

Sweating the assets

Best practice in asset maintenance is really important for mining companies, particularly in light of the current downturn in the industry. Ailbhe Goodbody looks at how companies can use it to keep costs down

The Hitachi EX3600-6 excavator

Mining is an asset-intensive business with extreme price competitiveness. With maintenance representing up to 30% of operating costs, it is critical that reliability is a focus of the business and not just a mine site.

Todd Schools, global industry solutions manager – metals & mining at Emerson Process Management, says: “In our experience, miners with effective asset-maintenance programmes usually have greater productivity and better control over their profitability.”

Asset management and maintenance represent a large expense that mining companies would like to reduce or better anticipate for budgeting. With the rising costs of machinery and equipment for mines, it has become increasingly important to have defined best practices for asset maintenance.

Good asset maintenance allows mining companies to manage the operational cost of equipment more effectively. Best practices are driven by historical evidence and trends over years of data collection.

Greg Smith, general manager, mining support group at Hitachi Construction Machinery, recommends: “As technology changes, the methods and focus points will inevitably vary, so aligning your asset-maintenance strategy with what is deemed best practice is a key driver in lowering the overall cost per tonne of any mining operation.”

Reducing unscheduled downtime and minimising scheduled downtime are key strategic goals for all mining companies. By recognising defects prior to failure, the sooner a potential



failure can be detected, the lower the cost and fewer resources required for repair.

Matt Desmond, vice-president – global services at Hexagon Mining, explains: “This minimises production impact and repair, or replacement expenses. Stresses to systems, parts and components cause and contribute to failure, as well as diminishing reliability and predictability of assets and equipment in general.”

Operations and maintenance departments at mines often have opposing views on what constitutes asset-maintenance best practice. The operations side is focused on keeping the production on track; any equipment downtime is therefore seen as a detriment. In contrast, for maintenance personnel to maximise equipment availability, units must be serviced in a

planned manner so that potential problems can be addressed before costly failures occur.

Adrian Beer, senior vice-president, mining & enterprise asset management at ABB Enterprise Software, says: “There is a lot of debate around what best practice is. A good system will include the identification of the systems and equipment that have the most significant impact on the business and ensure that these are proactively managed from a perspective of risk and criticality.”

Planned downtime of equipment is usually a necessity to avoid hundreds of thousands of dollars in lost production due to unscheduled downtime of the mine’s equipment. Geoff Gauthier, marketing supervisor at Wenco International Mining Systems, comments: “Repairing the equipment

“In our experience, miners with effective asset-maintenance programmes usually have greater productivity and better control over their profitability”



before it breaks will obviously cost much less, as catastrophic failures can result in a machine being down for weeks."

Predicting failures and wear allows the mine to get the parts in stock before they become a difficult commodity, allowing them to put the machine back in production right away.

For example, Gauthier says: "Having a down while the machine was planned to be operational prevents meeting the production plans and could jeopardise blending or meeting production quotas before the train leaves for the port."

By also having reliable and accurate information about the status and the history of assets, from discrete components to the complex plant, mining companies are able to significantly reduce their downtime, dramatically increase their scheduling

ability and improve their operational visibility of both process availability and financial performance.

While fundamentally an enterprise asset-management (EAM) process ensures that assets are available for use and operating efficiently, implementing a best-practice EAM includes having proactive maintenance strategies in place with work defined and scheduled to the right people, equipment and skills. In this way, mining companies can reduce unplanned work and improve response times, while significantly reducing the risk of safety incidents with well-documented safety information, maintenance processes and training.

Best practice could also be framed as optimal practice. Beer says: "Our leading customers make optimising decisions on maintenance activities

across scarce resources within their organisations. To achieve this requires both a technological and organisational shift in the way that maintenance and production departments conduct themselves."

Maintenance should not be considered in isolation of production nor contractual requirements – within an organisation, it is a matter of balance to achieve optimal results.

