ASSET MANAGEMENT: THE CHANGING LANDSCAPE OF PREDICTIVE MAINTENANCE

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Report Highlights

This research report, based on responses from 149 executives, will take a year-over-year (2012 to 2013) look at how leading companies use data and analytics to manage the reliability and maintenance of their asset base.

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"We need to predict failure, not just respond to it. Our maintenance program is expensive and it is set to standards based on manufacturing recommendations versus actual experience."

~ Production Manager, Large Utilities Company

As seen in Aberdeen's December 2012 report, *Asset Management: Building the Business Case for the Executive*, lingering uncertainty around an economic recovery is keeping capital and operational budgets tight. Indeed, companies are pressured more than usual to get the most out of their current asset base. To overcome this, many companies use specific capabilities and technologies to predict equipment or asset failure so they can avoid costly downtime while reducing maintenance costs. This research report, based on responses from 149 executives, will take a year-over-year (2012 to 2013) look at how leading companies use data and analytics to manage the reliability and maintenance of their asset base. While the majority of respondents are manufacturing companies, asset management, and the use of analytics for asset management, is also a strategy and process for other industries, including power generation, automotive, telecom, Government, IT management, etc. The study also reinforces that predictive asset management must also take into account not just the asset itself, but the environment around the asset.

Business Context

Given the current economic climate, complexity of business processes, and unstable customer demand, executives in asset-intensive industries must make rapid and difficult business and operational decisions. To remain competitive, companies seek out new ways to get the most out of their assets, assure their assets stay online, and plan for unexpected failures. In fact, when asked about which risks had the biggest impact on operations, survey respondents from Aberdeen's 2013 Asset Management study indicated that failure of critical assets is again the top concern (see sidebar). In fact the top three risks have not changed noticeably from 2012 to 2013. However there is some movement as you move further down, with talent

Top risks that have the largest impact on the organization (2013 vs. 2012)

- Failure of Critical Assets: **40% vs. 40%**
- Non-Compliance: **39% vs. 34%**
- Product Failures: **38% vs. 34%**
- Supplier Quality: **25% vs. 28%**
- Failure to Acquire and Retain Talent: **25% vs. 14%**
- Logistic Risks: **14% vs. 22%**

acquisition and retention taking the place of logistic risks. This talent issue is a growing concern and something manufacturers cannot take lightly.

The challenges for managing asset lifecycle and maintenance are different depending on the asset. For a company commissioning a new piece of equipment, the challenge may be bringing the asset online quickly after acceptance. For complex asset-based industries, it may be related to tool and process qualification. For a running facility, it is maximizing asset effectiveness, availability, and reliability, while for other enterprises it may be related to asset decommissioning. These are compounded by ongoing challenges coming with a retiring workforce, an aging infrastructure, safety considerations, and compliance to regulations, among others.

> "The largest challenge by far has been cultural inertia in what has been traditionally a highly reactive approach. At sites that have done the changes, we have increased capacity utilization by about 20%, decreased maintenance costs 25%, and reduced spare part inventory by 20%."
>
> ~ Raymond Castle, Manufacturing Manager, Global Reliability Engineering

