

The Role of Software in Asset Performance Management

Reduce maintenance cost, downtime and safety incidents

October 2010

Mehul Shah and Matthew Littlefield

Executive Summary

While frozen budgets have been a key issue for maintenance organizations, the results from Aberdeen's fourth annual research study revealed that managing employee and plant safety, reducing maintenance costs and minimizing asset downtime is placing increasing pressure on these groups. This report, including responses from 117 executives, will serve as a guideline for maintenance and reliability professionals to understand how to proactively manage these challenges in this uncertain business environment.

Best-in-Class Performance

Aberdeen used the following four key performance criteria to distinguish the Best-in-Class, with top performers achieving the following results:

- 91% Overall Equipment Effectiveness (OEE)
- 3% unscheduled asset downtime
- 8% reduction in maintenance cost year over year
- Over achieve return on assets targets by +11%

Competitive Maturity Assessment

Survey results show that the firms enjoying Best-in-Class performance shared several common characteristics, including:

- Ninety-four percent (94%) of Best-in-Class companies are establishing the strategy of optimizing maintenance and operation processes
- Best-in-Class companies are three times as likely as Laggard organizations to standardize processes for risk quantification
- Best-in-Class companies are 65% more likely than Laggard companies to invest in an Enterprise Asset Management (EAM) solution integrated with performance management and analytics

Required Actions

In addition to the specific recommendations in Chapter Three of this report, to achieve Best-in-Class performance, companies must:

- Start with optimizing maintenance and operations processes by creating a culture of collaboration among these teams
- Establish metrics that are critical to your operations and provide timely visibility of those metrics to appropriate decision makers
- Invest in predictive management and analytics solutions to help employees quickly and efficiently understand the true value of the vast amount of data collected throughout the asset lifecycle

Research Benchmark

Aberdeen's Research Benchmarks provide an in-depth and comprehensive look into process, procedure, methodologies, and technologies with best practice identification and actionable recommendations

How Does Your Performance Compare to the Best-in-Class?



- Compare your processes
- Receive a free, personal PDF scorecard
- Benefit from custom recommendations to improve your performance, based on the research

[Take the Assessment](#)

Receive Your Free Scorecard

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Chapter One: Benchmarking the Best-in-Class

Business Context

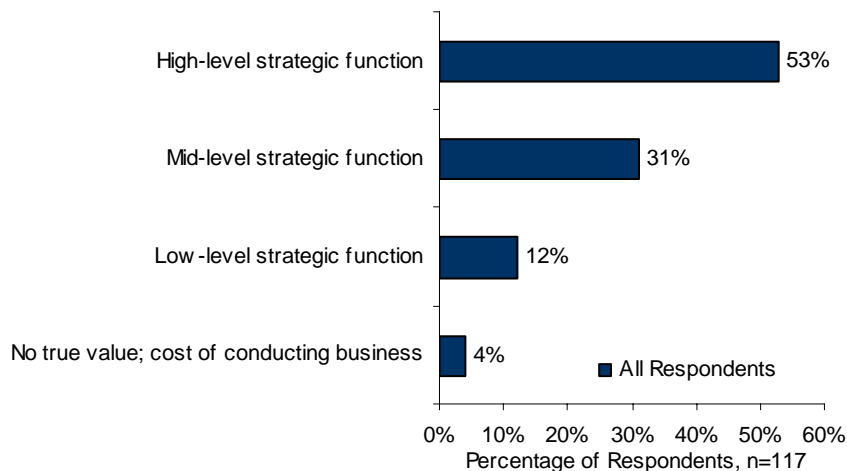
The year 2010 has been uncertain until now, especially in the context of asset management. While the economic recovery has been in process, the capital and operational budgets are still very tight in the majority of companies. At the same time industrial accidents such as the Gulf of Mexico oil spill, the Virginia coal mine explosion and the Chilean mining accident have constantly been in the headlines this year driving immense pressure on executives in asset intensive industries. While the key for companies has always been bottom line performance, it is very clear that this goal cannot be achieved by jeopardizing safety and maintenance of the plant assets.

The purpose of this study is to highlight the vision and the strategies of companies that are able to successfully optimize operations and maintenance processes with zero tolerance towards safety incidents. We will look into the role software plays in providing the right information to the appropriate decision makers, resulting in long term business viability.

Asset Management as a Strategic Driver

Asset management has long been viewed as a cost center, as a necessary cost of doing business and a function that adds no strategic value to the organization's bottom line. Interestingly, this perception is quickly changing now (Figure 1).

Figure 1: Perceived Role of Asset Management



Source: Aberdeen Group, October 2010

The results of the Aberdeen's latest survey on Asset Performance Management (APM) show that more than half of the total respondents view asset management as a high level strategic function, while a third view it as a

Fast Facts

Best-in-Class enterprises significantly outperform their competition. These enterprises enjoy:

- ✓ 91% Overall Equipment Effectiveness (OEE)
- ✓ 3% unscheduled asset downtime
- ✓ 8% reduction in maintenance cost
- ✓ +11% over achieving return on assets targets

mid-level function. The growing impact of asset management processes on organizations' bottom lines as well as on the safety of plant and employees has certainly elevated the importance and the criticality of this function in the eyes of senior management.

This change in mindset is much needed in order to address the top two challenges faced by companies today; change in culture required to move from break fix maintenance to proactive maintenance techniques and insufficient resources with necessary skills and experience. It is interesting to note that both these challenges were the top two challenges in the 2008 survey on [Asset Performance Management](#). The growing support from the senior management will help maintenance organizations address these challenges by establishing predictive asset management practices and investing in resources to make that vision a reality.