Beer notes: "Practically, it is still common for asset maintainers to 'hoard' spare parts on the off chance that they are required. This can lead to significant costs being tied up in working capital (inventory). With a well-designed and implemented asset-maintenance process, a warehouse can save any organisation (not just a mine) millions of dollars."

The ability to constructively analyse information with a common approach allows an organisation to assess performance problems and develop recommendations whenever indicators trend negatively or an issue occurs. This process ensures that everyone in the organisation understands what their role is to ensure the quickest and most appropriate rectification of any issues.

Ultimately, the best practice is the one that ensures that equipment is maintained proactively, which in turn keeps it up and running and available to meet production demands.

KEEPING COSTS DOWN

With the current downturn in the mining industry, many mining companies are trying to 'sweat the assets' to get the most from their fleets for the least expenditure. Good practice in maintenance management has a large role to play in this – good maintenance practice, while not a highly visible or attractive expenditure, is vital to keep an operation running efficiently. Through good maintenance practices, mines can extend the life of their current fleet and delay, or in some cases completely avoid, new equipment purchases.

The current mining downturn is only highlighting the need for asset-maintenance systems. With the purse strings tightened, it becomes crucial to keep existing machines running and keep production strong. Given these times, miners need to focus their attention on getting the absolute most out of the equipment they currently operate. Unplanned downtime not only diminishes productivity, but it also drives up costs.

"Fluctuating metal prices, declining ►

“Practically, it is still common for asset maintainers to ‘hoard’ spare parts on the off chance that they are required”

Emerson has been focusing and investing in new products and services for asset maintenance



influence the ability of each component to push beyond the originally targeted life is the challenge, but ultimately the best avenue to achieve a positive result from 'sweating the asset'."

This process should result in the continual re-alignment or ability to adapt the target life expectancy of each component to be more reflective of an individual application rather than an average-based benchmark.

'Best in class' mine sites have an in-depth understanding of their assets in order to lower their maintenance costs, including minimising inventories of spares. Good maintenance practices, which include utilising online predictive maintenance tools and continual improvement of maintenance processes, set these sites apart.

Implementing proactive maintenance practices play a significant role in optimising a mine's ability to get the most from any machine on site. Examples include oil sampling, tracking major-component life, use of approved fluids and adhering to regular maintenance intervals.

'Sweating the assets' exploits components by employing a condition-based maintenance programme instead

"Asset maintenance is an area of increasing focus. Unfortunately, it is also an area prone to cutbacks

ore grades and increased operational costs are driving mines to look for ways to increase efficiencies and decrease costs," says Michael Lewis, vice-president for product innovation at Modular Mining Systems. He goes on to explain that maintenance continues to represent a significant percentage of mines' operating costs.

"Because of its ability to help mines reach their goals, asset maintenance is an area of increasing focus. Unfortun-

nately, it is also an area prone to cutbacks," he adds.

Good maintenance practices have a huge role in any attempt to extend maintenance intervals for major components. Smith explains: "The industry direction towards predictive maintenance is largely about gaining a better understanding of component-life expectation based on cycles, as opposed to unit hours. Balancing this with operational factors and how they

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of a time-based preventative maintenance programme. Robust maintenance practices involve being able to assess and analyse performance consistently.

Monitoring the components based on condition, rather than simple useable life recommendation, gets the most utility up to just before the point of failure – if the state and performance of assets and processes are well understood, then the boundaries of performance can be reached, allowing equipment to be fully utilised without any increase in the risk of failure or negative performance.

Desmond suggests: “It requires real-time data monitoring of the assets to know where to focus your maintenance practice. A condition-based practice requires discipline, data analysis and innovative maintenance programmes to keep the pulse of machines, as well as the best processes and skillsets to intervene when there might be failure.”

Implementing these programmes requires a combination of historical information, near real-time monitoring, and skilled workers with management support and mature processes and procedures. Desmond says: “The

expectation is that the predictive system or programme, through condition monitoring and real-time interfacing, can analyse the data, detect faults or potential failures, diagnose potential issues and predict how long the equipment, component or system can operate safely.”

