

KOMATSU



PreVail

Remote health management system





Komatsu is continually investing in research and development to deliver technology products that will revolutionize mining.

We are proud of our investments in advanced technology. Our resources are committed to developing methods and solutions focused on higher productivity and reliability and safer operations.

We offer an array of technology products that address health monitoring, production and machine performance, such as the PreVail RHM and Vibration Monitoring systems, along with equipment upgrades such as our world class electrical control system platforms.

Along with these products, our Smart Solutions team delivers substantial value to our customers' operations by constantly engaging with the mines in order to help predict down-time or issues that could cost time and resources.

We are committed to delivering solutions that will create value through safer, more productive and reliable products.

PreVail RHM helps sharpen your competitive edge

The mining industry is highly innovative in its quest for greater efficiency and safety.

Your P&H equipment plays a key role. Keeping it up and running at high reliability and productivity levels is a key factor to sustaining good cost control and profit growth.

PreVail Remote Health Management (RHM) technology helps you achieve that objective by providing your operations and maintenance management teams with timely, efficient machine health and performance knowledge.

Equipped with that knowledge, the PreVail RHM system positions you to drive your assets and your operations toward greater levels of reliability, productivity and profitability.

Data ➡ Information ➡ Results

PreVail RHM is set up to deliver valuable knowledge

Knowledge is power: It is essential for effective decision making. PreVail RHM:

- Distills information from machine health and performance data.
- Recognizes familiar patterns and deviations from normal control limits.
- Makes connections between what is happening now and what has occurred before.
- Enables you to identify and carry out the right actions at the right times to increase asset utilization, efficiency and production.

Data to Information to Knowledge: The PreVail RHM system taps into the powerful communication, command and control capabilities of the electrical control system, transforming the data and information it produces into more refined knowledge of great value to your operations and maintenance management teams. That knowledge is available in several forms including KPI (key performance indicator) dashboards graphical analysis tools, predictive modeling and reporting tools.

The PreVail RHM system is available on the following P&H equipment:

- Electric mining shovels
- Blasthole drills
- Wheel loaders



PreVail RHM helps unify maintenance and operations

Your operations management team is focused on optimizing production

Your maintenance management team applies strategies including reliability-centered maintenance in support of that objective.

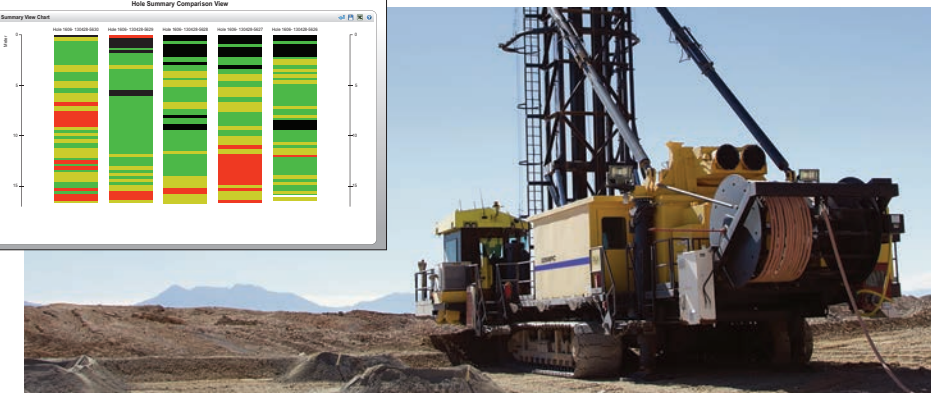
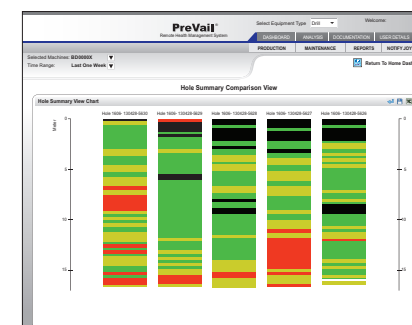
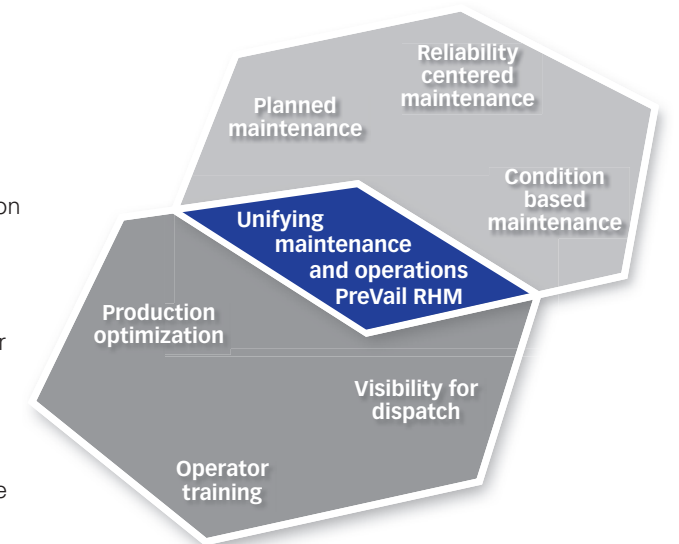
Both teams are unified by the PreVail RHM system through the power of information management technology.