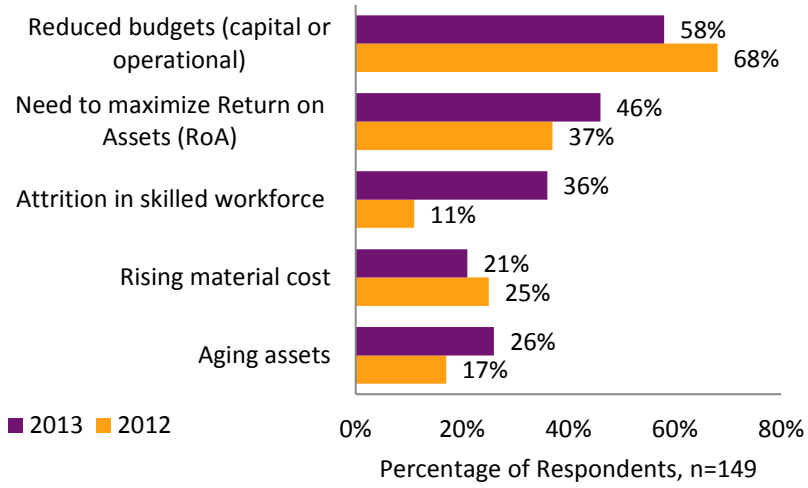
Given these complexities, companies need innovative ways to keep their assets operating as intended. Predictive maintenance is an approach that allows maintenance, quality, and operational decision makers to predict when an asset needs maintenance, which changes unplanned downtime into a planned stop and avoids costly disruptions. Predictive maintenance typically includes collecting information on things like usage, wear, and other asset condition readings from many disparate sources. The purpose of this study is to highlight the capabilities of companies that successfully optimize operations and maintenance processes. We will also look into the role software plays in providing the right information to the appropriate decision makers, which results in predicting asset failures.

A Changing Manufacturing Environment

Economic uncertainty has forced companies to put the brakes on spending, which is reflected in held-up capital expenditures

and lowered operational budgets in order to maintain operating income (Figure 1). Although there has been a 10% drop from 2012 this is still the overwhelming top pressure. This can mean delayed or altogether eliminated investments in new assets. Such an environment puts additional pressure on maintenance groups to get more out of their existing asset base and maximize Return on Asset (RoA).

Figure 1: Year-over-Year Comparison of Pressures Driving Focus on Asset Management



Source: Aberdeen Group, December 2013

Any increase on RoA will help alleviate the pressure of reduced budgets. When companies can effectively manage their assets and use their precious budgets to improve operations, they are at a competitive advantage. Where the real differences show up is in the attrition in skilled workforce and aging assets. Attrition in the skilled workforce was identified by 36% of respondents, when you consider that in 2012 it was only 11% of all respondents that is shockingly high increase. This will only increase as more and more Baby Boomers retire. Compounding the issue is the fact that the asset infrastructure is aging as well,

making it more difficult to keep assets productive. A predictive maintenance approach will help address all of those top pressures by reducing costs, lowering the need for new investments, limiting and optimizing labor demands, and subsequently improving return on assets.

Maturity Class Framework

Aberdeen used four key performance criteria to distinguish Best-in-Class performance. These metrics measure the success of an organization's asset management not only in terms of how it improved plant efficiency, but also how successful these programs are for achieving financial goals.

Respondents were divided into three categories based on their aggregate performance in these five metrics: the top 20% of performers (Best-in-Class), the middle 50% (Industry Average), and the bottom 30% of performers (Laggards) (Table 1).

Table I: Top Performers Earn Best-in-Class Status

Definition of Maturity Class	Mean Class Performance
Best-in-Class: Top 20% of aggregate performance scorers	3.5% Unscheduled Asset Downtime 89% Overall Equipment Effectiveness (OEE) +24% Return on Assets (RoA) vs. Corporate Plan -13% Reduction in Maintenance Costs
Industry Average: Middle 50% of aggregate performance scorers	8.3% Unscheduled Asset Downtime 83% Overall Equipment Effectiveness (OEE) +4% Return on Assets (RoA) vs. Corporate Plan -4% Reduction in Maintenance Costs
Laggard: Bottom 30% of aggregate performance scorers	16.9% Unscheduled Asset Downtime 69% Overall Equipment Effectiveness (OEE) -7% Return on Assets (RoA) vs. Corporate Plan +1% Increase in Maintenance Costs

Source: Aberdeen Group, December 2013

Metric Descriptions

Unscheduled Downtime –Amount of unscheduled time the asset is offline against total availability

OEE – Multiplication of availability times performance times quality

Maintenance Cost – Year-over-year change in total maintenance costs

RoA – Percentage of return on asset (new income/total asset) goal achieved versus corporate goal

Steps to Achieving Best-in-Class

- ➔ Use analytics
- ➔ Close the talent gap
- ➔ Combine sustainability and maintenance

These metrics show that even in the face of reduced operational budgets the Best-in-Class save money by reducing maintenance costs and improving productivity. The superior performance on those three metrics is evident in the improved return on assets. In fact, the Best-in-Class outperform their corporate return-on-asset expectations by 20%.

