May - June 2023

Machinery Lubrication

INDIA

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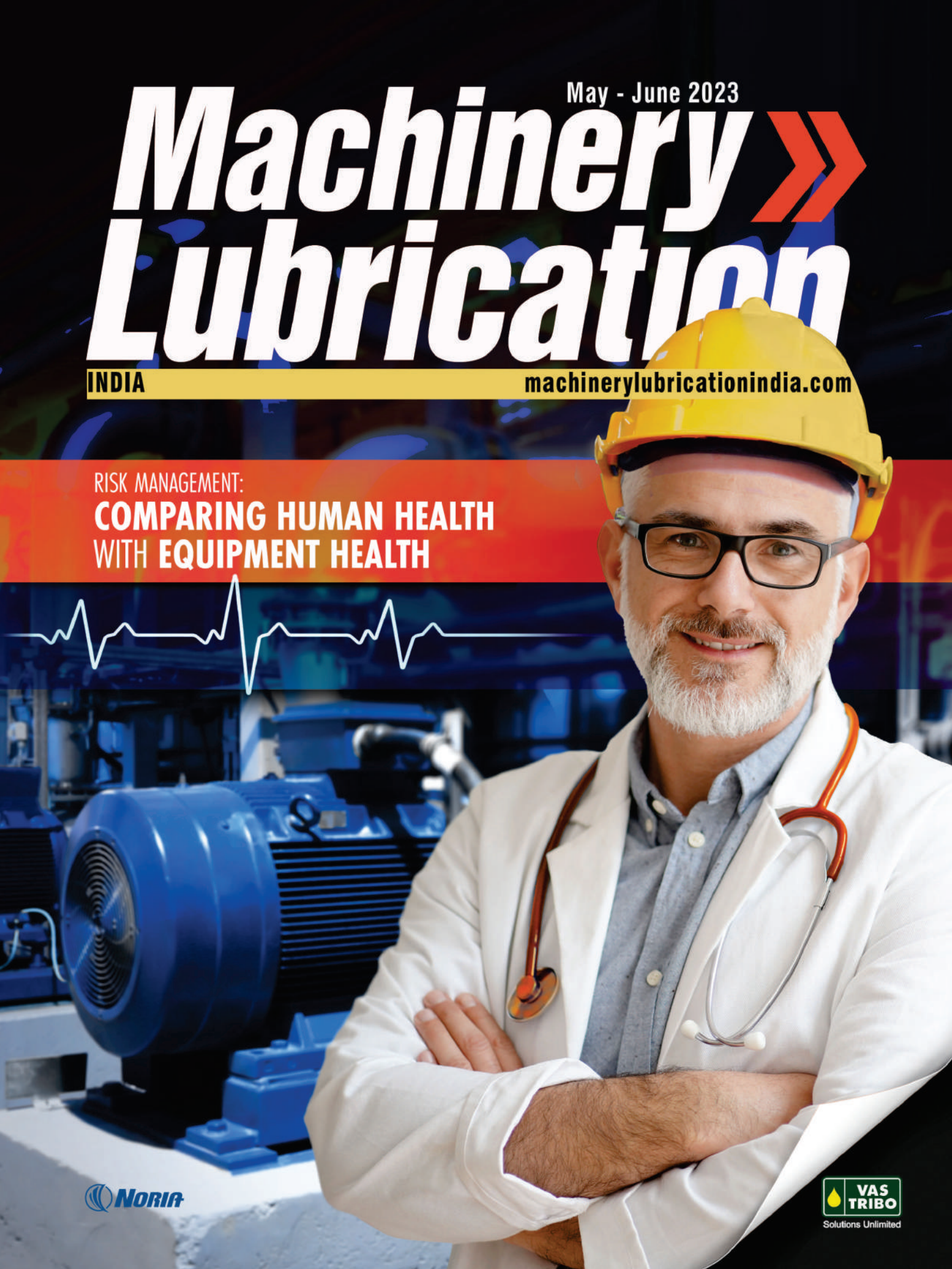
RISK MANAGEMENT:

COMPARING HUMAN HEALTH WITH EQUIPMENT HEALTH



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AS I SEE IT

COVER STORY

EDITORIAL FEATURES

Publisher's Note

The simplest definition of behavioral science is that it studies human behavior. It explains why individuals engage in specific behaviors by experimentally examining the impact of factors such as conscious thoughts, motivation, social influences, and habits. Some of the main proposition of the behavioral science approach is that the goals of the organization are to be harmonized with an understanding of human needs.

Jim Fitch, the CEO and a co-founder of Noria Corporation says "Tribology isn't just about the oil" in one of his articles 'Tribology is a behavioral science' in Machinery Lubrication magazine. He says "In recent years, it has become increasingly clear to me that applied tribology is more about training and behavioral science than about engineering and material science. I would guess that for every bearing that failed due to a problem lubricant (wrong selection, poor quality, etc.) ten others fail due to problem lubrication (neglect, procedural, timing, etc.). No amount of expertise in lubrication and machine reliability will overcome the destructive aftermath caused by rotten maintenance culture."

"Despite realizing that change is necessary, employees are often afraid of big changes in the organization, preferring the dissatisfaction of the status quo to the risks of a new reality," said Harvard Business School Professor David Garvin in the online course Management Essentials. "Often, the most important thing a manager can do is not identifying the need for change, but provokes the momentum to begin and maintain the change."

Most organizations are infected with cultural problems. Some organizations achieve transformation but transgress to their bad habits and past addictive practices. No matter how thoroughly you prepare for change, everything is not always going to go according to plan. You need to be ready for several potential outcomes. By doing your best to anticipate roadblocks, you can take some of the mystery out of the equation.

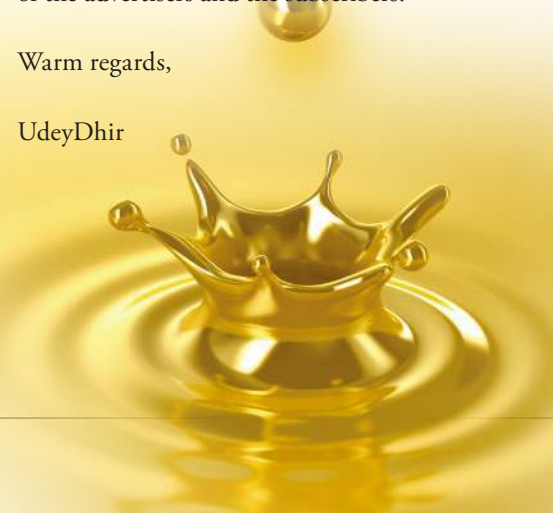
A multitude of attitudes, perceptions and values are prevalent among employees and these characterize their behavior and influence their performance. One of the crucial ways to bring in these changes is through training. You can modify employees' behavior by removing the obstacles that prevent them from working towards the change. Once those hindrances are identified, even the most complex problems can be addressed and corrected.

The cover story of this edition also revolves around this discussion and compares human health to equipment asset health. It primarily discusses that professionals are required to act on test results by interpreting the available options, making the wisest decision and then acting on that decision. The key takeaway of this story is that just as our health needs our attention, our equipment is not sentient and it depends on us to take action.

Some other topics covered in this edition include:
KPIs to ensure proper lubrication selection, the value of a platform dedicated to lubrication program management, lubrication Dos and Don'ts, machinery configuration quick wins that optimize machine performance, oil analysis pitfall, and contamination control objectives.
We look forward to your support and feedback to enable us to improve the content and layout of Machinery Lubrication India. We welcome readers to participate by sending their feedback & contributing articles and case studies. We look forward to the continued patronage of the advertisers and the subscribers.

Warm regards,

UdeyDhir



Make Touchstones of Lubrication Excellence Shine

> Using our senses, we register facts and fine nuances that collectively help us arrive at opinions and conclusions on quality, functionality, attractiveness, comfort and value."

Almost subconsciously, our senses gather information on our surroundings. They recognize subtleties, discern unique features and examine characteristic details. This could be a glass of Spanish red, a seat on a flight to London or a test drive of a Tesla Roadster. Using our senses, we register facts and find nuances that collectively help us arrive at opinions and conclusions on quality, functionality, attractiveness, comfort and value. Perception is reality.

Computers with deep-learning algorithms fed by innumerable sensors are used to collect and process data. Notwithstanding, they are no match for our senses and our brain. Artificial intelligence is better at augmenting our intelligence but not replacing the cognitive ability of our brain flanked by human senses. If you think I'm wrong, try having a conversation about your favorite sports team with Alexa or Siri. Or ask a simple question like, "Can a fish be taught to ride a bicycle?"

This high level of human perceptiveness is applied to our work environment and maintenance culture. Let me give you an example. In criminology, there is a concept known as the broken windows theory. It states that "visible signs of crime, anti-social behavior and civil disorder, such as broken windows in abandoned buildings create an urban environment that fosters further crime and disorder, including serious crimes." In other words, the perception of a neighborhood in decay bolsters criminal behavior.

Another example: let's take the workshop that's attached to my garage at our family home. It's a microcosm of the broken windows theory. If I keep my workshop tidy and everything organized, other family members who use it will do the same. However, the moment I leave behind a mess from a recent project, these same people will soon add to the mess. They will certainly not clean up my mess, nor will they clean up after themselves. Tools and scrap will be scattered about.

Of course, what I'm referring to is innate to our human psyche. You don't have to be an industrial psychologist to grasp the veracity of my message. Perhaps you have plenty of your own examples to corroborate. But here's the deal: in a plant environment, the touchstones of excellence go far beyond a clean and orderly state. Tidiness is important, but it is not enough. It is preposterous to think that anything close to excellence in maintenance, reliability and lubrication is achievable where conspicuous or even subtle symbols of "broken windows" exist. This subject is so important that I thought it worthy of my column today.

Broken Windows in the Context of Reliability

"Broken windows" is the precursor to a broken culture that leads to waste and neglect. A broken culture is the precursor to broken machines and exacts its toll on an organization — financially and culturally. It's the cycle of repair and despair. It's been said that "reliability is 80% culture and 20% everything else."

Many maintenance organizations attempt to fix the problem by making superficial changes. They might come up with a slogan, pass out t-shirts, invest in a sexy instrument or send somebody to a conference. You can put lipstick on a pig, but it's still a pig. These aren't real fixes by themselves. They are token or imaginary fixes, and they spawn distrust.

Real fixes require critical mass. You have to cross the chasm, fully and completely; no pretending, no lipstick. Folks, you can't put a Band-Aid on cancer. Maintenance teams are wise to the difference. They will make you pay.

So, what are the symbols of broken windows in the context of maintenance, reliability and lubrication? The first thing that comes to mind is pretending to save money by buying cheap or simply not investing. I don't mean going wildly overboard. It's always about optimizing, not maximizing.

