

The Cost of Oil & Gas Equipment Mismanagement

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The days of unabashed and frivolous capital expenditures are over. Companies depend on maintenance managers to ensure that investments like top drives, mixers, pump and cement trucks operate more efficiently and last longer than ever before. However, these challenges are just the beginning of their concerns. Maintenance managers face many operational challenges on a daily basis, including machine repair costs, machine replacement costs, worker safety concerns, aging equipment, and aging just-in-time inventory that sits in the corner *if* failures occur. Although maintenance managers implement an assortment of maintenance techniques, known as the maintenance mix, often times more advanced maintenance techniques are saved for only the most critical of assets because of up-front costs.

Maintenance managers most commonly rely on a regularly-scheduled (preventative) maintenance program. This is a practice we have all subscribed to in our everyday lives, as well: from brushing our teeth each day to changing our vehicle's oil every three months, we have all been conditioned to follow a regularly scheduled maintenance program to keep things in pristine working order. So it's no surprise that this is the default practice applied to equipment maintenance. A regularly scheduled program is an easy way for maintenance managers to improve uptime and save money on expensive equipment repairs.



A regularly-scheduled, or preventative, maintenance strategy, in actuality, is one of the worst techniques to keep equipment working properly

But with a preventative maintenance approach, maintenance managers can spend much of their time running from one crisis to the next to minimize the effect of equipment failure. And with scrutiny on efficiency and budgets, these managers often feel like they have no resources or time to focus on better, more proactive approaches. It is time to take a step back and take a deep breath. It is time to evaluate a holistic maintenance strategy. It is time adjust our maintenance mix.

A regularly-scheduled, or preventative, maintenance strategy, in actuality, is one of the worst techniques in the maintenance mix to keep stimulation and extraction equipment working properly. The cost of this type of maintenance program is actually more than a strategy in which machines are run to failure. Think of all the wasted time, effort and money spent fixing something that was in perfect working order in the first place. The reverse can also be true; there is a need to fix little problems before they balloon into bigger problems. When detected early, a bearing with a small defect can result in a quick and easy fix, but if left unchecked, it can cause much bigger problems later. Fortunately, there is a better way to detect and repair small problems **before** they grow into costly catastrophes, all without unnecessary or excessive tinkering with the equipment.

1. Bigger Than You Think

This problem is bigger than you might think. It is not restricted to oil & gas applications but can be found in almost all applications with critical equipment. The Electric Power Research Institute (EPRI) has calculated comparative maintenance costs for different maintenance techniques in US dollars per horsepower (HP) per year. Researchers found that a scheduled maintenance strategy is the most expensive to run at \$24.00 per HP. A reactive maintenance (run-to-failure) strategy is the second most costly at \$17.00 per HP, but has the additional cost of compromising safety. Drawing a parallel to pumps used within oilfield stimulation, maintaining a 1,500 HP motor with a scheduled maintenance strategy would cost approximately \$36,000 per year, while a reactive maintenance strategy would cost \$25,500 per year, according the EPRI study. That cost might not seem like much, but when

multiplied by the number of rigs across the entire fleet (1,500), the cost skyrockets to \$54M per year for a scheduled maintenance plan and \$38M for the reactive strategy. As these numbers start to add up, it's easy to see why equipment maintenance is such an important topic. In fact, according to Forbes Magazine "one out of every three dollars spent on preventative [or schedule based] maintenance is wasted." Looking at the maintenance costs of large assets across a fleet can start to give us an understanding of the cost of equipment maintenance, but it only begins to tell the story of the true cost of equipment *mismanagement*.



When multiplied by the number of assets across an entire fleet, maintenance costs skyrocket to \$54M per year for a scheduled maintenance plan and \$38M for a reactive strategy

To identify the true cost of equipment mismanagement, take a closer look at the issue. There are many costs associated with maintaining a pump, such as a yearly cost of \$36,000 or the capital costs of a new triplex or quintaplex pump, which can be upwards of \$350,000. Also, there are hidden costs of unplanned purchases and associated operational costs. For example, according to a study conducted by the Corporate Executive Board, an unplanned purchase of a \$17 fan will end up costing closer to \$117 when operational and logistical costs are taken into account. But these losses pale in comparison to the true loss of a machine going down, which is loss in production. In oil and gas, equipment uptime is directly correlated to the company's bottom line. So when drilling stops at a well site, virtually all cash flow associated with the well stops. This is further compounded when you consider operational costs for fracturing crews on-site. At risk is not only money, but also jobs and reputations. And the same can be said for downstream rotating equipment. Reliability, therefore, is critical. So much so, that it is a standard practice for companies to have several backup equipment trucks onsite that may or may not be needed, because they have no idea if their pump is about to fail -- even if the pump was just serviced. There has to be a better way than just hoping machinery doesn't go down and having backups just in case it does.