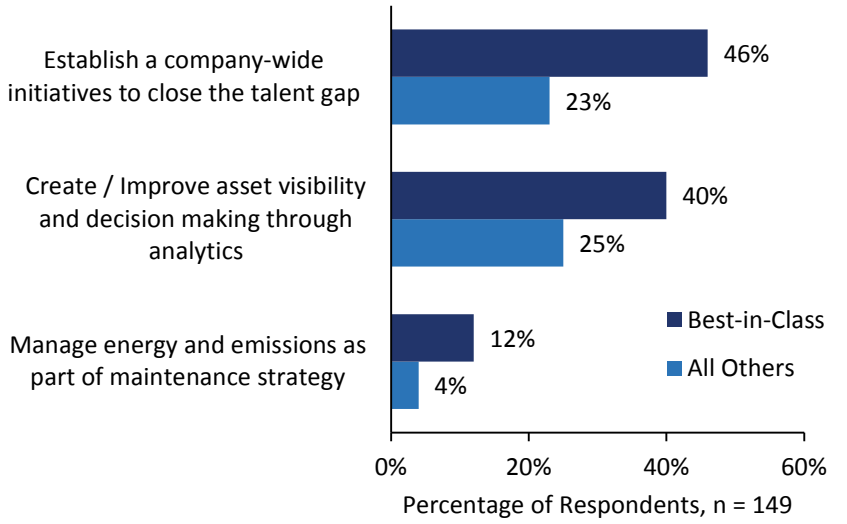
Strategic Actions

To truly maximize return on assets, the Best-in-Class implemented three strategic actions (Figure 2). First, they use analytics to improve visibility and decision making, which has actually grown in adoption by the Best-in-Class, increasing from 25% in 2012. This allows these companies to predict their maintenance and safety, reduce the overall risk in their operations, and even forecast the eventual replacement need of an existing asset and plan the necessary budget well in advance. As the asset moves through different phases, it is managed by employees in different groups, which include project planners, engineering teams, maintenance, operations, etc. To account for this, Best-in-Class companies establish strategies, as shown in Figure 2, to provide visibility into information collected across these different lifecycle stages to all employees, enabling them to make intelligent decisions.

Additionally, because the Best-in-Class are able to accurately predict when maintenance is needed, they are also more likely to outsource parts of their maintenance activities to a third party. While this is still a Best-in-Class action, as it was in 2012, the initiative to close the talent gap has risen to the top, which is the second action that the Best-in-Class undertake. The talent gap was not an issue identified in 2012 (only 11% of respondents), but now that over a third of manufacturers are seeing the effect it has on their operations, various steps are being undertaken. Actions like cross-training, standard

operating procedure (SOP), and knowledge management systems are being implemented. Predictive Maintenance is another effective plan to address this issue, since maintenance is only performed when warranted; the demand from maintenance personnel is limited.

Figure 2: Strategic Actions



Source: Aberdeen Group, December 2013

"Culturally, a majority of the workforce has only operated through the growth period. Now they have to adapt to extracting value from the previous capital investment."

~ General Manager, Large Global Resources Company

Aberdeen's *Asset Management: Building the Business Case for the Executive* report revealed that the Best-in-Class are much more likely to incorporate sustainability into their maintenance strategy that still holds true for 2013, and is the third and final step for the Best-in-Class. By managing their energy and emissions, the Best-in-Class not only reduce their operational costs but also put themselves in a better position to comply with future regulations. Another benefit with including sustainability in the maintenance strategy is that it can be leveraged as additional asset-performance monitoring. If an asset consumes energy or emits emissions outside its normal range, managers can use this information to perform needed maintenance.

