

SOLUTIONS

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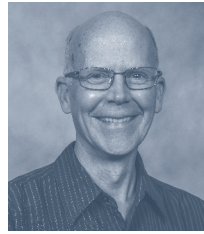
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FROM THE CHAIR



Gina Hutto-Kittle

Gina Hutto-Kittle, CMRP
SMRP Chair

Dear Members,

It is with great joy and excitement that I write to you today as chair of SMRP. I want to first thank Vlad Bacalu, CMRP, CMRT, CAMA, for his work leading SMRP as chair this past year. From launching a host of new certification benefits to debuting SMRP's very first international Symposium, 2019 was an exciting year.

I would also like to thank everyone who made the SMRP 27th Annual Conference in Louisville, KY a success. From Conference Chair Kevin Clark to the conference committee and those who presented or exhibited, thank you for another fantastic SMRP Annual Conference. As we wrap up 2019, I am excited for what is in store for SMRP by way of global events in 2020.

This past year, SMRP hosted its inaugural international symposium in Lima, Peru. Due to the overwhelming success of the Peru Symposium, SMRP will host not one but two international symposia in 2020. The first will

take place in Abu Dhabi, UAE, February 10 – 12, 2020. The two-day event will be SMRP's first foray into the Middle East alongside our global partner, the Gulf Society for Maintenance & Reliability (GSMR). The two-day event will be conducted entirely in English – I encourage you to consider the Abu Dhabi Symposium in your travel plans for 2020.

Following shortly after the Abu Dhabi Symposium, SMRP will head south to Colombia for the Bogotá Symposium, taking place March 24 – 25, 2020. This event will be conducted in Spanish and will feature track sessions, general sessions, networking opportunities and on-site access to certification exams.

As I write to you today, the registration for both events is currently open. Early bird rates will close for the Abu Dhabi Symposium on January 3, 2020, and on January 28, 2020 for the Bogotá Symposium. As SMRP becomes increasingly more global, I encourage you to attend an international symposium in 2020 and connect with fellow professionals and practitioners from around the world.

I'm excited for what the future holds and I look forward to serving you as SMRP chair this year!

Capacity Through PRODUCTIVITY

David E. Brown, CMRP

Most companies have a strong focus on expansion and cost-out capital, but a weaker focus on manufacturing asset utilization and productivity despite the fact that there is often greater business value in the latter. This is because the management processes required to drive value delivery from productivity have not been made as tangible. Some businesses have achieved a strong focus by dedicating people to asset productivity, but even businesses with this focus are often weak in incorporating productivity initiatives into the business strategy for capacity. For the purposes of this article, “productivity” will refer to improvements in manufacturing practices, processes, and support systems that eliminate production losses and improve the ability to make what you want to make when you want to make it.

For any process, there is a substantial operational benefit to be gained from productivity, and the operational improvements accrete business value.

However, for processes that need additional capacity, the gross profit contribution is large and direct. This is because productivity delivers additional production. The effective capacity of a plant is increased as it operates more consistently and closer to its ideal production rate. Sales fulfilled from this additional capacity have an oversized contribution to gross profit. Productivity provides additional production without increasing overhead, staffing, or operating time. Frequently, the only additional costs related to productivity improvements are for raw materials, packaging, and about 1/3 of average unit energy costs. The percent increase in gross profit can be double the delivered percent increase in production, and the additional capacity is provided without expansion capital.

It must be noted that organizations, by nature, do not drive productivity improvement. Organizations give attention to large failures, but that attention is naturally more focused on

Leading indicators can help make productivity a more tangible consideration for meeting future capacity needs.

repairs than the root cause. Smaller, recurring losses are often unrecognized or accepted as natural variability. Managers must implement systems and processes to focus the organization’s attention on productivity. This starts by measuring all losses and continues by setting up metrics, goals, and reviews that give visibility to progress and encourage the organization to use the data productively.

Leading indicators can help make productivity a more tangible consideration for meeting future capacity needs.

It is important to know that there is substance (enough defined initiatives) behind the intent to reach improvement targets and to have visibility of progress. To achieve this, indicators need to meaningfully reflect the anticipated timing and value of improvements. This starts with value loading productivity initiatives, projecting their capacity impact, timing, and probability of success. Metrics that forecast the additional capacity to be delivered from initiatives for each production line or business may then be developed.