Machinery Lubrication

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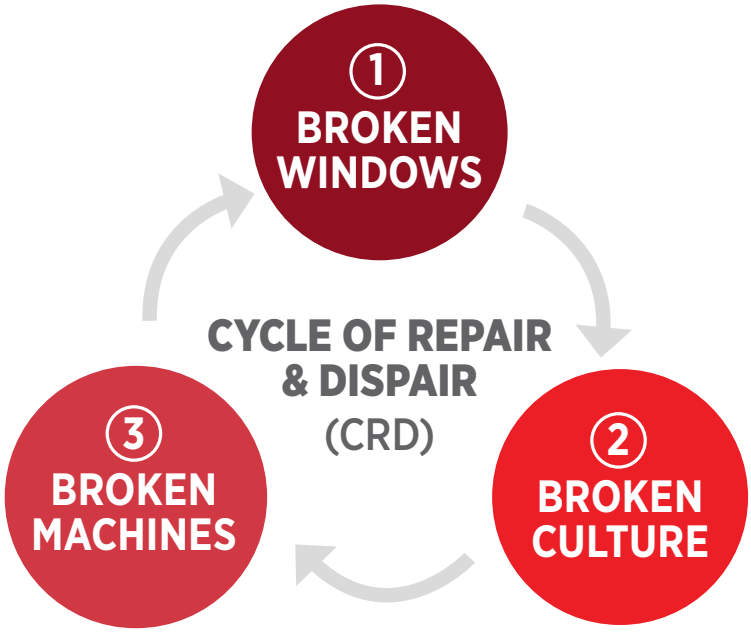
Look around you; what do you see? How do your machines appear? Are they ready for the antique roadshow? Are they cobbled together with baling wire and duct tape? Next, look at your lube room, tools, transfer containers, instruments and accessories. Are they dated, broken and collecting dust? How about the lubricants? Are they tidy, tightly sealed and fresh, or have you applied the FISH principle (First In, Still Here)?

Are planning and scheduling proactive or reactive? Nothing breeds a dysfunctional culture more than Whack-A-Mole maintenance. Does your team still utilize paper-and-pencil methods, or are modern dynamic routing apps on mobile devices in use for inspection and PMs? The list goes on.

A Picture is Worth a Thousand Words

The images that follow are examples of touchstones that drive excellence. They are an ensemble of things done right. Good choices induce good outcomes. There is not just a single "right way," so consider your options too. But remember, optimizing rarely involves doing nothing at all. Make real, lasting change, but keep improving. Be a Kaizen-driven organization and take action.

Finally, if you have ideas you want to share, please forward them to me at jfitch@noria.com. ***ML***



Symbols of program decay (broken windows) promote a dysfunctional culture. This leads to breakdown maintenance and more decay.

In lubrication, excellence can be clearly defined. It shouldn't be ambiguous. Contact the ICML for their recently published ICML 55.1 standard. Aligned to this is Noria's Ascend™ Chart, which tracks the progress from the current state of lubrication to the optimum reference state (excellence).

About the Author

Jim Fitch has a wealth of "in the trenches" experience in lubrication, oil analysis, tribology and machinery failure investigations. Over the past two decades, he has presented hundreds of courses on these subjects. Jim has also published more than 200 technical articles, papers and publications. He serves as a U.S. delegate to the ISO tribology and oil analysis working group. Since 2002, he has been the director and a board member of the International Council for Machinery Lubrication. He is the CEO and a co-founder of Noria Corporation. Contact Jim at jfitch@noria.com.

AN IMAGE OF Lubrication Excellence

1. Ultrasound to optimize the timing and application of grease
2. Cloud-based auto-schedule dynamic lubrication and inspection routing tools
3. Modern lubricant storage and handling products and practices
4. Universally applied lubricant identification tags
5. Dynamic metrics on work and reliability management
6. Training for all professionals and trades on lubrication and oil analysis
7. ICML certification of competency, oil analysis, lubrication practices, lubrication engineering
8. Machines readied for Inspection 2.0
9. Machines readied for live-zone oil sampling, modern onsite and laboratory oil analysis
10. Machines readied for optimum lubricant selection and contamination control hardware
11. Where applicable, online sensors for real-time condition monitoring


LubePM
2.
3.
8.
ISO VG 46
GCH-46-S-PAO
9.
7.
International Council
for Machinery Lubrication
has satisfactorily fulfilled the requirements established by
the Council for professional attainment in
Machinery Lubrication
and, is therefore designated by the Council as a:
Certified Level I Machinery Lubrication Technician
11.
DES-CASE
SENSOR
TECHNOLOGY

RISK MANAGEMENT: COMPARING HUMAN HEALTH WITH EQUIPMENT HEALTH

By Jeff Walkup B.Sc. M.Sc. Vice President Sales & Marketing- Fluid Life Inc.

As the title would suggest, comparing human health to equipment asset health reveals some striking similarities, but also uncovers differences that should be considered. In the world of tribology and equipment lubrication, we often use the illustration that "anything a doctor can do with blood, we as maintenance and engineering professionals can do with various kinds of lubrication." The human body is the most remarkable organism — or machine if you will — known to humankind. We proactively undergo examinations (diagnostic testing), and when the results are not what we are hoping for, we move heaven and earth to do anything we can within our power to preserve our health and save our lives.

What about high-dollar, mission-critical equipment and machines that are the heart and soul of a business organization? Do we do the same for the equipment we are entrusted with? Do we move as fast or pay the same amount of attention? What would happen if we paid more attention to that report, that dashboard alarm, and prioritized our

corrective actions based upon actionable insight, information, end-user domain knowledge, common sense and a dose of good old-fashioned wisdom?

HUMAN HEALTH DIAGNOSTICS VS. EQUIPMENT HEALTH DIAGNOSTICS

I am in the middle of dealing with my own health crisis because of a recent diagnosis and treatment of B-Cell Non-Hodgkin's Follicular Lymphoma. In June 2021, I found a lump in my neck and reported it to my medical team. Once reported, this led to additional blood tests, ultrasounds, CAT scan, live X-ray needle biopsy and then a PET Scan to confirm the assumed diagnosis and next steps. None among us ever wants to hear those three dreaded words: "You have cancer!" However,

being able to assess all the data available to me, examining statistical outcomes of the treatment efficacy available and getting expert advice from oncologists and other specialists allowed me to make the wisest decision that was right for me.

Compare and contrast that to the reality of asset and equipment health management. I have been involved in the business of tribology and lubrication as an end-user, reliability engineer and vendor in industries such as mining (both surface and underground), heavy construction and aggregates, rail transportation, oil and gas and renewable energy. I have seen organizations deploy state-of-the-art condition monitoring and analysis technologies in the form of inline oil sensors, wireless vibration accelerometers, SCADA data, Artificial Intelligence (AI), Machine Learning (ML), Industrial Internet of Things (IIoT), Edge Computing and Big Data — always with the thought that this would be the next all-encompassing silver bullet to solve every issue.

In the end, a piece of hardware, a sensor, an oil sample, an FFT or a thermography image is just that — a bit of data that needs to be prioritized, acted upon with root cause identification and resolved through a deliberate course of action. In the high-dollar engineering and maintenance world, professionals are required to act with deliberate and intentional purpose, or the outcome is nothing more than putting out fires, changing parts, maintaining the status quo and performing business as usual.

> NONE AMONG US EVER WANTS TO HEAR THOSE THREE DREADED WORDS: "YOU HAVE CANCER!"

Technology is great. The advancements that have been made in just the last ten years alone in the field of machinery condition monitoring have been amazing. But successfully utilizing the data these tools give us really boils down to action and prioritization — moving from a diagnostic approach to a prognostic approach. This requires combining the data from technology sources with a solid understanding of and commitment to basic maintenance fundamentals and traditional oil analysis.

Your outcomes, will be different than another maintenance or reliability specialist at a different organization based on your environmental conditions, maintenance expectations and personal experience. Using your experience, gathering insights from oil analysis reports and sensor data and combining that with the expertise of your lab and lubrication vendor will help you make the wisest decision.

THREE STAGES OF RESPONSE

What we discussed above is essentially the "stages of response" you would go through after receiving results from testing. The three stages include interpretation, decision and action. These stages can apply to both machine health monitoring and human health. Just as with my own cancer diagnosis, you need to be able to bring together all the data available, examine the options available, make the wisest decision for your equipment and organization and then act on that decision.

1. Interpretation

- **Questions about the results:** Do you have trust in the numbers, flags and commentary? If you do have concerns, chat with your laboratory (or doctor) to get more details.
- **Knowledge of the situation:** This is typically an internal conversation — you may discuss it amongst your family

or dive deep into your own understanding of your situation. From an organizational perspective, your operations group should be able to provide context around oil service hours, component hours and recent repairs that can potentially impact the interpretation of the results.

- **Additional perspective:** Different parties can interpret results differently, so getting perspectives (or second opinions) from equipment manufacturers, oil suppliers or other sources can help build consensus.

2. Decision

- **Weigh your options and make the call:** You could be faced with a "do something or nothing" decision, or you may have multiple options to consider — whatever the decision, it will impact the response protocols implemented.

3. Action

- **Ignore the results:** If you decide not to respond to the oil analysis results (or your doctor's recommendations), carefully consider what result would require an immediate response and include them in your protocols.
- **Gather more perspective:** Like gathering perspectives within the Interpretation phase, you can gather more perspective on how to respond from the OEM or oil suppliers (or peer groups and other medical professionals) and decide the best course of action.
- **Monitor more closely:** Depending on the results, you may determine that you need to stay the course but monitor the situation for a period of time. For equipment health, more frequent oil sampling, additional testing or cross comparison against other condition monitoring techniques (e.g., vibration) may be in order. Again, set the protocols for what additional monitoring should be done and the timing and triggers for immediate response.
- **Perform an inspection:** Depending on the issue's severity, humans will get additional tests and biopsies done to confirm the results and determine possible next steps. Based on the results and interpretation of your oil analysis results, you can brief your team before performing a machine inspection to help them pinpoint what to look for.
- **Perform the repair:** Sometimes, the best response is to perform the surgery or take the medication to repair the issue, followed by close monitoring. For machinery, the most common initial repair response is to change the oil. Follow-up with additional monitoring (e.g., oil sampling, condition monitoring) to confirm if the issue is resolved or if further action is required (e.g., inspection).
- **Change the PM interval:** Shorten or extend the PM interval to determine if the oil analysis results improve or degrade. This is similar to shortening the time between doctor visits and testing in order to monitor an improvement or decline in health.
- **Improvement projects:** If you see a recurring problem happening, consider additional improvement projects to resolve the issue, such as flagging optimization, training and process mapping. For your own health, this could mean diet, exercise and changes to your overall lifestyle.

OBJECTIVES FOR CONSIDERATION

As simple as it may seem (get the data, interpret the data and decide), when it comes to setting out on a course of action for equipment maintenance (or human health maintenance, for that matter), one also needs to consider the following:

1. Focus on the long game

- You run a marathon of 26 miles, 385 yards and 10 feet. If you know the goal but forget to watch for the holes in the road, the rocks, the uneven surface or the first hill at mile one, it could mean the difference between finishing the race or losing focus and getting injured.
- A marathon is not a sprint; it is a long, hard race, not for the faint of heart. Neither is it easy to change the course of a less than effective maintenance program. Live with a mindset of continuous improvement, making incremental changes each day.

2. Keep the main thing the main thing

- Do not let individual or chronic problems continue to go south. Knowledge is power, and sometimes things can be explained and corrected. We are all

BRIEF YOUR TEAM BEFORE PERFORMING A MACHINE INSPECTION TO HELP THEM PINPOINT WHAT TO LOOK FOR.

human beings and have vain imaginations. Do not become polarized by data or overanalyze it (analysis paralysis). Be cautious, not paranoid (there is a significant difference).