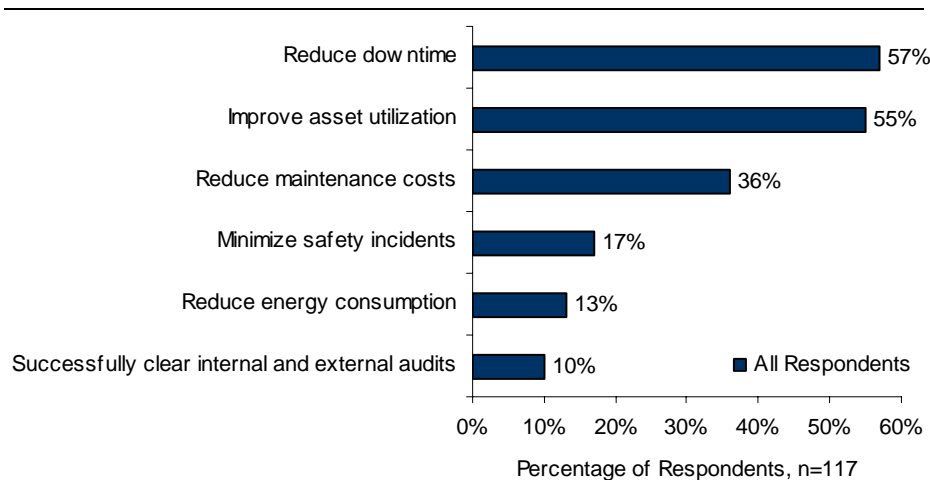
"The current economy has simply made us focus more on the efficiencies of the process and the value in reliable operation. The asset management system is much more visible to the top management."

~ Steven J. Cooke,
CQA, CQE
Senior Quality Management
Engineer
ADGAS

Managing Downtime and Utilization

When asked about the top two goals for maintenance, an interesting trend came to focus. This trend is also highlighted in some of the other findings that will be discussed later in the report.

Figure 2: Top Two Goals



Source: Aberdeen Group, October 2010

The primary goal of maintenance has always been to minimize downtime and the primary goal of operations has been to maximize utilization. While the top goal selected by 57% of the responding companies is to reduce downtime, which is not a surprise, a close second is to improve asset utilization, selected by 55% of total respondents. The majority of respondents to this study are maintenance professionals and the fact that this team is goaled to improve asset utilization is definitely a step in a positive direction. Maintenance processes cannot be effective if established in a siloed fashion. It is important to have both these groups working closely together to optimize both operations and maintenance processes. This will

be a key step in achieving the top two goals of minimizing downtime and maximizing asset utilization.

The 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 APM program not only from how it has improved maintenance and operations processes, but also how successful these programs are in achieving financial goals.

- **Overall Equipment Effectiveness (OEE)** – measured as a percentage by multiplying availability times performance times quality
- **Unscheduled asset downtime** – measured as the amount of unscheduled time the asset is offline against total asset availability
- **Return on assets** - measured as the percentage of return on asset goal achieved
- **Maintenance costs** - measured as year over year reduction in total maintenance costs

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	<ul style="list-style-type: none"> ▪ 91% Overall Equipment Effectiveness (OEE) ▪ +11% (to plan) return on assets ▪ 3% unscheduled asset downtime ▪ 8% reduction in maintenance cost
Industry Average: Middle 50% of aggregate performance scorers	<ul style="list-style-type: none"> ▪ 80% Overall Equipment Effectiveness (OEE) ▪ +6% (to plan) return on assets ▪ 13% unscheduled asset downtime ▪ 3% reduction in maintenance cost
Laggard: Bottom 30% of aggregate performance scorers	<ul style="list-style-type: none"> ▪ 58% Overall Equipment Effectiveness (OEE) ▪ -8% (to plan) return on assets ▪ 28% unscheduled asset downtime ▪ 4% <i>increase</i> in maintenance cost

Source: Aberdeen Group, October 2010

Respondents were divided among three categories based on their aggregate performances in these four 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 average performance of Best-in-Class, Industry Average, and Laggard organizations.

These metrics closely align to the top three goals highlighted in Figure 2: minimize downtime, improve utilization and reduce maintenance costs.

Overall Equipment Effectiveness (OEE) is a metric that has been gaining importance in increasing numbers of asset intensive organizations. This is a comprehensive, composite metric that includes throughput, availability and quality. This metric helps organizations to view the collective performance of these highly inter-related functions, rather than looking at each of the metrics individually. Best-in-Class companies are able to optimize all the three processes included in the metric by performing at 91% OEE while Laggards are behind by 33% compared to the Best-in-Class. This has also enabled Best-in-Class companies to minimize unscheduled downtime to 3%.

While many may think that this improved performance might come with increased costs, the trend shows an inverse relation between cost and operational metrics for the Best-in-Class. These high performing companies are able to reduce annual maintenance costs by 8%. The effective management of assets and overall maintenance costs has helped the Best-in-Class to overachieve their Return on Asset (RoA) targets by 11%. Realizing such performance requires effective high level strategies as well as business processes and software solutions to successfully execute those strategies.

For the first time, Aberdeen Group looked into the benefits of investing in software for asset management.

“We are at the early stage and are transiting from a traditional engineering and technical group to asset management group. Our expectation is to drive the cultural change with regards to the maintenance of our asset in order to better prevent, predict rather than react.”

~ Gilles Bocabartelle, Vice President, Asset Management, Pride International, Inc.

Table 2: Quantifying Investments in Asset Management Software

Metrics	Performance
Overall Equipment Effectiveness (OEE)	Reduced by 8%
Maintenance Cost	Reduced by 9.5%
Asset Downtime	Reduced by 14%

Source: Aberdeen Group, October 2010

The results shown above highlight the benefits that companies are able to realize by investing in asset management solutions, which will be highlighted in Chapter Two. Software plays a critical role in establishing a predictive asset management culture. It provides employees with the visibility to the right information and enables intelligent decision making. Companies that are able to successfully use software to automate asset management business processes are reducing OEE by 8%, asset downtime by 14% and overall maintenance costs by 9.5%. Companies can use this data as a business case to understand the true value of investing in software solutions.

The Best-in-Class PACE Model

Minimizing downtime and improving utilization, while reducing safety incidents and costs requires a combination of strategic actions, organizational capabilities, and enabling technologies that can be summarized as shown in Table 2.

