

Maintenance, Repair, and Operations (MRO) in Asset Intensive Industries

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The impact Maintenance, Repair, and Operations can have on corporate performance is regularly misinterpreted and undervalued by manufacturing organizations. Too many companies inaccurately think MRO consists solely of waiting for an asset to go down, and then fixing or replacing it. By taking this approach, companies will miss out on improving production capacity while reducing their inventory investment. Aberdeen's December 2011 *Enterprise Asset Management in 2012: A Data Driven Predictive Approach to Maintenance* revealed how 119 asset intensive manufacturers use asset management strategies to improve profitability and stay competitive in the marketplace. In this Analyst Insight, we will delve into how a well-executed MRO program can improve asset management and inventory optimization. This report will serve as a guide for maintenance and reliability professionals looking to improve the availability, reliability, and safety of their assets, people, and products.

Business Context

Given the current economic climate, volatile energy prices, and unstable customer demand, executives in the asset-intensive industries must make rapid and difficult business and operational decisions. To remain competitive, manufacturers are looking for new ways to get the most out of their assets, assure their assets stay online, and plan for unexpected failures.

As shown in Figure 1, manufacturing executives are laser focused on maximizing the return of their current asset base. Overall, the ultimate goal of any successful MRO program is to extend the lifecycle and efficiency of the asset base. By keeping assets at peak performance levels, the enterprise is able to maintain a higher level of quality, resulting in less scrap and higher yields.

Another area of focus of MRO is cost reduction. Such costs include freight, loading, unloading, warehousing, service / maintenance fees, and inventory management costs. In addition, MRO also focuses on the continuity of supply and vendor support through contracts directly with the manufacturer or through a local distributor. This means evaluating and accurately assessing which parts are stocked in house or by the supplier based on the criticality of the parts respective to the asset. Accurately assessing the criticality of parts to their respective assets and adjusting stock levels accordingly frees up capital.

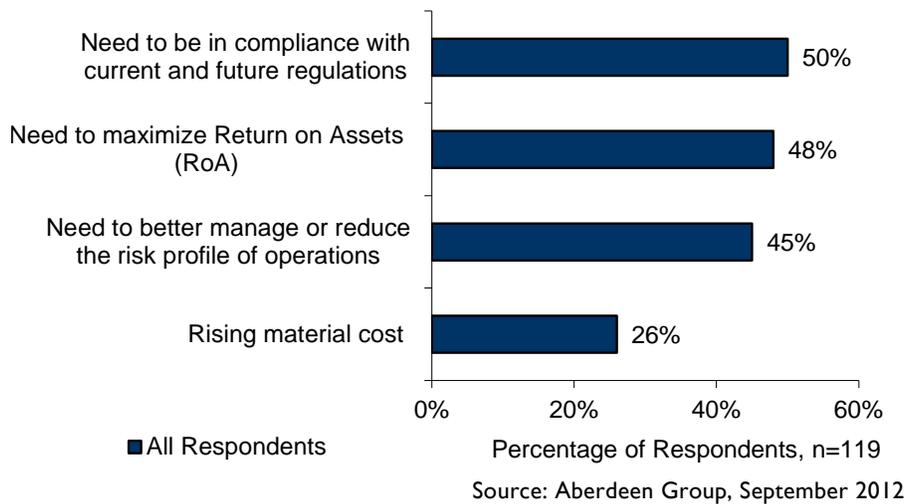
Analyst Insight

Aberdeen's Insights provide the analyst's perspective on the research as drawn from an aggregated view of research surveys, interviews, and data analysis

Sector Definition

Asset intensive industries include, but are not limited to: oil and gas, mining, metals and metal processing, energy and utilities, chemicals, pharmaceuticals, and pulp and paper.

Figure 1: Pressures Driving Focus on Operations



"Risk management are often perceived to be a department's function when the overall company needs to embrace this as a single effort to reduce risk and increase the company's overall viability."

~Paul Lim, Corporate Management Executive, SC Asia

The pressure of compliance and risk is a big area of concern for asset intensive industries. Industry specific regulations, such as NERC and FERC for Utilities in North America, drive companies to focus attention towards managing the reliability of assets. The risk of non-compliance will not only result in fines, but environmental incidents such as the Deep Water Horizon. These incidents have resulted in both loss of life and brand damage, which is nearly impossible to repair.