- As a leader, you set the vision of where you are going and what the future looks like. You then set the mission as to how your team gets there (responsibilities and action plans).

3. Correct course as soon as possible

- From time to time, you may need to course correct because of internal or external issues. It is important to get back on course as fast as you can to limit the possible downstream effects if your response is too delayed.
- Set up realistic goals and key performance measurements; as the saying goes, "that which gets measured gets done."

4. You have a team to support you

- Reach out and ask for help. You do not need to carry the weight of this alone. We do not always need to be the smartest person in the room and as you look around your team, empower them; let them have a part in the learning and the success that will come.
- I have always believed that the answers will be found in the room. Lean on your team and trust them to do their jobs.

5. The answers are indeed in the room

- Empower your team to speak their minds if they have a better or innovative solution to an issue. Anything less than that is a disservice to one another, to your organization and to the voiceless equipment you are charged with managing.
- I know that I expect — no, I demand — that kind of thinking and leadership from my oncology team. Wouldn't you?

6. Take bad thoughts captive

- Do not let your bad thoughts live rent-free in your head. By this, I mean we tend to worry about things that never happen. We worry about things we do not have control over — things that happen regardless if we worry or not. Lastly, we worry about things from yesterday or tomorrow, and because both of those are days we do not have, we only make today worse and counterproductive.
- Put your energy into things you have direct control and influence over. Be aware of the other things and learn from them but have a short memory (that includes the good and the bad). Tomorrow is a day found only on a fool's calendar.

7. You are in charge of the data

- Not the other way around. All these things are tools — arrows in your quiver; use them wisely, but do not be a victim of analysis paralysis. Think of this as using the proper wrench size and type (metric or SAE) for the proper application.
- Do not be a victim. If you have an oil analysis program that triggers water at too low of a ppm and you have zero capability of achieving that, then make relevant and applicable adjustments. The same would go for ISO Particle Count Cleanliness and other test flags. If you do not take charge of your data, all you have is white noise or a dashboard of yellow and red alerts that are demoralizing, and your team will lose focus.

8. If not me, then who?

- Our world is always looking for somebody else to do the job and take the blame, so inevitably it gets overlooked. If you see a need, take charge. You do not have to be the leader to be in charge; leadership is about influence. It is all about super accountability and if everyone could apply just a bit of that, think of what our improvements could be.

9. Anything worth doing is worth doing well

- Our world is full of mediocrity, so do not strive to be the second best.
- Stop for a moment and think of all the Olympic Medal Winners, from Gold to Silver to Bronze and even those that might miss the medal platform altogether. In many cases, only tenths of seconds separate first from fourth and beyond. Strive to be the best as humanly possible within your capabilities. In the end, all we are responsible for is our attitude and our efforts.

10. When faced with unwelcome news, press in

- Everything is not about you but should be about others. When life throws you a curve ball, swing for the fence. Be a blessing to others on your team. Do not

be a complainer but rather a solution provider. A bad attitude is truly just like a cancer: it seeks to eat, destroy and devour all that is good. Life owes none of us anything but a chance and what we do with that chance is completely up to us.

- In a comparable manner, think of how you can apply this philosophy to your job as a maintenance or engineering professional. You speak on behalf of your equipment — your assets that do not have a voice and cannot speak on their own behalf. Every day, week, month and year, countless components will fail (with many failures being lubricant-related). Having a vigilant, well-informed oil analysis program is one of the best steps to take. My father used to say to me, "Do not be a dumb smart guy; do not let your fancy schooling and book learning get in the way of your real education and learning when you are in the field working with old Bessie — the engine, pump and hydraulic system. If you listen closely to her, she will tell you what is happening, what is ailing her."

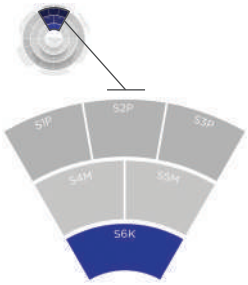
CONCLUSION

I have many challenges before me with my health, and if anything, this has taught me to value what is important: to love people and to always be willing to pass along what I know to make our world a better place. Employing a state of urgency causes self-reflection in establishing my personal and professional priorities, such as what I do today and what really counts from an eternal perspective. I look at what impact I have on the lives of those I work with, being a servant leader and leaving a legacy when I have taken my last breath.

At present, my prognosis has been a "watch-and-wait," meaning that just like a maintenance professional, I will take more frequent "oil" samples and then do triggered testing based on those results. I will closely watch the trends, react accordingly, and do my absolute best to take care of myself with rest, nutrients, exercise and ensure a healthy work-life balance. When we have our health, we have everything and should pattern or copy this approach to some extent into our professional lives. Our equipment will run itself to destruction if we let it. It is not sentient and depends on you to be its advocate. ***ML***

KPIs to Ensure Proper Lubrication Selection

More about this **ASCEND™ Factor**



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Stage:
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About:
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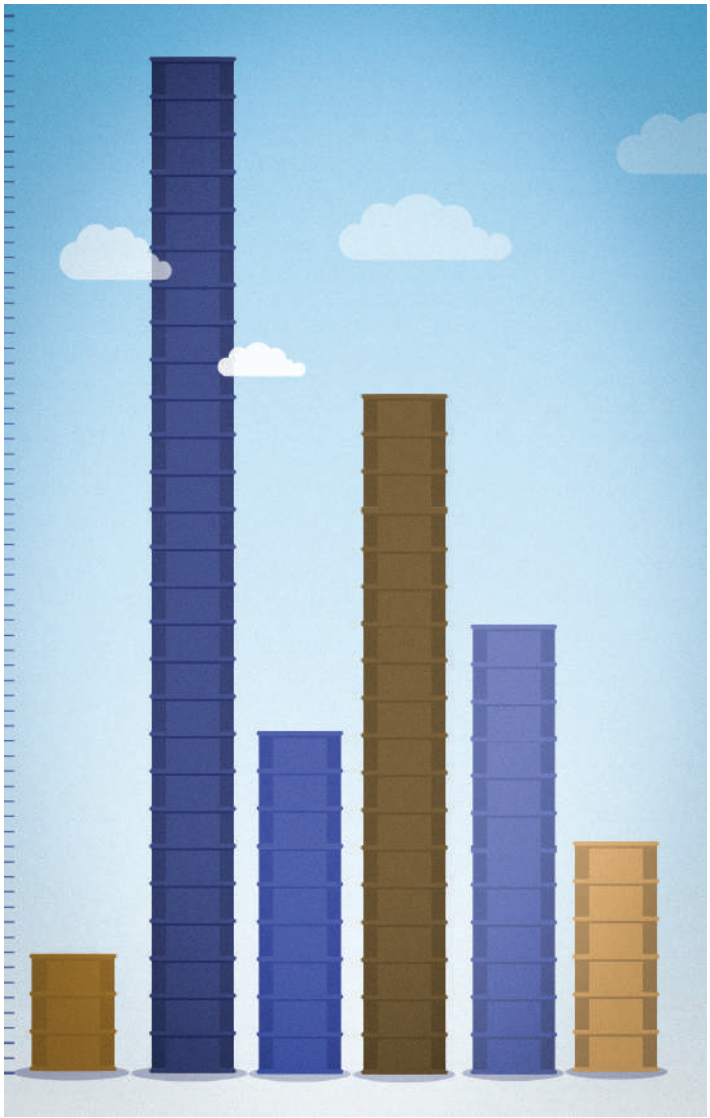

With the movement to digital solutions for tracking and managing most decisions that are made in reliability and maintenance, an area that is often left out is lubricant selection. This is the most fundamental step in a lubrication program: selecting the proper lubricant for the application at hand. Be that as it may, the task of choosing lubricants is often relegated to the lube tech, operator, maintenance personnel or whoever happens to be next to the equipment in need of lubricating. Seldom is there much emphasis put on the selection and even less emphasis is placed on a mechanism to track how well we are doing in this realm.

Since lubricant selection impacts many facets of equipment operation, there are many ways in which we can track the performance of our lubricant selection process. Some methods can be leading, some lagging, but all are focused on giving us insight into the process as a whole.

Often, the selected lubricant is either the cheapest one available or whatever the OEM recommends for the

machine. Either case can lead to a state of excess or a state of waste, which ultimately needs to be avoided. Therefore, we need to have some information to help prepare us to track the process.

Leading Indicators

Let's begin with some leading indicators for our lubrication selection process — leading indicators meaning that we are tracking items that are intended to get our desired result. For example, if you are dieting, caloric intake would be a leading indicator of weight loss. For selecting the ideal lubricant, a few items we may track are:

1 Lubricants that match/exceed the OEM specification

OEMs often spec a lubricant based upon the design of their equipment. We need to ensure the lubricant we select meets or exceeds the spec from the OEM and is adjusted based on our unique environment and application. A lubricant that doesn't meet these standards could result in sub-optimum performance.

2 Number of lubricants on-hand

This could be viewed as a way to track the consolidation of lubricants in the plant. Ideally, we minimize the lubricants, keeping only on hand what we need to operate without sacrificing the needs of the equipment. By tracking the number of lubricants and even the number of applications using that lubricant, we can help keep our consolidation efforts in place.

3 Age of lubricants in storage

Lubricants all have a shelf life; ideally, we will utilize them before they go bad in storage. By tracking their age, we can help adjust our inventory levels. This also aids in our consolidation efforts by converting some equipment over to other lubricants (where applicable) to improve inventory turnover.

4 Lubricant purchase costs

As with most items, cost shouldn't be the only factor, but it still needs to be considered. Develop a matrix of cost against the performance of the lubricant to get a better sense of if it is worth the added cost. Also, tracking purchases over a time period can help justify moving to a higher-performing lubricant (which will need to be changed less frequently).

(Side note: The lead time for delivery of lubricants is becoming a large issue due to supply chain disruption. While it may not require a long-term metric, some are using this as a criterion when selecting a lubricant right now. Having a dialogue with your supplier about lead time or volume on hand may help minimize any surprises in the future.)

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Lagging Indicators

Lagging indicators track what just happened, meaning that they result from the action we are hoping to achieve. Using the same weight loss analogy, the number on the scale after you step on it is a lagging indicator. So is your waist size. If we are selecting the proper lubricant for the application, a few of the key metrics we might hope to track are:

Energy consumption

Lubricant selection has a direct impact on the energy consumption of a piece of equipment. Think about viscosity (which is only one of many properties that can impact this); if it is too high or too low, there will be an impact on energy. By tracking amp draw or kW hours of lubricated equipment, we can help dial in the selection and also recoup some money based on the lube program.

Operating temperature

The hotter something runs, the faster it breaks down. If the machine is working harder to churn through a lubricant, the temperature will rise. Some lubricants have lower internal friction and can help lower operating temperature. Similar to energy conservation, this metric can help with selection and serve as a leading indicator of equipment/lubricant failure.

Change intervals

Lubricants should be changed before they reach the end of their life. If lubricant properties are matched to the machine's needs, we should expect to see an increase in the change interval. It could also be a result of our lubricant analysis program to help set ideal change intervals.

Lubricant disposal

Looking at either the volume of lubricant disposed of or the cost of disposal provides a lagging metric of how well we are doing with lubricant change intervals, leaks, and subsequently, selection. Proper lubricants can help with all of these factors, and again, this cost can be directly affected by lubricant selection.

