So if you're upset because you think the world is run by idiots – well, you might have a point. (See, you *are* really smart!) Most research shows that it's easier to simplify things so you can compete. The truth is that when it comes to getting people to take action, explaining your value is more valuable than actually *having* it.

In the end, the main reason people don't do what you want them to do is not because your ideas are terrible; they just seem to lack value. It's useless to bring your A game if no one wants to play. You have to make the game appealing and then make people feel valuable for participating. The idea is to position yourself up front with all the influence tactics you can and then throw all your effort behind that.

Being good at what you do these days is just not enough. People have to like what you do, and, in reality, they have to like *you*. Everything mentioned above – being solutions-focused, retaining top performers – it's all important, but are you *personally* influential enough to make any of that actually happen? How do you know you have that kind of influence? When you're really influential, you've created enough buy-in that people will be on your side even when you're wrong. True influence exists at places like Muzak, where classic rock becomes elevator music. There's obviously some strong buy-in taking place when a guy with a "special" kind of musical genius proclaims, "I really like Def Leppard! … But only on the oboe."

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Is Your Maintenance **Lean** or Lean?

James Reyes-Picknell

Manufacturers, miners, processing plants and even offices are going "lean" these days. In the accounting world, lean has an attractive sound: lean = cheap. Low cost to an accountant means less spending on anything you must pay for. Labor, materials and anything associated with them are costs and, therefore, subject to cost cutting, budget cutting and targeting within lean initiatives. But cutting these costs often leads to poor performance. If this has happened to your company, then you have moved beyond lean, you've become sick.

Low cost per unit of output (e.g., ton, barrel, car, etc.) is the goal, not low cost. You want to reduce waste in all its forms. Although cost savings are often a by-product of the process, that's not all. Less waste translates into energy savings, more efficient and effective use of labor and materials, fewer accident risks, fewer environmental risks and working smarter not harder. Lean maintenance means no wasted effort, motion, materials, consumables, excessive inventories, or other expensive resources.

Accounting systems are overly simplistic and the easiest way to higher profits in the short term (another driver of destructive behavior) is to cut costs. You can cut maintenance all together, but you'll stop producing very soon afterwards – that extreme is well understood. But how do you know if your maintenance is too lean?

Look at measures used for your maintenance performance for guidance. I really like "schedule compliance" or "schedule success," a far more positive way to look at it. Thank you to Doc Palmer for teaching me that one. You cannot achieve a high level of schedule success without having a number of other things working well. Breakdowns won't be running your schedule for you. That means your proactive work, such as preventive maintenance (PM), predictive maintenance (PdM) and detective maintenance (DM), are all working well. You get them done on schedule and you follow up in a timely manner on problems that are revealed. This implies you've got effective PMs, PdMs and DMs

defined, and perhaps you've invested in reliability centered maintenance (RCM) already. Sticking to a schedule suggests that there is a schedule, therefore, you successfully schedule planned work.

Your planning must be effective as well. You can't get work done without needed materials, parts, tools and support equipment as defined in your plans. Your supply chain must be supporting you in a timely manner with the right materials at the right time and in the right place.

All of these processes must be working; measure them and make sure you are not optimizing one at the expense of the other. Getting all these processes working efficiently and effectively indicates that they are mutually supportive processes and not mutually exclusive. Do your performance measures encourage mutual support or are they designed as if each process operates in its own isolated silo?

Encourage learning; you want to see changes and you want to reward the changes that make a positive impact

Make sure your performance rewards system is not encouraging the wrong behaviors. Punishments are the biggest no-no. Punish a mistake and the behavior (which actually may be positive) that resulted in the mistake will stop. Mistakes happen no matter how well-intentioned your actions. I mess up every day as owner of my own business, but I certainly don't intend to do it – it just happens. If I beat myself up for each mistake that costs me money, I'd be out of business long ago. It's okay to make a mistake if you learn from it. The second time the mistake happens, it shows you didn't learn and that is bad behavior. Encourage learning; you want to see changes and you want to reward the changes that make a positive impact.

It's difficult to discourage wrong behaviors. Just look at our legal systems and you'll see plenty of evidence that doesn't work well. The behaviors continue and punishment doesn't make a dent in them. We end up spending more incarcerating our failures as a society. Isn't that what we do by punishing for mistakes in maintenance (or anywhere in business for that matter)? Fire the guy who just learned an important (and usually expensive) lesson and you are destined to repeat it. That's not lean.

Stop encouraging the wrong behaviors. They are often habits – bad ones. We don't break habits easily either. Do you reward the crews who put in herculean efforts to bring you back online after a major breakdown? If so, you are rewarding the wrong behavior and encouraging the habit. Why did the crew or management system allow the breakdown in the first place? That sort of breakdown should have been found and avoided; that's our job in maintenance. We are being paid to keep things running, not to allow them to break so we can waste money fixing them. There is always a lesson in a breakdown, but what is it? Are you doing root cause failure analysis to identify the technical, human and systemic events and conditions that allowed the failure to progress to breakdown? That sort of analysis takes time away from repairs, but it leads to lean results. Change the conditions that lead to the failures; your processes and management practices will probably change, too. Replace the old (bad) habits with new ones. That takes effort. On average, it takes about 21 days to ensure a new practice becomes a new habit. New (good) habits will replace old (bad) ones, but don't expect it to happen without a lot of dedication to the new habit in those first few weeks.

Can you do all this on your own as a lowly maintenance manager? Not a chance. Maintenance is one of those business functions that impacts and interacts (sometimes indirectly) with almost every other functional area of the business – human resources, payroll, benefits, IT/IM, supply chain, security, public relations, unions/employee associations, production, operations, engineering, projects, finance, accounting, inbound and outbound logistics, vehicle pools, etc. If you want to change, you will have an impact on one or more of those other areas under someone else's management. You are doomed if you attempt to make any change that has any impact outside of maintenance on your own. You need collaboration and a lean mind-set throughout the organization. You won't get that without top level buy in and sponsorship.

If your lean efforts consist of annual budget slashing, denial of budgeted courses when they are requested and periodic calls for cost reductions, then you'll never get there. Your business will probably become sick if it isn't there already. If you are already there, then your efforts to change the way of thinking in the minds of those who hold the purse strings have probably already been met with defeat. You need help getting the business message across. Lean requires effort and a changed mind-set. As Einstein put it so well, "You cannot solve a problem with the same mind-set that created it." That shift in mind-set requires a new approach, new perspectives. The effort will cost your business something in the short term, but it does not have to be a high cost unless there's a lot of resistance, which usually comes from the middle management ranks. If you can successfully spot the low-hanging fruit that is undoubtedly there, you'll be able to pay for much, if not all, of the effort in that area alone.

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Work Execution Management — Cmms
computerized maintenance management system

The Class 1.5 CMMS

History, Features and Challenges

Rui Alves

Most maintenance professionals have heard of a computer maintenance management system or the term CMMS and know the general benefits such a solution provides. CMMS utilization has been on the rise since the late 1980s and it's hard to find any large company involved in equipment maintenance that doesn't use a specialized software package to assist in its equipment maintenance efforts.

Throughout the last decade, capital intensive industries have moved away from stand-alone software solutions to the integration of their CMMS onto company-wide software packages under a methodology called enterprise resource planning (ERP). As companies grow, they tend to integrate procedures into a unified system with benefits that range from increased workflow efficiency to a much deeper, real time and accurate reporting that helps top management make faster and more informed decisions.

Needless to say, the costs associated with these integrated solutions are quite high. Software customization, IT equipment, employee training and continuous IT maintenance all pile up to a rather high monthly bill. This means that only companies that are large enough, both in terms of organizational complexity and revenue, stand to benefit from the use of these systems.

The same main underlying reason that presently justifies the use of ERP systems in large companies is driving the use of individual

Large Companies – late 80s–90s	Large Companies – from mid-90s to now
Stand-alone CMMS solutions	CMMS integration with other company modules
High initial investment	High initial investment
High operational costs	High operational costs
Increased maintenance workflow efficiency	Increased company-wide workflow efficiency

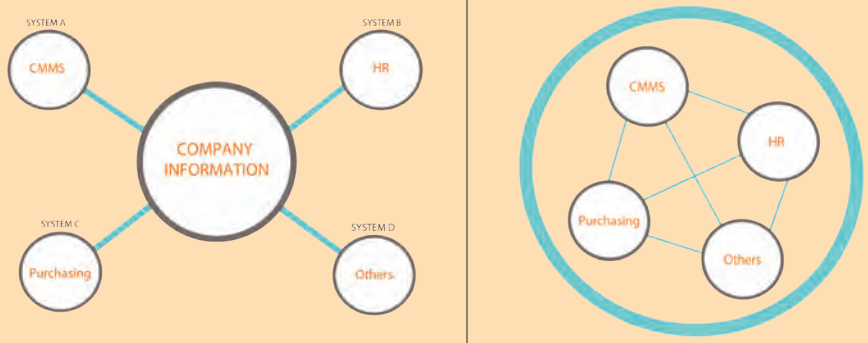

Figure 1: The image to the left shows the CMMS as a stand-alone module in large companies from the late 80s to the 90s, while the image to the right shows the CMMS as an ERP module in modern large companies

Small and Medium Sized Companies – late 80s–late 90s	Small and Medium Sized Companies – from late 90s to now
No CMMS or basic outlook/Excel based asset management	Stand-alone CMMS solutions Medium companies already implement more integrated solutions enterprise asset management (EAM) Low initial investment Low operational costs Increased maintenance workflow efficiency

management modules by smaller companies, very much like what happened in the 80s and 90s to their larger counterparts. The reason is that IT costs are now low enough to justify the investment in software tools by smaller organizations to help manage their assets. The average user is also a lot more tech-savvy than before and can take over responsibilities that used to be done by the CMMS developer (e.g., system configuration).

CMMS CLASSES

While the big players of the ERP world are currently fighting for new installations or upgrade contracts with large organizations, other vendors are focusing on small and medium sized companies since they are coming into the CMMS market in larger numbers than ever before.

The current CMMS/EAM/ERP market environment can be summarized into three main classes:

- Class 1 CMMS refers to a pure computerized maintenance management solution that is a stand-alone software package that provides very basic equipment maintenance workflow, maintenance scheduling and simple reports. There is either very little or no asset component breakdowns.

The average user is also a lot more tech-savvy than before and can take over responsibilities that used to be done by the CMMS developer

- Class 2 solutions have an extra asset categorization/breakdown layer built on top of the Class 1 CMMS, essentially turning the CMMS into an EAM. These applications go a lot further in report depth and include inventory control, purchasing and financial data, which is a start in the move towards the use of a full ERP. Class 2 packages are also expected to have efficient multi-site and multi-user capabilities.
- Class 3 CMMS is an EAM module fully integrated onto an ERP.

CMMS CLASS 1.5

The highlighted area in Figure 2, Class 1.5, is where the current CMMS vendor challenges lie and where the CMMS world is expected to see the most profound changes in the next couple of years.

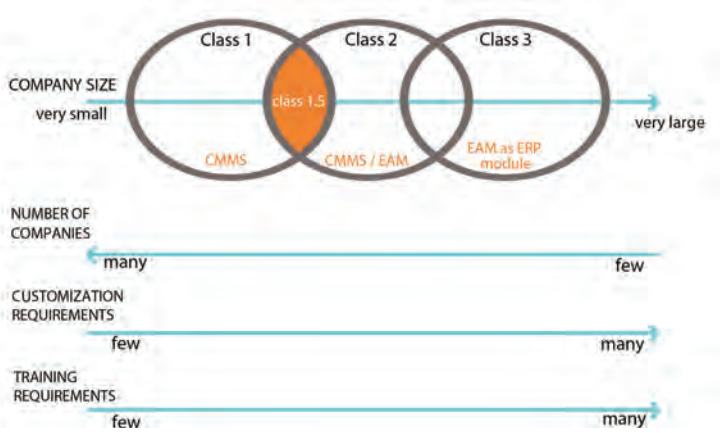

Figure 2: CMMS classes, company sizes and CMMS implementation requirements

Class 2 and Class 3 markets are established with enough options of reputable vendors, while the Class 1 market is not technologically complex, meaning the requirements can be easily implemented by software developers with no maintenance concepts knowledge. This leaves an unexplored area of opportunity containing a large number of companies that require more functionality than a basic CMMS can provide, but have no need for the complexity of a full EAM.

CMMS CLASS 1.5 FEATURES

The companies that fall into Class 1.5 should prepare for what are probably unavoidable strategies by CMMS vendors that will shape the type of options available to them in the near future. Table 1 summarizes some of these options, along with comments on what they mean to potential customers.