Having an efficient MRO strategy is an effective way to ensure that all equipment and processes are in compliance with regulations. At the same time, MRO is particularly important in industries with complex products or long lifecycles, since any form of unscheduled downtime can translate into missed product deadlines and affect the company's bottom line. Therefore, as part of the MRO strategy, it is important to also have a comprehensive view of the supply chain. If there is a supply chain disruption, it would delay the delivery of the critical part needed to fix the asset and potentially result in the asset being offline for hours (at best), if not days.

Maturity Class Framework

Aberdeen used four key performance criteria to distinguish the Best-in-Class from Industry Average and Laggard organizations. These metrics measure the success of an organization's MRO program not only in terms of how it has improved plant operations, but also how successful these programs have been for achieving financial goals.

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

Table 1: Top Performers Earn Best-in-Class Status

Definition of Maturity Class	Mean Class Performance
<p>Best-in-Class: Top 20% of aggregate performance scorers</p> <p>Industry Average: Middle 50% of aggregate performance scorers</p>	<ul style="list-style-type: none"> ▪ 22% Increase in Operating Margin vs. Corporate Plan ▪ 2% Unscheduled Asset Downtime ▪ 13% Reduction in Maintenance Cost ▪ 24% Increase in Return on Assets vs. Plan ▪ 1.3% Unscheduled Downtime due to Lack of Spare Parts ▪ 5% Increase in Operating Margin vs. Corporate Plan ▪ 5% Unscheduled Asset Downtime ▪ 5% Reduction in Maintenance Cost ▪ 3% Increase in Return on Assets vs. Plan ▪ 2.0% Unscheduled Downtime due to Lack of Spare Parts
<p>Laggard: Bottom 30% of aggregate performance scorers</p>	<ul style="list-style-type: none"> ▪ 8% Decrease in Operating Margin vs. Corporate Plan ▪ 7% Unscheduled Asset Downtime ▪ 1% Increase in Maintenance Cost ▪ 5% Decrease in Return on Assets vs. Plan ▪ 6.3% Unscheduled downtime due to Lack of Spare Parts

Source: Aberdeen Group, September 2012

The Best-in-Class outperform their competitors in all five metrics. They also successfully experience lower unscheduled downtime and maintenance costs, achieve greater return on their assets, and over perform their financial metrics. Even in the face of reduced capital budgets, the Best-in-Class save money and improve performance. The Best-in-Class also have better visibility into their assets and inventory, with only 1.3% of their downtime attributed to the lack of a spare part.

Key Business Capabilities

Based on the findings of our research and interviews with end users, Aberdeen’s analysis of the Best-in-Class reveals that optimizing operations and maintenance processes requires a certain level of maturity in process and organizational culture as well as knowledge and performance management. In this section, we will examine the specific business capabilities and technology enablers driving this business value for the Best-in-Class.

Definition for the Key Performance Indicators

- √ **Operating margin** — Defined as the difference between the actual operating margin and budgeted operating margin
- √ **Unscheduled Asset Downtime** — measured as the amount of unscheduled time the asset is offline against total asset availability
- √ **Maintenance Cost** — measured as year over year reduction in total maintenance costs
- √ **Return on Asset (RoA)** — measured as the percentage of return on asset (new income / total asset) goal achieved versus corporate goal
- √ **Unscheduled Downtime due to Lack of Spare Parts** — measured as the amount of unscheduled time the asset is offline because there is a missing part or out of stock

Process Capabilities

One of the key areas for companies is the ability to predict (and have visibility into) asset health (Figure 2). The Best-in-Class are twice as likely as Laggard organizations to establish maintenance procedures around risk-based inspection to assess the health and performance of assets.