2. A Better Approach?

In the same EPRI study mentioned above, researchers identified a much more reliable strategy. They found that a predictive maintenance strategy is the most cost-effective at only \$9.00 per HP and all but eliminates the risks of secondary damage from catastrophic failures. By using a predictive maintenance strategy, operations and maintenance managers can have the insight to determine when their machines will fail and have enough advanced notice to make the necessary preparations to fix the problem with as little downtime as possible. On the surface, this seems like the optimal approach with no downside. The company can save money on maintenance and ensure longer uptime.

Several factors, however, keep companies from adopting and enjoying the benefits of such a predictive maintenance strategy. These shortcomings are primarily associated with the traditional approaches that have been used to implement predictive maintenance strategies, not with predictive maintenance itself. These two traditional approaches are (1) a complete end-to-end automated solution that covers everything from the site survey to installation to remote monitoring and (2) a manual route-based solution where technicians and experts regularly visit each asset to collect measurements, and then return back to perform the analysis.



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3. The Traditional Approach

To understand the issues surrounding the two techniques, think of equipment health as analogous to our own health. Visiting the doctor for a yearly physical is a common way to assess your overall wellness and to predict future health issues. Imagine you go to your doctor's office and, after sitting in the waiting room for half an hour, you finally see the doctor who checks your temperature and only your temperature. To be thorough, he checks the temperature at multiple locations on your body and gives you a diagnosis of good health. With no other conversation, he sends you on your way -- after you have already paid, of course. In this scenario, everything seems viscerally wrong from a healthcare standpoint. But this is the exact approach many companies take with machine health. They outfit their machines with only accelerometers and use only vibration to monitor the machine's health, similar to the doctor only checking your temperature as an indicator of your overall health. Although this is a great indicator of wellness, it is not the only one. The practice of using a limited number of diagnostic tools is a problem for both traditional methods -- manual route-based and automated. The two approaches fall short, either because of the route-based technician's lack of expertise to measure and analyze other sensors, or the measurement platform's lack of flexibility in integrating or expanding to new or custom sensors.



Your physical was inconclusive and your time and money was wasted

Now back to the doctor analogy. You decide to do your due diligence and ensure that you actually are in good health. You continue your physical evaluation by visiting another doctor who can measure your blood pressure and cholesterol. Again, you have to pay this doctor and the only thing you receive is a diagnosis based on the narrow scope of your blood pressure and cholesterol. As silly as it sounds, this mimics the real-world approach to traditional machine health assessments. Maintenance managers try to give their machines a more complete health diagnosis but are left with a less than holistic machine health assessment. This is a result of disparate monitoring systems being cobbled together to take the measurements. In the end, just like the case of going to separate doctors, this makes it costly and difficult to scale a monitoring solution across all assets because of the high up-front costs of the initial system, the cost of adding on subsequent systems and then integrating everything together.

On the opposite end of the spectrum, companies can perform manual measurement rounds, which are less expensive in theory, but, in reality, cannot be scaled to cover a large number of assets. The technical prowess required to take and analyze measurements coupled with an aging workforce prevent companies from solving the problem by indiscriminately placing more people on it. Even if this weren't the case, there are no economies of scale to be gained with this method. Monitoring five times more assets would result in five times the cost and even more logistics. Thirty people performing 60,000 rounds per month to

cover 2,000 assets could suddenly become 150 people performing 300,000 rounds per month to cover 10,000 assets. Why? Because people don't scale. Adding different sensors results in even more people, because of the expertise needed for the different measurement specialties. The very nature of this work becomes incredibly inefficient. Specialists can spend up to 80 percent of their time manually collecting the data with only 20 percent of their time left to actively analyze the data and uncover root-cause issues that prevent costly repairs in the future. And because it's manually collected by a variety of people, there is the potential for dirty, disparate data.