It is easy to see that the features specified in Table 1 come from the desire to decrease costs in a move that benefits both vendors (that now have a cheaper product to sell) and customers (that now have a resourceful tool at a cheaper price).

CHALLENGES

The challenges that need to be overcome to allow for faster, widespread use of the Class 1.5 CMMS rest in the mind-set of decision makers. Technical solutions, like shared servers and cloud computing, are all well-proven, but need to be deeply understood and accepted by managers.

Class 1.5 companies are rather special in that they come from a Class 1 category with staff that saw a company grow using techniques that they now find difficult to let go of because they have worked in the past. Realizing that they are now on another level and the required tools need to be different is not an easy step. It's not the cost of the Class 1.5 CMMS anymore, it's the mind-set that keeps users stuck to a Class 1 solution.

CONCLUSION

The features of the Class 1.5 CMMS make perfect technological and financial sense. Because of this, they will overcome the challenge of change resistance and become the standard for CMMS implementations in the foreseeable future.

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TABLE 1

Feature	Why?	What It Means?
Software will be completely cloud-based, with no local computer or local area network (LAN) options.	More powerful hardware may now be shared among several customers, making it a lot cheaper per user to purchase, operate and maintain.	Better and cheaper service since professional and experienced suppliers will now be taking care of better machines. Server uptimes of 99.999 percent are common in the industry. No need for dedicated IT staff.
Software will be completely user-configurable.	Vendors will cut costs as they do not use the time to configure systems.	Vendors will make the software easier to configure.
Software will be non-modular (not because it won't have different components, but because those components won't be charged extra).	Vendors will push for simplified payment options – modular options would complicate that process.	Companies get more functionality as it is being added to the core program.
There will be minimal direct vendor customer support.	Vendors will cut customer support costs.	There will be a push for user-driven forums that will allow the user community to support itself.
There will be no customization.	Vendors will have a one size fits all approach to their offers. This decreases development costs.	Companies will have to compromise and adjust some procedures to the CMMS instead of the other way around.
There will be only online training materials and no on-site training programs.	Vendors will cut customer support costs.	Companies will be responsible for their own training programs.
Fees will be structured on a simple cost per user per month basis.	Vendors will push for simplified payment options.	Companies have the flexibility to pay as they go.
Mobile access is built-in.	Current Web technologies allow the development of desktop and mobile versions almost simultaneously from the same source code resulting in development costs reduction.	More access options for companies. Increase mobility and job efficiency without having to pay more for it. Data available from anywhere at anytime.

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PART 2

Why Single-Source Supply Contracts Can Disappoint

RELIABILITY 2.0 Las Vegas Presenter

Heinz P. Bloch

Part 1 of this article in the Dec/Jan 2014 issue of Uptime introduced the premise that all manufacturers operate with business models that emphasize quality, low price, or innovation. It started with the common sense position that a manufacturing entity that simultaneously and consistently achieved all three would soon become the only surviving provider of the asset in question. Part 2 looks at the caveats in process pump engineering addressed by machinery quality assessment (MQA).

For decades, the most successful equipment users have engaged in up-front assessments of machinery reliability. They allocate time and money for MQA. These seasoned users buy only from competent vendors and establish such competence by pre-procurement MQA endeavors. As part of such assessments, these successful users review documentation showing pump assembly drawings and related indispensable documentation. Potential design weaknesses can be discovered in the course of reviewing dimensionally accurate cross-sectional drawings. Examination and review of cross-sectional drawings is important[1-4]. There are two compelling reasons to conduct this drawing review during the bid evaluation phase of a project. Firstly, some pump manufacturers may not be interested in responding to user requests for accurate drawings after the order is placed. Secondly, the design weaknesses or vulnerabilities could be significant enough to require extensive redesign. In the latter case, the purchaser may be better off selecting a different pump model[2,5].

CHEAP PUMPS ARE RARELY A WISE CHOICE

It is intuitively evident that purchasing the least expensive pump will rarely be the wisest choice for users wishing to achieve long run times and low maintenance outlays. Although a new company may occasionally be able to design and manufacture a better pump, it is not likely that such newcomers will suddenly produce a superior product. Therefore, it would be more reasonable to choose from among the most respected existing manufacturers (i.e., manufacturers that currently enjoy a proven track record).

The first step should involve selecting and inviting only those bidders that meet a number of pre-defined criteria. Here's the process by which one can determine acceptable vendors for situations demanding high reliability:

- Acceptable vendors must have experience with size, pressure, temperature, flow and service conditions specified.
- Vendors must have proven capability in manufacturing with the chosen metallurgy and fabrication method (e.g., sand casting, weld overlay, etc.)
- Vendors'"shop loading" must be able to accommodate your order within the required time frame (door-to-door delivery of product).
- Vendors must have implemented satisfactory quality control and must be able to demonstrate a satisfactory on time delivery history over the past several (usually two) years.
- If unionized, a vendor must show there is virtually no risk of labor strife (strikes or work stoppages) while manufacturing of your pumps is in progress.

USE SUPPLEMENTAL SPECIFICATIONS

The second step would be for the owner/purchaser to:

- Specify for low maintenance. As a reliability-focused purchaser, you should realize that selective upgrading of certain components will result in rapid payback. Components that are upgrade candidates have been identified in the literature since the mid 1960s, so be sure to specify those. Review failure statistics for primary failure causes. If bearings are prone to fail, realize that the failure cause may be incorrect lube application or lube contamination. Address these primary failure causes in your specification.
- Evaluate vendor response. Allow exceptions to the specification if they are both well explained and valid.
- Clearly document the equipment design to prevent future failure analysis and troubleshooting efforts from being greatly impeded. Your plant will require pump cross-section views and other documents to effectively manage future repair and troubleshooting work. Do not allow the vendor to claim that these documents are proprietary and that you, the purchaser, are not entitled to them. Place the vendor under contractual obligation to supply all agreed-upon documents in a pre-determined

time frame and make clear that you will withhold 10 or 15 percent of the total purchase price until all contractual data transmittal requirements have been met.

- *Contractually* arrange for access to a factory contact on critical orders. Alternatively, insist on the nomination of a "management sponsor," which is a vice president, director of manufacturing, or a person holding a similar job function at the manufacturer's facility or head offices. You should communicate with this person for redress on issues that could cause impaired quality or delayed delivery.

Following these guidelines will give best assurance of meeting the expectations of reliability-focused owner/purchasers.

WIN OR LOSE—IT'S ALWAYS THE PURCHASER'S CHOICE

January 2013 marked the 36th anniversary of an article on "Eliminating Cooling Water from General Purpose Pumps and Drivers"[5]. The article documented why many of the world's largest refineries had discontinued using cooling water on pump bearings in the early and mid-1970s. There were also comprehensive write-ups dealing with cooling water elimination from pumps in the 1982, 1988 and 1998 editions of the book, "Improving Machinery Reliability"[1]. Working closely with only the three or four most knowledgeable pump manufacturers might have brought to light why the world's most profitable pump users had deleted cooling water from pumps in the 1960s and early 1970s.

Which leads us to Case 1: ***Why are the uninformed still using cooling water on pumps?***

This question was prompted by a recent visit to a midsize refinery in the United States. As of 2007, the facility continued to use cooling water on hundreds of pumps. The state government pointed out that the refinery's water use placed much stress on a scenic river. Indeed, the refinery could have gained environmental compliance and greatly extended bearing lives much sooner. It could have deleted cooling water from process pumps years ago. In case you're wondering, the basis for deleting cooling water from pump bearing housings equipped with rolling element bearings is found in the immutable laws of physics. Placing a cooling water jacket around a bearing's outer ring will prevent it from thermally expanding. As the hot inner ring grows and the internal bearing clearances vanish, the bearing is excessively preloaded and fails prematurely. Or, if cooling coils are provided in the oil sump and the cooling water is indeed cold, some of the water vapor in the moist air floating above the oil will condense. The oil then becomes contaminated with water, which has much lower film strength than oil, so the bearings will fail prematurely.

Over the past three decades, this refinery probably spent a small fortune on avoidable pump repairs. It no doubt consumed hundreds of thousands of gallons of cooling water unnecessarily and, for a certainty, used more energy than was really necessary. That's food for thought, especially since the facility's pump repair frequencies were inferior to those typically seen at best-of-class pump user companies. The refinery is certainly the loser here and we'll leave it to the reader to decide where the problem originates. (Hint: Dig deep and peel off the many layers of indifference.) Again, working with three or even four knowledgeable pump manufacturers would increase the probability of becoming acquainted with these facts.

Here's a second, similarly relevant case history: ***Upgrading is the customer's job.***

A major manufacturer of very thoughtfully engineered upgrade components for pumps sent two of its managers to explain these superior upgrade products to a well-known pump manufacturer. After carefully laying out why reliability-focused users have implemented pump upgrades using the components at issue, the managers concluded that:

> "Pursuing the OEM avenue, i.e., convincing the pump manufacturers of the merits of upgrading their pumps, is not possible. For some time now, the technical sales approach does not seem to work with U.S. pump manufacturers. By any measure, they only want to cut the cost, not improve quality. We determined that the only way many U.S. pump manufacturers will listen is if their end-customers demand our superior upgrade components on new equipment. We are convinced that we must begin with selling to the end-customers first."

The attitude displayed by original equipment manufacturers (OEMs) shouldn't surprise us at all. This experience is not new and an article by Joe Askew[6] is among many publications that fully support the same findings. The article prompted the following comment from a technical editor in the United Kingdom:

> "It's all about cost and widespread ignorance of how inefficient some systems are. What makes it so tragic is the terrible waste of energy and the consequences of that waste. Europe has experienced one of its hottest and most uncomfortable summers to date (2012). It's only when plants appreciate the missed opportunities and cost savings inherent in energy conservation that they will be motivated to take real steps to install and run their systems efficiently."

Again, it's up to the equipment user to demand better performance. Surely, a solid and well detailed user specification that includes upgrade measures implemented by best practices companies would do wonders here. And unless a corporation or facility has such a specification, the kind of narrow focused and repair intensive response one gets from many pump manufacturers will be perpetuated. Dealing with three or four highly competent manufacturers will be of benefit. At least it makes an attempt to move the reliability focus along. In contrast, single sourcing is a reward for low pricing and all too often slows down the process of innovation.

A third case history was excerpted from an e-mail contributed by an observant engineer. He concluded: ***OEMs want your spare parts business:***

"One of our designers was recently meeting with a major client, his engineering company and a major manufacturer of lobe blowers in Europe. Both the owner and the engineering company wanted pure oil mist on the bearing end and purge mist on the timing gear end of the blower. The manufacturer refused to approve pure oil mist and would not give warranty coverage. What is more interesting is that he told everybody the reason why. He said he would not be able to sell as many bearings and parts if he allowed the installation of pure oil mist."

Dealing with three or four highly competent manufacturers will be of benefit, at least it makes an attempt to move the reliability focus along

That, too, is not surprising. When bid invitations for a major petrochemical facility in Texas were sent to a number of pump manufacturers in 1976, three potential pump vendors replied that they could not accept warranty responsibilities for the several hundred pumps they proposed to furnish for this project. These pumps were to be provided with pure oil mist. No constant level lubricators and troublesome oil rings were involved. Not to be fooled, the user-purchaser responded by standing up to the three pump manufacturers. Each was notified that they would be released from all responsibilities affecting *bearing performance* and *bearing life*. However, if they would not accept all customary responsibilities for the *hydraulic performance* of their products, they would be disqualified from supplying pumps for this project and all future jobs requiring pure oil mist on pump bearings.

The three vendors then quickly agreed to give warranties on the hydraulic ends of their pumps. Every one of their pumps was still in service almost four decades later, although none of these three "legacy" pump

manufacturers still exist today. Lack of innovation was probably among the factors hastening their demise.

SINGLE SOURCING COMPRESSORS?

Suppose you have good experience with Compressor Manufacturer X, but the oil-free piston design of "X" incorporates piston rings and rider bands that, of course, are contacting the cylinder bore. A measure of wear will take place and parts need to be replaced in certain intervals. Compressor Manufacturer Y makes labyrinth piston compressors (Figure 1) that require fewer parts replacements and thus have higher availability. Regrettably, your project engineers and reliability professionals know little if anything about "Y." Understandably, Manufacturer Y rarely sees fit to spend time educating owner-purchasers who make it a habit to buy only from technologically challenged Manufacturer X.