Table 2: The Best-in-Class PACE Framework

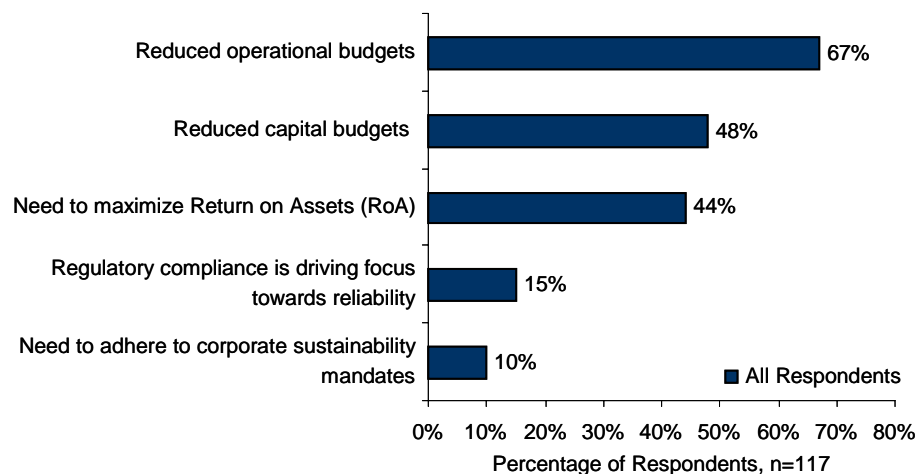
Pressures	Actions	Capabilities	Enablers
<ul style="list-style-type: none"> Reduced operational and capital budgets 	<ul style="list-style-type: none"> Optimize maintenance and operations processes Implement advanced asset performance management and analytical capability 	<ul style="list-style-type: none"> Frequent risk based assessments to understand the risk profile of the asset Executive focus on aligning asset performance and corporate performance Asset performance data is collected in real time Asset performance data is mined for predictive analytics Historical as well as real-time asset performance data is used as actionable intelligence for optimized decision making 	<ul style="list-style-type: none"> Enterprise Asset Management (EAM) EAM with Performance Management and Predictive Analytics Document Management / Master Data Management SCADA Distributed Control Systems (DCS) Dashboards Analytics Risk Management Compliance Management Spare Parts Management Failure Mode and Effect Analysis (FMEA)

Source: Aberdeen Group, October 2010

Primary Drivers and Best-in-Class Strategies

According to the latest quarterly Aberdeen Business Review (Q3 2010), which collected survey responses from over 1,650 companies on business goals, strategies and challenges, 65% of survey participants indicated that they believed the economic recovery had begun but only 7% of all respondents feel the recovery will be either steady or rapid. This finding is exemplified by the top pressures driving companies to focus on asset management

Figure 3: "Top Two" Drivers Impacting Asset Management



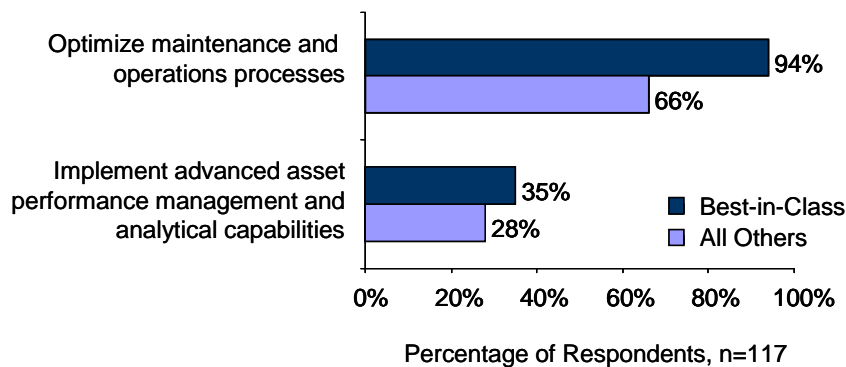
Source: Aberdeen Group, October 2010

The findings of the current, as well as the [2009 APM report](#), revealed a similar trend for the top two pressures (reduced CAPEX and OPEX). While the findings of the 2009 APM report showed maximizing RoA as the top pressure, this year's report reveals that the top pressure for organizations is reduced budgets, which clearly reflects the economic downturn. With an increasing number of un-funded projects in the last few years, several functional groups have been lobbying for attention from upper management to get a piece of the (already reduced) capital and operational budgets. The reduction and / or delay in CAPEX has further impacted the investment in new assets which is only putting additional pressure on maintenance groups to get more out of their existing asset base.

The pressure of compliance, even though selected by only 15% of the total respondents, is a big area of concern for asset intensive industries. Industry specific regulations such as NERC & FERC for Utilities in North America are driving 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 ones that we have seen this year have resulted in both loss of life and brand damage which is near-impossible to repair.

The results of the survey found two strategies that differentiated Best-in-Class performance. Ninety-four percent (94%) of Best-in-Class companies are focused on optimizing maintenance and operations processes; which is again aligned to the top two goals highlighted in Figure 2.

Figure 4: Top Strategies



Source: Aberdeen Group, October 2010

The first step to optimize these two key processes is to enable collaboration among maintenance and production teams. Enabling cross functional collaboration is generally the most difficult strategy to execute considering the possible communications walls between these functional groups. Those able to foster collaboration will have a greater chance in realizing Best-in-Class performance.

The second step is to enable real-time visibility into key areas of maintenance and operations. Companies need to empower their employees with real-time visibility and implement advanced asset management and

Acronyms Defined

- CAPEX** - Capital expenditure
- OPEX** - Operational Expenditure
- NERC** - North American Electric Reliability Corporation
- FERC** - Federal Energy Regulatory Commission

"We are trying to address the link between a process operation problem and the way in which an asset might have been installed or how it is maintained. When we find a new problem using our performance management initiative we are connecting this to an asset performance program to address the root cause. We are also creating a reliability center for asset management to drive uptime. Operations will identify and prioritize the culprit and maintenance can then address it."

~ Keith Phillips,
Process Control Engineer and
Team Lead, SABIC-IP

analytical capabilities, to enable predictive asset management programs. Providing key information to employees will enable companies to be predictive in managing operations, maintenance and safety processes and reduce the overall risk profile of an organization.

Aberdeen Insights — O&G and Utilities Industry Trends

Aberdeen Group did further analysis to understand the trends in Oil & Gas (O&G) and Utilities industries. Both of these industries are asset intensive and are traditionally known for their advanced asset management processes due to the nature of their business.