To conclude our analogy, remember that the ultimate goal of this whole journey is to gain a holistic view of your overall health. After visiting multiple doctors and gathering multiple diagnoses you would be frustrated, to say the least. Each doctor used a separate tool to assess your health and the ability to integrate all of your health data did not exist. As a result, you would not have a holistic or accurate assessment of your health because the doctors couldn't be brought together to communicate their findings and give an accurate diagnosis. Added all together, your physical was inconclusive and your time and money was wasted. This wouldn't be because the doctors didn't want to deliver a conclusive review of your overall health, but rather that they are limited by their roles, their instrumentation and their ability to communicate the data with each other or you, the patient. When dealing with separate monitoring systems (and sometimes manually entered data) this is all too often the case. Not only do the systems not talk very well with one another and the enterprise, but there also isn't an option for you to perform your own analysis because there is no access to raw data.



There needs to be a better approach to condition monitoring

Overall, traditional approaches present problems in four main areas:

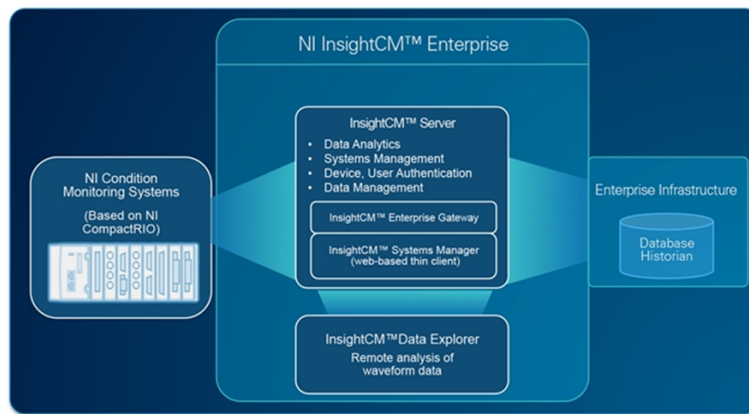
- **Flexibility** – Integration with a multitude of sensors
- **Scalability** – Financial and logistical possibilities to expand to cover all assets
- **Accessibility** – Raw data that can be easily integrated and analyzed on an enterprise level
- **Cost** – Capital expenditures of the end-to-end solution.

There needs to be a better approach to condition monitoring. It should provide a holistic view into the health of the machine, be cost-effective enough to be applied to more assets, and be flexible enough to evolve with new sensors and techniques for machine monitoring.

4. A New Way Forward

Fortunately, there is a new way forward that takes a platform-based approach to condition monitoring and helps you to regain control of your maintenance mix. To overcome the challenges that the traditional maintenance mix presents, this platform must deliver:

- The flexibility of the solution to scale with your evolving needs, such as support for new types of algorithms, support for a wide variety of I/O and emerging sensors, and the ability to scale to large numbers of systems
- An openness that allows you to gain access to the raw engineering measurements to adapt to new and innovative analysis techniques and extend the solution to meet your maintenance program requirements
- Interoperability with third-party hardware and software packages so that you can integrate with existing CMMS and ERP systems and any database historians or process management enterprise software used
- Rugged mechanicals and a breadth of available algorithms
- A monitoring hardware and software solution for a price that allows you to scale your online condition monitoring solution to cover the bulk of your rotating machinery assets
- The services to help facilitate your end-to-end solution from your asset to your IT infrastructure, either directly or through a network of partners



There is a new way forward that takes a platform-based approach to condition monitoring and helps you to regain control of your maintenance mix.

NI InsightCM™ Enterprise is a solution to this dilemma. This ready-to-run integrated hardware and software solution for online condition monitoring helps companies gain insight and improve operations and maintenance programs by understanding the health of rotating machinery. This extensible suite acquires and analyzes measurements, generates alarms, gives you the ability to visualize and manage data and results, and simplifies remote management for large numbers of monitoring systems. NI InsightCM Enterprise offers:

- Built-in analytics and alarming capabilities, and remote interactive visualization of waveform data
- Scalability to hundreds of acquisition devices per server
- Support for vibration and process measurements using integrated hardware options
- Remote management of monitoring systems and users
- IT-friendly security features that include user and device authentication

With these new solutions, it's time to regain control of your maintenance mix and proactively manage your equipment.

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[Discuss your maintenance mix with a local field engineer](#)