Figure 1: Labyrinth piston compressor principles (Illustration courtesy of Burckhardt Compression, Winterthur, Switzerland)

A similar argument could be made for liquid-flooded twin screw compressors (Figure 2) from Manufacturer A. Many design contractors and even single source provider "A" think that wet screw compression means that oil flooding is used in twin screw positive displacement machines. The single source provider has little or no incentive to tell others that Competitor B makes big and small twin screw compressors that are water-flooded. Science tells us that water removes far more heat from a compressed gas than a charge of oil. That "B" could have done the job in a single compressor housing was not known to you and after "A" happily sold you two compressor casings in series, "B" considers it a waste of time to submit bids to fulfill any of your future business needs. The same goes for integrally geared compressors, where some vendors have experience with four stages, while others may have provided as many as 10 stages of compression. Again, making two or three different vendors your technology providers can be essential for present and future success.

Here's another issue: Are your reliability engineers willing to do what others did 40 and 50 years ago, that is to understand the immense value of intelligent lubrication technology and take a stand for it? If the answer is in the affirmative, we commend you. If it is negative, we encourage you to ask a few questions and include the most important ones: What are you planning to do about a lack of understanding in your organization? Which vendors have you identified as capable advocates of sound technologies and innovation? How do you best include them in your list of technology providers?

LESSONS LEARNED

The owner-purchaser must become educated. Unless owner-purchasers insist on quality, they will likely and inadvertently buy maintenance or repair-intensive products. More often than not, the user will then be at the mercy of a single source supplier. Relying on feedback or input from a single design contractor or a single equipment manufacturer is rarely sufficient. In the final analysis, the buyer gets what he or she deserves. It will be either more downtime risk and bloated maintenance budgets or higher long-term equipment reliability and profitability. And let us not forget the imputed value of educating a whole generation of reliability engineers. While often overlooked, the educational benefits of dealing with more than one supplier deserve to be considered.

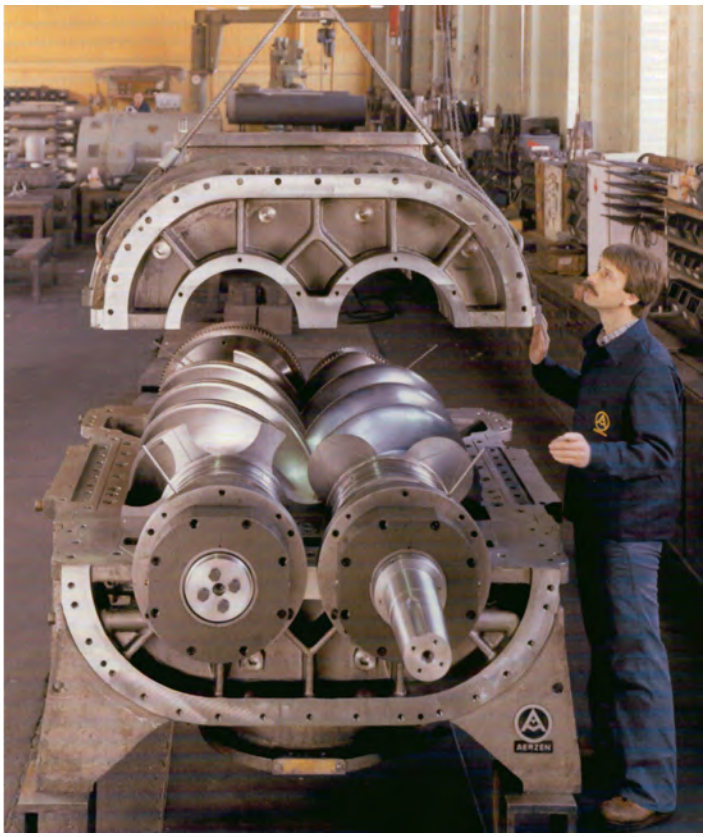

Figure 2: Wet screw compressor (7000 hp, water-flooded) at assembly. (Photo courtesy of Aerzener Maschinenfabrik, Aerzen/Germany and Aerzen USA, Kulpsville/PA)

The choice is clearly up to the owner-purchaser. As of today, no petrochemical or oil refining company that I know of has reached best-in-class status while single sourcing important equipment and components. Hopefully, this two-part sequence of articles has revealed some of the reasons why.

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Machinery Health Monitoring Depends on Accelerometers

PART 3 Calibrating Accelerometers

Wayne Tustin

This is Part 3 of a five-part series. Part 1 (Uptime Oct/Nov 2013) **dealt with the mechanical aspects of using accelerometers, while Part 2** (Uptime Dec/Jan 2014) **addressed the electronic aspects of dealing with those small signals. Part 3 is intended for machine monitoring users of accelerometers and deals with calibrating accelerometers to determine their sensitivity.**

DO YOU USE THE WORD "CALIBRATE" PROPERLY?

Calibration is defined as an orderly procedure for determining sensitivity, which is the ratio between electrical output and mechanical input -- millivolts per g or millivolts per m/s^2.

WHY MUST WE CALIBRATE?

Our accelerometers were calibrated where they were manufactured in order to determine their sensitivity. Later, we must recalibrate them because sensitivity can change (with ambient temperature, for example) and our readings would be wrong.

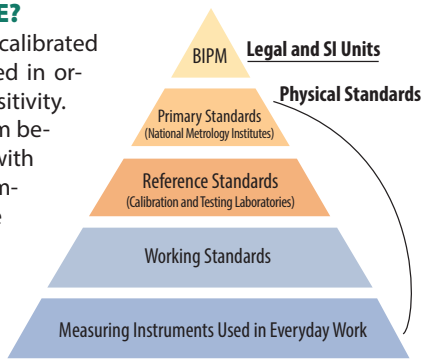

Figure 1: Calibration levels triangle

STATIC CALIBRATION

Part 1 discussed using the earth's gravitational field for a 1g turnover or static check of wire strain gage, piezoresistive and variable capacitance accelerometers, which respond down to zero frequency. It should not be used for crystal or piezoelectric accelerometers since they do not respond down to zero frequency.

DYNAMIC CALIBRATION

In all calibration using sinusoidal motion (oscilloscope), be sure your shaker's acceleration waveforms are sinusoidal. Otherwise, errors can result.

RELATIVELY CRUDE CHECKS

Consider the veescope shown in Figure 2. Place one on the armature of your shaker. Attach your accelerometer. "Eyeball" the wedge while adjusting shaker displacement (frequency previously set at 44.2 Hz) to peak-to-peak D=0.1 inch. Calculating A=0.0511f^{2}D shows that you are shaking at A=10g. Alternately, use D=2.5 mm at 44.5 Hz and calculate A=0.00202f^{2}D=10g.

Divide the electrical output (value) from your accelerometer/signal conditioner by 10 to get sensitivity in pC/g or mv/g.

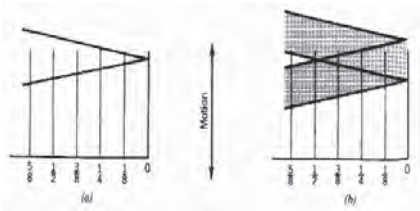

Figure 2: A veescope

ABSOLUTE CALIBRATION

Rarely performed outside national standards laboratories, absolute calibration of an accelerometer is based upon the primary standards of mass, length and time. Sensor output is measured by a voltmeter that is also traceable to the National Institute of Standards and Technology (NIST) or other standardizing agency.

Time and frequency can be linked to a National Measurement Institute (NMI) in the form of broadcasted Coordinated Universal Time (UTC) signals linked to the Bureau International des Poids et Measures (BIPM) and International Atomic Time (TAI). The second is now defined as the duration of 9,192,631,770 cycles of cesium radiation.

In Figure 3, the laser interferometer measures D. Alternately, a calibrated reticle microscope could measure D. Source frequency f is monitored by a time-based instrument. The accuracy of D (length) and f (time) reference instruments should be traceable to international standards: f in hertz and D in inches or mm are used in either to calculate peak acceleration A in g units.

$$\mathbf{A = 0.0511f^2D \text{ or } A = 0.00202f^2D}$$

Finally, the accelerometer's electrical output in millivolts is divided by acceleration in g to calculate sensitivity in mv/g.

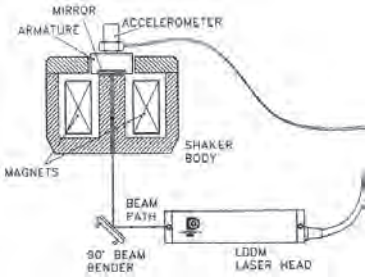

Figure 3: Absolute calibration; not shown, an oscillator or digital signal source or the power amplifier powering the shaker

See the several methods in ISO Standard 16063-11 for details on techniques, uncertainties (as low as ± 0.4% at PTB and 0.3% at NIST) and limitations.

Should your calibrations be traceable to NIST or to another country's standards lab? You might be interested in learning about the equipment used at the U.S.-based NIST. The federal technology agency uses the Endevco absolute calibration shaker + laser unit shown in Figure 4. Stroke D is 0.5 inch. Its beryllium armature is very stiff. Displacement is sensed by a helium-neon (HeNe) laser shining downward from above the shaker. The laser is supported by four square aluminum legs that rest upon the lab floor. The isolated shaker platform is separately supported by four dark colored steel legs. The shaker is said to have less than five percent transverse motion at all frequencies and less than two percent acceleration distortion.

A similar German system is shown in Figure 5.

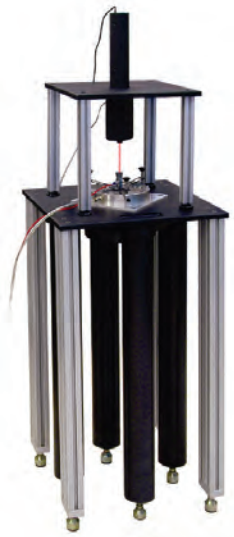

Figure 4: Endevco's Model 2916A absolute calibration shaker + laser

Figure 5: Absolute calibration shaker with laser (photo courtesy of Spektra USA)

SPECIALIZED SHAKERS

For machinery fault warning, the frequency range 10 to 10,000 Hz is adequate; 1-inch or 25 mm is more than enough stroke. Most important is purity of waveform, which should be routinely checked with an oscilloscope and spectrum analyzer.

Several manufacturers offer semi-automated accelerometer comparison calibration systems. Figures 6 and 7 show an air bearing calibration shaker said to feature minimum lateral motion. An adjustable amount of DC in the coil, rather than springs, axially positions the shaker armature.

Figure 6: Air bearing shaker (image courtesy of The Modal Shop)

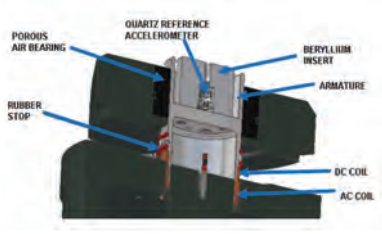

Figure 7: Armature details (image courtesy of The Modal Shop)

COMPARISON CALIBRATION USING TWO METERS

Provided your reference or standard accelerometer has been precisely calibrated and you take care with your techniques and execution, your results can be very acceptable. Specialized electrodynamic (ED) shakers (examples in Figures 6 and 8) are usually employed. You may encounter difficulties at both very low and very high frequencies. *It is important that both accelerometers experience the same mechanical input.* An idealized back-to-back holding fixture (as in Figure 8) gives identical motion to the two accelerometers.

Figure 8: Electrodynamic calibrator

The best way to know the sensitivity of your reference or standard accelerometer is to have it calibrated by your country's NMI. Turnaround time may be a problem, so own two standard or reference units, one in use and one in transit.

Alternately, send your standard or reference units to an accelerometer manufacturer or an independent calibration lab, which send *their* standard or reference units to your country's NMI.

The frequencies at which you calibrate should match those used at the NMI or intermediate lab so you can certify your own traceability to your country's NMI.

You could commence with two accelerometers connected back-to-back on a rigid fixture driven by an ED shaker so they experience identical accelerations as much as possible. One would be your "standard" or "reference" unit whose sensitivity S_s has been given to you (by NIST or another agency) and the other an "unknown" unit whose sensitivity S_u you wish to determine to calibrate. Commence shaking and read accelerometer electrical outputs E_s and E_u.

Does it seem logical to you that the two electrical signals, E_u and E_s, would be directly proportional to the two sensor sensitivities, S_u and S_s? That is,

$$\frac{E_s}{E_u} = \frac{S_s}{S_u}$$

Read E_s and E_s off the two precise and expensive meters. You already know S_s. Calculate S_u by cross-multiplying and dividing.