While Figure 2 highlighted asset downtime as the top goal; for both O&G and Utilities industries the top goal selected by more than 60% of the companies is improved asset utilization. Both these industries face growing pressure to produce more output. This has compelled executives in both these industries to maximize asset utilization to address the growing demand.

Another trend that was revealed for the O&G industry was the fact that these companies are more than two times as likely as their competitors to be driven by regulatory compliance and nearly three times as likely as their competitors to be driven by the need to minimize health and safety incidents. Employees in this industry work in a high risk environment where the probability of a safety incident is much higher than a lot of other industries. The compliance laws are also more stringent because of the potential impact of an adverse event on the environment and employee safety. In such a scenario, proactively managing risk due to compliance requirements and the possibility of health and safety incidents is a critical driver for the O&G industry.

In the next chapter, we will see what the top performers are doing to achieve these gains.

Chapter Two: Benchmarking Requirements for Success

The way in which companies implement the business processes designed to manage asset performance and support the strategic actions being taken must be highly correlated to successfully responding to market pressures in order to achieve Best-in-Class performance.

Case Study — Scottish Power

Scottish Power (SP) is one of the “Big 6” energy suppliers in UK, with over 8,000 employees and a customer base of 5.2 million. SP has 6 Gigawatts (GW) of coal, gas, and hydro generation across the UK and is one of the largest onshore wind operators generating 800 Megawatts (MW) of energy. Additionally, when SP merged with Iberdrola in 2007, the total combined capacity of the resulting company totaled an approximate 44GW with an additional 11GW of renewable energy.

Being an asset intensive organization SP experienced a number of pressures driving their maintenance strategy. Achieving safety and environmental compliance and reducing the risk of catastrophic failures are the top priorities for SP. In addition, addressing some of the other challenges such as operational assurance, managing aging assets, maximizing ROI and minimizing costs is critical for their success. SP established a “High Reliability Organization” program to effectively address these challenges. This program was supported by the senior management and the executives provided the commitment and resources needed to make this initiative a success. A detailed roadmap was developed which included scoping, requirement analysis, implementation, and improvement phases.

One of the key pillars of the program was to implement a Reliability Centered Maintenance (RCM) strategy. The drive to change from break-fix maintenance to an RCM strategy was strong but it was a time-consuming process and also costly to implement. SP faced challenges with its ability to have easy access to relevant information such as failure modes, effects, asset health, and past repairs among others. Without timely access to historic as well as the current information, it became very difficult to implement an RCM strategy.

In 2007 SP decided to invest in an Asset Performance Management (APM) solution. The solution was first implemented across five sites in 2007, specifically around controlling critical sub systems. During the same year SP invested in integrating the platform with its Enterprise Asset Management (EAM) system. It set up its alarms in the EAM system and synched up with the new platform. In 2008, SP continued the implementation across the five sites and extended the reach of the platform to other assets. Finally, in 2009 SP decided to extend the platform across the other seven sites.

continued

Fast Facts

Best-in-Class companies are more likely to adopt the following business capabilities as compared to Laggards:

- √ **2-times** likely as to standardize risk assessment processes
- √ **3-times** as likely as to standardize risk quantification processes
- √ **2-times** as likely as to collect asset performance data in real-time

Case Study — Scottish Power

SP was also able to go live with a Key Performance Indicator (KPI) dashboard architecture to provide visibility into top risks, the priority of those risks, and other KPIs by developing an enterprise scale solution with tight integration across the systems.

According to Martin Sedgwick, the head of asset management at Scottish Power, “Cost outage rate is a critical metric for the energy industry. We have seen a 15% to 20% improvement in cost outage rate over the last three years. While the investment in software was critical in achieving this improvement, other strategies such as collaboration and a risk management culture helped us to get the maximum value out of our technology investments.”

Competitive Assessment

Aberdeen Group analyzed the aggregated metrics of surveyed companies to determine whether their performance ranked as Best-in-Class, Industry Average, or Laggard. In addition to having common performance levels, each class also shared characteristics in five key categories: (1) **process** (the approaches they take to execute daily operations); (2) **organization** (corporate focus and collaboration among stakeholders); (3) **knowledge management** (contextualizing data and exposing it to key stakeholders); (4) **technology** (the selection of the appropriate tools and the effective deployment of those tools); and (5) **performance management** (the ability of the organization to measure its results to improve its business). These characteristics (identified in Table 3) serve as a guideline for best practices, and correlate directly with Best-in-Class performance across the key metrics.

Table 3: The Competitive Framework

	Best-in-Class	Average	Laggards
Process	Maintenance procedures are based on risk based inspection to assess the health and performance of assets.		
	65%	43%	29%
	Established risk based approach that considers safety in the maintenance strategy		
	50	41%	38%
	Standardized processes in place to respond to unsafe operating conditions across the enterprise		
	67%	63%	50%
Organization	Executive ownership and sponsorship for asset performance strategies across the enterprise		
	56%	35%	28%
	Maintenance and production teams work collaboratively		
	72%	49%	44%

	Best-in-Class	Average	Laggards
Knowledge	Asset performance data is collected in real time		
	43%	27%	18%
	Centralized knowledge warehouse to store asset performance data from different plants		
	30%	21%	21%
	On-demand asset lifecycle information easily accessible by maintenance and production employees		
	30%	27%	20%
Technology	Enterprise Asset Management (EAM)		
	72%	57%	40%
	EAM with Performance Management and Analytics		
	28%	17%	17%
Performance	Failure data is used to perform root cause analysis to understand the impact and the probability of failures		
	61%	38%	25%

Source: Aberdeen Group, October 2010

Capabilities and Enablers

Based on the findings of the Competitive Framework and interviews with end users, Aberdeen’s analysis of the Best-in-Class reveals that optimizing operations and maintenance processes as well as implementing advanced asset management capabilities require a certain level of maturity in process, organization 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, a summary of these capabilities and enablers can be found in the Table 3.

Process

One of the key areas of focus for companies is the ability to be predictive in their asset management strategies. This requires both a risk management framework that is standardized across the enterprise and also access to timely and relevant information by employees. This will enable employees to make effective decisions to prevent an adverse event or contain losses when there is an adverse event.