Checks and Balances

Simply setting metrics to track the process isn't enough — action has to be taken to achieve the desired results. For some organizations, the responsibility of lubricant selection doesn't fall to one person; rather, a committee is tasked with the process. While the goal is not to create bureaucracy for the sake of it, there needs to be a system of checks and balances to ensure lubricants aren't needlessly added or dropped from the inventory. It is common for industrial facilities to add equipment or update lines periodically, so the lubricant properties needed tend to change as well. Without keen oversight, your lubricant inventory can get out of hand. The goal is to create a process that is sustainable and that consistently gives us the desired result, which is to provide the proper lubricant to a piece of equipment that meets the needs of the equipment, has adequate life at an appropriate cost and can be delivered in a proper manner. ***ML***

About the Author

Wes Cash is the Vice President of Services for Noria Corporation. He serves as a senior technical consultant for Lubrication Program Development projects and as a senior instructor for Noria's Oil Analysis I and Machinery Lubrication I and II training courses. He holds a Machinery Lubrication Engineer (MLE) Machine Lubrication Technician (MLT) Level II certification and a Machine Lubricant Analyst (MLA) Level III certification through the International Council for Machinery Lubrication (ICML). Contact Wes at wcash@noria.com.

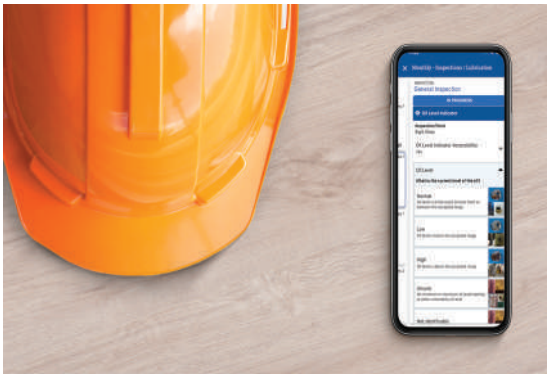
The Value of a Platform Dedicated to **Lubrication Program Management**

> Providing dedicated software solutions for maintenance and reliability professionals to manage lubrication is particularly critical with the advent of new innovative advancements in the age of Industry 4.0."

With an industry increasingly focused on improving machine reliability through the deployment of best practices in lubrication and oil analysis, there is a need to establish better management tools to accomplish these objectives. Providing dedicated software solutions for maintenance and reliability professionals to manage lubrication is particularly critical with the advent of new innovative advancements in the age of Industry 4.0. Here's why:

As a **maintenance supervisor,** there is the burden of responsibility to ensure equipment is being properly taken care of. You must rely on a sufficiently trained maintenance crew and the right tools to monitor activities, expenses, parts, lubricants, etc. Daily task execution has an opportunity to provide education in real time. For example, inspections should be accompanied by objective questions and picture examples to coach the inspector on best practices. Meanwhile, inspection results, route compliance, lubricant consumption and more can and should be automatically tracked.

As a **maintenance planner,** efficiently organizing work activities is important to help anticipate potential causes of delays and then plan the parts, labor and resources needed to improve productivity. This is necessary as planning lubrication activities requires complete awareness of the recurring needs of each machine, along with feedback from inspections and other condition monitoring findings to trigger on-condition tasks.



As a **maintenance scheduler**, managing the recurring route activities, such as regreasing bearings with ultrasonic techniques at various intervals, can be challenging. Doing so requires tools to merge and assign routes to available personnel with various viewing formats. As routes get assigned from a dedicated lubrication platform, they should automatically be made available on the technician's mobile device, complete with all task detail, asset data, images, procedures, etc.

As a **reliability engineer,** controlling against improper lubrication and contamination are common challenges when improving equipment reliability. A dedicated lubrication management tool will help transition current practices to best practices, including proper lubricant selection, procedures and machine modifications for contamination control, sampling, inspections, filtration and more.

As a **lubrication technician**, keeping track of lubricant type, volume and frequency of application can be overwhelming across countless lubrication points. A connected lubrication mobile application can walk you through these details on-the-fly while tracking completions, usage and inspection conditions. Moreover, as turnover occurs in the workforce, there must be a streamlined software solution to integrate historical knowledge with modern best practices.

Why Lubrication Needs a Dedicated Management Tool

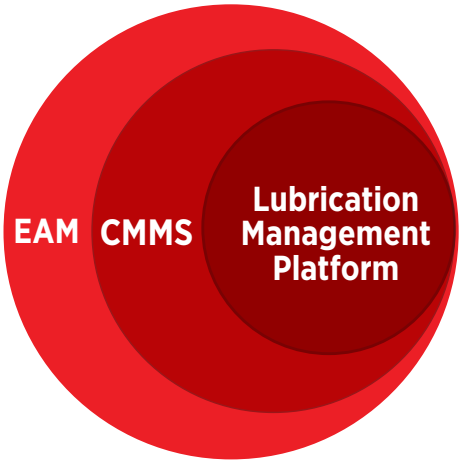
Proper lubrication is critical to minimizing friction in industrial rotating equipment. Thus, it's an essential activity in maintenance to keep lubrication in check with routine activities, such as inspections and oil changes. However, common mistakes often go unnoticed or inaccurately diagnosed, for example, when bearings are relubricated with the wrong grease or when contaminants enter an oil reservoir through an open port. These lubrication issues are like the case of the boiling frog — an apologue that places a frog in a gradually heated pot of water where, lacking any sense of danger, the amphibian will contently remain until it is boiled alive.

When common lubrication issues happen, failure is often not immediate. Instead, the consequences tend to be initially silent as they slowly snowball into more significant problems without an obvious connection to the root cause. Or worse, they gradually decrease equipment productivity or increase preventive maintenance, i.e., more frequent bearing replacements or oil changes. Why is that worse? Not only are these costly, but much like the boiled frog, the lack of a sudden failure event creates complacency, downplaying urgency and negatively impacting the perceived need for action.

For a lubrication technician, the need for procedures and guidance can be more apparent for tasks such as flushing a circulating system before switching incompatible lubricants. But as mentioned, even daily activities need careful management to ensure they are done correctly. For example, it's important to consistently know which lubricant to use, how much, how often, and where to apply it, what to inspect for, and so on.

Yet, managing lubrication activities requires more than that:

- Planners and schedulers require tools to develop efficient plans and routes.
- Maintenance managers need tools to track lubricant usage and consider consolidation efforts to minimize costs and risks of cross-contamination.
- Reliability engineers need dependable data to make decisions based on lubricant condition monitoring and analyze opportunities for equipment modifications.



For a plant manager today, these key lubrication activities are essential to long-term plant operations and reliability. But without the right strategy and tools, lubrication will continue to hinder these necessary improvements.

Integrating Lubrication Management Tools into your CMMS or EAM

For many, managing maintenance activities is done with a Computerized Maintenance Management System (CMMS) software or platform. Managing the overall lifecycle of your assets is done with an Enterprise Asset Management (EAM) software. The benefits of streamlining maintenance activities or maximizing the value of your assets are essential for most industrial facilities. Yet even in 2022, some activities, like lubrication, are often subtly influenced by everyday challenges.

EAMs and CMMSs are often viewed with many overlapping features and intended applications. For example, many common features of a CMMS, such as managing work orders and predictive maintenance, are also features of an EAM. In general, an EAM is designed to be more holistic than a CMMS by managing assets at a higher level.

Choosing an EAM is often a decision when an organization reaches a certain personnel size or when there exists a need for a more

diverse set of features. Yet, these added features usually come with a tradeoff. For example, a CMMS is often preferred for maintenance personnel who value a program designed and dedicated to more everyday maintenance objectives.

Similarly, while lubrication can be run through a CMMS, it is not designed for the unique aspects of everyday lubrication, especially when prioritizing best practice lubricant management efforts and transitioning through machine modifications to improve reliability. At various organizational levels, different software solutions become more relevant and beneficial.

At the plant floor and maintenance management levels, a dedicated management solution targets these lubrication objectives to control contamination, minimize lubricant cross-contamination, optimize the dynamic routing of various intervals, monitor lubricant use and compliance of tasks and more. Moreover, these can then communicate the CMMS management aspects such as work order activity and inventory.

Lubrication as a Reliability Strategy

Those who have been challenged with frequent unplanned downtime due to improper lubrication find difficulty in managing lubrication as it requires ashifting the collective mindset regarding proper lubrication. When successful, countless organizations have used lubrication initiatives for decades as a winning move to reduce costs, save time and improve equipment reliability.

Maintenance teams who need a proven solution must take lubrication seriously. A central management tool is needed to help the key individuals who champion these lubrication initiatives. This includes initially identifying where the opportunities are, documenting best practices, monitoring stages of implementation and keeping overall objectives in focus.

These lubrication management solutions should be designed for everyday lubrication activities, both on the plant floor and in management. For example, take a look at the list below, overviewing the top nine benefits that save you time and money when leveraging management tools designed for lubrication. Images from LubePM are seen throughout as an example solution for lubrication management. If you are a maintenance or reliability professional, ask yourself — do you know how your lubrication program is doing? If lubrication is aimed to be part of your reliability strategy, these management tools can help keep these objectives on track. Also, for those interested in a free Ascend ™ Self-Assessment to help benchmark your lubrication program, visit noria.com/free-assessment today. ***ML***

About the Author

Bennett Fitch is the Chief Strategy Officer for Noria Corporation. He is a mechanical engineer who holds a Machinery Lubrication Engineer (MLE) certification, a Machine Lubricant Analyst (MLA) Level III certification and a Machine Lubrication Technician (MLT) Level II certification through the International Council for Machinery Lubrication (ICML). Contact Bennett at bfitch@noria.com.

A Dedicated Lubrication Management Platform -

The Top Nine Benefits that Save You Time and Money

1. **Database of Best Practice Procedures and Videos** — For example, each lubrication point is assigned lubrication procedures based on industry best practices, including inspections, relubrication, filtration, lubricant drain and fill, sampling, modifications, change-outs and more. Additionally, video-based procedures enhance the learning objectives. For example, Task-Based Training videos provide training for key tasks in 15 minutes or less.

2. **Dynamic Procedures** — Most CMMSs only allow for static procedures that require manual edits for updates. For example, as lubricants are changed, such as for consolidation or supplier changes, the lubricant referenced in the procedure must be manually updated. A dedicated lubrication management platform should dynamically update procedures for lubricant or machine hardware changes, including text and images.

3. **Mobility** — Lubrication route details should be accessed and performed using a mobile application. Also, machines can be scanned, such as with a QR code, to provide guidance with route activity or quick access to pictures and data on each lubrication point.

4. **Learn-as-you-go Inspection Routes** — Modern machine inspection must come with a comprehensive guidance and tracking tool. For example, a mobile app walks the inspector through a detailed machine inspection, showing visual examples of what is considered normal and abnormal and specific conditions to report. Additionally, instructions are triggered for on-the-spot follow-up actions for certain abnormal conditions. All conditions are objectively tracked for data analysis, along with notes and pictures.