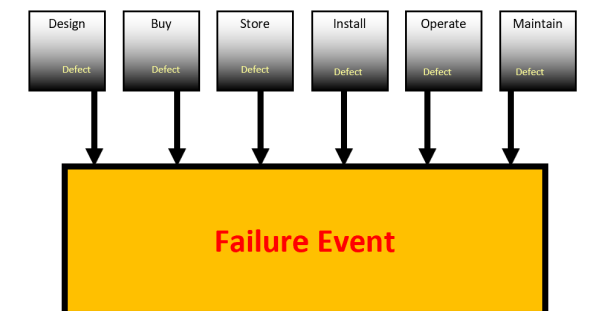
To value load productivity initiatives, the losses that are targeted for elimination need to be quantified in terms of capacity impact. This is done by measuring at the process constraint and quantifying it in terms of the finished production. Note that while some losses may be completely eliminated, this is not likely for many losses. This may be accounted for by factoring in a probability of success for each initiative.

Also, recognize that there is some degree of “swimming against the current” with productivity initiatives. As some losses are eliminated, others that were previously hidden by larger losses may start to impact production. This could result in less of an increase in capacity than originally expected. Fortunately, there are also ways to “get the current flowing with you,” we’re making the right adjustments results in unexpected productivity improvements. The two factors that can effectively produce this result are best practices and natural work teams.

Best practices reduce failures and increase improvement sustainability. The process of implementing best practices solves systemic issues, as the organization more reliably makes the right adjustments in the right manner. All production failures stem from defects that were previously introduced in the way we design, buy, store, install, operate and maintain our process (see figure 1). With improved practices, there are fewer failure causing defects. Also, productivity improvements identified through problem solving and root cause analysis must be embedded into good practices, or obstacles in productivity will strike again in the future. There is plenty of industry knowledge defining best practice, of which every plant should take advantage (in an intelligent order and over time). Implementing best practices results in better operations with fewer losses (productivity).

Each individual in your organization has different natural interests and insights, and some welcome additional opportunities to make a difference in these areas. Natural work teams can arise if communication allows being informed and enables suggesting solutions. Recognizing helpful contributions, orientation and skills training reinforce this environment. An organization widely motivated to share ideas and contribute solutions can result in operations where productivity is continuously improving.

Many businesses would greatly benefit from better incorporating productivity into capacity strategy, particularly where sales forecasts indicate the need for additional capacity. Productivity improvement and engaging with more formal, quantified initiatives should be encouraged within plants on a continuous basis. Plants with a history of improving productivity may receive preference with expansion capital because these plants have practices that maximize return on investment. In organizations fostering natural work teams, and pursuing best practice implementation, leading indicators to verify that improvement goals are credibly backed by initiatives can give tangible means to incorporate high-value productivity improvement into business strategy.





Last time you did a root cause failure analysis (RCFA) and found the root cause was at the "Organizational" level, did you tell your chain of command it was their fault?

I will tell them for you today.

2009

I was preparing to take command of Charlie Company, Recruit Training Regiment at Parris Island, SC. Major Shelton, our battalion executive officer, and I were casually talking about the training while observing recruits on their final three-day evaluation called "The Crucible."

Something he said hit me like a howitzer. He may not have had a second thought, but a picture became clear and I realized something that I don't believe he or most of my peers grasped within the frame of recruit training at the time.

The only way to be successful is to push leadership all the way to the bottom of the organization.

Before taking command of Charlie Company, I observed many recruit graduations. Drill instructors are notorious for working themselves to death. Working between 100 and 120 hours per week is average for them. But even with all that effort, they seemed angry at the poor quality of Marines. The title of "Marine" seemed cheap as their passion for training was lost on 13 weeks of pushing recruits through like cattle to meet a quota. They felt the vision of recruit training had become:

Ignore quality to make as many Marines as you can.

I hated it. Training should be rewarding for the drill instructors and the new Marines. If I had been a reliability engineer back then, I would have called what I did an RCFA. I found the root cause either way. It was poor leadership. It was us.

My mind was racing for a solution. Charlie Company needed a new vision.

Make the best basically trained Marine possible.

I gave them back the ability to fail recruits for quality issues. If they told me a recruit shouldn't graduate for moral- or attitude-related reasons, I supported it.

Next was guidance to leverage the recruit chain of command to reinforce good performance. For years, we had ignored that there were three levels of leadership built into the recruit structure. We treated the recruit structure like a flat organization.