A significant role that asset ►

At the Cobre del Mayo mine in Sonora, Mexico, Paola Flores and Francisco Bustamante put Hexagon Mining’s Leica Jigsaw to work



Fleet-management systems

Fleet-management systems (FMSs) may also be used at a mine site to effectively manage all the elements involved in asset maintenance. Such a system can be the silent, ever-watchful system that gathers the data for the maintenance crew to make the most data-driven decisions. Gauthier explains: “It’s important for this information to reach the appropriate people so that a decision can be taken before large costs are incurred in the shift.”

Integration between FMSs and maintenance-management systems can enable the bi-directional exchange of information.

Simon Van Wegen, maintenance product

manager at Modular Mining Systems, says: “For example, when the MineCare solution is used with the DISPATCH system, maintenance activity and repair times are tracked by the DISPATCH FMS and utilised by the MineCare solution for trending, reporting and other related tasks.”

Integration with Modular’s DISPATCH system also leverages the capabilities of the DISPATCH FastFeedback module. With FastFeedback, operators are alerted to improper actions in real time, allowing them to self-correct undesirable behaviours, such as applying the service brake at high speed, to prevent equipment damage.

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A Komatsu 830E truck with Komatsu PC8000 hydraulic shovel

management plays is managing the situational factors as they relate to equipment and asset performance. Pure condition-based monitoring only considers the alarms and machine tolerance-type performance recommendations, usually those of the OEM.

Beer recommends: "These need to take into account all of the different environments that this particular type of equipment may operate in, and may be tweaked for some of the specific environmental factors, such as ambient temperatures."

With Modular Mining Systems' MineCare 3 solution, mines can perform remote equipment health monitoring, data collection and support

However, by taking into account the specific environmental conditions in which the asset operates – including the operating performance models, load cycles or demands placed on the equipment – a best-practice maintenance strategy can significantly increase the useable life and performance of equipment.

One important distinction is between operator and production abuse and actual component and machine failure or maintenance practices. Desmond says: "Human interaction and disruption is a leading factor in stress to operations and equipment. There are many situations where an asset's productive life is reduced or terminated because of abuse or misuse.

"While not a specific maintenance issue, it's important to shape an operations culture that understands the negative impacts and the vital role it has in extending useful productive life."

Maintenance can then focus on more mature efforts of condition monitoring and predictive maintenance because they are not always reacting to unplanned or unnecessary failures.



CUTBACKS

The maintenance-management budget is a large part of overall mine running expenses. Due to the current downturn in the industry, some mining companies have been cutting back on their maintenance spend as cost pressures increase on their businesses, despite

the fact that this is widely considered to be a false economy – an apparent financial saving that in fact leads to greater expenditure in the long run.

Smith notes: "Strangely enough, it is generally considered and accepted to be a false economy, yet mines continue to make cuts to maintenance budgets anyway. Unfortunately, it is the most obvious short-term way to make the numbers on a budget look good on paper, immediately."

However, what can seem like a good cost saving in the short term often translates into longer-term pain for the organisation.

Mining is an asset-intensive industry, and those assets need to be maintained in order to sustain mine productivity. Some may simply cut back or eliminate certain maintenance tasks, but that short-term gain can be costly later in terms of more unplanned downtime and lower availability.

Smith cautions: "What the mines are actually accepting by doing this is increasing the level of risk or exposure to catastrophic failure."

For example, actions such as deferring necessary repairs can lead to failures that take equipment out of

Software

Software is an important part of managing asset maintenance at mine sites. The appropriate software solutions for the site will depend on the mine's methods for approaching maintenance and reliability, as well as the maturity of the mine's maintenance department.

A reliable software package can bring all of the data needed to aid the decision-making process into a central repository. Software can capture sensor and alarm data in real-time and help the operations and maintenance teams focus on areas for improvement. This can be co-ordinated with operations for continuous monitoring, through giving alerts based on condition rules and scenarios, as well as trending and historical data analysis.