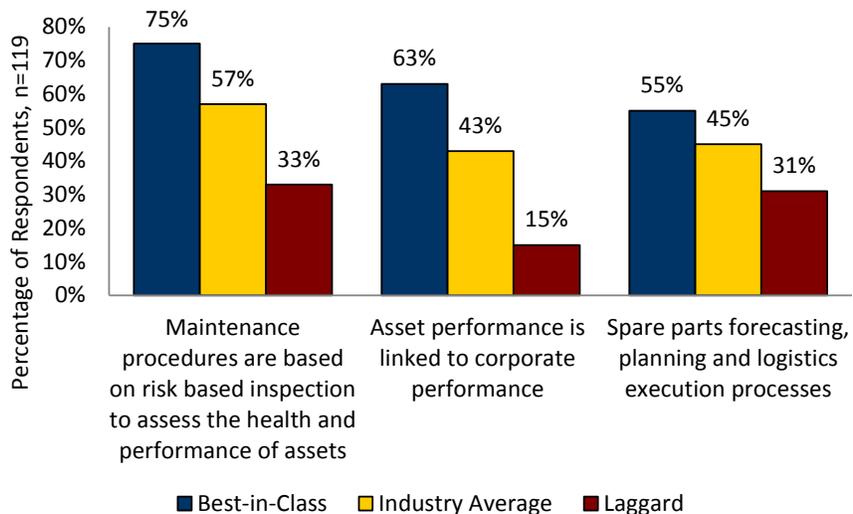
A risk-management framework needs to include:

- standard procedures to assess the top risks with maintaining and operating the asset
- the ability to quantify those risks based on the probability of the event occurring and the impact on the organization
- prioritization of risk and escalation to the appropriate decision makers
- a preventative plan to address the risks identified

One additional required step is to establish a contingency plan and closed-loop processes to mitigate the risks of an adverse event. Establishing controls will ensure that employees are well aware of their responsibilities if there is a safety incident, environmental disaster, or any kind of adverse event.

Depending on the kind of asset — rotating, moving (fork lifts), linear (roads), etc. — and the criticality of an asset, companies need to establish a maintenance strategy. Risk-based inspection will allow companies to better understand their asset and establish an appropriate strategy based on the asset type.

Figure 2: Process Capabilities



Source: Aberdeen Group, September 2012

The Best-in-Class also have the ability to predict, maintain, and plan the inventory level of spare parts. In doing so, they are better able to know

which parts will become scarce and prevent stock outs. The Best-in-Class understand the importance of having a stocking strategy on spare parts to minimize costs. This means accurately accessing how many spare parts are kept on hand and what agreements are in place with suppliers to keep big ticket items in stock that can ship on an expedited basis. This is critical for capital equipment because there is no way any company can afford to stock everything on site, due to inventory costs and sometimes physical limitations such as space and storage control issues. In doing so, 1.3 % of unscheduled downtime among the Best-in-Class is due to lack of spare parts, unlike their competitors who see up to a 6% rate.

In addition, Best-in-Class companies are over twice as likely as their competitors to link corporate and asset performance. This allows maintenance and reliability personnel to think about their jobs in financial terms. Understanding the impact of an asset going offline to the organization's budget will motivate employees to ensure asset reliability and worker safety, and to minimize asset downtime.