A risk management framework needs to include:

- standard procedures to assess the top risks
- 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

One additional step that is required is to establish a contingency plan and close looped process to mitigate the risks of an adverse event. Even for the Best-in-Class companies there will be certain events that are not

"Some of the initiatives that are currently in place in our organization are operational excellence and maintenance and integrity execution. To ensure these initiatives get entrenched in the organization, health checks and audits are carried out at regular intervals. Benchmarking of producing assets is also carried out to identify gaps and define measures to close the gaps."

~ Emeka Maduekwe,
Shell Global Solutions
International BV

foreseeable. Establishing a contingency plan will ensure that employees are well aware of their responsibilities if there is a safety incident, environmental disaster or any kind of adverse event.

The Best-in-Class are two times as likely as Laggard organizations to establish maintenance procedures that are based on risk-based inspection to assess the health and performance of assets. 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 enable companies to better understand their asset and establish an appropriate strategy based on the asset type.

Another area of focus for the Best-in-Class is to understand the impact of asset management on safety. The Best-in-Class are 34% more likely than Laggards to have standardized processes in place to respond to unsafe conditions. This speaks to the point of having a contingency plan in place as well as roles and responsibilities assigned in the case of an adverse event.

Finally, the Best-in-Class are also more likely to consider safety while establishing a risk management strategy for asset management. In addition to providing visibility into information such as asset condition, utilization and asset failure, it is important to have critical safety information such as near misses, root cause of safety incidents, and repeatable accidents to help employees understand the impact of maintenance processes to employee safety. Having this information readily available will also help organizations effectively address compliance requirements and to effectively manage internal and external audits.

Organization

A collaborative organizational culture goes a long way in reaping the benefits enjoyed by Best-in-Class companies. If you are looking to move from reactive to predictive asset management processes, the first area of focus should be to get sponsorship / buy-in from senior management. Best-in-Class companies are two times as likely as Laggards to have executive ownership and sponsorship for asset performance strategies across the enterprise. A successful APM initiative requires organizations to operate beyond functional boundaries and balance asset availability and utilization by improving collaboration among functional teams.

Once senior management sponsorship is established, it is important to enable collaboration among maintenance and operations teams. This is a key to effectively executing the top strategy being established by 94% of Best-in-Class companies (optimize maintenance and operational processes). Addressing cultural issues is always a difficult task and where a different culture is deeply ingrained in the fabric of the organization, it is the one that takes the longest time. Strategies such as establishing common goals across both the groups and moving managers from one group to another to better understand the challenges for each of the groups can go a long way in addressing these cultural roadblocks.

Knowledge Management

Enabling predictive asset management processes 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.

Best-in-Class companies are more than two times as likely as Laggards to collect asset performance data in real-time. In addition, Best-in-Class companies are also 50% more likely than Laggards to provide maintenance and production employees with on-demand asset lifecycle information. Both these capabilities are critical and will provide a strong foundation to enable some of the other capabilities mentioned in this research report. Real-time data into asset performance will enable employees to understand the current condition of the equipment and provide critical information such as how well the equipment is running and if the asset requires any immediate repairs. Asset lifecycle information is also a key to better understanding the asset base. Sometimes pieces of equipment are as old as 50 to 60 years, and it is critical to have asset history data such as the repairs undertaken, prior failures, frequency of failures, and spare parts used in order to better understand the asset and make appropriate repair decisions.

Another important area of focus is the time required to access information. In addition to enabling predictive asset management, timely access to relevant information is especially important to address the compliance pressure, and for performing internal and external audits. Best-in-Class companies are 40% more likely than their competitors to invest in a centralized knowledge warehouse to store asset performance data from different plants. Accessing data stored in different home-grown systems and spreadsheets can be extremely time-consuming and it also affects the quality of the data. Best-in-Class companies are collecting data in a centralized warehouse to ensure the quality and timeliness of the information.

Performance Management

Understanding the performance of equipment and creating a strategy for improvement is critical to reducing downtime, improving utilization, minimizing costs and reducing health and safety incidents. Reliability Centered Maintenance (RCM) has been a widely successful strategy which involves understanding the criticality of assets, enabling visibility in equipment data both from the operators as well as maintenance employees, analyzing failure mode and effects as well as jointly establishing strategies to enable predictive asset management.

Best-in-Class companies are over two times as likely as Laggards to use failure data to perform root cause analysis to understand the impact and the probability of failures. Understanding an asset and its criticality to operations is the first step for the success of any maintenance strategy. Best-in-Class companies are ensuring that they are well aware of the root cause analysis of any failure, whether it is mechanical, electrical or just operator error, so

"We have good corporate sponsorship and have been able to implement RCM. We are currently working to optimize our use of CBM technologies in support of our maintenance basics."

~ Kurt Oates, Manager,
Manufacturing Operations
Nebraska Public Power District

that corrective and preventive steps are taken to either stop or reduce the impact of an adverse event.

Case Study — Arch Coal

St. Louis-based Arch Coal is the second largest US coal producer. In total, Arch Coal contributes about 16% of America's coal supply from their 11 mining complexes in Wyoming, Utah, Colorado, West Virginia, Kentucky, and Virginia. In total, Arch Coal has a total of 5,000 employees and operates 26 coal miles in the United States. Arch Coal is traded on the New York Stock Exchange under the ticker symbol ACI.

Arch Coal started an initiative that they called it as Arch Initiative in Maintenance (AIM) five years ago. One of the major drives behind AIM was to bring all other programs such as planning and scheduling, reliability and predictive management into one global program. This enabled Arch Coal to standardize these programs based on the best practices learned in different mines and share that across their global enterprise. The goal was to highlight maintenance best practices and common themes across the company and take it to the next level. For example, the AIM group was able to standardize their preventative maintenance task. Another focus was to effectively manage their supplier base. In the last two and a half years they have certified many of their suppliers based on the audit and also established processes to help their supplier to improve.