Establishing Predictive Business Capabilities

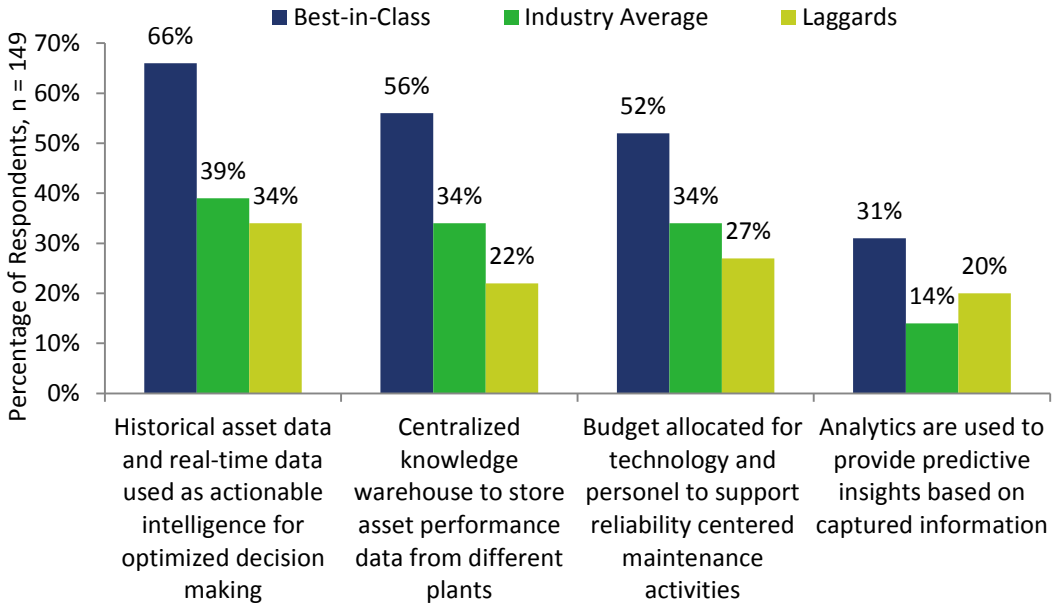
One of the main goals of asset-intensive companies is to minimize unscheduled asset downtime. A strategy to achieve this goal is by managing assets and maintenance predictively. Predictive maintenance and asset decisions require that the right decision maker have timely access to information in the right form. Best-in-Class companies use the data they collect more effectively, and turn the data into actionable intelligence (Figure 3). Figure 3 also highlights that the capabilities needed for a Best-in-Class asset management process also hinge not just on predictive analytics, but a business intelligence process as well.

Instead of collecting critical asset data and storing it in siloed systems (like spreadsheets and isolated databases), Best-in-Class companies collect and store the data in a centralized location, which lets them ensure the quality and consistency of asset data across their enterprise. In order to make the best decisions, the Best-in-Class provide real-time as well as historical data to key decision makers for predictive decisions. In doing so, the Best-in-Class are able to detect any anomalies and failure patterns to identify the assets that are at the greatest risk. Predictive analytics uses statistical and data mining techniques to derive forward looking intelligence from vast amounts of historical data. Predictive analytics, in combination with business intelligence, is a more proactive approach, and relies on determining correlations between variables from past events and then using that information to predict future results. The use of predictive analytics and business intelligence is essential for a company to be successful in their predictive maintenance endeavors.

2012 Best-in-Class adoption rate of predictive capabilities

- Historical asset data and real-time data used as actionable intelligence for optimized decision making: **76%**
- Centralized knowledge warehouse to store asset performance data from different plants: **65%**
- Budget allocated for technology and personnel to support reliability centered maintenance activities: **62%**

Figure 3: Business Capabilities



Source: Aberdeen Group, December 2013

To ensure that issues are addressed in a timely manner, the Best-in-Class have also established roles and responsibilities for all levels of the organization in the case of an adverse event. This step helps companies adopt a predictive maintenance culture and deploy teams to continually improve processes for reliability and condition-based maintenance programs.