5. **Dynamic Rules and Calculations** — As a machine's

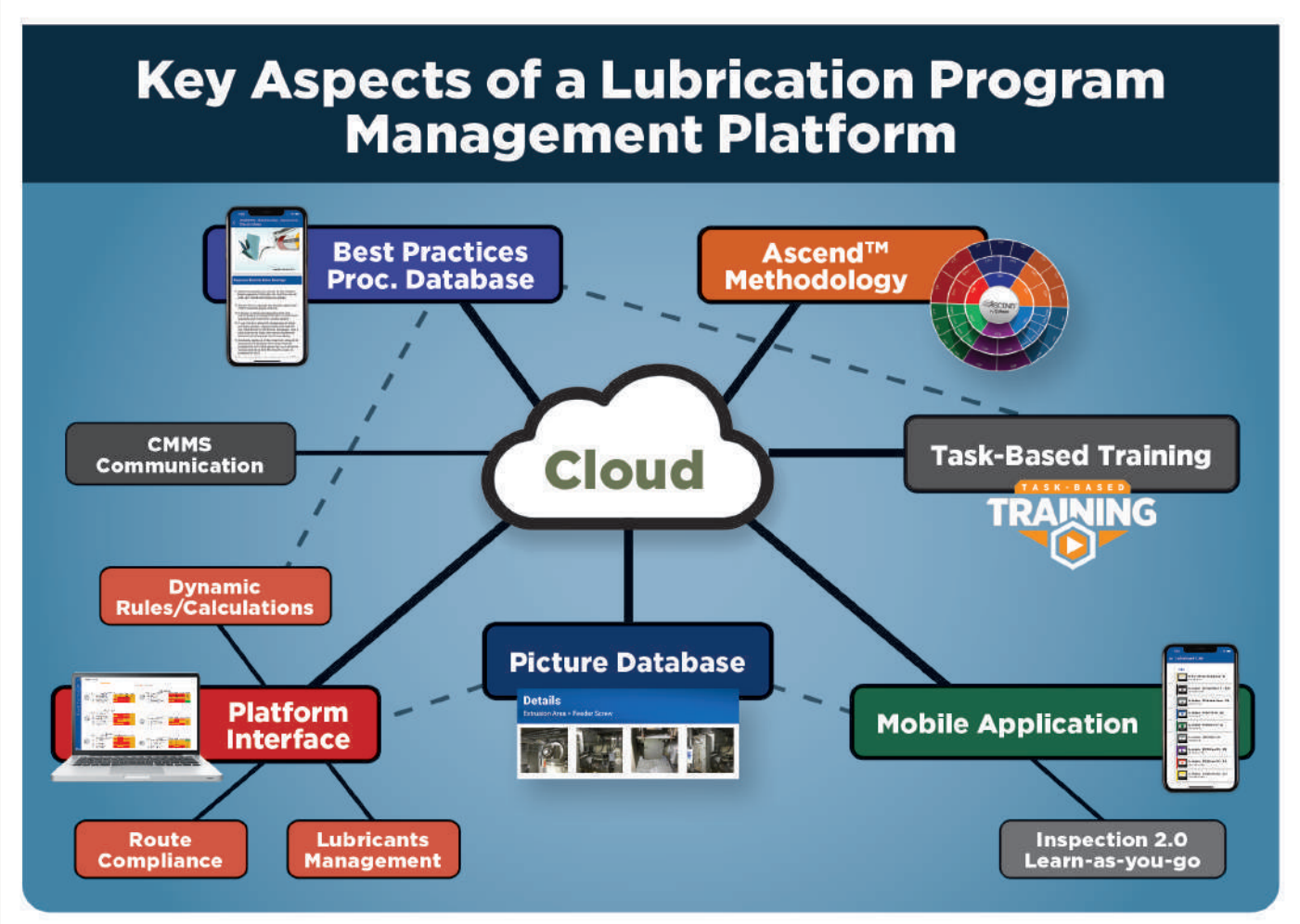
operating or environmental conditions change, so should lubrication requirements. Calculations, such as regreasing intervals, are updated as needed, and a dynamic rule structure adjusts task requirements automatically.

6. **Cloud-based Accessibility and Security** — All data should be connected by cloud services such as Microsoft Azure or Amazon AWS, providing a fast and reliable solution that is secure by industry standards and easily accessible from anywhere.

7. **Manage and Consolidate Lubricants** — As anyone who has a printed lubricant list on their wall knows, these are difficult to keep updated. Rather, lubricants should be centrally managed on a dedicated lubrication platform, designed to minimize cross-contamination and save money through integrated lubricant consolidation. A master lubricant list automatically compiles all lubricants in use, making it easy to know where each lubricant goes. Additionally, each lubrication point specifies a recommended lubricant to meet reliability objectives. As lubricants are changed over in machines, the lubricant list and any lubricant references are automatically updated. Along with the lubricant brand, each lubricant has a unique code and label that shows up anywhere the lubricant is referenced to minimize chances of cross-contamination.

8. **Lubrication Implementation Manager** — Changing lubricants or modifying machines for lubrication best practices can take time, often months or years. With a lubrication management platform, these changes follow a user-dependent approval process, and implementation tracking dashboards are monitored while completion stages take place. Meanwhile, reoccurring tasks are dynamically revised as lubrication points are updated in real-time.

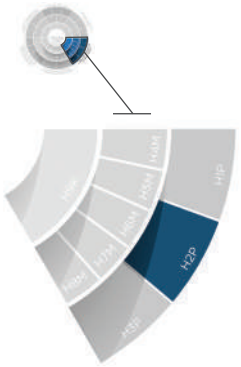
9. **Ascend Guidance for Lubrication Excellence** — As with any reliability initiative, a lubrication program should be guided by industry best practices. The Ascend™ Chart, for example, is a holistic methodology for assessing the current state of lubrication against world-class standards. The lubrication management platform should provide guidance as metrics are visualized to simulate the progress of lubrication best practices using the Ascend™ Chart. This helps prioritize lubrication efforts throughout all stages of lubrication program development, particularly early on.



Machinery Configuration

Quick Wins that Optimize Machine Performance

More about this **ASCEND™ Factor**



Factor:
H2P – Handling and Application Devices

Level:
Platform (P)

Stage:
Lubricant Handling & Application

About:
Often overlooked, proper machinery configuration ensures that machines designed for generic applications match specific operational contexts.

Learn More:
noria.com/ascend/

The landscape of manufacturing and industrial processes is constantly changing. Historically, titans of industry capitalized on large, cumbersome, overbuilt, sluggish equipment that had to be continuously maintained by a labor force that was paid an incredibly low wage. Modern industry is stressed to operate in a leaner landscape with fewer workers, purpose-built equipment and margins that, in many cases, are razor thin. This leads to improvement activities that get more and more out of less and less: more product and profit out of fewer people and with fewer failures or disruptions to business. In order to do this, practices and equipment both have to evolve to maintain pace with demands.

Fewer items are more scrutinized than the facility's physical assets; we have to make sure they perform how they are supposed to, when they are supposed to, and for however long they are supposed to. For this to happen, many factors have to be balanced, and often the equipment may not be capable of performing to this level in its current state. A higher state of configuration must be achieved — an optimum state that allows maintenance, operations and reliability to perform all necessary checks on the equipment without interrupting its service, all while maintaining or improving the inherent reliability of the piece of equipment.

Changing the configuration of assets or modifying them to improve performance is not a task that should be taken on lightly. To best modify the equipment for performance, we would first have to define how we want the equipment to improve. You can define optimized performance in many areas, and depending on your organizational goals, the changes to the equipment would have to follow suit. What follows are some of the most common reasons for modifying equipment to increase performance.

Increased Energy Efficiency

You can save money and improve performance by focusing on how much energy the equipment consumes. This energy can be electricity, diesel, gas, etc.; as such, we have a level of control in

optimizing energy consumption compared to work produced. If we are focusing just on the lubrication realm of control, there are a few ways we can improve energy efficiency.

Lubricant selection is the first step in this process. We need to carefully and deliberately pick which lubricant to use based on the equipment's needs and environment. A lubricant slightly too thick, too thin or without an appropriate additive package can translate into huge frictional losses, wear and temperature increases. Factors include the viscosity of the lubricant at operating temperature when compared to the required viscosity of the component; NLGI grade of greases to help minimize churning losses; viscosity index of the lubricant to maintain suitable film size at all in-service temperatures; friction modifier additive packages to minimize losses during start-up conditions. Lubricant selection can be a challenge for some equipment subjected to frequent operational changes and wide changing environmental conditions such as temperature swings.

In addition to selecting the proper lubricant, we must also ensure that we are operating the machine at the appropriate lubricant level. This is most critical in splash-lubricated or bath-lubricated machines, and doesn't just apply to under-lubrication. An excessive amount of lubricant inside the housing can create a condition of parasitic drag that will greatly increase the workload of the driving component, leading to increased heat and energy consumption.

Machines are designed to move through the lubricant at a certain level; variations in that level can impact the lubricant film being generated. We have to be able to splash or lift the appropriate volume at operating speeds. This is true for grease-lubricated components as well. It is common to see greased bearing overfilled with grease purging out of the seal. This puts a drag on the system and should be avoided.

Keeping lubricant volumes at the right level is just as much about inspection as it is application methods. We need to be able to add lubricants slowly so as not to bog down the system. This is most critical in greasing and ties to the previously mentioned condition of housings being over filled. Grease should be added slowly while the machine is in motion. This helps distribute the fresh grease while pushing the old grease out of the way. If grease is added quickly, the component operates in an over-pressured condition, leading to increased energy consumption. With oils, we must maintain the proper oil level in all environments, so being able to top-up or purge based upon any fluctuations is important.

Maintainability

Simply putting items on equipment in the hopes that they will improve reliability is not enough; we should also look to add accessories that aid in the maintainability of the equipment. Many of these modifications can be done quickly and are low-cost as well. The goal is to make the machine easier to inspect, work on and maintain with minimal disruption to operation. Some quick items that can help with this are:

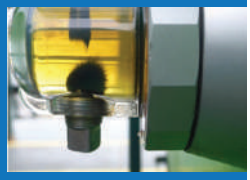
- **Sight Glasses —** Mark them for the correct oil level in operation and when turned off. This allows most people to inspect them and know what the normal level should be.

- **Quick Connects —** Alternate male/female or size of fittings to help minimize the risk of connecting filter carts backward. Color-coded options are also available to help with cross-contamination of different fluids.

- **Grease Line Extensions —** For hard-to-reach places or equipment that isn't safe to be near during operation. We can extend grease lines to make the application of grease easier and safer while the equipment is running.

- **View Ports/Expanded Metal —** Having a way to physically see the equipment or even inside the equipment during operation helps diagnose issues. Replace solid metal guarding/sheeting with expanded metal so we can have line-of-sight with the components.

- **Magnetic Plugs —** These give us a crude sense of advanced wear inside the machine. Check during oil changes for any presence of ferrous debris.



By making even minor improvements in equipment configuration, you can yield significant savings and ensure a more reliable operation in your facility.

Equipment Life Extension

One way to impact total life cycle cost is to keep equipment running at an acceptable level for longer. If we can reduce the failure rate, we can expect the machine to be able to perform longer with fewer issues. This is very much the root of proactive maintenance. To make this happen, we have to focus on the root cause of equipment failure. Oftentimes, contamination is one of the leading causes of equipment failure, and this serves as one of the most common places to start in terms of equipment configuration to enhance reliability.

Contamination control has two sides: exclusion and removal. Excluding contaminants means keeping them out before they can impact the equipment; removal is getting them out once they find their way in. Ideally, the asset will be modified to assist in both of these areas, and our maintenance practices will be changed to help maintain the cleanliness that the machine requires. It is much cheaper to exclude contaminants than to remove them once they get in.