Your ability to obtain increased operational control and efficiency is supported by the PreVail RHM system key performance indicator report analysis dashboards. They provide easy-to-understand machine productivity and reliability information including:

- **Fleet productivity** (status, utilization) helping you identify equipment performing less-than-optimally for corrective action
- **Utilization analysis** showing which units are operating, non-operating or fault-sidelined
- **Mean time between shutdown analysis** providing reliability benchmarks helping to identify units requiring increased availability
- **Runtime distribution analysis** revealing equipment with lower runtime hours for corrective action leading to increased availability
- **Filtered outage / sub-system analysis** that identifies faults and systems requiring corrective action for increasing availability

- **Filtered outage list** providing analysis of faults using parameters such as parent-child faults by severity, faults linked to operator for faster root-cause findings, more uptime
- **System warnings analysis** pointing to patterns, potential failure modes
- **Alert management** expediting communication of fault alerts by severity for faster response, issue resolution and more uptime
- **Load distribution** (load count, average payload, under-loaded count, over-loaded count) helping you identify operators who can benefit from making adjustments to operating technique
- **Cycle time performance** (average cycle time, dig time, swing time, tuck time, swing angle) helping you increase productivity by identifying training needs for inexperienced operators

- **Operating practices analysis** showing instances and severity of motor stalls, boom jacks and swing impacts
- **Fuel burn visualization** - correlating the industry's lowest wheel loader fuel burn advantage to tonnage moved
- **Mobility analysis** - tracking tons per hour moved over the percentage of time in propel, providing detail to optimize blending flexibility in any application more efficiently than any other prime production loading machine
- **Detailed hole summary** providing details about what occurred while drilling a hole to better plan and execute blast plans such as final depth, drilling time and specific energy
- **Mobile device alert notifications** containing complete fault information sent to your mobile communication device, expediting awareness that a fault has occurred, enabling the PreVail RHM log-in to begin failure analysis and expedite repair process with an "escalation engine" enabling you to simultaneously alert Smart Solutions service centers for fast response, mean time to recovery (MTTR)





The PreVail RHM system helps reduce cost per ton/meter through early warnings

To help identify and provide early warning detection of faults or failures before they occur, the PreVail RHM system supports condition-based equipment monitoring (CBEM) models that use algorithms to detect certain systems data trends that deviate from normal control limits.

PreVail RHM system: Enabling proactive resolution for maximum uptime

Komatsu remote health management analysts supported by engineers, subject matter specialists and customer support technicians develop and manage the CBEM models to help mines obtain this added knowledge value from the PreVail RHM system.

When real-time data collection and analysis reveals a system data anomaly, the CBEM model recognizes that development and its potential impact on machine health. It responds by issuing a first-snapshot notification (FSN) to the Komatsu support office nearest to the mine operation.

Komatsu Prognostics and Remote Health Monitoring personnel act upon the FSN by checking, interpreting and verifying the development. They then issue a work order to launch corrective action as part of a typical remote health monitoring work flow for effective issue-resolution process control.