Knowledge and Performance Management Capabilities

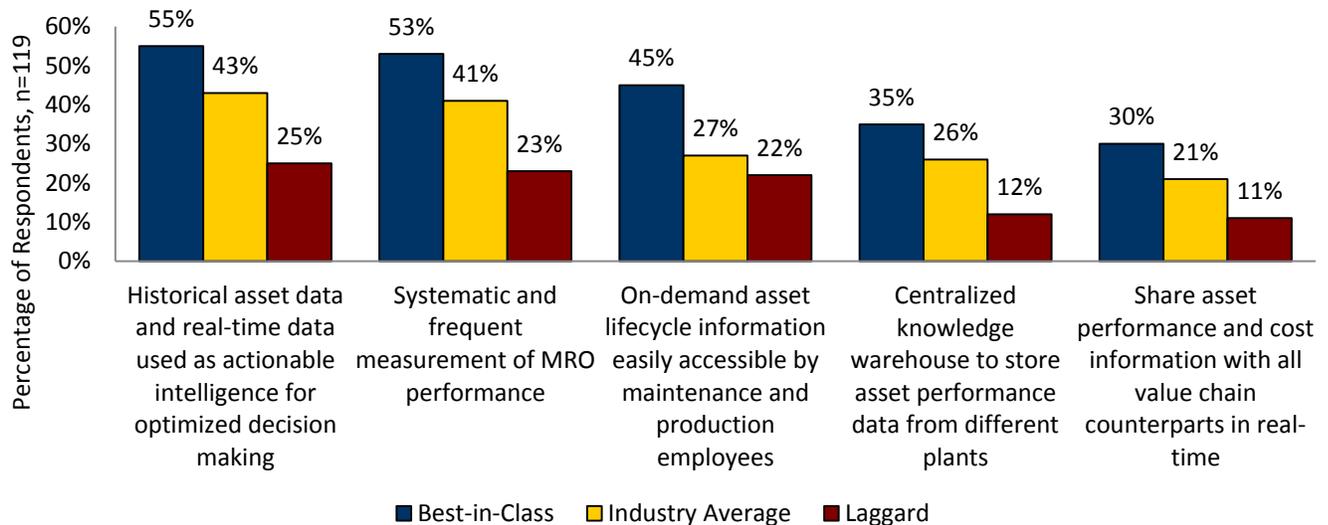
Enabling predictive maintenance requires timely access to the right information in a form that enables employees to make effective decisions. Organizations should focus on reducing the time required by maintenance and reliability professionals to find information needed for their day-to-day job such as operating logs, maintenance plans, spare parts availability, safety alerts, and equipment manuals.

As seen in Figure 3, the Best-in-Class understand the importance of collecting critical information about their assets in a centralized database and providing that information to their maintenance and operators. In fact, they are more likely than their competitors to provide this information in an on-demand fashion to ensure that more employees gain access to the information. For asset intensive industries, it is often the case that assets are located in remote locations; by gaining access to this information in an on-demand fashion (through a mobile device), it enables their workers to make sound decisions. At the same time, the Best-in-Class also enable access to real-time as well as historical data.

"The challenge is to encourage, enable, and reward the supply chain to be honest in the discussion of risks they face and measures they are taking to treat those risks."

~Michael Graham, Business Development Executive, Small Engineering Services Company

Figure 3: Performance and Knowledge Management Capabilities



Source: Aberdeen Group, September 2012

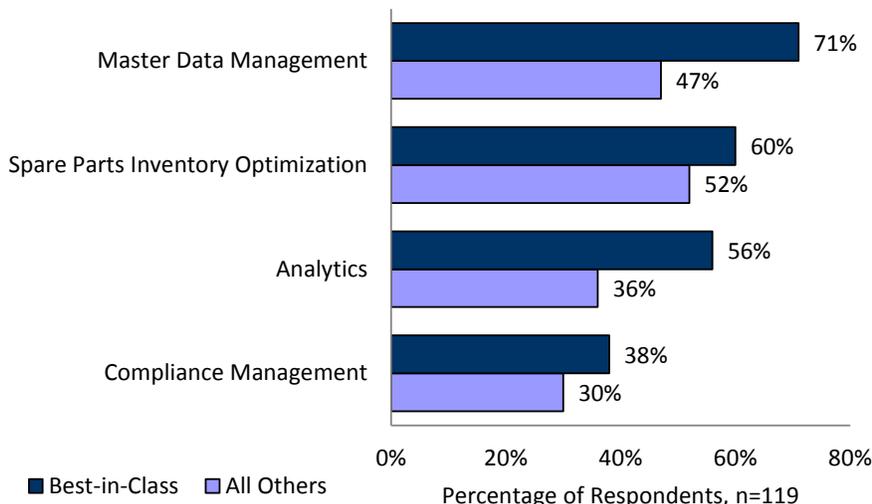
Best-in-Class companies not only leverage the data of their assets to improve performance, they are also twice as likely as their peers to measure their own MRO performance with metrics such as MRO savings, inventory reductions, and supply base reductions. This enables the identification of best practices and incorporates them across the entire enterprise.

By utilizing these capabilities, Best-in-Class companies are able to constantly adapt to whatever issues spring up with their assets. They realize enterprise asset management and plant maintenance are vital to reducing service costs and increasing asset reliability and availability.