COMPARISON CALIBRATION, ONE METER

Instead of using two expensive meters, consider the ratio method shown in Figure 9. Here, potentiometer R divides whichever signal is

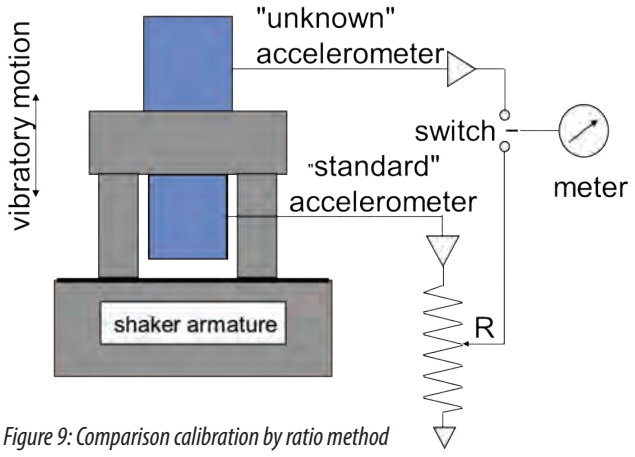

Figure 9: Comparison calibration by ratio method

larger so a selectable fraction can be compared with the smaller signal. Assuming that both amplifier gains are unity:

$sensitivity_{unknown} = R \times sensitivity_{standard}$.

Continually tap the meter, ensuring to avoid meter stiction, while adjusting R as you switch back-and-forth between the two accelerometer systems, seeking the same meter reading from both.

Figure 10: Specialized calibration accelerometer
(image courtesy of Dytran Instruments)

Figure 10 shows a way to save building a back-to-back fixture. It is a standard or reference accelerometer (sometimes called a double-ended accelerometer) in which the sensing crystal is attached to the "roof" rather than the "floor," as in most PE accelerometers. The roof is drilled and tapped to accommodate a stud directly holding the unknown accelerometer. Avoid any intermediate structure or adaptor.

At extremely high frequencies (above 5,000 Hz), the published sensitivity S_s of the standard unit is accurately known only with a specific mass loading.

Avoid operating at or near shaker armature + load resonance. Some specialized shakers have their first $f_n > 50$ kHz, but by the time we add all this load, the first f_n must drop significantly.

Figure 11: Back-to-back calibration

Figure 12: Comparison calibration

Using some variation of Figure 9, we check sensitivity at perhaps 10 different frequencies over the frequency range in which we'll use the unknown accelerometer. Keep the results as a table or plot.

Such a run is often repeated at other intensities to be sure the accelerometer is linear in order to verify that its sensitivity (in picocoulombs per g or in millivolts per g) does not change with intensity.

HIGH FREQUENCY CALIBRATION DIFFICULTIES

Above 5000 Hz, comparison calibration becomes rather difficult because the displacements are extremely small.

For example, if A=10g peak, at f=5000 Hz, D is a little less than 8 µinch or 0.2 µm. Since the displacements are extremely small, the reference and test accelerometers may not experience the same motion. As discussed in Part 1, surfaces must be clean and smooth and treated with a light film of oil before you carefully torque the hold-down studs. If in doubt that motions are identical, reverse the accelerometer's physical positions without changing the electrical connections.

PORTABLE CALIBRATOR

On some jobs, it's more convenient to perform calibrations in the field, rather than carry all sensors back to the lab (see Figure 13).

CONCLUSION

We have looked at several accelerometer types that currently are popular and their mechanical aspects. In this article, we focused on the calibration of these sensors and systems. For our next and final two articles, we will examine accelerometers attached to various machines so they can report on machinery health.

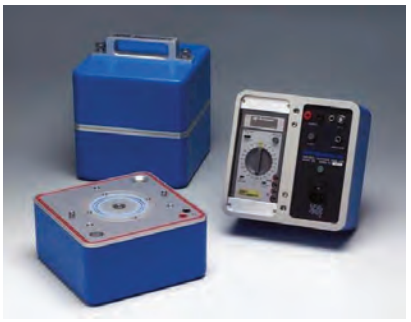

Figure 13: Portable accelerometer calibration lab
(image courtesy of Spektra)

On some jobs, it's more convenient to perform calibrations in the field, rather than carry all sensors back to the lab

References: The foregoing material is extracted from iBook 9, Calibration, of the 33 iBook Apple Bookstore series by Wayne Tustin on Dynamic Environmental Testing, used in Equipment Reliability Institute ERI on-site and open short courses, as well as in ERI distance learning.

Wayne Tustin has been involved with vibration and shock measurement and testing since about 1950, mainly as a teacher. He emphasizes the practical aspects of vibration and shock measurement and testing, and he favors simple explanations. www.equipment-reliability.com

Comparison between Cross Effects in New and Effective Static/Couple Solutions for

Two-Plane Field Balancing of an Overhung Rigid Rotor

José A. Méndez-Adriani

This article compares the cross effect produced using the effective static/couple solution with the cross effect produced employing the new static/couple solution for two-plane field balancing of an overhung rigid rotor. The analysis proves that the cross effect is exactly the same for both solutions. For practical applications, the new solution is more direct than the effective solution.

INTRODUCTION

An overhung rigid rotor is one that has its balance correction planes located outside the supporting bearings, as shown in Figure 1[1], and whose rotational speed is well below the first critical speed[3].

Cross effect, also known as the correction plane interference, can be defined as the change in the unbalance indication at one correction plane caused by a change in the unbalance at the other correction plane. The overhung rotors can be difficult to balance because of high levels of cross effect. To minimize cross effect, two trial weights, which generate a couple of forces, are added for the third run[1]. Under identical conditions, the correction plane interference ratios for the new static/couple solution are comparable with the correction plane interference ratios for the effective static/couple solution[2].

ANALYSIS

Figure 1 illustrates an overhung rigid rotor as a shaft with a disk of width ℓ and radius r for attaching trial and correction weights rotating in a clockwise direction with an angular speed ω as seen from the right side. The rotor is supported on the near bearing N close to the rotor and on the far bearing F far from the rotor, which are separated by a distance h. The center of gravity G of the rotor is farther away from the right correction plane R and closer to the left correction plane L, which is localized at a distance c from the near bearing N[1]. This is considered a perfectly balanced rotor.

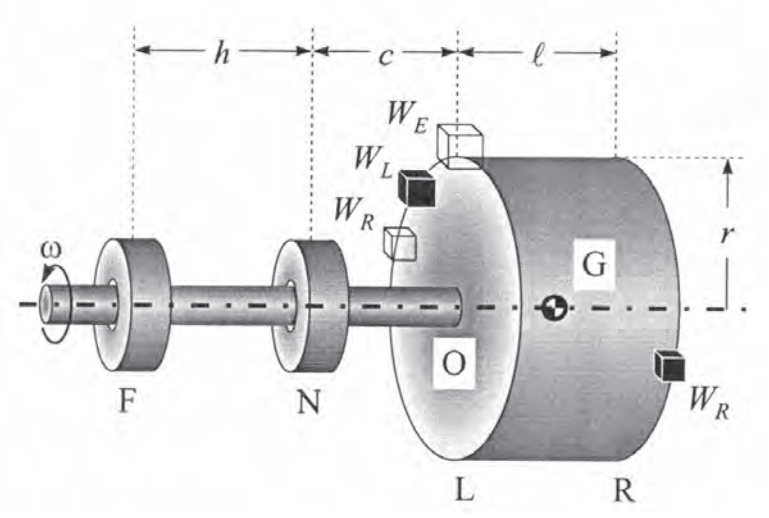

Figure 1: Overhung rotor supported on bearings

A condition of dynamic unbalance is created by adding the weights W_L and W_R to the left and right correction planes, respectively. These two weights generate the two corresponding centrifugal forces, which are proportional to the factor $S = (r/g)\,\omega^2$, where g is the acceleration due to gravity[1]. Assuming the radii to attach trial and correction weights are equal, that is $r_L = r_R = r$, then the factors $S_L = S_R = S$[2]. The unbalance weight in the left correction plane, $\vec{W}_L = (W_L, a_L)$, as well as the unbalance weight in the right correction plane, $\vec{W}_R = (W_R, a_R)$, expressed in polar coordinates, are complex vectors that are known as phasors, whose magnitudes W_L and W_R are the amounts of unbalance weight in the left and right correction planes, respectively, and whose directions are the corresponding angles, a_L and a_R of the unbalance weights[1,2].

If the two additional unbalance weights, $\vec{W}_R$ and $-\vec{W}_R$, are added to the left correction plane,

Cross effect, also known as the correction plane interference, can be defined as the change in the unbalance indication at one correction plane caused by a change in the unbalance at the other correction plane

the state of unbalance is not altered. The vector combination of the left unbalance weight $\vec{W}_L$ with the right unbalance weight $\vec{W}_R$ in the left correction plane gives the quasi-static unbalance weight $\vec{W}_E = (W_E, a_E)$ in the left correction plane, whose magnitude W_E is the amount of unbalance weight in the left correction plane and whose direction is the angle a_E of the unbalance weight in the left correction plane. This can be written as follows[1] in Equation 1:

$$\vec{W}_E = \vec{W}_L + \vec{W}_R$$

Therefore, the dynamic unbalance produced by the unbalance weights in the left and right correction planes is equivalent to the dynamic unbalance produced by the quasi-static unbalance weight in the left correction plane plus the couple unbalance created by the set of opposite unbalance weights in the left and right correction planes[1].

From the definition of the mobilities for the near and far bearings, $\vec{\mathbb{M}}^N$ and $\vec{\mathbb{M}}^F$, respectively[2], the influence factors are given by the following expressions[1] in Equation 2:

$$\vec{S}_L^N = \left(1+\frac{c}{h}\right)S\vec{M}^N,\ \vec{S}_R^N = \left(1+\frac{c+\ell}{h}\right)S\vec{M}^N;$$
$$\vec{S}_L^F = -\frac{c}{h}S\vec{M}^F,\ \vec{S}_R^F = -\left(\frac{c+\ell}{h}\right)S\vec{M}^F$$

The general equations that relate the unbalance weights in the left and right correction planes of the rotor with the vibrations in the near and far bearings are the ones that follow at continuation[1] in Equation 3:

$$\vec{N} = \vec{S}_L^N\vec{W}_L + \vec{S}_R^N\vec{W}_R$$
$$\vec{F} = \vec{S}_L^F\vec{W}_L + \vec{S}_R^F\vec{W}_R$$

Within the common balancing procedure, for the second run, the addition of a trial weight $\vec{W}_{TL}$ in the left correction plane according to Equation 3 leads to Equation 4[1]:

$$\vec{N}_2 - \vec{N} = \vec{S}_L^N\vec{W}_{TL}$$
$$\vec{F}_2 - \vec{F} = \vec{S}_L^F\vec{W}_{TL}$$

And, within the effective balancing procedure, for the third run, the addition of a trial weight $-\vec{W}_{TR}$ in the left correction plane and of the opposite trial weight $\vec{W}_{TR}$ in the right correction plane to form a couple according to Equation 3 leads to Equation 5[1]:

$$\vec{N}_3 - \vec{N} = (\vec{S}_R^N - \vec{S}_L^N)\vec{W}_{TR}$$
$$\vec{F}_3 - \vec{F} = (\vec{S}_R^F - \vec{S}_L^F)\vec{W}_{TR}$$

The indicated couple unbalance weight in the right correction plane $\vec{W}_{IR}$ caused by a trial weight $\vec{W}_{TL}$ in the left correction plane is deduced from Equation 6:

$$\vec{F}_3'' - \vec{F} = (\vec{S}_R^F - \vec{S}_L^F)\vec{W}_{IR} = \vec{S}_L^F\vec{W}_{TL}$$

The correction plane interference ratio, using Equation 2, is calculated as a percentage, as follows in Formula 7:

$$\%I_{(L\&R)L} = \left|\frac{\vec{S}_L^F}{\vec{S}_R^F - \vec{S}_L^F}\right| \times 100 = \left(\frac{c}{\ell}\right) \times 100$$

Therefore, the correction plane interference ratios for the effective static/couple solution[1] are exactly the same as the correction plane interference ratios for the new static/couple solution[2].

It is observed in the second run of the balancing procedure that instead of the addition of the left trial weight $\vec{W}_{TL}$ in the left correction plane to obtain the effective static/couple solution[1], that the quasi-static trial weight $\vec{W}_{TE}$ is added directly in the left correction plane to obtain the new static/couple solution[2].

CONCLUSION

The correction plane interference ratios for the effective static/couple solution and the new static/couple solution are equal. The new solution is more direct than the effective solution, which is advantageous for practical applications.