To exclude contaminants, we tend to focus on all the areas of the machine that could possibly ingest contaminants. The most common culprits are shaft seals, breather ports and fill ports. All of these can be upgraded to some degree to lessen the risk of contamination. Seals can be better selected for compatibility with fluid, temperature and even aggressiveness of contaminants, such as utilizing a labyrinth-style seal.

Breathers have long been employed, and it is very common to find desiccant breathers on many pieces of equipment and even lubricants in storage. These are a great solution for minimizing incoming particles and reducing moisture ingression. A good desiccant breather will dehumidify incoming air and dry the headspace inside the equipment. These should be employed anywhere there are large temperature swings and with equipment that may be at risk of water contamination.

Quick-connects allow the lubricant to be added, drained, and even recirculated within the system without opening it up to the environment. The goal should be to get the machine in a hermetic state where all lubrication, inspections and standard operational checks can be done without exposing the inside of the equipment to the atmosphere. Each time the equipment is opened, it is an opportunity for contamination and the introduction of a failure mode.

Removing contaminants has to complement any exclusion activities that are underway. Lubricants and equipment can be contaminated easily and quickly. The biggest tool in the removal arsenal is filtration. Filters can be added to equipment permanently (portable methods exist for more periodic decontamination). There is a vast array of options regarding filters, including filter types, locations, ratings, materials, etc. Each of these criteria must be scrutinized to match the optimum filter to our application.

While a particle filter is the most common form of contaminant removal, it is far from the only one. Systems that focus on removing other problems such as water, heat and varnish are also readily available and, in many cases, relatively easy to connect to equipment for use. Vacuum dehydrators, ion-exchange resin skids and heat exchanger packages can be customized and purposefully built to match your equipment's exact conditions. This more targeted approach yields longer life not only for the equipment but for the lubricant itself. This means fewer failures and fewer oil changes.

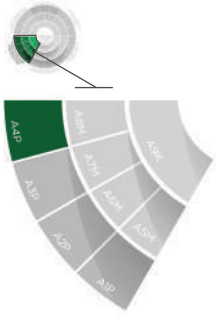
About the Author

Paul Farless is an industrial service technician for Noria Corporation. He holds a Machine Lubricant Analyst (MLA) Level II certification through the International Council for Machinery Lubrication (ICML). His duties include collecting data and preparing reports for the engineering team. Prior to joining Noria, Paul worked as an automotive maintenance technician for an auto-repair service company. He also served four years in the U.S. Navy as a gunner's mate third-class petty officer where he was responsible for the troubleshooting and maintenance of electromechanical and hydraulic systems. A detail-oriented team player, Paul works well in fast-paced environments and uses his military background to excel and maximize efficiency. Contact Paul at pfarless@noria.com

Factor: A4P

Oil Analysis Pitfall!

More about this **ASCEND™ Factor**



Factor:
A4P — Sampling Tools & Methods

Level:
Platform (P)

Stage:
Sampling Tools & Methods

About:
Accurate sampling is critical when developing a lubrication analysis program. Inaccurate samples can lead to incorrect decisions regarding machine performance.

Learn More:
noria.com/ascend/

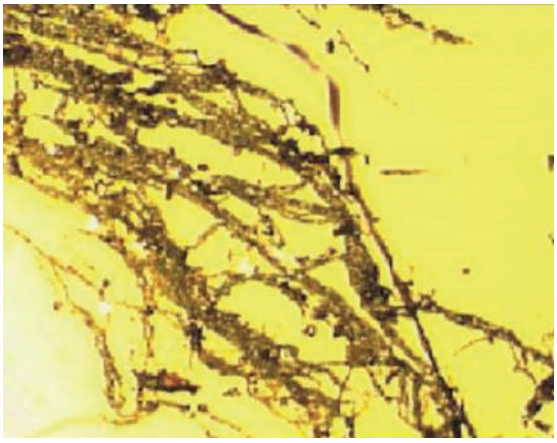
For better or worse, our world is very connected. Some of these connections allow us to communicate freely, while other parts allow us to gather a whole lot of information. I know that I am not the first person to use the phrase "analysis paralysis," but it really is relevant, especially when it comes to machine reliability. Don't get me wrong; analysis is extremely important, but focusing on a single aspect of a report or one specific technology can quickly turn into an issue itself.

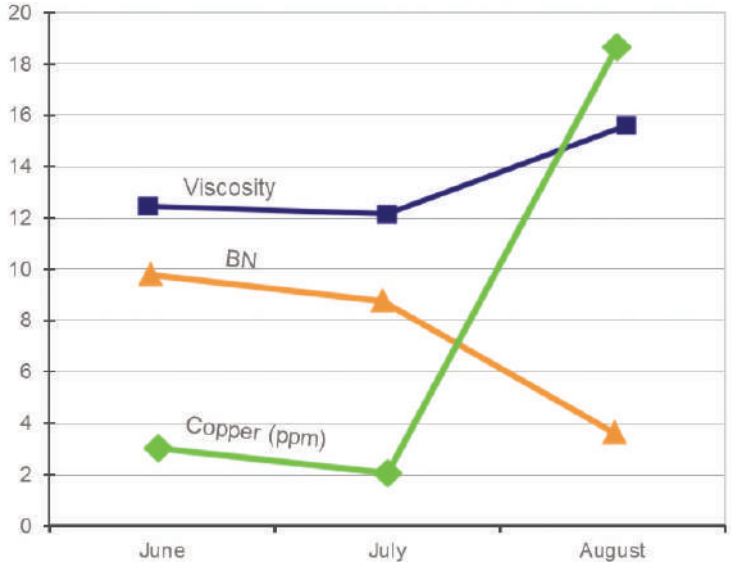
I recently had the opportunity to teach an Oil Analysis II class, which included case studies on failure investigations that we have seen or been a part of. Many of these were pretty unique situations and are meant to test how much information the students are able to use and if they could put the new knowledge into practice. Since this was a remote course, not all students were completely active in the exercise, but the ones that were did a very nice job, and it was obvious that they were honing their skills.

There was one case study exercise in particular (involving a CAT wheel loader) that I found interesting. There were some oil analysis values given, along with

	NEW OIL	USED JUNE	USED JULY	USED AUG
Viscosity (100°C)	12	11.8	11.5	16
BN	11	9	8	3
Sodium	N/A	0	0	60
Boron	N/A	0	0	15
Potassium	N/A	0	0	20
Copper	N/A	3	2	19
Lead	N/A	5	4	9
Water	N/A	Neg.	Neg.	Neg.
Blotter	N/A	-	-	Pasty center

A small history of the oil analysis





some pictures from the failure investigation.

Now, anyone that has been through the OA II course or has a good foundation in oil analysis might catch what is going on here, but the folks dealing with the machine had no formal oil analysis training.

The thing that folks noticed most frequently was the cavitation on the piston. And yes, that was part of what was wrong, but when we are looking for the root cause of failure, cavitation isn't the answer. This exercise was meant to show people that you can't just focus on one part of the puzzle and get to the solution. They were still in the detection phase of things and called the problem solved when they saw cavitation.

With no water in the samples, I was a bit curious as to what they thought was causing the cavitation or how it was caused inside the cylinder. Air could be the culprit, but this was not likely, in my opinion. I asked them to look a bit more at the oil analysis and determine what had changed. Base number was the first thing that they went to. It isn't inaccurate to say that the base number changed, but still, what was the cause of all of this?

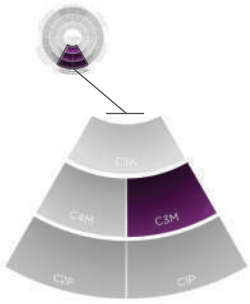
Diving more into the oil analysis part of the exercise, we see an increase in three key elements that showed up out of nowhere: boron, sodium and potassium — a few of the key building blocks for many coolants. We had gone over coolants and these building blocks about an hour before, and nobody caught this. They were too focused on the image of the piston and trying to figure out what the filtergram patch was telling them. ***ML***

About the Author

Jeremie Edwards is an Associate Technical Consultant at Noria Corporation. He is one of an elite few certified by the International Council for Machinery Lubrication (ICML) as a Machinery Lubrication Engineer (MLE) and did so in order to become the best advisor for clients when it comes to their continuing education needs. Before joining Noria, Jeremie served six years in the U.S. Army as a parachute rigger and was deployed in Afghanistan, Uzbekistan, Turkey and Germany. Contact Jeremie at jedwards@noria.com

Contamination Control Objectives: Cleanliness and Dryness

More about this **ASCEND™ Factor**



Factor:
C3M - Contaminant Exclusion

Level:
Platform (M)

Stage:
Contamination Control & Lubricant Reconditioning

About:
Implementing contamination control objectives and goals increases machine reliability. Highly critical machines should have stringent objectives.

Learn More:
noria.com/ascend/

With contamination being the leading cause of machine failure, one of the most important sections of a lubrication program is contamination control. Most plants I have visited have spent a lot of time and money creating a defensive machine design. While this is a proactive step to help machines ward off contaminants, this is really just a starting point. Contamination control objectives state how clean/healthy the lubricant inside a machine should be. This is a true measurement of how good or bad your contamination control program is.

Before defining contamination control objectives, it is best to have a good understanding of what contamination means in relation to lubricants. Simply put, contamination is anything that can damage or harm a lubricant or machine, such as solid particles, water and heat. When setting objectives, it is best not to use a broad-stroke, or a one size fits all approach. There are many factors that should be considered, such as machine type, risk of failure, cost of downtime and cost to repair. The objectives for each of these factors may be quite different due to the fact that contamination could affect them in different ways.

Target Cleanliness

ISO 4406:17 is the most widely used reporting standard for fluid cleanliness. This method assigns a code number to particles at three micron levels: 4, 6 and 14. Instead of a report showing the number of

particles at each of these micron sizes (which could be in the thousands), the code is used for quick reference; instead of reporting actual particle counts such as 1752, 517 and 55, the code would report 18/16/13.

Cleanliness targets are generally assigned by machine because some machines have tighter tolerances than others. For example, a Target Cleanliness Level for a hydraulic system might be 15/12/10, which would be much lower than a gearbox of the same criticality, 17/14/12. Hydraulics systems with components such as servos are at a far greater risk of failure due to particle contamination than most gearboxes. Another important note to consider when initially setting targets is not to start too low. Targets need to be attainable and can be readjusted over time.