Technology Enablers

Best-in-Class companies are found to be more invested in software solutions to automate the business process, knowledge management, and performance management capabilities. These tools allow decision-makers to bridge the gap between manufacturing, engineering, logistics, and maintenance.

Figure 4: Technology Enablers



Source: Aberdeen Group, September 2012

"Inventory levels have risen substantially in the last 5 years. The company is trying to identify slow moving inventory in an effort to write off / return or sell this old inventory."

~Quis Shahin, Procurement Consultant, UK Value Management

At the highest level, the Best-in-Class are more likely than their competitors to invest in a Master Data Management (MDM) system. When it comes to MRO processes, the data is complex and extremely large (such as supplier, equipment, maintenance, audit data, etc.). In addition, the data comes from various sources, such as an Enterprise Resource Planning (ERP), Enterprise Asset Management (EAM), Environment, Health and Safety (EH&S), data historians, control systems, or home-grown solutions. This makes it extremely challenging for manufacturers to make predictive and preventative maintenance decisions. An MDM system eliminates duplicate data points, scrubs out incorrect data, and standardizes the information into an authoritative master data source. This ensures the collected data is accurate and reliable.

The Best-in-Class supplement this solution with an analytics platform. Once manufacturers have standardized the way information is collected, the next piece is wrapping intelligence around the information. Adopting asset analytics and dashboarding modules automates data collection, analyzes and monitors data, and escalates events to appropriate decision makers at the right time, in the right format to prevent or reduce the impact of equipment failure.

In addition, the Best-in-Class use spare parts inventory optimization applications. Automating the spare parts inventory can help companies effectively manage spare parts, which results in lower inventory cost, and ensures that the right parts are available during asset breakdown, thus minimizing downtime. By providing maintenance personnel with visibility into spare parts, it lets them know when inventory is low and when new parts should be ordered. Often, asset downtime drags on not because maintenance personnel do not know how to fix the problem, but because the spare parts are not on site — they must be ordered, and may take days or weeks to arrive to the facility.

Real-Time Data for Inventory Management

While the Best-in-Class are more likely than their competitors to manage their data securely and gain insight behind this intelligence, they are also more likely to gain real-time visibility into their inventory information. Being able to collect and analyze inventory data is not enough; the ability to look at data in real-time is needed to make strategic inventory decisions. Table 2 reveals how manufacturers measure key components of their inventories.

"A key factor is to find in the market critical spare parts or equipment to replace the failed ones. The benefits are first, prevention of failures and second, when they happen implement the envisioned risk mitigation strategy."

Table 2: Real-Time Measurement of Spare Parts

Data Summary	Best-in-Class	Industry Average	Laggards
Fill Rates	60%	36%	13%
Stock Out Rates	33%	12%	15%
Inventory Accuracy	33%	21%	25%
Shelf Turns	30%	8%	11%
Lead Time in Critical Parts	22%	19%	0%