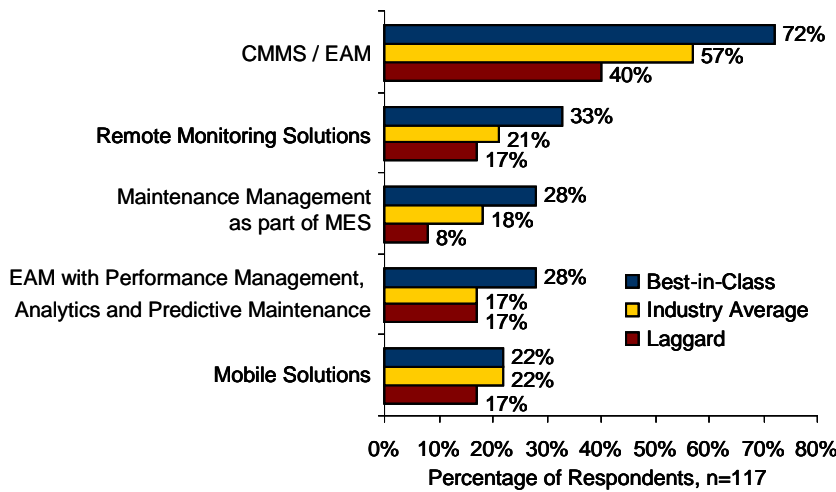
They established the role of director of maintenance and technical service as a person responsible for AIM. His group now acts as an internal consultant and works closely with the operations group to ensure that maintenance and operations are working hand in hand towards a common goal.

One of the success factors for this group was their Enterprise Asset Management (EAM) system. One of the major challenges Arch Coal faced initially was to train the employees on how to best use their EAM system. But once that challenge was addressed with proper training, Arch Coal was able to get the relevant information to various roles to make their job easier. Arch Coal also uses their EAM system to record all safety related incidents. This enabled them to understand historical trends, root cause and also helped to get all the information for audits and reporting. In addition, Arch Coal also uses different modules such as condition monitoring, warranty tracking and labor requisition from their EAM system. According to Robert McCreary, Director of maintenance and technical services, "Even though the commodity cost has increased over the last years, our cost has remained flat due to our AIM initiative. Our safety initiative has helped us reduce our incident rate to 1.02 and in our largest mine we have recorded 7 million man hours without a Lost Time Accident (LTA). Our collaborative culture, along with the functionality we use from our EAM system, has really enabled us to make this transformation."

Technology

Best-in-Class companies are found to be more invested in software solutions to automate the business process, knowledge management and performance management capabilities shown in Table 3.

Figure 5: Best-in-Class Technologies



Acronyms Defined

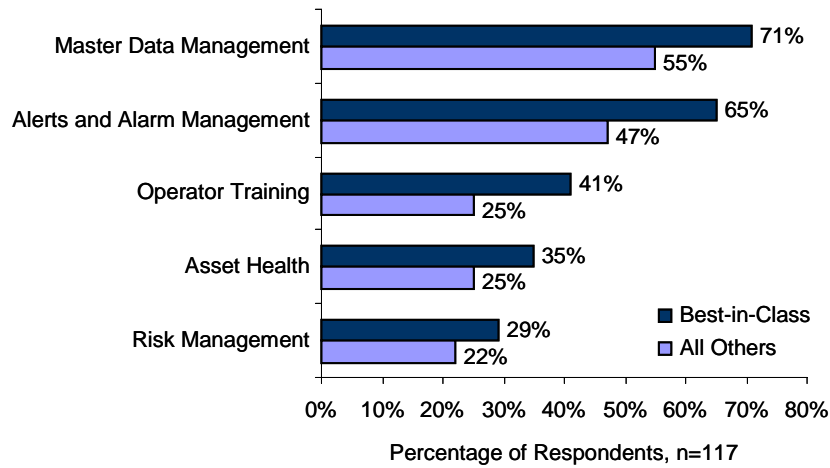
- ✓ CMMS: Computerized Maintenance Management System
- ✓ EAM: Enterprise Asset Management
- ✓ MES: Manufacturing Execution System

Source: Aberdeen Group, October 2010

Out of all the solutions highlighted above, Enterprise Asset Management (EAM) solutions have the highest adoption rate with 72% of Best-in-Class companies already invested in an enterprise wide asset management system. However the adoption among Laggards is still less than 50%. EAM solutions provide a relatively core set of functionality that closely aligns to how Best-in-Class companies approach technology adoption around asset management. EAM solutions help companies manage critical information related to work orders, materials, spare parts, employee data, procurement, and maintenance schedules and provide employees with a single platform to access this information on a timely basis to make intelligent decisions.

Another critical software solution that has a lower adoption rate, but is critical in enabling visibility into key data, is EAM with performance management, analytics and predictive maintenance. There are software vendors in the marketplace that go to market with performance management, analytics and predictive maintenance solutions. These are critical components / functionalities of an Asset Performance Management (APM) solution. The lower adoption rate of this technology provides a tremendous opportunity for companies that have not yet invested in this solution to provide employees with that real-time and historical data through an APM solution and enable effective decision making. Investing in an APM solution will enable companies to understand the value of both production and maintenance data, which is critical for the success of any reliability driven strategy. The importance of this solution is highlighted by the fact that 44% of overall respondents are planning to invest in this solution.

Figure 6: Enabling Predictive Management



Source: Aberdeen Group, October 2010

The technology enablers above highlight some of the key software tools required to enable predictive asset management strategies. Master Data Management (MDM) enables organizations to manage data (such as supplier data, equipment data, audit data, etc.) in a master data format to maintain consistency in the way data is collected and presented to decision makers. Asset health provides comprehensive information about the past history of an asset and can help in enabling key decisions about asset repair / overhaul or investing in completely new equipment. Risk management tools help to automate the risk assessment, quantification and prioritization process across the asset base.

Two other technologies that are absolutely a necessity in many industries (including but not limited to Oil & Gas, Utilities and Mining) are remote monitoring and mobility solutions. The adoption level of both these solutions are relatively low because of the cross industry nature of this research. 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 other critical tasks that traditionally required employees to go the work stations.

Remote monitoring solutions enable visibility into equipment that may be in an unsafe environment such as drilling in the mining industry or the exploration and production sector in the upstream oil industry. Best-in-Class companies are nearly two times as likely as Laggards 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.

"We are currently utilizing dashboards and Master Data Management. Dashboards help highlight areas where current emphasis are needed. Master Data Management has increased reliability of data by reducing potential for errors and has increased the confidence level of those using the systems and data."