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Jose Alberto Mendez-Adriani, Ing Mec (UCV, 1970), MSE Mech Eng (U of Michigan, 1973), FASP (MIT, 1980), ScD Mech Eng (City U of Los Angeles, California, 1989), QVA (IRD Mechanalysis, 1981), CMDB (Entek IRD, 1997), CTDPB (DSS, 2011); Industrial Practice: in the assembly plant of General Motors of Venezuela, 1976; Professor Emeritus of Mechanical Engineering and Postgraduate Tutor in Theoretical and Applied Mechanics at the Central University of Venezuela.

Identification and Characterization of

Work Shift Maintenance Time in Titanium Dioxide Plant

Roberto Máscia

Faced with the current level of globalization, mergers of companies seeking market leadership and the tough competitiveness between them, there is a constant search for process optimization, as well as materials, contracted services and workforce optimization. Increasing productivity in all areas has become an important and differential element for reducing business costs.

The lack of data and information on losses in productivity and service delivery in maintenance of industrial plants makes decisions to reduce losses difficult, or even leads to a wrong decision, costing much more for the company.

Historically (from 2009 to 2011), 31.5 percent of the maintenance cost was spent on labors (titanium dioxide plant – sulphate rote – Cristal Company). Identifying how the maintenance management system distributes the working hours for employees and the work order execution for each employee becomes crucial in identifying the losses and bottlenecks in the working day.

Problem Definition

What is the wrench time level (the effective time that a maintenance employee is working "hands-on") and what are the existing losses in the maintenance labor process in a titanium dioxide plant (sulphate route) at the Cristal company in Abrantes, Brazil.

Justification

Not knowing the level of workforce losses in maintenance services makes it difficult to develop an action plan aimed at potentially reducing maintenance costs by reducing time loss of the workforce in the maintenance process.

Objective of the Work

This project, using the Project Management Institute's Project Management Body of Knowledge (PMBOK) global standard for project management, aims to identify and characterize the working day shift of maintenance workers (own and contractors) in a titanium dioxide plant (sulphate route). In doing so, the company will have knowledge of the losses and be able to develop an action plan aimed at reducing workforce time loss in the maintenance process, therefore increasing productivity and staff motivation.

Literature Review

INITIAL CONSIDERATIONS:

Execution maintenance services within the work order process of companies is usually a centralized process coordinated by the planning area. It is the means used to manage (registration, control and distribution) man-hours in the plant to maximize its use and minimize the impact and cost required to work.

At Cristal company, titanium dioxide industry (paint pigment) - sulphate route, the work order execution flow (Figure 1) is computerized and begins with the opening of an occurrence. After analysis of the responsible area and checking for duplication, if data is correct, it is changed into a service request (SS). Then the respective area planner details the work order, specifying each activity required to meet the work order and linking skills and the estimated time for each activity. The work order is also comprised of interdependence between the activities so the software can do the weekly scheduled services and workforce distribution using either the program evaluation and review technique (PERT) or collaborative production management (CPM), which maximizes the manpower utilization forecast. Once the work order list for the next week is generated, planners send the warehouse a list of materials necessary for executing these scheduled work orders so the warehouse can deliver the materials to each field shop. The process enables supervisors and executors to identify any interference in the process, such as emergency work orders, failure in materials delivery, an equipment schedule not provided by the operator (clearance) for maintenance, or failed communication between maintenance and operation. By doing so, the system can run with maximization of resources.

Although the titanium dioxide plant has a more efficient workforce management system, some losses exist in the process as:

- Clothing change/moving to the job;
- Toolbox meeting;
- Filling in work permit;
- Going to the bathroom in the morning/afternoon;
- Displacement for lunch, snacks, water, coffee;
- Tools preparation.

The maximum productivity achieved with the workforce at the Cristal titanium dioxide site is an efficiency of approximately 77 percent. According to the 2006 scholarly article by Oliveira, Silva S., et al, on a maintenance planning strategy for a leap in productivity, the benchmark for workforce efficiency, considering the international reference for maintenance of refineries and petrochemical, is 65 percent.

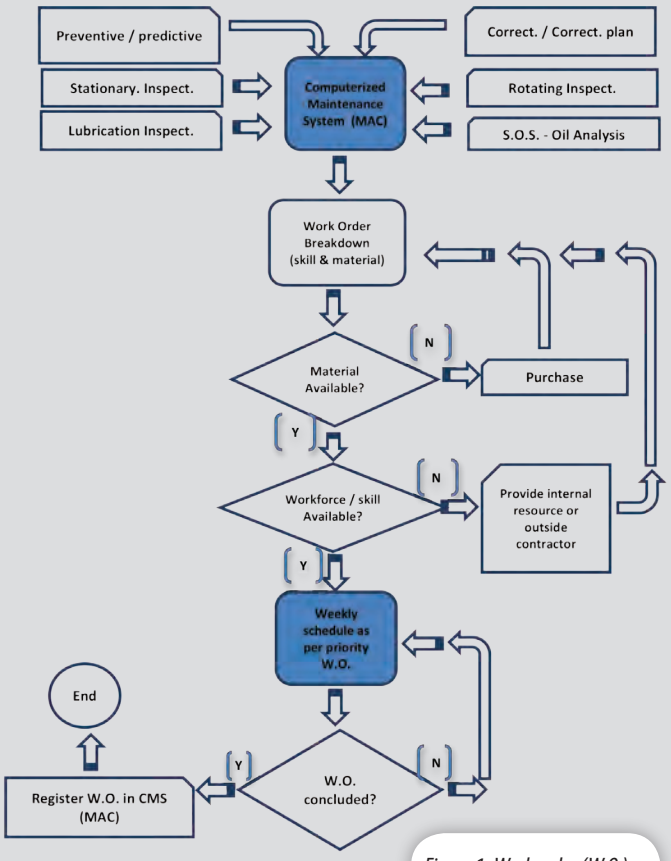


Figure 1: Work order (W.O.) execution summary flow at Cristal Company, Brazil.

Methodological Procedures

Measuring workforce efficiency, or the time the maintenance employee was working, also known as hands-on or wrench time, was done as a project using the methodology and knowledge of the PMBOK through the development of management plans following:

- Project Charter;
- Scope;
- Time;
- Cost;
- Risk;
- Communication;
- Quality;
- Human Resources;
- Acquisitions.

This was initially done in the plant and included a disclosure with the aim of the project details, a project team presentation for the people involved (director, managers, superintendent, supervisions and doers) and in a summarized way for the rest of the site via intranet, thus facilitating the project's receptivity and knowledge. A questionnaire was done during disclosure meetings with the maintenance crew, with the goal of determining how the productivity was from a doer vision, as well as identifying some bottlenecks that could be influencing productivity.

WORKFLOW MEASUREMENT:

For the measurement of each worker's maintenance workflow step in the field, there were three possibilities for data collection:

1. Using the recorded data by maintenance employees in work orders. However, the data was analyzed and it was verified that it was not properly appointed.

2. Implementing time cards, with employees recording each step on the card for later analysis. This method was discarded since it added another document in the process (production loss) and would have the same problem as Item #1.
3. Monitoring random work orders on-site at a chosen area (Figure 2), consequently the monitoring of each employee across selected work orders, Cristal and contractors, for each activity from the beginning to the end of the workday.

After defining the way to collect the data (#3 option), a spreadsheet was developed to record the collection of these data and to standardize the sampler's collection so it was easier to type into the database (see Table 1).

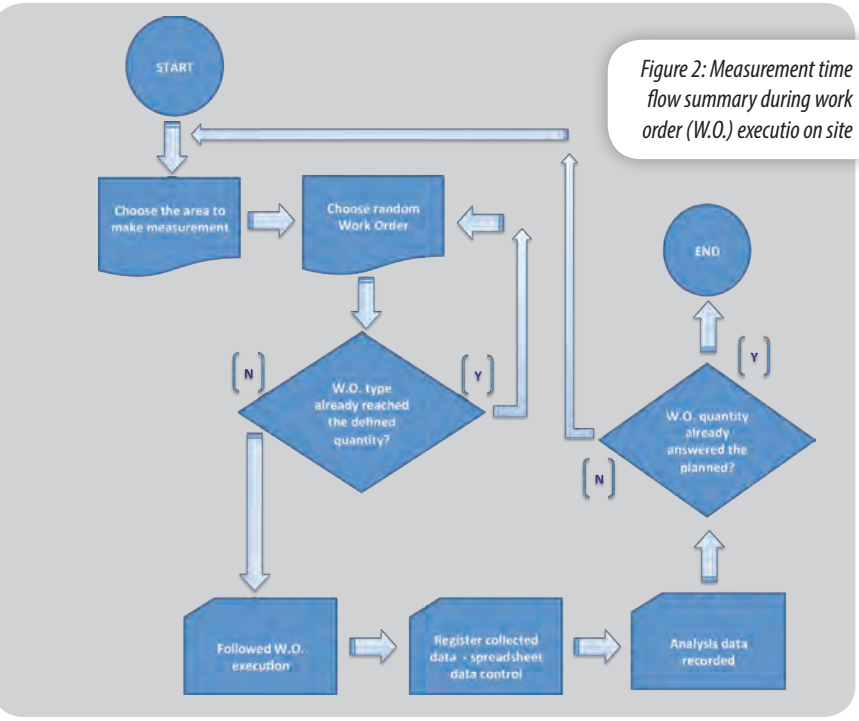


Figure 2: Measurement time flow summary during work order (W.O.) executio on site

	Site Area	SITE - MIC		
	Activities Description - Workingday	M-h	%	P/N
1	Displacement of locker room to workshop	1617,6194	3%	I1
2	Toolbox meeting	1974	4%	I2
3	Work order distribuition	1522	3%	I3
4	Tools preparation	2038	4%	I4
5	Displacement to get work permit	420	1%	I5
6	Work permit (fill in)	1805	4%	I6
7.1	Waiting electrician to lock equip	417	1%	I7.1
7.2	Lock out / show me	1189	2%	I7.2
8	Displacement to workplace	461	1%	I8
9	Waiting operation clearance (cleaning/draining/etc.)	639	1%	I9
10	Job execution in the morning	2478	5%	P1
10	Job execution in the morning	1589	3%	P2
10	Job execution in the morning	2358	5%	P3
10	Job execution in the morning	1151	2%	P4
10	Job execution in the morning	1881	4%	P5
11.1	Displacement: Pick parts up in warehouse	866	2%	I11.1
11.2	Displacement: Pick tools up (Tools shop)	549	1%	I11.2
11.3	Displacement: Field workshop/central workshop	375	1%	I11.3
12	Waiting crane/forklift in the morning	74	0%	I12
13	Waiting weather	632	1%	I13
14	Personal needs (toilet/water/etc.)	137	0%	I14
15	Unlock the equipment	65	0%	I15
16	Close work permit	151	0%	I16
17	Displacement to workshop with tools	353	1%	I17
18	Cleaning and put tools away	223	0%	I18
19	Personal needs (hygiene/toilet/water/change uniform/etc.)	512	1%	I19
20	Displacement workshop to cafeteria	787	2%	I20
21	Lunch	4299	9%	I21
22	Others (bank/HR/displacement to cafeteria/etc.)	1328	3%	I22
23	Displacement rest area to workshop	216	0%	I23
24	Work order distribution	835	2%	I24
25	Tools preparation	551	1%	I25
26	Displacement to get work permit	171	0%	I26
27	Work permit (fill in)	390	1%	I27
28.1	Waiting electrician to lock equipment	0	0%	I28.1
28.2	Lock out / show me	37	0%	I28.2
29	Displacement to workplace	620	1%	I29
30	Waiting operation clearance (cleaning/draining/etc.)	534	1%	I30
31	Job execution afternoon	3651	7%	P6
31	Job execution afternoon	2220	4%	P7
31	Job execution afternoon	2301	5%	P8
31	Job execution afternoon	1313	3%	P9
31	Job execution afternoon	2887	6%	P10
32.1	Displacement: Pick parts up in warehouse	757	2%	I32.1
32.2	Displacement: Pick tools up (tools shop)	606	1%	I32.2
32.3	Displacement: Field worshop/central workshop	270	1%	I32.3
33	Waiting crane/forklift in the morning	373	0%	I33
34	Waiting weather	583	1%	I34
35	Personal needs (toilet/water/etc.)	205	0%	I35
36	Unlock the equipment	144	0%	I36
37	Close work permit	309	1%	I37
38	Displacement to workshop with tools	692	1%	I38
39	Cleaning and put tools away	767	2%	I39
40	Personal needs (hygiene/toilet/water/change uniform/etc.)	142	0%	I40
41	Displacement to central dress room/shower	2347	5%	I41
Mor	Total hours: productivity in the morning	8424	19%	PM
Mor	Total hours: non productivity in the morning	16776,619	33%	IM
Aft	Total hours: productivity afternoon	12372	25%	PT
Aft	Total hours: non productivity afternoon	11677	23%	IT
	Total hours: productivity TOTAL	21796	43%	TP
	Total hours: non productivity TOTAL	28453,619	57%	TI
	Grand Total	50249,619	100%	

Table 1 - Description of activities (execution and losses) followed in the field and their respective percentage

To make the data representative, a control was created to avoid concentration of the survey in the following points: weekday, the work order priority (emergency x urgency x normal), confined space and planned or unplanned work order. Regarding the amount of work orders to be sampled, it was determined that it would be the number of work orders corresponding to three months of labor workforce performing in maintenance, representing approximately 40,000 man-hours.