"Asset management programs are often supported by inadequate tools used by people without the correct culture and approach. As a result, it often happens that we don't know the boat we're sitting on."

~ Stefano Papini, Large Industrial Equipment Manufacturer

Leveraging Sustainability Data

The previous section discussed how the Best-in-Class are managing their energy and emissions as part of their maintenance strategy. In this section we will uncover the supporting business capabilities needed to ensure the success of this initiative (Table 2).

Best-in-Class companies integrate their energy management program with their overall asset management program. This means that they implement strategies and technology to collect

energy, emissions, and asset data in a single repository and provide this information to key decision makers for these types of decisions. The gap between the Best-in-Class and their peers in having this integration has actually grown, going from 31% more likely in 2012 to 92% more likely in 2013.This gives the Best-in-Class visibility into any anomalies within their asset base and alerts them if the asset is running at unacceptable performance thresholds.

Table 2: Sustainability Capabilities

Capability	Best-in-Class	Industry Average	Laggards
Visibility into anomalies when assets exceed acceptable performance thresholds	58%	43%	31%
Asset data utilized to minimize energy consumption	54%	28%	21%
Benchmark the performance of each asset to determine the cost of maintaining it at its current energy consumption levels versus replacing it with a newer, more energy efficient asset.	51%	34%	15%
Energy management integrated with overall asset management strategy	46%	28%	15%

Source: Aberdeen Group, December 2013

Best-in-Class companies are also more likely to benchmark the performance of each asset to determine the cost of maintaining versus replacing it. For example, if a motor uses more energy than expected, with the available data, maintenance managers can schedule maintenance to diagnose and fix the problem. This capability will allow companies not only to reduce energy consumption but also to improve operational metrics.

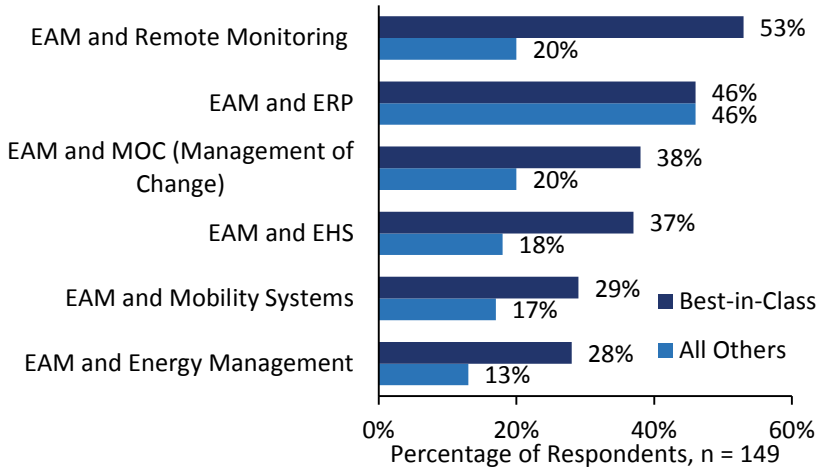
Technology Enablers

The Best-in-Class invest in technology solutions to automate their business processes as well as their capabilities. They are

also more likely than their competitors to invest in an Enterprise Asset Management (EAM) solution. An EAM system provides a single platform for connecting workers, assets, processes, knowledge, and decision-making capabilities based on collected information. Predictive analytics builds on these investments in EAM systems by merging historical data from controllers, sub-meters, data historians, and paper-based systems with real-time data to predict potential asset failures. All of which aids the move from reactive to proactive maintenance.

By integrating their EAM system with other high-level business systems, such as ERP (Figure 4), the Best-in-Class receive vital information faster and as a result make maintenance and asset-related decisions quicker. An integrated solution offers enterprise-wide visibility into the complete asset lifecycle, from the design phase to final asset decommissioning.