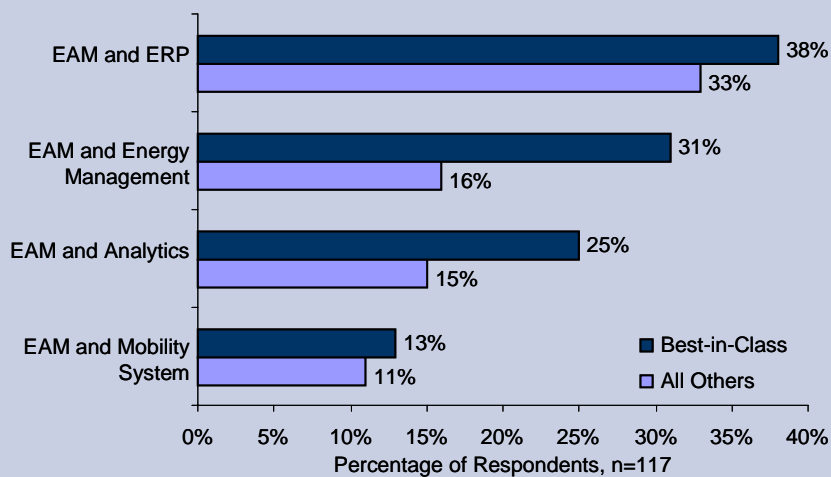
~ Phil Lochbrunner
Manager, Manufacturing
Vulcan Materials Company

Aberdeen Insights — Technology Interoperability

While Best-in-Class manufacturers are more likely to invest in asset management technology, these companies are also establishing interoperability among existing technology investments.

The primary role of technology is to facilitate information sharing across the enterprise so that employees have visibility into the manufacturing process. One of the roadblocks to this facilitation is the fact that companies have adopted technology applications that function independently in a siloed manner. Best-in-Class companies are more likely to integrate EAM solution with Enterprise Resource Planning (ERP), analytics, energy management and mobility solutions.

Figure 7: Integration



Source: Aberdeen Group, October 2010

This integration provides companies with the ability to streamline maintenance operations through better planning and scheduling of production and maintenance tasks. An integrated solution offers enterprise-wide visibility of the complete asset lifecycle, right from the design phase to the final disposition and provides this visibility to appropriate decision makers in an effective fashion such as on mobile devices. Finally, integration allows companies to connect their maintenance applications with higher-level business systems more easily which in turn results in increasing responsiveness and an ability to make quick and intelligent asset management decisions.

Chapter Three: Required Actions

Whether a company is trying to move its performance in asset management from Laggard to Industry Average, or Industry Average to Best-in-Class, the following actions will help spur the necessary performance improvements:

Laggard Steps to Success

- **Foster a culture of collaboration across functional teams.** To establish effective asset management processes it is important to have functional teams such as operations, maintenance, and safety to work hand in hand in understanding how asset management impacts all these areas. Less than half of Laggard companies have established a culture of collaboration across these groups. Collaboration is probably one of the biggest roadblocks for these companies to realize Best-in-Class performance.
- **Establish frequent risk based inspections for assets.** To promote a risk management culture, Laggards can start with implementing maintenance procedures based on risk based inspections to assess the health and performance of assets. This will enable Laggards to better understand their assets and its criticality to the overall operations. Best-in-Class companies are more than two-times as likely as Laggards to implement this capability.
- **Enable real time visibility into asset data.** Moving from reactive to predictive asset management processes requires employees to have real time visibility into asset data as well as visibility into historic information related to the assets. Laggard companies need to invest in master data management and analytics solutions to enable visibility to appropriate decision makers.

Industry Average Steps to Success

- **Consider safety as a critical part of a maintenance strategy.** Reliable assets enable companies to reduce downtime, improve the quality of the product and minimize health and safety incidents. The Best-in-Class are more likely to establish standardized processes to respond to unsafe operating conditions and establish a risk based approach that considers safety in the maintenance strategy. Understanding the impact of maintenance processes on safety will enable Industry Average companies to prevent adverse events that can result in major environmental or safety disasters.
- **Automate risk management processes for predictive decision making.** Industry Average companies need to first implement an enterprise risk framework to manage risk across the enterprise. This will help to have a structured process of identifying, quantifying and prioritizing risk and have procedures in place to mitigate the risks that can be the most damaging to the organizations' success. Industry Average companies need to then invest in risk

Fast Facts

72% of the Best-in-Class have implemented CMMS/EAM.

In addition Best in Class companies are:

- ✓ 30% more likely to implement MDM solutions
- ✓ 40% more likely to invest in asset health solutions
- ✓ Nearly two-times as likely to invest in remote monitoring solutions

How Does Your Performance Compare to the Best-in-Class?



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management solutions to automate the processes so that employees can easily understand the areas of top priority for success.

- **Invest in performance management, analytics and predictive maintenance solutions and integrate with EAM.** Optimized decision-making can only be achieved by providing critical asset data as actionable intelligence to key decision-makers, where actionable intelligence is defined as relevant and timely data presented in the proper context. A majority of capabilities discussed in this research require visibility into key maintenance, safety and operations information. Only 17% of Industry Average companies have invested in a solution that will enable their employees with that visibility.

Best-in-Class Steps to Success

- **Establish integration of EAM system with ERP, analytics, and mobility solutions.** More than 72% of Best-in-Class companies have implemented an EAM solution but only a third of the Best-in-Class have invested in connecting EAM with other software solutions. Connecting EAM with ERP, analytics and mobility will enable companies to use a single platform to access data in a timely and effective fashion resulting in increasing responsiveness.
- **Invest in mobility solutions.** Empower employees with mobile devices that are integrated with asset management solutions. Adoption of mobility solutions for asset management will reduce error because of manual data entry during routine operator rounds and will enable employees to initiate work orders without going to their workstations.

"The value derived from our asset management strategy is mostly efficiency-driven. By interfacing EAM with ERP, we reduce duplicate entry for key business data and enhance our validation of the data entry. Also, as a result of the integration between these two systems, we are able to report and analyze costs of work order and equipment levels, rather than just at a general ledger or project level, resulting in better historical data and management reporting."