Without any accountability, we had all been "pencil whipping" the paperwork for years to show that recruits were filling their recruit leadership roles. We didn't trust them to lead. Bad on us.

We changed that attitude in one day. Drill instructors were empowered to hold the recruits responsible for their performance. Fireteam leaders, squad leaders and the guide (all parts of the recruit structure) were all held responsible for their team members' performance, including hydration, event preparation, studying, testing, timeliness and more.

Intuition says that making the best basically trained Marine possible would result in higher attrition. However, surprisingly, Charlie Company had the lowest attrition out of all companies in the entire regiment. Changing the vision and changing the culture resulted in fewer injuries, fewer testing failures and fewer moral issues. The drill instructors were proud of the quality of Marines that they were producing!

In addition, Charlie Company earned the highest performance metrics in First Battalion over four straight training cycles!

There were other benefits. Although the average number of heat casualties during the three-day Crucible event would range between 30 and 60 recruits, Charlie Company was the only company ever to go through the event in August with zero heat casualties. And we repeated that four times. Recruit leaders were blowing our minds.

My drill instructors were phenomenal! I loved them then and still do.

And, as a result of the changes implemented, they loved their work again. Instead of resenting the new Marines, they welcomed them as brothers.

Do you want a reliability centered organization? Leadership drives culture change.

As much as we had already accomplished, there was more.

Tan belt martial arts qualification was a requirement for recruit training, but additional belts were not. During my fourth training



The gray belt qualification

cycle, with less than a week until graduation, one of my senior enlisted marines handed me a stack of Marine Corps martial arts training records for signature.

"Gunnery Sergeant, what is this?"

One of the drill instructor teams had trained and tested their entire platoon through the gray belt qualification.

How did they find time for that?

A smaller training company required more administrative time per recruit. That time was leveraged as additional training in knowledge, fitness and martial arts. This platoon was leading the company (and the battalion) in performance for all the required skills and still had time to teach and earn gray belt qualification. And they did it safely.

I was thoroughly impressed. I was excited! They advanced my vision further than I could have dreamed!

Point the horses in the right direction, turn them loose and go along for the ride.

To be fully honest, as proud as I am of their accomplishments and as proud as my bosses were of my other accomplishments, additional martial arts training was an unnecessary risk in the eyes of my bosses. I took a bit of a beating for that one, but I didn't let that filter down to the drill instructors who ran with my vision. As far as I was concerned, they outperformed my expectations.

And I am glad I handled it that way.



2012

Three years later, I ran into that same gunnery sergeant Camp Leatherneck in Afghanistan. He was a combat engineer.

"Sir, you have to see this!"

His unit was responsible for building and recovering expeditionary bridges. Afghanistan is a dangerous place for Marines, and recovery involved eight hours of exposure to the enemy, which was more than enough time for an attack.

"We are re-writing the book on expeditionary bridge recovery."

I watched in awe as an armored flatbed backed up to the 80-foot-long bridge, ripping it out of the ground in one piece and evacuating in less than 45 minutes.

The vision was still alive. He was saving lives. I couldn't be prouder.

I feel very fortunate to have had such incredible mentors and teachers during my time in the Marines. They showed me how to lead with a vision, how to mentor, how to inspire, how to supervise and how to reward the right behaviors. If it weren't for the Marine Corps and those specific commanders, I don't believe I would have any of those lessons.

Executive Reliability

In the September/October issue of Solutions, I wrote to inspire reliability engineers, the Jedis of the business system. Today, I want to inspire members of executive-level leadership. Having been in leadership roles with more than 8,000 Marines, I can empathize with your responsibilities, pressures and frustrations.

I want to help you make your whole organization, not just your maintenance program, a reliable one. War is hell, but business has its own wars to wage. Before I retired from the Marines, I thought the business world would be efficient, driven by money and profits. Upon retiring and joining the civilian business world, though, what I learned was that business can be volatile, explosive and chaotic.

You can't see it, but a smile is slowly forming across my face... Marines are born to bring order to chaos... I've found my next mission.

Reliability engineers fight the business culture, alone and unafraid, to make what positive impacts they can for an organization. A good root cause analysis will start with a specific failure and dig deep to find the most effective and efficient solution possible: effect, equipment, people, system and organization. There may be corrective actions necessary at many levels, but typically, there are root causes within the organization that are driven by executive decisions and policies.