Desmond comments: "As more innovative technology becomes available, nearly all mines seek solutions to help manage fleet maintenance

from a predictive, preventative and root-cause-of-failure approach."

Asset maintenance is just one interdependent part of the entire operation, whether the process relates to the asset lifecycle process or whether it is part of the overall 'operational' process that balances production, asset availability and market demand. In addition, analysis of maintenance determines, or gives an indication of, how effective or efficient the decisions have been.

Beer says: "The efficiency of these processes, with visibility of reliable and accurate information, allows the organisation to manage the relationship between production demands, asset availability and the market and contractual demand or production schedule of the operation. Accessing the information and data within the operational technology further simplifies the task of making optimal decisions in a dynamic environment."

service unexpectedly and disrupt the production cycle.

Mines are pushing the practical service lives of their mobile production equipment to unprecedented levels. "Ten or 15 years ago, mines considered 50,000 to 60,000 hours of service from a haul truck acceptable. Today, those same mines are pushing for 100,000 hours of service," says Lewis. "We have customers who are already getting 100,000 hours trying to push it even further."

Some mines also resort to component sharing, a practice in which a failed part in one piece of equipment is replaced with a used part from another piece of equipment. "This tactic is almost always a temporary solution," Lewis adds. "The used part will inevitably give out from the extended wear and tear, and may actually lead to a more costly failure than the mine initially tried to avoid."

Depending on the mine's culture, maintenance may be asked to stretch their budget – especially if production and maintenance are in two separate silos. Gauthier says: "Due to the durability of modern machines, the symptoms of bad maintenance may unfortunately take longer to detect, leaving new maintenance crews with inherited problems of previous neglect."

Mines with a holistic view of the problem of reducing cost will reduce production stress on the machines and give more time to the maintenance crews to do an even better job of fixing the machines before problems occur. This will significantly reduce cost over time.

Schools advises that a more appropriate plan for miners is to shift investments into more sophisticated maintenance programmes that use online predictive-maintenance technologies and review maintenance strategies to ensure that they are adding value and are focused on failure modes that are actually occurring at the mine.

Schools suggests: "This process should start with a mine site's most critical assets, such as overland conveyors, shovels, draglines or mills. Understanding the consequences and likelihood of failure gives a full understanding of risk and will pay quick dividends."

True asset management provides a broader, site-wide perspective to optimise the long-term management of capital assets. It seeks to integrate planning, engineering, funding and IT perspectives. Don Castor, product