Target Dryness

If you have been in the lubrication world for any amount of time, you know just how harmful water can be for machines and lubricants alike. Water is not a good lubricant for machine components. Moisture targets are much the same as the cleanliness targets in that you want to stay under the proposed limit. By using

Contamination | Particle

ISO 4406: 2021 SOLID CONTAMINANT CODE

Renard Series Table

EXAMPLE PARTICLE COUNT	
Size in Microns	Count Larger than Size per ml
4	1,752
6	517
10	144
14	55
20	25
50	1.3
75	0.27
100	0.08

$R_4 / R_6 / R_{14}$
ISO 18/16/13

1,752 Particles > 4µm/ml

517 Particles > 6µm/ml

55 Particles > 14µm/ml

NUMBER OF PARTICLES PER ML		RANGER NUMBER (R)
More than	Up to and Including	
5,000,000	10,000,000	30
2,500,000	5,000,000	29
1,300,000	2,500,000	28
640,000	1,300,000	27
320,000	640,000	26
160,000	320,000	25
80,000	160,000	24
40,000	80,000	23
20,000	40,000	22
10,000	20,000	21
5,000	10,000	20
2,500	5,000	19
1,300	2,500	18
640	1,300	17
320	640	16
160	320	15
80	160	14
40	80	13
20	40	12
10	20	11
5	10	10
2.5	5	9
1.3	2.5	8
0.64	1.3	7
0.32	0.64	6
0.16	0.32	5
0.08	0.16	4
0.04	0.08	3
0.02	0.04	2
0.01	0.02	1

If only two range numbers are used: ISO*/16/13 or ISO 16/13

4µm	6µm	14µm	ISO Code
1,301	321	41	18/16/13
2,500	640	80	18/16/13
2,501	641	81	19/17/14
5,000	1,300	160	19/17/14

One more particle

4X as many particles

Calculator
machinerylubrication.com/Read/29526/oil-cleanliness-targets

a calculator available on the Machinery Lubrication website, the target dryness for a middle-of-the-road criticality hydraulic system came to 100PPM. At the same time, the gearbox with the same criteria would have a target of 300 PPM. With this calculator, you can quickly get cleanliness and dryness targets by answering only six questions.

Temperature

While particle and moisture contamination are often monitored, one factor that doesn't get much attention is temperature. When you have a hundred to a thousand assets running in a plant that is already hot due to the process, there is a good chance your machines are being exposed to high temperatures. But how hot is too hot? This one is a little trickier to set than cleanliness and dryness targets, as there is more data to consider. In general, temperature objectives list the maximum temperature at which a machine or component should run. Remember, viscosity is the single most important property of a lubricant; as temperatures go up, viscosity goes down. If your machines are running hotter than they should, you are most likely not protecting your lubricated components.

It may seem like a big undertaking to set up contamination control objectives on your site. Break it down into small pieces and start with the most critical machines. The life extension of lubricated components can be drastically increased if you can keep the lubricant cool, clean and dry. These objectives can help keep score on how well you are fighting off contaminants at your plant.

About the Author

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LEAN MANUFACTURING EXPLAINED

Lean manufacturing or "going lean," refers to a series of methods, philosophies and tools to minimize waste in your business and maximize production. Read about different ways your company can go lean.

What is Lean Manufacturing?

Lean manufacturing, or simply "lean," is a systematic method designed to minimize waste in a manufacturing system while productivity remains constant. Originating in Japan in the Toyota Production System (TPS), lean manufacturing strives to minimize waste within a manufacturing operation, with the idea being to clearly portray what adds value by removing what doesn't. As your company begins to think about lean manufacturing it's important to keep in mind the process of going lean takes time – like turning a cruise ship around.

There are several different lean techniques, allowing each organization to fit lean manufacturing techniques into its own distinct production process. We're going to discuss the eight types of waste lean manufacturing seeks to eliminate and five common lean principals, tools and techniques manufacturers around the world have implemented into their manufacturing processes.

Lean Manufacturing : 8 Types of Waste

As we mentioned earlier, going lean starts with eliminating waste to focus on what adds value to your process, which leads to adding value for your customers. It's important to know the types of waste and how they affect your business. There are eight types of waste:

- Defects
- Overproduction
- Waiting
- Non-utilized talent
- Transportation
- Iventory
- Motion
- Extra Processing

1. **Defects:** Probably the most visible type of waste, defects are scrap products or products that don't meet commercial specifications. They can lead to many types of waste, most notably one we will discuss later – waiting. Defects cause delivery delays and logistics headaches which most likely leads to a decline in customer satisfaction. It's also going to cost money to rework defected products. Fixing defects causes your company to spend extra time fixing issues and filing paperwork.
2. **Overproduction:** Companies love to produce in bulk. While it seems like a good idea initially, customer needs change fairly constantly and the market fluctuates and forces change even more frequently. Overproduction causes excess inventory which leads to storage expenses like paying for space and paying for people and equipment to move the product around.
3. **Waiting:** Waiting is a byproduct of many types of waste and it wreaks havoc on customer satisfaction. A good way to look at waiting is, a product or your customer might be ready for the next step (packaging or shipping for example), but the next step in your process isn't ready to perform the task. In healthcare, this might look like a full waiting room. In manufacturing, this might look like machinery downtime causing packaging delays.
4. **Non-utilized talent:** Often overlooked as a form of waste, not using your employees to their full potential, talents or skills can have a big effect on your company's bottom line. Poor teamwork, minimal training, bad communication and unnecessary administrative tasks are common examples of non-utilized talent waste.

5. **Transportation:** Transportation is the movement of goods from one location to another. In manufacturing, this might mean performing different tasks in different locations. For example, producing product parts in China and shipping them to America to assemble. This process doesn't add value to the end product, it doesn't change the end result and it adds more cost. If you look at Toyota's manufacturing setup, many of their suppliers are near the production plants.

6. **Inventory:** Similar to overproduction, inventory waste happens when your product is sitting there waiting to be sold. The difference between overproduction and inventory waste is, inventory has a physical cost associated with it, whereas overproduction is assumed. Overproduction often causes inventory waste by making more than your customers want or assuming demand will be there down the road.

7. **Motion:** The unnecessary movement of people, machines or items that don't add value is the waste of motion. In other words, wasting time. This form of waste is usually caused by not following the 5s' lean manufacturing principal. Common examples include, employees looking for materials or equipment or poorly designed workspaces.

8. **Extra Processing:** Extra processing or over processing refers to adding work that isn't required. Extra processing costs hit you in the form of the time of your staff, materials used and equipment wear, and they add up over time. It also makes your process less efficient because employees performing the extra processing tasks could be doing value-adding tasks instead.

7 Lean Manufacturing Principles, Tools and Techniques to Consider

Now that we're aware of the types of waste we want to minimize, let's look at five common lean manufacturing tools and techniques to help you mitigate waste and maximize production.

1. **Kaizen:** The Japanese term "Kaizen" translates to "change for the better." The idea behind Kaizen is continuous improvement. It makes teams work together proactively and take responsibility for their areas within the company. Together, employees make incremental improvements in the manufacturing process. With kaizen, there is always room for improvement, and workers should constantly look to improve the workplace. This philosophy also emphasizes that each individual's ideas are important and that all employees should be involved in the process to better the company. An organization that practices kaizen welcomes and never criticizes suggestions for improvement at all levels. This helps to create an environment of mutual respect and open communication.

How Kaizen benefits you Implementing Kaizen improves your productivity, effectiveness, safety and lessens waste	
Benefit	Description
Less waste	Inventory and employee's skills are used more efficiently
Employee satisfaction & commitment	Employees have a direct impact on how things are done which gives them more of a stake in the company, leading to a commitment to do a good job
Improved retention	Happy and engaged employees are more likely to stay put
Customer satisfaction	Engaged employees means improved product quality and fewer defects

2. **5S System:** The 5S system is an organizational method stemming from five Japanese words: seiri, seiton, seiso, seiketsu and shitsuke. These words translate to organize, tidiness, clean, standardize and sustain. They represent a five-step process meant to reduce waste and increase productivity and efficiency.

- Seiri (organize): The first step, Seiri, involves eliminating clutter and unnecessary items from the workspace.
- Seiton(tidiness or orderliness): Next, workers must set an order by ensuring there is a place for everything, and everything is in its place.
- Seiso (clean): This step involves cleaning the workspace and always keeping it in a clean state.
- Seiketsu (standardize): Standardizing all work processes and keeping them consistent, so any worker can step in and perform a job if necessary is vital.
- Shitsuke (sustain): Finally, we want to constantly maintain and reinforce the previous four steps.

How the 5s System benefits you the 5s' help you minimize multiple areas of waste	
Benefit	Description
Reduces cost through less storage space	Getting rid of unused materials, tools and equipment, and organizing frees up a lot of space. This kind of cost savings hits on not only storage rental costs but heating and cooling, cleaning and the maintenance of the space
Cleanliness	Cleanliness translates into improved maintenance and less downtime. If a machine is clean, you'll be able to spot defects and issues like oil leaks. This lets you perform preventative maintenance to prevent downtime
Safety	Cleanliness directly relates to improved safety. It removes clutter which can reveal electrical, chemical or mechanical hazards. Organizing tools and equipment in areas closeto where they're needed minimizes movement, reducing injury

3. **Kanban:** Kanban helps eliminate inventory and overproduction waste by implementing a method for regulating the flow of goods inside and outside the factory. It translates to "billboard" or "visual signal" and relies on visual signals to help employees control inventory. A Kanban card can be placed in a visible area to signal when inventory needs to be replenished. With this process, products are assembled only when there is demand from the consumer, allowing companies to reduce inventory and waste. The Kanban method is highly responsive to customers because products can be manufactured by responding to customer needs instead of trying to predict their future needs.

A basic form of Kanban is having three columns: "To Do," "Doing," "Done." Once you've begun a project or the first step in a process, move a colored sticky note with

your name on it to the "Doing" column, so everyone knows where you're at in the process. Columns can be labeled to match your particular project and there can be as many columns as you need.

How Kanban benefits youKanban is a great way to manage work processes and maximize time and efficiency	
Benefit	Description
Flexibility	With the Kanban technique, priorities are alwaysbeing reassessed based on the most recent information
Continuous delivery	Kanban helps you deliver exactly what your customers want by continuously delivering smaller batches of product. This lets your team constantly update processes based on new business requirements
Waste reduction	Kanban improves your productiity and efficiency, reducing waste like over production,unnecessary motion, defects and waiting

4. **Heijunka:** Heijunka is the Japanese word for "leveling." Level scheduling is a type of production that purposely manufactures products in smaller batches by sequencing varying products in the same process For example, let's say you produce sunglasses and you get an order for 500 of the same style of sunglasses each week. The orders come in as 200 orders on Monday, 50 on Tuesday, 100 on Wednesday, 100 on Thursday and 50 on Friday. Rather than trying to meet that order in sequential order, you could use Heijunka and level the demand by making an inventory of 100 sunglasses close to shipping for Monday's order. Make sure 100 sunglasses are in inventory every Monday and the rest of the week, produce 100 sunglasses each day (a level amount).

   Implementing Heijunka requires you to set the pace of your manufacturing according to what's known as Takt time. Takt time is the rate at which your customer makes a purchase or the time it takes to finish a product to meet customer demands. In other words, you're matching your production rates to meet your customer's demands, creating a level process.

How Kanban benefits youKanban is a great way to manage work processes and maximize time and efficiency	
Benefit	Description
Flexibility	With the Kanban technique, priorities are alwaysbeing reassessed based on the most recent information
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Waste reduction	Kanban improves your productiity and efficiency, reducing waste like over production,unnecessary motion, defects and waiting

5. **Just in Time (JIT):** Just in Time is a management philosophy involving only producing a product when the customer wants it, in the amount the customer requested it and sent to where they want it without it being hung up in inventory. In other words, instead of making and stockpiling products in anticipation of what your customers might want, you make what customers order when they order it. This lets you allocate your resources (employees, machines, etc.) to only work on things you'll be paid for. Just in Time helps improve inventory costs, reduce space, reduce lead time, increase productivity and more.