Figure 4: Interoperability between Enterprise Systems



Source: Aberdeen Group, December 2013

One area of interoperability that has grown rapidly from 2012 to 2013 is in remote monitoring (39% of Best-in-Class in 2012, 53% in 2013). This solution provides functionalities that enable employees with critical capabilities such as the ability to

Remote monitoring solutions enables visibility into equipment that may be in an unsafe operating environment with extreme temperatures, such as drilling in the mining industry or the exploration and production sector in the upstream oil industry.

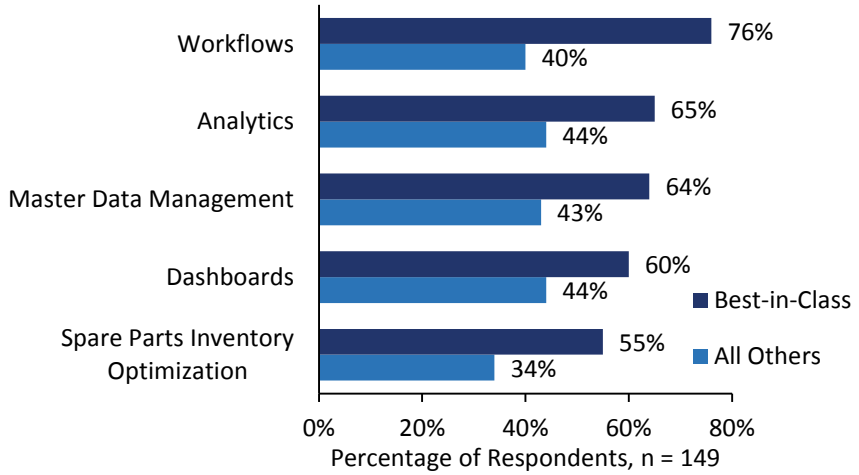
"The knowledge and resources needed for creating or maintaining a mechanical integrity / reliability program is significant. Starting "small" helps build the knowledge, but resources seem to always be a constraint."

~ Production Staff, Medium Bulk Chemicals Manufacturer

remotely turn the assets on or off, forecast future failures, monitor asset usage information, and regulate power usage. This increased integration between systems is most likely tied to two reasons, the limited workforce that is available for most manufacturers and increased use of remote assets. Integrating these two solutions allows Best-in-Class companies to more easily collect and monitor asset data at the equipment level and use that data to make predictive maintenance decisions with limited employee involvement.

In addition to enterprise solutions, Aberdeen also analyzed specific modules or technology enablers that differentiate Best-in-Class performance (Figure 5).

Figure 5: Technology Enablers



Source: Aberdeen Group, December 2013

Asset information can be collected in multiple formats and types of data, from structured to unstructured or semi-structured data, in combination. This plethora of information means that organization end up analyzing a mix of data (i.e., information coming from spreadsheets, data historians, valves, control systems, enterprise systems), which could prove to be a waste of time and resources. To overcome this challenge, the Best-in-

Class use Master Data Management (MDM) to scrub out incorrect or duplicated data, and make sure that information is standardized. This ensures the data they collect is accurate and reliable, which is vital for proper decision-making.

The Best-in-Class supplement this solution with an analytics platform. Once a company has standardized the way information is collected, the next piece is wrapping intelligence around the information with the use of analytics. Analytics provide decision makers with intelligence around when and where a problem may occur, but more importantly, how to resolve the issue. While the top overall enablers have not changed from 2012 to 2013, the order of highest use has. The use of workflows is now the top enabler, which again can be tied into the attrition of skilled workers manufacturers are dealing with. The combination of asset analytics, workflows, and dashboarding modules automates data collection, analyzes and monitors data, and escalates events to the appropriate decision makers at the right time, in the right format, to prevent or reduce the impact of equipment failure. These applications summarize data from multiple business units and enable organizations to plan out their maintenance (workers and/or spare parts) more efficiently, which is critical when you are dealing with understaffed or inexperienced maintenance team.