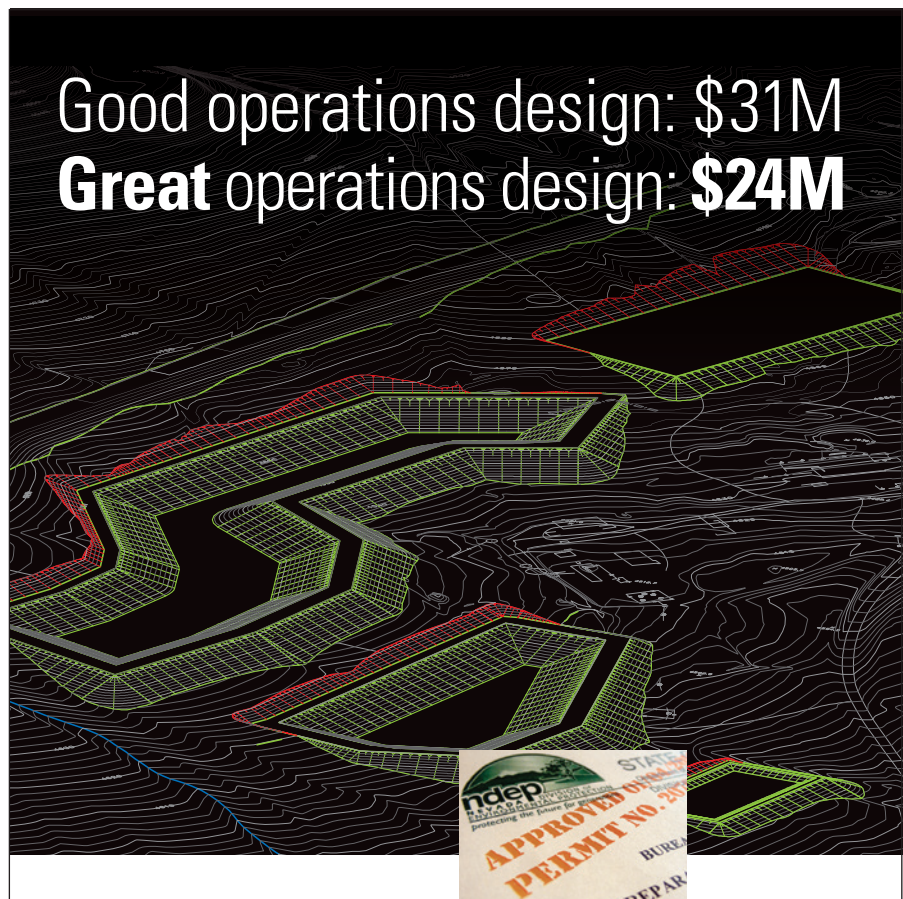
marketing manager, mining division at Komatsu America Corp, says: "When combined, these perspectives allow for informed and prioritised decisions, based on reliable data that best utilise scarce resources."

Meticulously capturing reliable data by tracking and managing work requests, utilisation, planned/unplanned downtime and maintenance labour will gain the highest return on maintenance budgets.

Beer notes: "In reference to best

practice, we see our leading clients approach this challenge with a deliberate and measured review of their maintenance practices, looking for areas such as inventory management and maintenance scheduling as cost-saving measures for their operations.

"Those at the other end of the spectrum that make wholesale cuts usually end up with pretty disastrous outcomes, and often at a time when they can least afford it." ▶



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Asset management needs to take into account all the different environments that the type of equipment may operate in

Photo: ABB

A common trend in recent years is the transition from in-house maintenance to outsourced maintenance. In such cases, the mining organisation still controls the work to be completed, but the contractor is responsible for undertaking the work; this removes the personnel overhead from the mining organisation and can allow contractors to balance their resources over multiple sites.

Beer adds: "We see huge potential savings for our clients by being able to quickly and easily transition between in-house and external support without reducing their visibility of assets' health and condition, or losing track of the type of work done to equipment by whom.

"This contractor and third-party management capability provides great flexibility for clients who need to be able to quickly implement business-practice changes to gain the most benefit of making the change."

UNPLANNED DOWNTIME

Asset maintenance can be planned to prevent costly unplanned downtime, while also maximising service life. The goal of asset maintenance is to meet an expected level of service, in the most cost-effective manner. This can be achieved by aligning maintenance schedules in accordance with the manufacturers' recommendations and using genuine OEM parts.

Castor says: "In the current market, it's essential to optimise maintenance intervals and plan which required maintenance tasks can be done at the same intervals to reduce downtime. Providing a defined level of service quality, monitoring performance and planning maintenance in order to manage risks associated with unplanned downtime events will help reduce the life-cycle costs of mining machines and maximise service life."

Simply put, this can be achieved by

OEM involvement

OEMs can get involved in promoting best practice in asset maintenance at mine sites, for example by consulting with mines to assess fleet conditions or offering ongoing training.

In some cases a maintenance-and-repair contract (MARC) may be implemented.

Smith outlines the main advantage: "Having the OEM take control of the asset and match the maintenance strategy to what is best for the machine, as opposed to one that is



formalising the maintenance process and documenting the best practices. Gauthier explains: "This means extracting the knowledge out of experienced mechanics (not managers) of what needs to be done, when it needs to be done and of course why it needs to be done. They 'why' is essential to have buy-in from the future maintenance group."