Analysis of Results

INITIAL CONSIDERATIONS

The data sampled in the field was registered in spreadsheets per production area and contractors' skills (fitters, rubber and fiber, scaffolding, electrical and civil) that provide service for maintenance. A total of 50,250 man-hours was measured, spread among types of losses and execution (hands-on).

LOSSES

From an employee's point of view, the top five losses were attributed to:

1. Work permit clearance process.
2. Activity details in work order need improvement.
3. Availability/delivery of materials in the warehouse.
4. Communication among planner, doer and operations before details work order activities need to be improved.
5. More electricians for work permit process need to be provided.

ANALYSIS OF LOSSES AS A FUNCTION DURING PART OF THE DAY

In Figure 3, which summarizes data collected from contractors and Cristal employees, the time of hands-on represents a total of 43 percent, consequently a loss of 57 percent. Also, the graph shows a greater loss in the morning (33 percent), where it was observed that this loss was related to the time of arrival at the shop, the toolbox meeting, the work order distribution by supervision, tools preparation, the work permit process, stopping to get parts and losses mainly due to displacements (see Figure 4). In the afternoon, which is usually the same work order continuity, so there is no need to open a work permit, the percentage of effective work (hands-on) is slightly higher than the percentage of losses. (25 percent vs. 23 percent, respectively). Displacement is the biggest reason for working hours losses (see Figure 4) and spare parts is the biggest reason inside the displacement.

Conclusion

There is great potential for reducing losses in working hours in a chemical plant of titanium dioxide by 22 percent through actions related to the

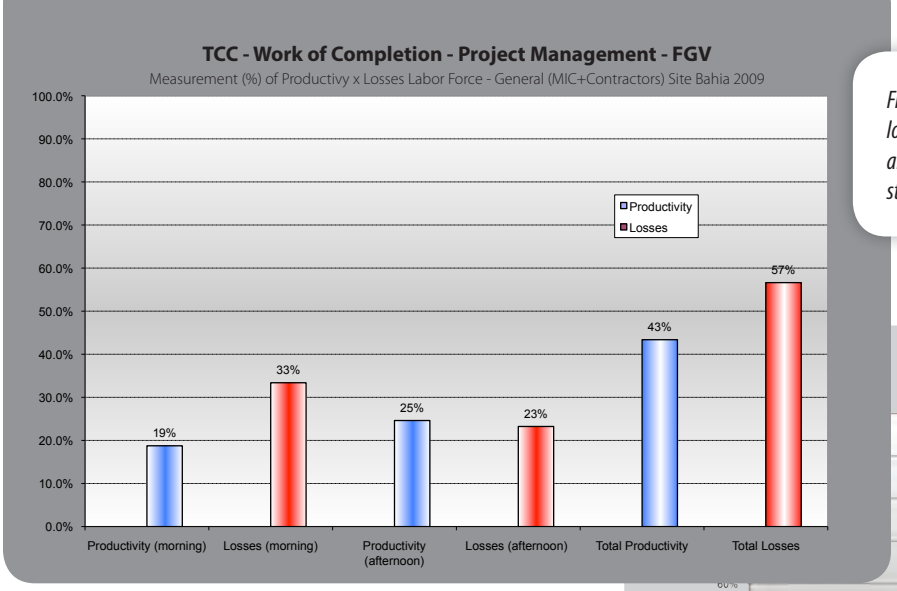


Figure 3: Productivity and losses result in the morning and afternoon among maintenance staff and contractors

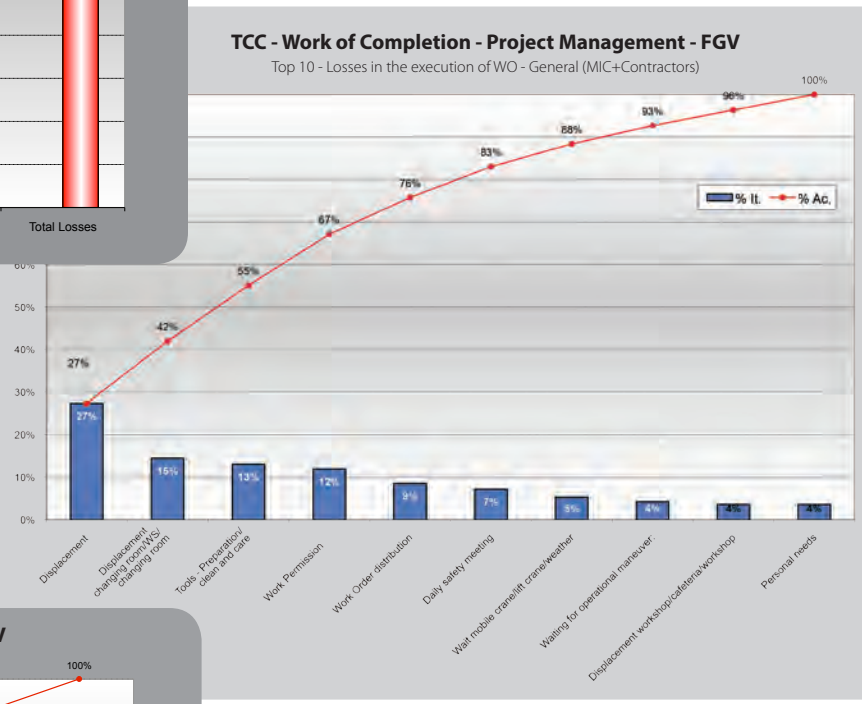


Figure 4: Losses percentage on a Pareto chart for maintenance own and contractors

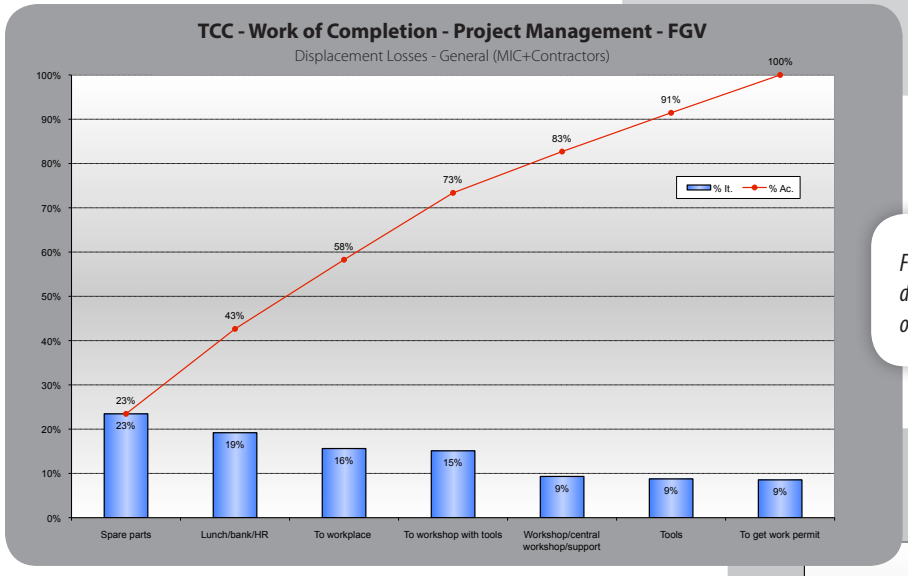
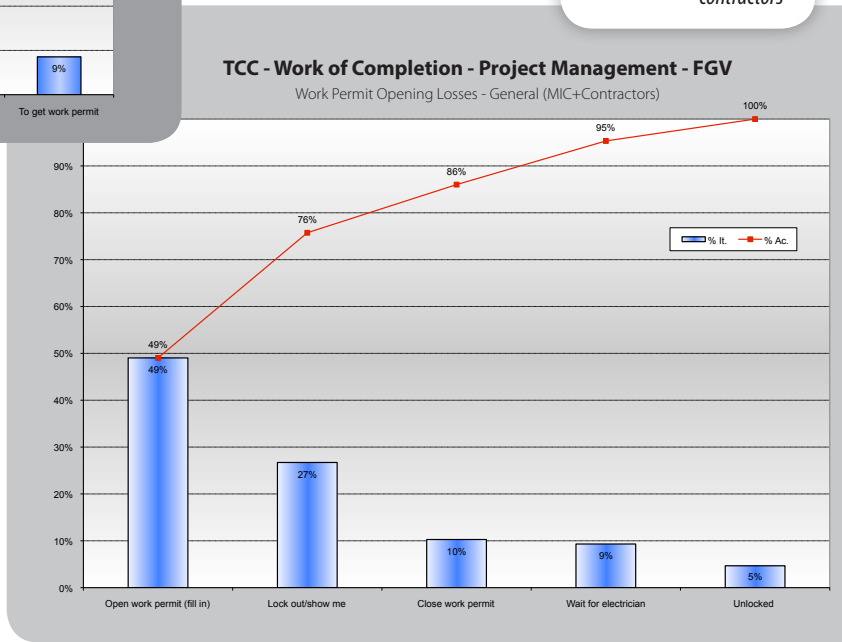


Figure 5: Pareto's loss percentage displacement - maintenance own and contractors

Figure 6: Pareto Work Permit percentage losses – maintenance own and contractors



organization/flow and working methods applied in maintenance's everyday life.

Furthermore, planning is an important tool that maximizes productivity through the convergence of all involved to the same goal: work order execution in the fastest time possible to reduce losses.

Supervision is fundamental for gaining participation for productivity improvement through efficient distribution of work orders and monitoring of work execution.

Roberto Máscia has been a Mechanical Engineer since 1987. He received his Master's degree in 2001 (developed an alloy against erosion), his MBA in 2009 (measured the maintenance wrench time) and Safety Engineer in 2010 (identified the consequence of lack of energy at a chemical plant).

Unleash the Power of Predictive Analytics!

Can Your Machine Tell You When It Will Fail in the Future?

Mario Montag

Asset-intensive organizations of all sizes and levels of manufacturing maturity are unleashing the power of predictive analytics to gain significant improvements in asset reliability.

As the wealth of information generated by sensors and machines in asset-intensive organizations increases, the opportunity for data-driven optimization drastically increases as well. Utilizing predictive analytics within asset-intensive industries presents itself as a non-intrusive method of predictive maintenance. Until now, data overload had served as a challenge and a threat to decision clarity and the ability to provide accurate, actionable information. According to past studies, an effective predictive maintenance program can result in a savings of eight percent to 12 percent over a program simply utilizing preventive maintenance strategies[1]. Organizations should begin planning and executing predictive analytics initiatives because the benefits are significant, they are easy to get started and they enable forward-thinking organizations to gain a competitive edge.

BENEFITS OF PREDICTIVE ANALYTICS

Although the phrase predictive analytics represents a wide variety of attributes from statistics, mathematical modeling and simulations, data mining and machine learning, it can be summarized as a method to predict the likelihood of future events or the attributes associated with such asset failures. Such a strategy can capitalize on an organization's "big data" by analyzing any available historical data to forecast future events at up to real-time speed in an effort to enhance future operating procedures. Whether predicting asset remaining useful life (RUL), probability of failure, conditional trending, or any other arbitrarily defined feature, all will result in elevated efficiency and effectiveness throughout daily processes, which translates into reduced maintenance costs and increased revenue.

Some organizations see the value of being able to predict future asset failures as the Holy Grail, but opt to start with enhanced root cause analysis using the same statistical methods to predict future events. The ability to analyze many different factors, like machine sensor data, historical failures, weather, employee training, preventive maintenance records, OEM manufacturers and any additional factors influencing asset reliability, provide a unique perspective in gaining additional visibility into why specific failures took place in the past. This root cause analytical exercise builds a strong foundation for the deployment of predictive analytics.