Don't look, but all the REs in the room are nodding right now.

Have your subordinate leaders shared the inefficiencies and losses incurred from your policies? Probably not. That's why I'm here.

I tell everyone to read. Every book you read is immediately increasing the value in your knowledge bank and will grow interest over time. While we talk today, I'm going to suggest that you read some books. Read. Now that you are an executive, or if you want to be, reading is more important now than it has ever been.

1: Create a vision to align your organization

I know three authors who can help you understand what a vision should look like and how vital that vision is to your success. I gave you the example above, but the research has to be your responsibility. Read these books:

Making Common Sense Common Practice by Ron Moore. Ron will help you understand the whole reliability picture and how your decisions impact your bottom line in ways you may not have heard before.

The Journey to Improved Business Performance by Stephen J. Thomas. The book is written from the perspective of a maintenance manager, but you can read it from the perspective of an executive to understand how your productivity-improving policies can actually destroy productivity.

Strategic Project Management Made Simple by Terry Schmidt. I told your reliability engineers to read this one, too. If your vision is not supported by an aligned set of projects, your organization is eating itself alive.

2: Manage risk by balancing your whole financial statement

Ron Moore also explains leading and lagging indicators from a level that I believe you will appreciate.

Finances are all very understandable to executives. It is the language we speak. Metrics, however, are more complex and powerful than we may realize.

You want to improve your bottom line and meet a quarterly financial performance goal. Cut headcount, defer spending, etc. But what does it cost?

If you can change a spreadsheet and see a positive change in your lagging indicators, you are taking a loan out against your company for an investment that has no return. You will pay for that decision.

If you instead make a change that supports improving a leading indicator, even at the short-term cost of losing ground on a lagging indicator, you have just invested in your company's future. There will be a positive return on that investment.

Get very familiar with Ron Moore's book.

3: Trust your people, train them and hold them accountable

It's time for another vignette:

Decentralized command is one of the foundational principles of the Marine Corps. Decisions that impact strategy are frequently made by tactical leaders, operating from a good mission statement and commander's intent. But even the Marine Corps is not immune from the temptation to centralize the command function.

In 2005, a 21-year-old sergeant could be in a firefight, get on the radio and have a barrage of artillery fire and air support on station in a matter of minutes.

In 2012, with the advancement of technology and video surveillance, the same 21-year-old sergeant in the same situation waits two hours for three commanders to be woken up from sleep to review the battlefield video and authorize escalation of force. The commanding general finally gives the approval to execute the fire mission, but now,





Conducting fast roping exercises in 2004

The bad guys have walked off the objective and we destroy a herd of sheep in an impressive barrage of artillery...

So the real question is, what did we gain by tightening the reigns and bringing tactical approvals to the top of the organization? What risk did we reduce?

1. We lost time, money, credibility and trust within the organization.
2. We increased the risk, not decreased.
3. A herder lost sixty sheep.

What are you gaining by taking authority away from your subordinate leaders? Maybe you are the reason your organization is not moving forward on its own.

"I can't trust them with it. There is too much risk associated with letting go of the control I have right now"

I will challenge that:

1. You can't grow to a higher level yourself if you are tied to the responsibilities that should be managed below you.

2. You are creating more risk than you are eliminating by holding that control. You just can't see it from your position.

Develop your people, then trust your people. Read these books:

It's Your Ship by Captain Abrashoff. Captain Abrashoff will give you some very valuable lessons about creating a culture of achievement by setting the right climate and releasing the reigns.

First, Break All the Rules by Buckingham and Coffman. If you value statistics and surveys, this one will give you the data to back up any positive changes you want to make in your organizational culture.

In 2004, at the Infantry Officer Course, we were conducting fast roping exercises. Basically, the process is to load a bunch of Marines in a helicopter, hang a huge braided rope out the back of the helicopter and then have the Marines slide down the rope like a fire pole as fast as possible to get them onto the ground and into the fight as quickly as possible.

We were all new lieutenants and some of us were slower than others at getting out of the aircraft. Some, in fact, were just plain timid about it.

As the helicopter took a lap around the landing zone to come pick us up for another trip, the captain tore into us about our disgusting performance and, if this had been live combat, the resulting death of our fellow Marines. I won't quote him exactly because it would not be appropriate, but I will quote this part:

"SAFETY IS NOT PARAMOUNT; TRAINING IS PARAMOUNT! SAFETY IS SECONDARY!"