What's required for Just in Time?

Just in Time lean manufacturing plays off of many other lean tools and techniques. Here's what you'll need to implement the Just in Time philosophy.

- Reliable equipment is vital for JIT to work properly. You can't have machinery constantly breaking down or producing low-quality products.
- Well designed workspaces are key for the JIT flow. Use the 5s system to improve workspace layout and flow to minimize inefficiencies.
- Improve the quality of your workforce by setting up Kaizen teams, so employees take ownership of their own areas.
- Define standards for how each operation should be performed.
- Since JIT lean manufacturing doesn't create inventory, it strives to produce only according to customer demand. Using the Kanban technique signals the previous process what needs to be made.

6. **SMED:** Single-minute exchange of dies (SMED) is a process used to greatly reduce the time it takes to complete equipment changeovers. Officially developed by Japanese industrial engineer Shigeo Shingo, the SMED process led to an average reduction in changeover times of 94 percent across multiple industries. Implementing a SMED process has multiple benefits when it comes to going lean and minimizing waste. These benefits include:

   The SMED process involves a series of steps or "elements", which are categorized in two types: internal and external. Internal elements need to be completed while the equipment is stopped, while external elements can be completed while the equipment is running. The goals of SMED is to have as many external elements as possible while streamlining and simplifying all other elements.

Implementing SMED consists of five steps:

For a more in-depth look at impementing SMED and the SMED process, check out the link in the beginning of this section.

- A decrease in manufacturing costs;
- The ability to produce smaller lot sizes;
- Improved schedule flexibility and responsiveness to customer demand;
- Lower inventory levels;
- Improved machine startups;
- Identifying a pilot area;
- Identifying elements;
- Separate external elements;
- Convert internal elements to external elements;
- Streamline the remaining elements.

7. **Poka-Yoke:** Poka-Yoke – a Japanese term roughly translated to "mistake proofing" – is a technique used to make sure your lean process produces quality products. It's purpose is to minimize or eliminate defects by preventing, correcting, or bringing to light any human errors that are occurring.

   A simple example of poka-yoke is when a car with a manual gearbox requires the driver to step on the clutch pedal before the vehicle will start. For cars with automatic transmission, the poka-yoke (process or step) is the switch that requires the car to be in park or neutral with the driver's foot on the brake before the car will start.In manufacturing, poka-yoke can be implemented at any step of the manufacturing process where human error can cause something to go wrong. For example, a device holding pieces for processing might be modified to only allow pieces to be held in the correct orientation required for input. Another example would be a digital counter that counts the number of spot welds on each manufactured piece to ensure the welder makes the correct number of welds.

There are three types of poka-yoke for detecting errors in a manufacturing setting:

- The contact method identifies defects by testing the product's shape, size, color and physical makeup.
- The fixed-value method (constant number) sends out an alert to the operator if a predetermined number of movements are not executed.
- The motion-step method (sequence) makes sure the predetermined number of steps for a particular process have been followed

Generally, the operator is alerted when a mistake is impending (known as a warning poka-yoke) or the poka-yoke device prevents the mistake from being made itself (known as a control poka-yoke). Benefits of implementing poka-yoke include less money spent training operators; elimination of certain quality control operations; lessening the number of repetitive operations; a reduction in the number of product rejects; built-in quality control; preventing defected products from reaching your customers and more.

Benefits of Lean Manufacturing

Using lean manufacturing principals, techniques and philosophies to go lean gives you a competitive advantage by eliminating the eight types of waste discussed earlier. Let's take a look at some real-world examples of how going lean gave companies the upper hand.

- **Thrustmaster of Texas:** This case study from Lean Enterprise Institute (LEI) takes us to Thrustmaster of Texas. Thrustmaster manufacturers heavy-duty thrusters that rotate 360 degrees around a fixed axis. These thrusters are used on ships and other vessels so they can maneuver efficiently. During an 18-month process of going lean (considered a short time in the eyes of LEI), Thrustmaster implemented lean manufacturing techniques to streamline work and material flow which led to a 100-percent increase in on-time delivery. Now, the company's production can fluctuate with market demand and new market opportunities are presenting themselves thanks to changes in cost structure.
- **Velux:** is a Danish company that manufacturers skylights and roof windows operating out of Poland. It focused their lean manufacturing transformation on their production area. Its employees completely changed the layout of the production floor for better flow. The idea for this change stemmed from a five-day Kaizen. Once they saw the effects going lean had on their production, they decided to implement it to the whole supply chain – from design to final product. Through various lean manufacturing principals and tools, Velux introduced Kanban and the use of visual tools to help with realizing changes in their processes. Today, Velux continues to practice lean manufacturing and holds 5s assessments each month with different people to look for ways to keep improving.

Bottom Line

Nearly 60 percent of production activities in manufacturing operations around the world are waste, according to Vorne Lean Production. When it comes down to it, almost every company has room for improvement when it comes to minimizing waste, making high-quality products and lowering their overall production cost. If you decide to go lean, remember it takes time to implement the correct methods, tools and philosophies we've discussed. Once you're team(s) learn these techniques, they'll be able to reduce one or more of the eight types of waste just by doing their job.

As you consider implementing lean manufacturing, it's important to keep the lean manufacturing cycle in mind. There are five steps in the lean manufacturing cycle:

- Identify value. This means thinking about the end customer and what they deem valuable.

- Map the value stream. Layout all the steps within your process and get rid of those that don't add value.

- Create flow. Figure out ways to make the valuable steps more streamlined in a tight sequence to provide the end customer with as much value as possible, quickly.
- Establish pull. Create more demand from your end customers, so they're looking for the product rather than you having to push it on them.

- Strive for perfection. Continuous improvement is key in lean manufacturing. The goal is to always be thinking of ways to eliminate waste and document and standardize the processes that generate success.

Finally, it's important to always respect the human elements when talking about going lean and implementing lean principles. This means striving to keep employees happy and engaged with their work by making this goal a core principle. Without a respect for employees and the people within your organization, people tend to disengage and not perform at a consistently high level. It's a relatively easy principle to put into practice as there are only a few elements to keep in mind, but each element tends to become difficult to manage since you're dealing with humans and not machines. Key elements include:

- Don't overwork employees.
- Show them their purpose by outlining what their work is achieving and align their purpose with their own goals.
- Maintain a high level of accountability for successes and failures.
- Always get to the root of any issue by speaking with employees directly.
- Give stability and a little variety in their tasks.

The "Lube-Tips" section of *Machinery Lubrication* magazine features innovative ideas submitted by our readers.

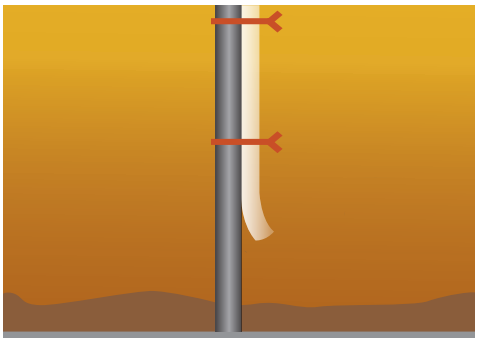
Control Oil Loss

If you decide to implement a program to control oil losses, one of the first steps is to check records of the amount purchased compared with the amount sent for disposal. Try to account for the difference by looking for leaks, products consumed in the process, evaporative losses and products wasted due to contamination or misapplication.

The Chain Reaction

Abrasive wear can cause a chain reaction in lubricated machinery. The typical chain reaction is:

- Abrasive particles become work hardened.
- Work-hardened particles produce more particles.
- New particles become work hardened.
- The chain reaction continues until the particles are removed by filtration or the machine fails.



Oil Sampling Pointer

For reservoirs, drop tube oil sampling is rarely the ideal method. However, if it cannot be avoided, it is important to consistently sample as close to the active fluid zone as possible. Measure the standoff distance desired from the bottom of the sump and attach the drop tube with wire ties (or another suitable method) that distance from the end of a rod. Consistency in sample location will help make the analysis results more suitable for trending. ***ML***

Did You Know?

Additional tips can be found in our Lube-Tips email newsletter. To receive the Lube-Tips newsletter, subscribe now at

machineryLubrication.com.

Have Some Tips?

If you have a tip to share, email it to editor@noria.com.

Castrol Launches New Auto Care Products to Cater to Growing Market Demand

Castrol, a prominent name in India's lubricant industry, has recently made a significant move by expanding its product portfolio into the thriving auto care segment. With this move, Castrol reinforces its commitment to innovation, growth, and delivering unparalleled value to its partners and consumers. The newly introduced range includes Castrol Chain Cleaner, Castrol Chain Lube, Castrol 3-in-1 Shiner, Castrol 1-Step Polishing Compound, and Castrol Anti-Rust Lubricant Spray.

Brakes India forays into lubricants with all-new Revia

Brakes India, one of the most trusted names in the automotive sector for safety & quality, forays into the lubricants segment, in the all-new Revia brand. Leveraging Brakes India's strong distribution network and 60+ years of rich legacy, the company is diversifying into the engine oil space catering to both passenger cars and commercial vehicles segments with its newest brand.

Revia engine oil has a wide product portfolio with 9 grades of engine oil – 5 for Passenger cars and 4 for commercial vehicles. The company also offers the premium fully synthetic range for SUVs and MUVs.

Revia 15W40 CK4 engine oil is compliant with latest BS6 norms and caters to all new generation engines.

Honda Motorcycle & Scooter India launches new engine oil 'Pro Honda' for Honda 2 Wheelers

Pro Honda, a genuine global oil brand of Honda Motor Co. Ltd, Japan, is exclusively formulated, tested and approved by Honda engineers to help maintain the "designed-in performance" of Honda 2 Wheelers. HMSI is the first to introduce the Pro Honda brand among all Honda network countries for its customers.

Both the grades are now available at all authorised HMSI touchpoints and open market in packs of 600 ML, 800 ML, 900 ML, 1000 ML & 1200 ML. The Pro Honda 10W30 grade is priced starting at INR 333 (800 ml) and Pro Honda 5W30 grade is priced starting at INR 311 (600 ml)

The 5 in 1 technology of range provides better anti-rust properties, longer engine life, higher fuel efficiency, low viscosity which reduces friction & environment friendly-low emissions. Pro Honda is a pioneer in low viscosity with low friction technology.

Goodyear Lubricants to launch new BS-6 compliant lubricants for India, manufactured in Haryana

Goodyear lubricants has announced a new range of vehicle lubricant oils for distribution in South Asia, Southeast Asia and New Zealand. The new lubricant product line is designed to reduce carbon footprint and be in compliance with ongoing BS-6 and EURO 6 standards. The tyre giant is developing the new line of cleaner and more sustainable products in collaboration with Assurance International Limited.

For India and other markets, the new engine oil and other lubrication products will be produced using the latest technology and equipment at the Assurance Int Ltd. Goodyear claims that its new products ensure no direct impact on nature by eliminating oil drainage and waste into soil. The product line-up is expected to be launched by mid-January 2023.

The BS-6 compliant products will cater to both passenger vehicle and commercial vehicle segments. These will include engine oils, gear oils, brake fluid, coolants, transmission oils for both manual and automatic, hydraulic oils and other products to cater to vehicles.

For further optimising the new products to be environment friendly, Goodyear Lubricants will now have redesigned packaging that the company claims uses 15 percent less plastic.

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