Predictive analytics serves as another tool in the predictive maintenance toolbox, in addition to vibration, infrared and oil analysis, as a few other examples. Depending on a facility's reliance on a reactive maintenance approach, implementation of a fully functional predictive maintenance program can result in:

1. Savings of 30 to 40 percent;
2. 10-fold return on investment (ROI);
3. Maintenance cost reduction of 25 to 30 percent;
4. Breakdown elimination of up to 75 percent;
5. Reduction in downtime from 35 to 45 percent;
6. Increase in production of 20 to 25 percent.

Utilizing an array of statistical models with varying combinations and contexts of predictors (e.g., indicator readings), and the results delivered in a simple, yet actionable format, a manufacturer has the ability to:

1. Dispatch a technician with a preventive maintenance work order;
2. Ensure repair parts are in inventory prior to downtime;
3. Shift from reactive to preventive maintenance on an as needed basis;
4. Increase operational efficiencies and finished goods output;
5. Increase safety;
6. Save time and money.

Data supporting the use of predictive analytics in the workplace finds that predictive analytics is the future of asset reliability optimization. Organizations have been deploying traditional predictive maintenance processes and tools for decades. The historical lack of predictive analytics in asset maintenance departments is due to the lack of knowing how to get started and simple deployment solutions. New technologies and the growing trend in predictive analytics are making it much easier for organizations to start predictive analytics initiatives.

HOW TO GET STARTED WITH PREDICTIVE ANALYTICS

One of the main reasons for implementing predictive analytics in the plant is to positively affect reliability centered maintenance (RCM) initiatives. Understanding the intricacies and capabilities of predictive analytics is vital to the movement towards RCM. Predictive analytics is one of the main steps within RCM, but organizations don't know how to deploy it or get started.

Close to 70 percent of asset reliability initiatives do not achieve the expected results. Similar figures are found in large-scale information technology initiatives, like enterprise resource planning (ERP) implementations. Predictive analytics initiatives also can be another statistic in projects that never achieve the desired or promised results. Therefore, it is strongly recommended that organizations start small with a few key assets in one or two facilities to understand the deployment process and achieve actual results using their own data and equipment. Once success is achieved in early proof of concept (POC) initiatives, it is easier to build the required buy-in from senior stakeholders with the support of a clear business case and ROI.

An organization can take a variety of paths to achieve predictive analytics results. The first possible solution can be made internally by hiring a team of data scientists and purchasing the required statistical software and IT big data infrastructure. Another option is for organizations to purchase enterprise-wide software licenses with services to monitor and manually create actionable reports using predictive analytics. This is often times the most expensive option. The third and simplest deployment approach takes the form of acquiring analytics as a service (AaaS) from niche players in the field of predictive analytics for asset maintenance.

Regardless of which choice is selected, it is important that data is captured into databases and maintenance processes are documented accurately and consistently. The better the data, the better the results produced by the statistical (predictive) models. Not all data scientists are the same, so domain expertise is another important factor for achieving desired results with predictive analytics.

Predicative analytics is providing great results to reduce asset failures, improve reliability and reduce maintenance costs. Companies want to tap into the extensive amounts of maintenance and asset health data being captured on a regular basis that are not being fully leveraged to improve reliability and operational performance.

DON'T GET LEFT BEHIND

As machine to machine (M2M) deployments and the Internet of Things (IoT) phenomena continue to grow, it is safe to assume predictive analytics will follow in close pursuit. These two terms refer to the network of physical objects accessed through the Internet, specifically communicating with devices of the same type. Predictive analytics has been successfully applied in financial markets and consumer purchasing (marketing) trends. This technology and capability has started to expand the deployment of techniques to improve asset reliability in heavy machinery and manufacturing equipment. Industry-leading companies are seeing results as high as 90 percent in accuracy to predict asset failures days in advance, which help move them from preventative to predictive maintenance.

Predictive analytics can provide manufacturers with daily predictions or probabilities of failure, or downtime, for specific assets. The system must be able to take complex data as inputs and produce solutions that are concise and easy to interpret for maintenance crews who are actionable on the ground. The ability to provide an actionable plan independent of analytical training is unique and tangible.

References:
1. DoD. "RCM." Reliability Centered Maintenance. N.p., 10 Nov. 2012. Web. 06 Nov. 2013.

Mario Montag is the CEO of Predikto, a predictive analytics company purely focused on developing solutions to predict equipment failures in asset-intensive industries. Mario has 15 years of experience deploying technology solutions to large enterprises. www.predikto.com

Achieving Cost Reduction Targets

Through MRO Data Cleansing

Jocelyn Facciotti

THE DATA CHALLENGE

As competition and technology continue to evolve in today's industrial and manufacturing industries, companies are faced with the ever-increasing challenge of reducing costs and improving efficiency while maintaining production uptime. These manufacturing companies often have multiple sites spread across large geographic regions, each with thousands of MRO spare parts on hand to keep operations running. In such large organizations, several different employees enter items into various enterprise systems at each site with little or no standard guidelines and often in multiple languages. Over time, this lack of standardization causes materials data to become inconsistent and inaccurate, resulting in many negative effects that can be felt throughout all units of the business.

The most common effects caused by corrupt materials data include:

- Unidentifiable items;
- Excess inventory;
- Duplication;
- False stockouts;
- Equipment downtime;
- Inefficient part searches;
- Increased maverick purchases (direct buys);
- Limited benefits from enterprise resource planning (ERP) or enterprise asset management (EAM) systems.

These inefficiencies can cost companies significant time and money, while preventing them from making critical business decisions.

THE DATA CLEANSING PROCESS

To transform corrupt data into consistent quality data, a data cleansing process must be implemented to create one, common corporate catalog that can be maintained throughout the entire organization.

While the data cleansing process may appear very simple in nature, it requires a very unique and specialized set of software, people and procedures. Some data cleansing companies pride themselves on efficiency and speed through the use of automated software, but in reality, there is no software application that can accurately cleanse mass data files without human intervention. The data cleansing process is actually much more detailed and the most accurate results requires the use of automated software applications combined with the expertise of cleansing specialists to ensure consistency, accuracy and efficiency.

Step 1 – Establish a Standard Operating Procedure

The first step in any data cleansing project is to establish a custom standard operating procedure that will address data format, naming convention and abbreviation requirements. Each company and industry is different and it is critical that data be tailored to the specific enterprise system and business need. Once the standard operating procedure has been approved, it will become the single source for structuring materials data moving forward.

Step 2 – Pre-Cleanse

A pre-cleanse program passes through raw client data in preparation for the standardization and enhancement process. Using automated software, manufacturer names and part numbers are identified and segregated from the unstructured free text descriptions. Once segregated, the manufacturer names and part numbers are corrected and standardized, ensuring each unique manufacturer name and part number maintains one consistent format throughout the entire database (Figure 1).

TB WOODS (*Standardized*)	THOMAS & BETTS
T B WOODS	T&B
T.B. WOODS	T & B
TB WOOD	TandB
TB WOOD'S	T-B
TBW	THOMAS & BETTER
WOODS	THOMAS-BETTS

Figure 1

Step 3 – Assign Noun-Modifier Pairing

Following the segregation and standardization of manufacturer names and part numbers, a standard part naming convention must be applied to each item. As illustrated in Figure 2, a standard noun-modifier dictionary is used to assign each item with a noun-modifier pair, where the noun is

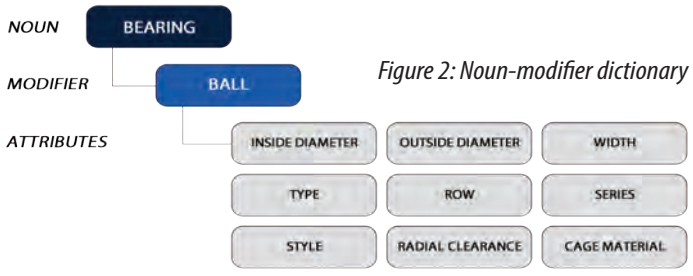


Figure 2: Noun-modifier dictionary

the primary identifier and the modifier is the secondary identifier. Each noun-modifier pair also contains an average of five to seven associated attributes, which further describe the characteristics of that item.

Step 4 – Populate Attributes

After standardizing and populating information provided in the customer's raw descriptions, the remaining attributes are populated using internal and external tools, such as the master parts library, which contains millions of pre-standardized items. An online research tool assists in the search and collection of additional parts information. Using these powerful tools, item descriptions are accurately and efficiently enhanced with information retrieved directly from manufacturer and original equipment manufacturer (OEM) catalogs.

Step 5 – Assign Classification Codes

Once all items have been correctly described by a noun, modifier and corresponding attributes, they now can be assigned United Nations Standard Products and Services (UNSPSC) and/or customer-specified classification codes. The classification codes are typically used for commodity segmentation, spend analysis and other custom reports, enabling companies to leverage purchases and gain insight for improved procurement-related efficiencies.

Step 6 – Identify Duplicate Items

After cleansing and classification is complete, duplicate items within the database are identified by direct duplicate (they have the same manufacturer name and part number) or by form, fit and function (they may have a different manufacturer name and part number, but are identical according to type, size and material). Once duplicates have been identified, they are assigned one common corporate part number, descriptions are duplicated to appear identical throughout the database and the items are flagged for customer review.

Step 7 – Quality Control Review

Due to the emphasis on quality and consistency, the next step involves a final human review of all items, typically conducted by an assigned project leader or dedicated quality control person. The quality control process ensures every item follows proper format and nomenclature according to predefined customer standards, while verifying enhanced descriptions are accurate and complete.

Step 8 – Send Review List to Customer

On average, 10 percent of the materials database is usually found to be review items, meaning items lacking critical information for accurate part identification, such as manufacturer name or part number. During the data cleansing process, these items are flagged and compiled into a customer review list. The review list is returned to the customer, who must then physically locate the item within the storeroom and record the necessary part information to be added into the material master.

Step 9 – Format Data to Customer ERP/EAM/CMMS

Once the missing information has been collected for all review items and the entire cleansed database has been approved by quality control, it is deemed complete and transferred to the IT department. At this stage, IT specialists format the data to the customer's specific enterprise system or computerized maintenance management system (CMMS) and exports it into a return file. The formatting stage is critical to achieving the desired end result as every enterprise system has its own unique layout, headers and character limitations. For instance, some systems have a 40-character limit on the short description, which presents a unique formatting challenge and requires a specific set of abbreviation standards during the cleansing process.

Step 10 – Return Cleansed File

Once the entire data file has been cleansed, standardized, enhanced, deduplicated, reviewed and formatted to the specified enterprise system, it is electronically delivered to the customer. At this time, the data can be uploaded to the live enterprise system.

In an effort to satisfy business objectives, data requirements and project budget, there are various levels of data cleansing available. Those levels include:

Level 1: Cosmetic Cleanse

The cosmetic cleanse identifies and standardizes manufacturer names and part numbers and assigns accurate noun-modifier pairs for efficient identification. During the cosmetic cleanse, duplicate items are identified within individual sites and across the corporation, while items lacking critical information are flagged as review items. The cosmetic cleanse is typically selected when data is being used specifically for procurement purposes, or when budgetary constraints are a critical factor. In this case, only pertinent part information is cleansed to enable accurate spend analysis, commodity segmentation and part identification.

Level 2 - Standardization Cleanse

The standardization cleanse identifies and standardizes manufacturer names and part numbers, assigns accurate noun-modifier pairs and standardizes the client-provided item descriptions. During the standardization cleanse, duplicate items are identified within individual sites and across the corporation, while items lacking critical information are flagged as review items. The standardization cleanse is typically selected when existing client data contains sufficient attribute information and enhancement is not required or desired. In this case, all existing information is cleansed according to predefined client standards, enabling improved part search ability, commodity segmentation and spend analysis.

Level 3 - Full Enhancement Cleanse

The full enhancement cleanse identifies and standardizes manufacturer names and part numbers, assigns accurate noun-modifier pairs, standardizes the client-provided item descriptions and provides attribute enhancements. During the full enhancement cleanse, duplicate items are identified within individual sites and across the corporation, while items lacking critical information are flagged as review items. The full enhancement cleanse is typically selected when data is being used by maintenance and engineering, in which case comprehensive and complete item descriptions are required for efficient part search ability. The full enhancement cleanse delivers data that is accurate, reliable and readily available, ensuring rapid part location, minimal equipment downtime and detailed management reporting.