I'm not suggesting that anyone forego safety. "Safety first" is a core value at my organization and at most other reputable corporations. The point is that the interlocked guarding, the cut-proof gloves, the face shields and emergency stop logic will not keep your people safe without training. Safety features and PPE are an added layer of protection on top of the training and skills that make your people valuable.

So what are you doing to improve your organization's skill level so that you can let go? What are you doing to improve your own skill level so you can reach higher?

We can all go to a university, we can all sign up for training courses and if this was all that was necessary to be valuable, a diploma would replace your resume.

"Bachelor's, Master's? Good enough. You're hired!"

This is not the case. Every single one of us is different, with different personalities, different capabilities and limitations and different work environments and operational needs. A corporate-required learning program and a university degree are good, but will never be enough. You don't know it all and there will always be gaps left where your required training program ends.

Personal development fills in the gaps left by education and training systems and helps us achieve more elusive business goals.

Read. Encourage your employees to read. And support their efforts for self-identified training and improvement opportunities. You won't regret it.

Conclusion

Point your organization in the direction you want it to go. Train and empower your people to take more responsibility than they are assigned. Let go of the reigns and enjoy the ride. If you have established a great vision, subordinate leadership becomes incredibly effective. The ride will be fast and furious, but precise. Executive Reliability.

If you are used to maintaining tight control, it's going to be a terrifying ride, like sitting in the back seat of a fighter jet during a live air-to-air combat mission. But letting go of the reigns under these conditions will result in organizational agility and precision like you have never seen before.

Captain Abrashoff says it best in *It's Your Ship*, explaining that risks taken within your scope of responsibility that support the boss' mission and vision are justifiable risks and are beneficial to the organization. Don't punish leaders in your organization for taking justifiable risks, or you will end up being the only horse on the team pulling the cart.

Create a vision. Educate yourself. Empower your people. Enjoy the ride.

P.S. In hindsight, it was my mistake to fail to consider that my bosses would be so uncomfortable with the gray belt training. One of the most important lessons I shared in the September/October issue was understanding your boss's needs. I learned from that. Please learn from my mistake.

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We look forward to working with you.



Solving the Asset Management Paradox with Demand-Driven Maintenance Budgeting

Colemann O'Malley and Drew Troyer, CRE

Asset management has a paradox. When demand for plant production is high, we do not always have the asset reliability on tap to deliver when the customer rings the bell. This causes us to miss out on sales and can significantly erode profits when reactive maintenance costs rise in an effort to deliver the demanded production. The reason is that product demand, asset reliability and investments in reliability are out of phase, which creates a “cycle of despair” for many organizations (Figure 1).

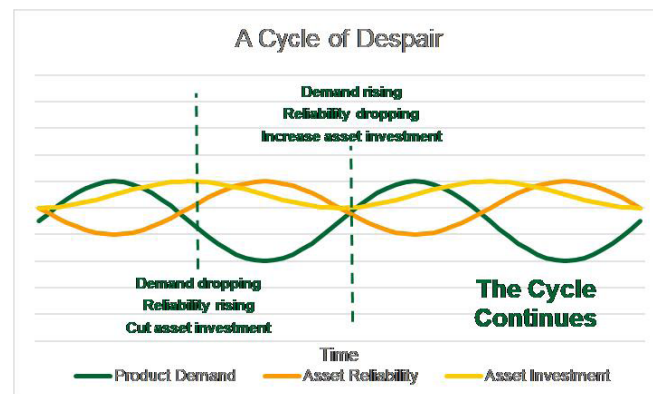


Figure 1 - The asset management cycle of despair.

Let's explore this concept further. Production demand drives the majority of decisions in most organizations. When the demand is high and profits are good, nobody thinks twice about spending money on equipment maintenance. However, when demand drops and profits are tight, managers naturally look for ways to reduce costs by reducing or postponing maintenance tasks.