PreVail architecture includes a data-collection module mounted in a secure compartment and connected to the control system module onboard the machine. The ability to transmit trend data and event files depends on the mine’s wireless network (WiFi, Mesh) or through a satellite channel. The PreVail RHM system includes web-based access for maintenance and operations personnel.

Key machine health factors that have the potential to cause costly interruptions or instant and delayed shutdowns are monitored 24/7 through a suite of predictive models applied to PreVail RHM system trend data. They include:

- Main power supplied via high-voltage trail cable
- Motor bearing thermal data
- Brakes analytics
- Dig attachment handle crowd belt tension

Following are two examples of PreVail RHM system CBEM early-warning “catches” that minimized cost and expedited a return to production.

PreVail RHM value example: Crowd gearcase temperature faults

Situation: A P&H electric mining shovel equipped with PreVail RHM system begins reporting crowd gearcase temperature faults.

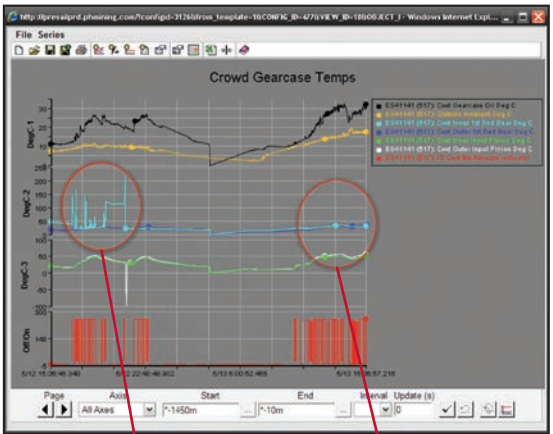
Challenge: Determine root cause of the faults as soon as possible, as one possible course of action would be a temporary disconnect of the RTD or resistor temperature detector applied to the crowd motor input shaft. To have No RTD link means having no temperature monitoring on the crowd input shaft – and heightened potential for crowd gear case failure.

PreVail RHM solution: Komatsu Prognostics and Remote Health Monitoring personnel use the PreVail system CBEM to analyze data points associated with the crowd gearcase bearings and temperature fluctuations. They alert field service personnel to the crowd gearcase temperature faults issue with a First Snapshot Notification (FSN). Field service technician examines the FSN and alerts mine maintenance to inspect the crowd gearcase, looking specifically for a loose RTD connection.

Result: Mine maintenance inspection confirms the root cause to be a loose RTD connection at the input card in the shovel boom I/O point for the crowd inner first-reduction bearing. This avoids a temporary RTD disconnection and heightened potential for a crowd gear case failure. As a result, the mine makes a simple fix with confidence backed by reliable data and continues to fully utilize the crowd gearcase and avoid replacing components suspected to be defective. What’s more, the mine avoids unplanned downtime and associated labor and equipment costs, as well as the opportunity cost associated with lost production.



Variations in RTD Signature indicate possible loose connection or faulty RTD.



RTD Signature with good connections. RTD Signature with loose connection.

PreVail RHM value example: Recurring hoist motor over-temp faults

Situation: At the height of summer when heat management is a concern, a P&H shovel equipped with the PreVail RHM system experiences a sudden and recurring onset of “Hoist Motor Field – Over-Temperature” faults affecting the rear hoist motor.

Challenge: How best to quickly determine root cause of the over-temp issue on an already-warm shovel that is causing relatively brief delays in the pre-strip loading operation in Wyoming’s PRB – and above all, put the shovel back on a good footing for sustained high levels of productivity.

PreVail RHM solution: Komatsu Prognostics and Remote Health Monitoring personnel use the PreVail RHM system CBEM to sift through data trends, interpret anomalies, and watch for further changes. They compile a First Snapshot Notification (FSN) from the data and relay that information to the Gillette Smart Solutions services team. The PreVail RHM system generates more detailed information, including the Centurion Troubleshooting Guide within its toolbox that lists “Insufficient cooling by the motor blower assembly” among possible “Motor Winding – Temperature Fault” causes. This finding is relayed to mine maintenance personnel who quickly verify that this is the root cause of the temperature fault issue.