BEFORE

Plant	Plant 1
Stock Number	222-113-509
Manufacturer Name	SKF USA
Manufacturer Part Number	23022CCC3W33
Material Description	23022 CC/C3W33SKF Bearing, ABC Co. 12345
Vendor Name	ABC Company
Vendor Part Number	12345

AFTER

Plant	Plant 1
Material Number	1000001
Manufacturer Name	SKF
Manufacturer Part Number	23022 CC/C3W33
Material Description	BEARING, ROLLER, 110MM ID, 170MM OD
PO Text	BEARING, ROLLER, 110MM ID, 170MM OD, 45MM WD, SPHERICAL, SELF-ALIGNING, C3 CLEARANCE, SKF, 23022 CC/C3W33
Vendor Name	ABC COMPANY
Vendor Part Number	12345
Old Item Number	222-113-509
Corp Number *	1000001

BEFORE

Plant	Plant 1	Plant 2
Stock Number	890723-01	880418-02
Manufacturer Name	SWAGELOK	Swaglock
Manufacturer Part Number	SS-810-C	SS810-C
Material Description	1/2" CAP PN:SS-810-C SWAGELOK	1/2" S.S. CAP, SS810-C
Vendor Name	XYZ Company	ABC Company
Vendor Part Number	81235	64526

AFTER

Plant	Plant 1	Plant 2
Material Number	1000013	1000013
Manufacturer Name	SWAGELOK	SWAGELOK
Manufacturer Part Number	SS-810-C	SS-810-C
Material Description	CAP, TUBE, 1/2" TUBE OD, 316 SS	CAP, TUBE, 1/2" TUBE OD, 316 SS
PO Text	CAP, TUBE, 1/2" TUBE OD, 316 SS, SWAGELOK, SS-810-C	CAP, TUBE, 1/2" TUBE OD, 316 SS, SWAGELOK, SS-810-C
Vendor Name	XYZ COMPANY	ABC Company
Vendor Part Number	81235	64526
Old Item Number	890723-01	880418-02
Corp Number *	1000013	1000013

BEFORE	AFTER
BEARING, ROLLER, TAPERED, TIMKEN #39520	BEARING, CUP, TAPERED ROLLER, 4.4375" OD, 0.9375" WD, 0.1250" RAD, STRAIGHT OUTER, TIMKEN, 39520
BEARING, CUP, TIMKEN #JLM710910	BEARING, CUP, TAPERED ROLLER, 4.1339" OD, 0.7283" WD, 0.0400" RAD, STRAIGHT OUTER, TIMKEN, JLM710910
BEARING, ROLLER, TAPERED, #JM716610, CUP	BEARING, CUP, TAPERED ROLLER, 5.1181" OD, 0.9449" WD, 0.1000" RAD, STRAIGHT OUTER, TIMKEN, JM716610
BEARING CUP, 2 TAPER, TIMKIN #492A	BEARING, CUP, TAPERED ROLLER, 5.2500" OD, 0.8750" WD, 0.1250" RAD, STRAIGHT OUTER, TIMKEN, 492A

Figure 3

THE RESULTS

Esthetically, the results of data cleansing are obvious, as the data now clearly maintains one consistent format and nomenclature throughout the entire organization, while containing enhanced information for improved part identification (Figure 3).

The real benefits, however, are those that may not be as visually obvious, but present the greatest return on investment. The most valuable benefits are those that come from the ability to now identify and remove excess, obsolete and duplicate items, while improving search and reporting functionalities within the enterprise system.

Key benefits include:

- Cost Reduction
  - Identification of excess-active and obsolete inventory.
  - Identification and elimination of duplicate items.
  - Reduction of equipment downtime.
  - Reduction of maverick purchases.
  - Reduction of expedited part orders.
- Improved Maintenance Efficiency
  - Efficient part searches.
- Maximum ERP/EAM/CMMS Benefits
  - Improved reporting capabilities.

From a long-term perspective, quality materials data is the key to maintaining operation costs and efficiencies. This process does not end once the data cleansing project is complete, though. Maintaining ongoing data quality requires a strict set of catalog management procedures to ensure accuracy and consistency as new items are added and existing items are modified or suspended. Most data cleansing companies offer some type of catalog management software or service for customers to maintain the quality of their cleansed catalog. However, unless the customer is able to dedicate an internal resource to manage the catalog, outsourcing this activity to the experts who originally cleansed the database will always deliver the best results.

No matter how expensive, functionality-rich, or industry recommended a CMMS may be, the reality is that the software is only as good as the data flowing through it. While data cleansing may add costs to an already expensive software implementation, the savings and long-term benefits far exceed the upfront investment. The results truly speak for themselves.

Jocelyn Facciotti is the Marketing Manager for I.M.A. Ltd., a company that specializes in MRO Data Cleansing and related MMDM services. Working with CMMS providers, integrators, and end users on a daily basis, Jocelyn emphasizes the positive results that quality data can deliver to an organization. www.imaltd.com

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".....many people don't understand common sense is very uncommon, so having them take a few minutes during the presentation to think about a common sense approach may help them.
MARTIN TAUBER

Q&A

Martin Tauber

Perhaps we could start with your career background. What are some of your past accomplishments and some information about your current role?

Originally, I was hired at Barber Foods/AdvancePierre Foods as a maintenance technician on the first shift. I was responsible for maintaining various types of food processing equipment and conveyors, and also fabricated any needed components. I was voted Employee of the Month in the first year of employment. I then participated in the total productive maintenance (TPM) and 5S summit. The training there resonated with all the plants and the managers. This led me to writing our single point lessons. So I got kidded for creating my own job. We were able to take downtime from 30 to 60 minutes per day due to poor setups to zero. I have now become the plant trainer and the 5S/TPM coordinator, running these events for the company. I am now behind the desk, but I still get to help the mechanics.

In reviewing your presentation: "How to Develop and Write a Repeatable Maintenance Procedure" at IMC-2013, why did you choose this topic? What value do you think it provided to the audience?

I value the common sense basics and try to convey this to the audience so they can take it back to their plants. Some maintenance technicians have much accumulated knowledge, but we take it for granted and don't document it. When I go to other plants, I find they just don't know how to do the basics. I walk them through some equipment basics and work with them to develop single point lessons. Then, we take a series of single point lessons and combine them into procedures that improve the machines. For example, focusing on just the basics, we took one machine operating at 35 strokes per minute and increased it to 80 strokes per minute. This was done just by adjusting the setups in manufacturing. Just by applying common sense principles.

What qualities do you think it takes to be a good presenter?

You have to give attendees something they can use. The information can't be too specific or for a certain group. It has to be applied generally and have wide acceptance and application. Also, you have to speak to your audience as an equal. They need to relate to you. I read all comments, both pro and con. For example, some comments on my evaluations said my presentation was just common sense. I agree, but many people don't understand common sense is very uncommon, so having them take a few minutes during the presentation to think about a common sense approach may help them. Also, I watch the audience to make sure my message is coming across clearly.

Those are good tips for any presenter. So finally, do you have any ideas for future presentations, either for yourself or something you would like someone else to address at the next IMC?

Documentation. We have many people enrolling in vocational schools, but they need to understand the real world outside of school. They may understand machines they've worked on in school, but not machines currently in use in plants. We will need to provide them good documentation for older, existing machines and know the optimum settings for the output. This is helpful for new people and it will keep the equipment running better. Much of the equipment has poorly written procedures and documentation; it must be better.

Any final advice that you would like to give our Uptime readers?

Yes, if I could give them any advice, it would be to go to the IMC conference and learn. You are never too old to learn. I am 60 and still learning.

with 2 Industry Leaders

that won the Best Presenter Award at the 28th International Maintenance Conference (IMC-2013)

Uptime Magazine recently caught up with Martin Tauber and George Williams. These conversations provided some interesting insights that Uptime readers will find valuable.

IMC 2013
The 28th International Maintenance Conference
Best Presenters

George Williams

Perhaps we could start with your career background. What are some of your past accomplishments and some information about your current role?

My background is mechanical, but I moved through a variety of positions within the maintenance organization at Bristol-Myers Squibb Co. (BMS) and eventually became a maintenance planner. My roles continued to grow to include regional and now global responsibilities. Aside from my duties at BMS, I have just completed my master's degree in reliability engineering management from Monash University. I also teach for the University of Wisconsin's maintenance management certificate program.

In reviewing your presentation: "Setting Your Organization Up for Success" at IMC-2013, why did you choose this topic? What value do you think it provided to the audience?

I partnered with Frank Wrath of the University of Wisconsin to put this together with an emphasis on the most common question I get from any class: "Where do I start?" This presentation was designed to give people an idea of where to start, regardless of where they are. Also, I wanted to show how to fill the gaps, regardless of available budget. You do not need money to attain skills in today's world filled with free webinars and vendors who are willing to come on-site for "lunch and learns."

What qualities do you think it takes to be a good presenter?

You need to be honest. Make sure you tell them the good and the bad that happened. Finally, no one is interested in what "you" did. People are interested in what you learned and how they can apply it. Give them that and you will do just fine.

Those are good tips for any presenter. So finally, do you have any ideas for future presentations, either for yourself or something you would like someone else to address at the next IMC?

Many folks have difficulty convincing their management team of the value a maintenance reliability organization can bring in terms of bottom line results. How to influence that level is something we as leaders need to bring to the conference. Not just, "you need a business case," but how do you get the paradigm shift. There should be solid examples we as leaders need to pass down to the next set of leaders. It needs to be something tangible they can take back and put to use.

"First, don't read your slides. Second, try to engage the audience through questions and direct comments."

GEORGE WILLIAMS

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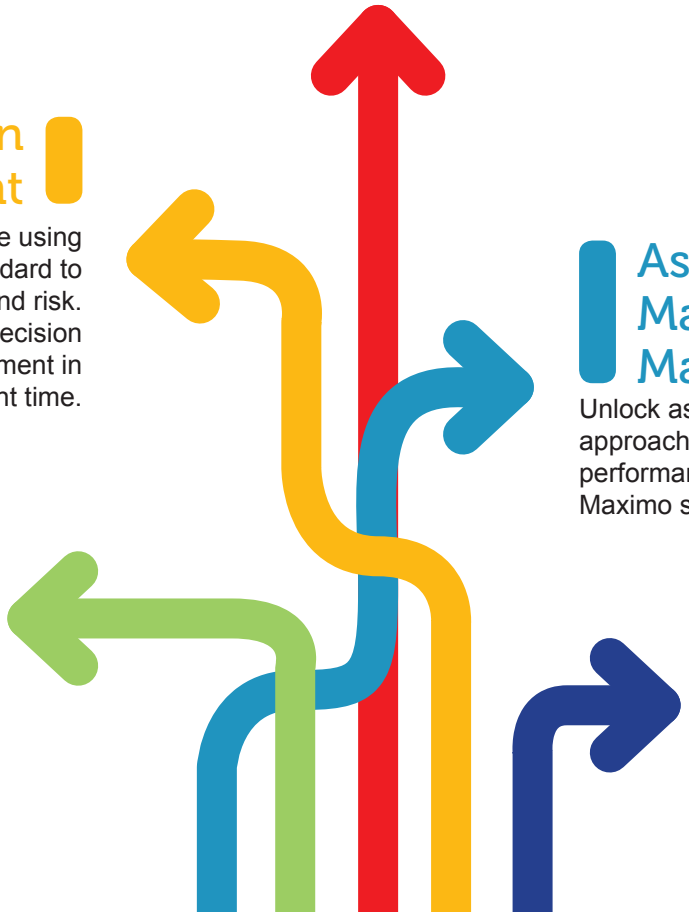

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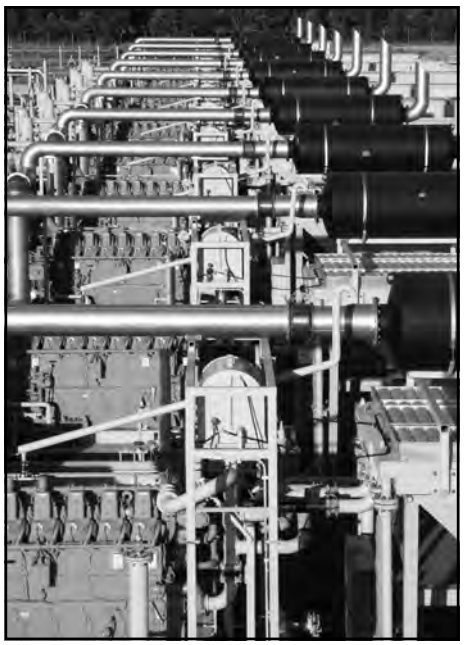

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