Asset Management: Using Analytics to Drive Predictive Maintenance

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 Analyst Insight, based on responses from 140 executives, will uncover how leading companies use data and analytics to manage the reliability and maintenance of their asset base. While the majority of respondents were 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, 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 *Asset Management* report indicated that failure of critical assets is a top concern (see sidebar).

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.

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 sources.
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.

**Forces Driving Predictive Maintenance**

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). 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: Top Pressures Driving Focus on Asset Management**

![Bar chart showing top pressures driving focus on asset management](chart.png)

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. A predictive maintenance approach will help address all of those top pressures by reducing costs, lowering the need for new investments, 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 1: Top Performers Earn Best-in-Class Status

<table>
<thead>
<tr>
<th>Definition of Maturity Class</th>
<th>Mean Class Performance</th>
</tr>
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</table>
| **Best-in-Class:** Top 20% of aggregate performance scorers | ▪ 1.7% Unscheduled Asset Downtime  
▪ 91% Overall Equipment Effectiveness (OEE)  
▪ +20% Return on Assets vs. Corporate Plan  
▪ -31% Reduction in Maintenance Costs |
| **Industry Average:** Middle 50% of aggregate performance scorers | ▪ 6.9% Unscheduled Asset Downtime  
▪ 83% Overall Equipment Effectiveness (OEE)  
▪ +7% Return on Assets vs. Corporate Plan  
▪ -11% Reduction in Maintenance Costs |
| **Laggard:** Bottom 30% of aggregate performance scorers | ▪ 14.8% Unscheduled Asset Downtime  
▪ 73% Overall Equipment Effectiveness (OEE)  
▪ -11% Return on Assets vs. Corporate Plan  
▪ 0% Reduction in Maintenance Costs |

Source: Aberdeen Group, November 2012

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. First, they use analytics to plan out capital expenditures. 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 (Figure 2). This outsourcing of non-critical maintenance can in turn help reduce cost by allowing companies to schedule these lower-cost repairs before they are needed, minimizing any
downtime by adjusting their workflow. All of which allows the Best-in-Class to limit their overall maintenance costs, which reduces their operating costs.

Figure 2: Strategic Actions

- Improve long term capital planning with better analytical tools: 25% Best-in-Class, 16% All Others
- Outsource maintenance activities to third party: 17% Best-in-Class, 7% All Others
- Manage energy and emissions as part of the maintenance strategy: 13% Best-in-Class, 4% All Others

Source: Aberdeen Group, November 2012

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. 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.

**Figure 3: Business Capabilities**

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.

**Leveraging Sustainability Data**

The previous section highlighted that 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).
Table 2: Sustainability Capabilities

<table>
<thead>
<tr>
<th>Capability</th>
<th>Best-in-Class</th>
<th>Industry Average</th>
<th>Laggards</th>
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<tbody>
<tr>
<td>Visibility into anomalies when assets exceed acceptable performance thresholds</td>
<td>60%</td>
<td>35%</td>
<td>23%</td>
</tr>
<tr>
<td>Asset data utilized to minimize energy consumption</td>
<td>56%</td>
<td>44%</td>
<td>23%</td>
</tr>
<tr>
<td>Benchmark the performance of each asset to determine the cost of maintaining versus replacing it with a newer, more energy efficient asset.</td>
<td>55%</td>
<td>35%</td>
<td>22%</td>
</tr>
<tr>
<td>Energy management integrated with overall asset management strategy</td>
<td>42%</td>
<td>33%</td>
<td>31%</td>
</tr>
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</table>

Source: Aberdeen Group, November 2012

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. 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. 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. In addition, the Best-in-Class are also more likely to integrate their EAM and remote monitoring. 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. This solution provides functionalities

"The company has widespread assets and attempts to have a clear view of the condition, problems, risks, and outlook as to downtime. The pressures driving asset management is the effect of downtime on revenue and excess cost of maintenance. By gaining a clearer view of what is happening at the asset level, we will have the ability to reduce these costs."

~ Maintenance Supervisor, Utilities Company
that enable employees with critical capabilities such as the ability to remotely turn the assets on or off, forecast future failures, monitor asset usage information, and regulate power usage. 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.

Figure 4: Interoperability between Enterprise Systems

![Interoperability between Enterprise Systems](image)

In addition to enterprise solutions, Aberdeen also analyzed specific modules or technology enablers that differentiate Best-in-Class performance (Figure 5). 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. Adopting 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. In addition, the Best-in-Class use spare parts inventory optimization applications. 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.

~ Victor Marina, VP of Business Development, IT Services Firm

“Real time information dramatically reduces time-to-solution when exceptions occur, which has a direct impact on customer satisfaction.”

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Figure 5: Technology Enablers

- **Master Data Management**: Best-in-Class 72%, Industry Average 51%, Laggard 31%
- **Analytics**: Best-in-Class 65%, Industry Average 46%, Laggard 29%
- **Workflows**: Best-in-Class 63%, Industry Average 43%, Laggard 38%
- **Dashboards**: Best-in-Class 58%, Industry Average 42%, Laggard 37%
- **Spare Parts Inventory Optimization**: Best-in-Class 36%, Industry Average 30%, Laggard 30%

Percentage of Respondents, n=140

Source: Aberdeen Group, November 2012
Key Takeaways

The main benefit of predictive maintenance is to avert unexpected asset failures, as well as enable targeted scheduling of corrective maintenance. 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 data that facilities generate and collect 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.

- **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 we can see in Table 1, Best-in-Class companies have the edge on performance compared to everyone else. That means that if everyone else

“In our capital intensive business, it is critical to assure operations continuity. There are no second chances to sell energy when it is not timely supplied. When a failure is not quickly remediated, it has a significant impact to our bottom lines.”

~Claudio Lopez, Procurement Manager, Utilities Company
fails in the transition to predictive-based asset maintenance, they just might fail altogether as a company.

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