An asset-maintenance plan allows mine sites to run to their maximum potential when it is designed to fully understand asset health with the use of predictive technologies and the full use of the data it provides.

Understanding the health of an asset, whether it is a critical shovel or conveyor, enables the site to run with the data necessary to schedule and fully plan downtime.

All of this can only be accomplished by having a solid monitoring system that tracks machine performance, production, alarms, historical health trends and downtime activity, and provides an easy way to retrieve and visualise the data.

Scheduling of routine inspections and monitoring of operating statistics provides an opportunity to look for

impacted too heavily by short-term operational influences."

Komatsu has partnered with engine supplier Cummins to improve engine filtration and pave the way for extended service intervals.

Castor explains: "This collaboration between OEMs benefits our customers by allowing for optimisation of fuels, oils, coolants and filters. Optimising these filtration systems can lead to improved uptime and reduced asset-maintenance costs."

trends in performance. Follow-up maintenance activities and/or defect recognition ensure that, rather than fixed-interval maintenance, a mining organisation is able to progress to a more appropriate predictive process.

With full understanding of the mining operation, trade-offs between the competing forces of production, contractual obligation and asset availability can then be knowledgeably or adeptly made.

Post-mortems of unexpected downtime with the equipment vendors and maintenance team, using the full set of history and information available, can result in significant process improvements – not to mention the benefits to the equipment vendors who gain further insight into the performance of their equipment.

"Organisations that adopt a proactive vs. reactive approach to maintenance are able to move away from a repetitive cycle of 'forever fixing' toward a goal of 'fix forever'," says Van Wegen.

For example, a mine that follows a reactive approach will be caught off guard when a truck blows a tyre along the haul route. This action could potentially cause the truck to swerve and block the road, shutting down travel and impacting the production schedule until the truck can be towed to the maintenance facility for service.

Alternatively, a mine that follows a proactive approach can analyse collected tyre sensor and other data to determine that the tyre is frequently overheating on a certain route.

The mine then has the option to reassign the truck to a less strenuous route, extending the life of the tyre until a repair can be scheduled for an opportune time. By doing so, production proceeds normally and the tyre is replaced without incident.

"A mine that follows a reactive approach will be caught off guard when a truck blows a tyre along the haul route"



The Hitachi EX8000-6 excavator loading a Hitachi EH5000AC-3 truck

Schools tells MM: “For example, a main ore-conveyor drive bearing that is beginning to fail can be detected with Emerson’s PeakVue technology months before failure.

“The bearing’s performance and health degradation can be monitored over time and plans can be put in place to perform maintenance at the time that is most opportune for the mine and in the most efficient manner. This directly translates to maintenance-dollar savings and availability gains.

Surprises and unplanned failures are extremely expensive and in most cases are avoidable.”

EQUIPMENT MONITORING

The most important areas of an equipment fleet to monitor as part of preventative maintenance depend on the site and its unique factors, the equipment being used and its applications.

However, generally speaking, it is important to monitor the components

that have the greatest range of variability in life expectancy due to operation outside the design parameters of the machine, as well as areas that are likely to result in significant downtime event should an unscheduled breakdown occur.

In some cases, fuel burn may be a better indicator than total hours and load factors, and tonnes hauled may be better predictors of parts that need replacement. Some monitoring systems have the ability to retain a history of normal system operating parameters.

Castor says: “This is very important because every machine establishes its own norms, and deviations from these norms serve as alerts to avoid expensive downtime and after-failure repairs.

“Each mine should know where it is spending its time and money on recurring repairs and implement preventive maintenance measures to reduce these expenditures.”

Quality preventative-maintenance programmes can deliver real benefits to a mine by maximising availability, minimising overall costs, extending the life of assets, and improving fuel consumption and productivity. ▼

“Surprises and unplanned failures are extremely expensive and in most cases are avoidable”



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