~Claudio Lopez, Purchasing Manager, Large Utilities Company

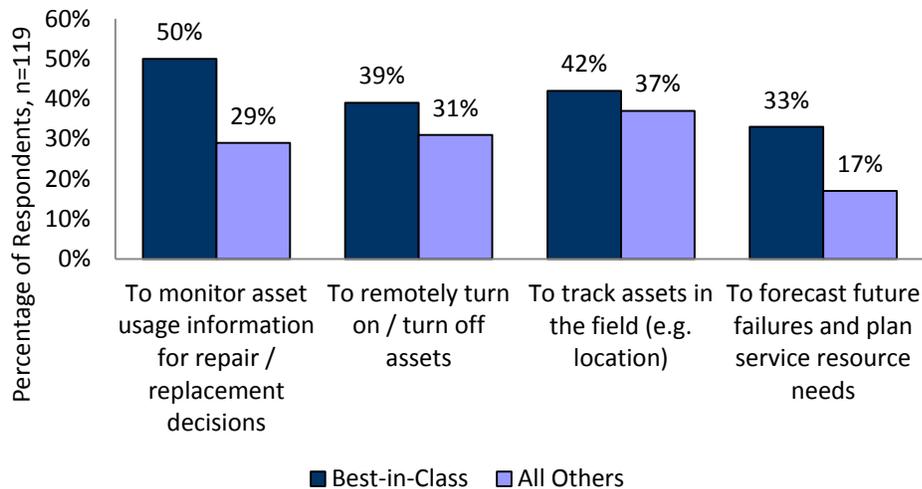
Source: Aberdeen Group, September 2012

Overall, the Best-in-Class have real-time visibility into key information to better enable inventory decisions, which could translate into significant savings. By having this data available in real-time, these leaders have a better understanding of their stock on hand and are able to predict their ability to meet maintenance demands. One important item, where Laggards do not measure any information, is in the lead time of critical parts. In asset-intensive industries, manufacturers cannot afford for their critical asset to stay offline for long periods of time. When an organization does not have visibility into how long it will take for a critical spare part to arrive, they are at risk of costing the company a lot of money. 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. Another key element to this visibility is understanding who the suppliers are to these spare-parts. Without knowledge of who the suppliers are, how much is spent on them, where and with what items, any MRO program would be fighting in the dark against an invisible enemy. Working collaboratively with the suppliers will enable manufacturers to figure out how to minimize shipping and warehousing costs, but also provide suppliers better lead times.

Remote Monitoring and Mobility Solutions

In asset-intensive industries, remote monitoring and mobility solutions are absolutely a necessity.

Figure 5: Connectivity to Remote Assets



Source: Aberdeen Group, September 2012

Remote monitoring solutions enable 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. Best-in-Class companies are more likely than their competitors to invest in remote monitoring solutions (Figure 5). This solution provides functionalities that enable employees with critical capabilities such as the ability to remotely turn on / off the assets, forecast future failures, monitor asset usage information, and regulate power usage.

Mobility solutions provide relevant information to field workers on their mobile devices. These solutions become very important during operator rounds when operators need to store inspection data. Storing this information on paper often creates the risk of data not being entered in the system in a timely manner and reduced quality of the data. Providing mobile devices will enable field workers to store inspection data in the system automatically, access pending work orders, track repairs, and perform other critical tasks that traditionally required employees to go the work stations.

Key Takeaways

In a time of economic tumult and unreliable capital markets, manufacturers are faced with increased pressure to do more with less. Companies are trying to get the most out of their current asset base by adopting a culture of predictive maintenance. Best-in-Class companies have taken a holistic approach to MRO by viewing asset management and maintenance at an enterprise level. The following actions should be taken by any company trying to maximize the value of their assets:

- **Factor risk into your maintenance decisions.** Best-in-Class companies use failure analysis to assess the risk of all their assets for maintenance decisions. Risk-based inspection will enable companies

to better understand their asset and establish an appropriate maintenance strategy based on the asset type to minimize an adverse event.

- **Implement a framework to forecast and predict the demand of spare parts.** The ability to predict the amount of parts you will need at a given time is the best way to reduce downtime. The Best-in-Class are 1.7-times as likely as their competitors to have this framework to be predictive in asset maintenance and ensure that they have the spare parts on hand.
- **Have real-time visibility into inventory management data.** The Best-in-Class invest in solutions to enable them to have real-time visibility and control into their spare parts inventory. By having the most up to date information, an organization is able to make educated decisions to ensure predictive and preventative maintenance.
- **Invest in a Master Data Management system.** Within asset management and more specifically MRO, there are large amounts of data being generated by maintenance, operators and plant floor personnel. An MDM system ensures that this data is accurate, reliable, and presented in a holistic view. The Best-in-Class take it a step further by coupling their MDM solution with analytics engine. This enables the Leaders to gain context around the information to make preventative and predictive decisions around asset maintenance.

For more information on this or other research topics, please visit
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Related Research	
<i>Enterprise Asset Management 2012: A Data Driven Predictive Approach to Maintenance</i> ; December 2011	<i>Operational Risk Management</i> ; October 2011
<i>Operational Risk Management Strategies for Asset Intensive Industries</i> ; March 2011	<i>A Risk Management Approach for Improving Safety and Productivity</i> ; February 2011
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