Maintenance is a typical target because asset reliability is no longer a priority when the plant is not in a sold-out condition. Unfortunately, investments in improving asset reliability and the realized asset reliability on the plant floor are “out of phase.” In other words, an investment in asset management today yields asset reliability at some point in the future. The reasons for this

Production demand drives the majority of decisions in most organizations. When the demand is high and profits are good, nobody thinks twice about spending money on equipment maintenance. However, when demand drops and profits are tight, managers naturally look for ways to reduce costs by reducing or postponing maintenance tasks.

lie in the physics of failure. If you defer preventive maintenance costs today, you save the money today, but you are investing in tomorrow's failure. A good rule of thumb is that it takes about two or three years to really see asset reliability improvements that are a byproduct of current asset investments.

In the “Cycle of Despair” depicted in Figure 1, when demand for our product is rising, we are cash rich and we invest in asset reliability, but the reliability improvements are slow to come because of the aforementioned lag. Just as asset reliability is beginning to peak, demand starts to drop, asset reliability is no longer a premium and the company, often in desperation or event survival mode, cuts its investment in the assets. As a result, we have the greatest asset reliability when it is needed the least and the lowest asset reliability when it is needed the most – just the opposite of our desired state. What's the answer? The solution is demand-driven maintenance budgeting that adapts the maintenance budget to market conditions while also minimizing operational risk to the organization.

Risks of a Variable Maintenance Budgeting

The manner in which organizations create the maintenance budget is often very casual. In many instances, this year's budget is simply last year's budget plus some percentage of budget increase. The casual observer might conclude that we can simply index maintenance costs to production levels – if we only need 80% of the production that we sold last year, we should only need 80% of the maintenance costs that we spent last year – right? Not at all.

Reducing maintenance cost generally requires reducing the number of tasks that are completed. Usually, this means reducing preventive maintenance tasks to inspect, monitor, clean, lubricate, adjust and, where appropriate, carry out time-based rebuilds or replacements. Arbitrary cutbacks in maintenance

create two major risks for the organization. First, when we cancel or defer maintenance, particularly proactive and preventive maintenance, the condition of the asset degrades with time. So, when the customer rings the bell and demand for the plant's production increases, the asset reliability is not on tap to deliver. Maintenance tasks are often deferred based on cost to the site, rather than benefit or risk, so our maintenance dollars are not spent as wisely as they could be. This results in our site risk increasing well beyond acceptable levels in just a few years, which can even result in extended and over-budget shutdowns to restore degraded equipment to maintainable conditions.

Another perhaps more insidious risk is so-called "corporate amnesia." As the term suggests, corporate amnesia occurs when a company forgets how to run its business. Most organizations depend upon the knowledge and know-how that resides tacitly inside of the minds of its workers. When we cut maintenance, we either reduce costs for materials or labor. Labor is further subdivided into permanent employees, nested contractors and on-demand contractors. If cutbacks in maintenance cause us to lose permanent employees through lay-offs or early retirements, corporate amnesia can set in. We also experience corporate amnesia when long nested contractors are let go. Because labor is the primary component of the majority of the preventive and predictive tasks that we eliminate, defer, or alter the frequency, corporate amnesia is a real risk. It is time consuming and costly to relearn how to run your business through a series of trial and error activities, especially when your business is preparing for an upswing in sales and profits.

Downmarket Maintenance Drivers

It would be great if maintenance spend could be proportionately pegged to product demand in real time to adapt to downmarket conditions, but it is not that simple. The reasons are that there are many varied drivers that require maintenance in a downmarket. Failure to prioritize these tasks leaves us with an unreliable plant that we cannot ramp up when demand for the plant's products increases. Here are some of the primary downmarket maintenance drivers:

- Keep the lights on tasks – They are tasks that must be performed just to be able to produce any volume of plant output.
- License to operate tasks – These are tasks that are driven by regulatory compliance. In some instances, the interval of some regulatory tasks can be increased, but you must be sure that you remain in compliance.
- Hours/cycles/miles-based tasks – Some tasks are hours/cycles/miles-based. For instance, the interval for greasing an electric motor, performing certain inspection and condition monitoring routes, etc., can be extended if the nature of the plant and its production allow for dropping a certain number of production days or shifts, but they still must be done. This is not possible for all manufacturing or process production plants.

In many instances, start-stop operations places more stress on the assets than continuous operations.