2012 Best-in-Class adoption rate of enablers

- Master Data Management: **72%**
- Analytics: **65%**
- Workflows: **63%**
- Dashboards: **58%**
- Spare Parts Inventory Optimization: **42%**

In addition, the Best-in-Class have grown in their use spare parts inventory optimization applications in 2013. Automating this inventory can help companies effectively manage spare parts, resulting in lower inventory cost and ensuring that the right parts are available during asset breakdown, thus minimizing asset downtime. Providing maintenance personnel with visibility into spare parts lets them know when inventory is low and when new parts should be ordered. All it takes is for one critical asset to fail for an entire assembly line to come to a halt. It could take

days, or even weeks, for a replacement to be shipped to get the operation back online. The Best-in-Class avoid such a scenario by gaining real-time access into their fill-rates, stock out rates, inventory accuracy, and shelf turns.

All of the enablers combine to help provide a platform to improve not only asset uptime, but also improve the quality of the product or service delivered. Being able to predict asset performance related to maintenance also provides the same platform for predicting an asset's overall ability to produce a quality part or level of service.

Key Takeaways

Predictive maintenance affects the entire organization. If an asset is malfunctioning it can lead to poor quality parts, which in turn, can increase warranty returns and reduce customer satisfaction. Also, by predicting asset failure, Finance can be informed ahead of time to improve their planning and budgeting or S&OP processes. Additionally, spare parts inventory and employee or operator workload can be optimized, which as was shown, is a growing concern. All of these actions affect the bottom line of the company. Aberdeen's *Asset Management: Building the Business Case for the Executive* research shows how companies move beyond just monitoring assets and have started embedding analytics and intelligence into the decision making process. Organizations looking to go from break-fix maintenance to a predictive maintenance strategy should incorporate the following recommendations:

- **Provide centralized, real-time data.** Adopting predictive maintenance can be a complicated task. The key to success is access to the right data at the right time in the right form. The Best-in-Class do so by collecting all the key information into a centralized database and

providing it to key decision makers in an on-demand fashion. This enables managers to avoid unplanned downtime, plan maintenance before an asset breaks down and increase overall plant availability.

- **Utilize predictive analytics to make educated decisions about future events.** The amount of asset-related data that is generated and collected is only increasing. Maintenance and reliability personnel need an easy way to drill down into this information to find any abnormal operating conditions so they can predict asset failure. Predictive analytics will help reduce the overwhelming load of real-time events and automate the monitoring and analysis of critical indicators that impact performance.

- **Provide integration between business systems.** Having a holistic view is vital to effectively manage asset maintenance. Integration allows organizations to connect maintenance applications with plant applications and higher-level business systems more easily. This results in faster reaction to adverse events and the ability to make quick and intelligent asset management and maintenance decisions. This enables companies to move from a reactive maintenance to a predictive maintenance strategy.

- **Prepare for the shortage of skilled workers – it is a legitimate concern and only going to get worse.** Skilled Baby Boomers are reaching retirement age every day. Companies that act now will position themselves to least affected by their departure. Implementing initiatives like cross-training, S&OP and knowledge management systems will go a long way to closing the talent gap that is growing in asset management.

➔ **Consider sustainability as a critical part of a maintenance strategy.** The most successful companies integrate their energy management initiative with their maintenance strategy. Not only does factoring energy and emissions into maintenance help reduce operational costs, but it can also shed light on potential asset issues**.**

Best-in-Class companies not only use predictive maintenance to improve overall asset performance, they also use analytical tools to cut through all the data and get to the predictive answers better and faster. This leads to better overall company performance through reduced operating costs, reduced scrap, improved customer satisfaction, and then increased revenue. As the data shows, Best-in-Class companies have the edge on performance compared to everyone else. That means that if everyone else fails in the transition to predictive-based asset maintenance, they just might fail altogether as a company.

For more information on this or other research topics, please visit www.aberdeen.com.

Related Research

Engineering Shortages? How Industrial Equipment Manufacturers Can Cope; October 2013

The Engineering Workforce Problem: Doing More with No More; April 2013

Asset Management: Using Analytics to Drive Predictive Maintenance; March 2013

Asset Management: Building the Business Case for the Executive; December 2012

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