Result: Avoided rear hoist motor failure and the cost to replace that unit. Extended rear hoist motor useful life due to effective ventilation. Approximately 7 hours of productive shovel up-time saved by avoiding the need to replace the hoist motor. Minimized cost: Replacement of a failed hoist ventilator motor costs far less than replacing a failed hoist motor. Shorter MTTR. More production.



The PreVail RHM system helps reduce cost per ton/meter through LCM

Komatsu supports several hundred P&H machines placed into service worldwide. Because PreVail RHM systems analysts have access to a global fleet of machines, the PreVail RHM knowledge base is substantial, growing and evolving at a rapid rate.

As a result, issues are being detected and analyzed with greater speed. Solutions are being developed and applied with increasing efficiency. Performance benchmarks and “best in class” standards are undergoing continuous improvement.

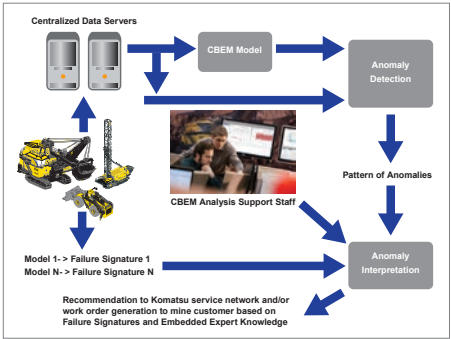
We are investing in an expanded base of Smart Solutions service centers worldwide, enabling us to provide our customers with consistently better machine monitoring, reliability and productivity.



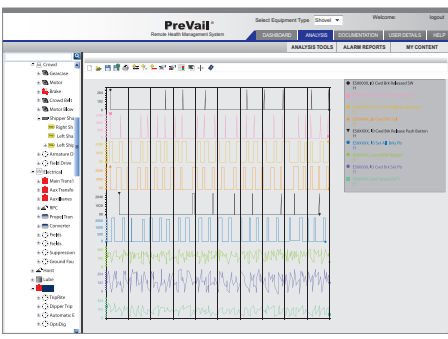
Smart Solutions service centers



KPI dashboards



Predictive modeling



Analysis tools

Our Smart Solutions service centers are situated in all of the major mining regions worldwide to be close enough to your operations to provide effective LCM support. Elements of LCM support include:

- PreVail RHM system support
- Quality OEM parts
- Quality OEM remanufactured components
- Preventive maintenance programs
- Repairs, rebuilds and relocations
- Performance-enhancing systems and machine upgrades
- Product training support
- Used equipment and components



PreVail RHM system:
Reliable information in support of efficient mining

Improve operator performance

- Benchmark production totals
- Analyze cycle times
- Benchmark operating practices
- Real-time event logs for dispatch viewing

Remote troubleshooting

- Detailed trends of historical data
- Detailed event log of historical events
- User-configurable analysis
- In-depth fault analysis: Patterns, Prioritization, Escalation

Web accessible

- Predictive and condition-based maintenance
- Failure mode monitoring alerts
- Duty meter calculations on key components
- Backed by FMEA's

Improved maintenance support

- Online schematics, manuals, electrical diagrams
- **24/7** Komatsu expert support
- Case management notification: annotate, e-mail, escalate
- Web accessible

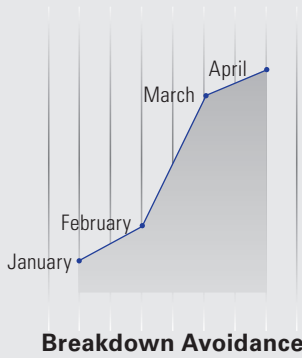
Ease of use

- Configurable notifications
- Simple summary reports e-mailed
- Personalized reports and trends
- Supports mobile workforce

Future upgrades

- Vibration monitoring
- Power monitoring

Bottom line:
PreVail Remote Health Management system technology positions your mine maintenance and operations management team for greater asset optimization and lower cost per ton/meter.



Contact a Komatsu Mining service representative for more information or visit <https://mining.komatsu>

Komatsu Mining Corp. Group

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