- Stress/strength tasks – In some process and manufacturing plants, we continue to run continuously, but at a lower rate. The casual observer might conclude that since we are placing less stress on the equipment, it requires less maintenance. In many instances, that is the case, but running at a reduced rate increases stress for some machines and can reduce energy efficiency for others.
- Mothball/idle tasks – In other circumstances, the organization may mothball or idle a production line or even an entire plant. Again, the casual observer might conclude that we can simply eliminate maintenance for the mothballed and idled assets. Again, that is not really the case. In the physics of failure, there are certain failure mechanisms that are dynamic in nature and some that are static in nature. The most common static mechanisms are rust and corrosion and fretting. A mothballed or idled plant requires an entirely different maintenance plan than an operating plant.

Upmarket Maintenance Drivers

One of the most important outcomes of the proper management of plant assets during downmarket cycles is that it allows us to respond to upmarket conditions without the lag experienced by our competitors. When an increase in plant utilization is required to meet new demand, equipment is placed under new stresses and requires increased investment to maintain reliability. A focus on condition-based preventive maintenance will result in a predictable and manageable increase in maintenance costs, and can help to synchronize our maintenance budget with our demand.

- Commissioning tasks – After assets are mothballed or idled, many will require extensive recommissioning tasks prior to returning to service. These are often one-time investments, but must be appropriately planned and budgeted well in advance of the expected return to service date. These tasks should be accounted for prior to idling any asset in a downmarket if conditions are expected to change.
- Hours/cycles/miles-based tasks – The same tasks that were extended based on dropping a certain number of production days or shifts now need to be re-evaluated based on the new production cycles. As discussed, this may even reduce stress on certain equipment where continuous operations reduce the stress experienced by the assets. Other equipment will require an increase in maintenance spend in order to meet new availability targets.
- Stress/strength tasks – When we continue to run continuously but adjust rates to meet demand, certain equipment will experience increased stress. Some equipment may require less frequent tasks, but many assets will require an increase in

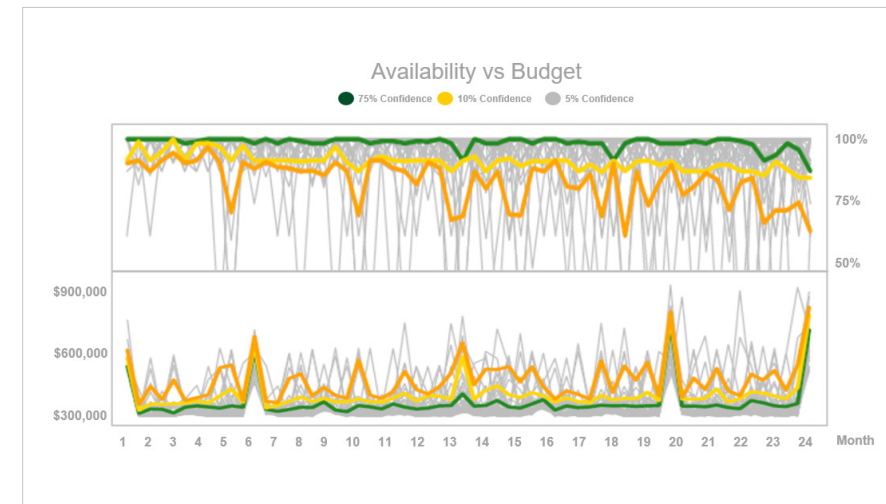


Figure 2 – Simulation of availability vs maintenance cost, showing a lead-lag nature of cost and availability.

budget with increased availability targets. This is especially true for failure modes that are process related, such as erosion related wear patterns.

- Turnarounds/Planned Shutdowns – In many plants, turnaround and shutdown intervals are dependent on production rates. As demand and availability needs increase, planned shutdown intervals and tasks must be re-evaluated and scheduled based on new production rates. Fouling mechanisms are especially dependent on production rates, with many increasing at a non-linear rate with production.

Demand-Driven Application

With so many key drivers in upmarket and downmarket conditions, how realistic is it to adapt our maintenance budget to our availability targets? At an equipment level, this is a straightforward task that can be accomplished largely through RCM-based approaches. Addressing individual failure modes, each with an estimated effect on production, has proven to be effective at minimizing risk and maximizing availability. Compared to a basic maintenance plan, the total investment in our equipment using this approach can be decreased by a drastic reduction in repair costs over several months.

But this is only half of our goal here.

In order to optimize the investment in our assets against our required availability, it is most beneficial to use more advanced analytical techniques. Data provided by tools such as RCM analysis, digital equipment models and online equipment monitoring is enabling a greater level of flexibility and accuracy than previously available to sites. Combined with developments in machine analytics, sites are now capable of performing highly complex optimization algorithms to adjust to both long and short term changes in market or asset conditions.