~ Chris Napoli,
Project manager,
Air Liquide Large Industries,
US

Aberdeen Insights — Summary

The impact of asset management is growing, as 53% of the overall respondents view it as a high level strategic function. This is both good and bad for the maintenance groups. Good because it will enable maintenance to get resources and sponsorship from senior management and (potentially) bad because these groups now should expect more scrutiny from the senior executives. Without increased visibility and control, this level of increased scrutiny can wreak havoc on the maintenance organization. This is especially important in asset intensive industries. With growing environmental and industrial disasters in the last two years, companies are being examined not only by senior management but also regulatory bodies and voluntary groups.

Successfully addressing the pressures faced by asset management groups require organizations to first create a predictive risk-based culture involving cross functional teams and then to enable these teams with the information required to make predictive decisions. Organizations should use the recommendations in this research, based on their maturity with asset management programs, to realize Best-in-Class performance.

Appendix A: Research Methodology

Between September and October 2010, Aberdeen examined the experiences, and the intentions of more than 115 enterprises on their asset management programs.

Aberdeen supplemented this online survey effort with interviews with select survey respondents, gathering additional information on Asset Performance strategies, experiences, and results.

Responding enterprises included the following:

- *Job title:* The research sample included respondents with the following job titles: CEO / President (12%); EVP / SVP / VP (10%); Director (12%); Manager (32%); Consultant (17%); Staff (10%); and other (6%).
- *Industry:* The research sample included respondents from the following industries: Oil and Gas (15%); Utilities (14%); Chemicals (11%); Industrial Products (9%); Metal and metal products (8%); Food & Beverage (8%); Field/ repair services (5%); Automotive (5%); Construction/ Engineering/ Architecture (5%); Aerospace and Defense (5%); Telecommunication (5%) and Others (10%)
- *Geography:* Fifty percent of respondents (50%) were from North America. Remaining respondents were from the European region (29%); Asia (8%); Middle East, Africa (7%) and South and Central America (6%).
- *Company size:* Thirty-eight percent (38%) of respondents were from large enterprises (annual revenues above US \$1 billion); 35% were from midsize enterprises (annual revenues between \$50 million and \$1 billion); and 27% of respondents were from small businesses (annual revenues of \$50 million or less).

Study Focus

Responding maintenance and operations executives completed an online survey that included questions designed to determine the following:

- √ The degree to which asset performance management solutions are deployed in their manufacturing operations and processes and the financial implications of the technology
- √ The structure and effectiveness of existing asset performance management implementations
- √ Current and planned use of asset performance management to aid operational and manufacturing abilities
- √ The benefits, if any, that have been derived from asset performance management initiatives

The study aimed to identify emerging best practices in asset performance management, and to provide a framework by which readers could assess their own management capabilities.

Table 4: The PACE Framework Key

Overview
<p>Aberdeen applies a methodology to benchmark research that evaluates the business pressures, actions, capabilities, and enablers (PACE) that indicate corporate behavior in specific business processes. These terms are defined as follows:</p> <p>Pressures — external forces that impact an organization’s market position, competitiveness, or business operations (e.g., economic, political and regulatory, technology, changing customer preferences, competitive)</p> <p>Actions — the strategic approaches that an organization takes in response to industry pressures (e.g., align the corporate business model to leverage industry opportunities, such as product / service strategy, target markets, financial strategy, go-to-market, and sales strategy)</p> <p>Capabilities — the business process competencies required to execute corporate strategy (e.g., skilled people, brand, market positioning, viable products / services, ecosystem partners, financing)</p> <p>Enablers — the key functionality of technology solutions required to support the organization’s enabling business practices (e.g., development platform, applications, network connectivity, user interface, training and support, partner interfaces, data cleansing, and management)</p>

Source: Aberdeen Group, October 2010

Table 5: The Competitive Framework Key

Overview	
<p>The Aberdeen Competitive Framework defines enterprises as falling into one of the following three levels of practices and performance:</p> <p>Best-in-Class (20%) — Practices that are the best currently being employed and are significantly superior to the Industry Average, and result in the top industry performance.</p> <p>Industry Average (50%) — Practices that represent the average or norm, and result in average industry performance.</p> <p>Laggards (30%) — Practices that are significantly behind the average of the industry, and result in below average performance.</p>	<p>In the following categories:</p> <p>Process — What is the scope of process standardization? What is the efficiency and effectiveness of this process?</p> <p>Organization — How is your company currently organized to manage and optimize this particular process?</p> <p>Knowledge — What visibility do you have into key data and intelligence required to manage this process?</p> <p>Technology — What level of automation have you used to support this process? How is this automation integrated and aligned?</p> <p>Performance — What do you measure? How frequently? What’s your actual performance?</p>

Source: Aberdeen Group, October 2010

Table 6: The Relationship Between PACE and the Competitive Framework

PACE and the Competitive Framework – How They Interact
<p>Aberdeen research indicates that companies that identify the most influential pressures and take the most transformational and effective actions are most likely to achieve superior performance. The level of competitive performance that a company achieves is strongly determined by the PACE choices that they make and how well they execute those decisions.</p>

Source: Aberdeen Group, October 2010

Appendix B: Related Aberdeen Research

Related Aberdeen research that forms a companion or reference to this report includes:

- [Asset Performance Management: Aligning the Goals of CFO's & Maintenance Managers](#); November 2009
- [Managing Risks in Asset Intensive Operations](#); March 2009
- [Asset Performance Management: Driving Excellence through a Reliability Strategy in Real-Time](#); November 2008
- [Enterprise Asset Management: Maximizing Return on Assets and Emerging Trends](#); June 2008
- [Risk Mitigation in Manufacturing Operations](#); March 2008
- [Ground Up Strategies for Asset Performance Management](#); September 2007
- [Benchmarking Enterprise Asset Management](#); June 2007
- [Collaborative Asset Maintenance Strategies](#); December 2006
- [Driving Enterprise Performance with Asset Information](#); July 2006
- [The Asset Management Benchmark Report : Moving Toward Zero Downtime](#); April 2006

Information on these and any other Aberdeen publications can be found at www.aberdeen.com.

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