Challenge
A construction aggregate plant operates 10 high horsepower secondary crushe drive motors and associated conveyor belts, producing 600 tons of product per hour. All heavy equipment requires maintenance, but the aggregate producer's costs were greatly magnified any time necessary maintenance was unplanned and unscheduled. The product must be supplied to the customers on a tight time schedule to fulfill their contracts, avoid penalties and prevent loss of future business. Furthermore, a sudden failure in one of the drive motors would cause rock to pile up in unwanted locations, extending downtime and increasing costs.

Clearly, preventative maintenance was preferable to unexpected failures. So, twice each year, the company brought in an outside vendor to attach sensors to the motors, do vibration studies, measure bearing temperatures and attempt to assess the health of the motors. But that was not enough. Unexpected breakdowns continued to occur. The aggregate producer decided to upgrade to a Condition Based Monitoring (CBM) sensor system that could continually monitor the motors in real time, apply data analytics to detect changes in motor behavior before they developed into major problems, and alert maintenance staff via email or text – anywhere they happened to be.

A wired sensor network would have been cost prohibitive. An aggregate plant has numerous heavy vehicles moving around, so any cabling would have to be protected. Additionally, the plant covers 400 acres and the cable would have to be trenched to numerous locations. Cable simply was not an option. The aggregate producer needed a wireless solution.

Wzzard Intelligent Sensing Platform
- Wzzard mesh wireless networks cover distances where a network of wired sensors would be cost prohibitive.
- The Wzzard mesh wireless network is an easy retrofit – it works with existing, industry standard sensors.
- The monitored machines need no data ports – Wzzard edge nodes collect relevant information from external sensors.
- Real-time access to data through an intuitive dashboard.
- Data analytics not only detects failures, it predicts failures.
- Alert levels set to provide real-time text message or email notification of thresholds exceeded.
- Wzzard cuts downtime and related costs.
- Wzzard makes machine condition data available wherever it is useful.
- Wzzard enables automatic alerts on your computer, tablet or smart phone.
Solution

Advantech installed the Wzzard Mesh Wireless Sensor Platform. First, each motor was equipped with three industry standard sensors: current draw, vibration and temperature. Changes in any of these parameters can be an early indicator of future problems. Each motor was provided with a single Wzzard mesh wireless sensor edge node with each node capable of connecting up to three sensors. The Wzzard edge nodes then used wireless mesh networking to publish the sensor data to a network gateway. The gateway then sent the data to the monitoring application.

Two additional Wzzard nodes were also installed to provide data routing support and ensure that the mesh network was robust enough to provided reliable, five nines (99.999 percent) uptime and connectivity, even though the environment included many large metal surfaces.

Why Use Wireless?

When sensors are spread out across a wide area, establishing a wired sensor network may be impractical. At a quarry site, for example, there is a lot of heavy equipment moving around so, above ground cabling would be in constant danger. Trenching the cable would protect it, but trenching costs $15USD/foot or more for cabling, conduit & installation. The quarry’s farthest motor is 840 feet from the control center so, wiring that single motor would cost $12,600 with nine more motors to go.

A wireless Wzzard mesh network installation is not only less expensive than running cable to all of the monitoring points in the quarry, it cannot be severed by mobile equipment or digging.

ADDITIONAL CBM QUARRY APPLICATIONS

Wzzard could monitor additional equipment in and around the quarry for better preventive maintenance and operations:

- Rock breaker
- Apron feeder to the primary crusher
- Overhead crane
- Dust collection/suppression system
- Freight elevator
- Eccentric trolley removal cart
- Service air compressor
- Man-lift elevator
- Sump pumps
- Air cannons
- Air vacuum clean up systems
- Water booster pumps
- Rock grapple
- Service trolleys
- Conveyor belt magnets
- Conveyor gravity take-up service winch
- Conveyor belt metal detectors
- Conveyor belt rip detector
- Belt monitoring systems
- Conveyor belt weigh scales
- Belt feeders
- Vibratory feeders
- Screw feeders
- Lime/cement silos
- Bin ventilators
- Sampling stations
Connect Anything, Monitor Everything

Since Wzzard Mesh Wireless Sensor Nodes can connect virtually any sensor, the aggregate producer also decided to install level meters in the surge bins. Like the sensors on the motors, these sensors were connected to Wzzard mesh wireless sensor nodes, which joined the other intelligent nodes on the mesh network. If the surge bins were in danger of overflowing, the system would send immediate alerts to the operator.

- Motor Vibration
- Motor Current Draw
- Motor Temperature
- Node Battery Status
- Surge Bin Level

Quick Return on Investment

Wzzard pays for itself the first time it predicts a pending failure.

**Unscheduled Downtime is Costly**

<table>
<thead>
<tr>
<th>Costs when CBM preventative maintenance is not applied - unpredicted motor failure during production hours.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loss of Revenue 600 tons for 8 hours x $10.00/ton</td>
</tr>
<tr>
<td>New Secondary Crush Driver Motor 1 x $29,000</td>
</tr>
<tr>
<td>Labor costs 2-3 operators and electrician 2,000</td>
</tr>
</tbody>
</table>

*Assumes that a new motor is readily available and can be installed in the first eight hours and that the quarry is running a single shift. Each additional shift adds $48,000. For a quarry running three shifts, add $96,000 per 24 hrs.

Total One-Day Cost: $79,000 USD

**Costs When CBM Predicts a Motor Failure.**

**Scenario 1: Required Maintenance - Motor Bearing Replacement**

- Motor Bearing Replacement $4,000
- Wzzard Monitoring System $18,500
- Total $22,500

Condition Based Monitoring Savings: $56,500 USD

**Scenario 2: Required Maintenance - Motor Rewinding**

- Motor Rewinding $18,000
- Wzzard Monitoring System $18,500
- Total $36,500

Condition Based Monitoring Savings: $42,500 USD

**Scenario 3: Required Maintenance - Complete Motor Replacement**

- Complete Motor Replacement $29,000
- Wzzard Monitoring System $18,500
- Total $47,500

Condition Based Monitoring Savings: $31,500 USD

**Installing Wzzard is a One-Time Expense**

<table>
<thead>
<tr>
<th>Wzzard ™ Intelligent Sensing Platform Hardware Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Quantity</strong></td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>12</td>
</tr>
<tr>
<td>10</td>
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<tr>
<td>10</td>
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<tr>
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<td>*****</td>
</tr>
<tr>
<td>1</td>
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<tr>
<td>*****</td>
</tr>
</tbody>
</table>

Total One Time Cost: $18,500 USD

CBM Saves You Money

**Costs When CBM Predicts a Motor Failure.**

**Installing Wzzard is a One-Time Expense**

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