These simulations show the interactions between site PM strategies and expected availability that are too complex to

be completed with traditional analysis. For example, Figure 2 above shows how expected availability and cost are correlated for a given PM strategy.

This relatively simple optimization reveals a few key insights into how a demand-driven budget drastically increases the flexibility of a site. For any given PM strategy, hundreds or thousands of simulations can be completed to assess the effect on the overall site availability. As our confidence in reaching a target availability increases, so does the required maintenance cost. Likewise, as the target availability increases, so does the required maintenance cost. This allows sites to manipulate several variables in a complex optimization, including target availability, confidence interval, PM strategies and total allowable budget.

Major decisions such as turnarounds/shutdowns and maintenance task deferrals, can be based on data and simulations instead of budget constraints and emotions. As we improve our data collection and analysis methodologies through the adaptation of digital solutions, our optimization continues to grow in both complexity and effectiveness. Our response time to changing market or equipment conditions continues to decrease with more advanced integrated solutions as well, allowing us to forecast more accurately, and respond more efficiently, to the inevitable upsets our plants experience.

Conclusion

Matching maintenance spend to market conditions is challenging and can result in a paradox. During upmarket conditions, when the plant is sold out, there exists a motivation to increase routine maintenance in order to maximize reliability. During downmarket conditions, there exists a motivation to defer maintenance to save costs. Unfortunately, this often results in desynchrony between when we have operational reliability and when we need it. With careful risk analysis and demand-based maintenance budgeting, we can solve the paradox and achieve our objectives to contain costs and deliver production when the customer rings the bell.



Dispatch from Louisville –

The SMRP 27th Annual Conference



First, and foremost, thank you to all those that dedicated their time and energy to make the SMRP 27th Annual Conference a success! With over 1,200 global professionals and practitioners in attendance, SMRP's largest annual event featured four days of world-class education, networking and on-site certification.

This year's conference took place at the Kentucky International Convention Center in Louisville, KY, October 7 – 10, 2019. Over four days, attendees took part in engaging workshops, informational track sessions, vibrant networking events and new business talks on the exhibition floor.

The conference kicked off with a moving keynote address from Aron Ralston, the New York Times best-selling author and inspiration for the major motion picture, "127 Hours," and closed with a spirited panel discussion about the future of maintenance and reliability.

One particular moment that stood out was when a group of students from Trinity High School's Engineering and Biotechnology program toured the conference. The students received hands-on demonstrations of various forms of non-destructive testing, and were amazed at the intricacy and accuracy of monitoring technology. One student mentioned, "I didn't know that such small measurements could cause big problems and downtime." As we continue to look toward closing the skills gap, moments such as this on the exhibit floor are just part of the small steps SMRP is taking to ensure there is a next generation of maintenance, reliability and asset management professionals.

The SMRP Annual Conference has long been known for its engaging and informative workshops, track sessions and networking events – and this year was no different. Thank you to the sponsors, exhibitors, presenters, speakers, attendees and staff who made this event possible. We look forward to seeing you in Columbus, OH next year!

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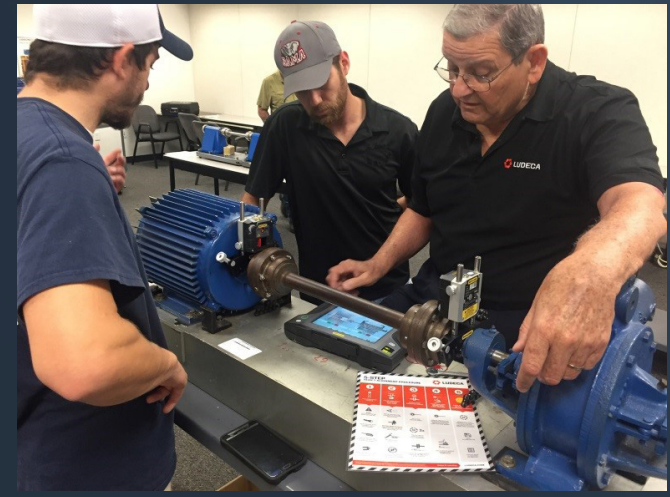
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IN THE SPOTLIGHT

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