

PREDICTIVE DIAGNOSTICS

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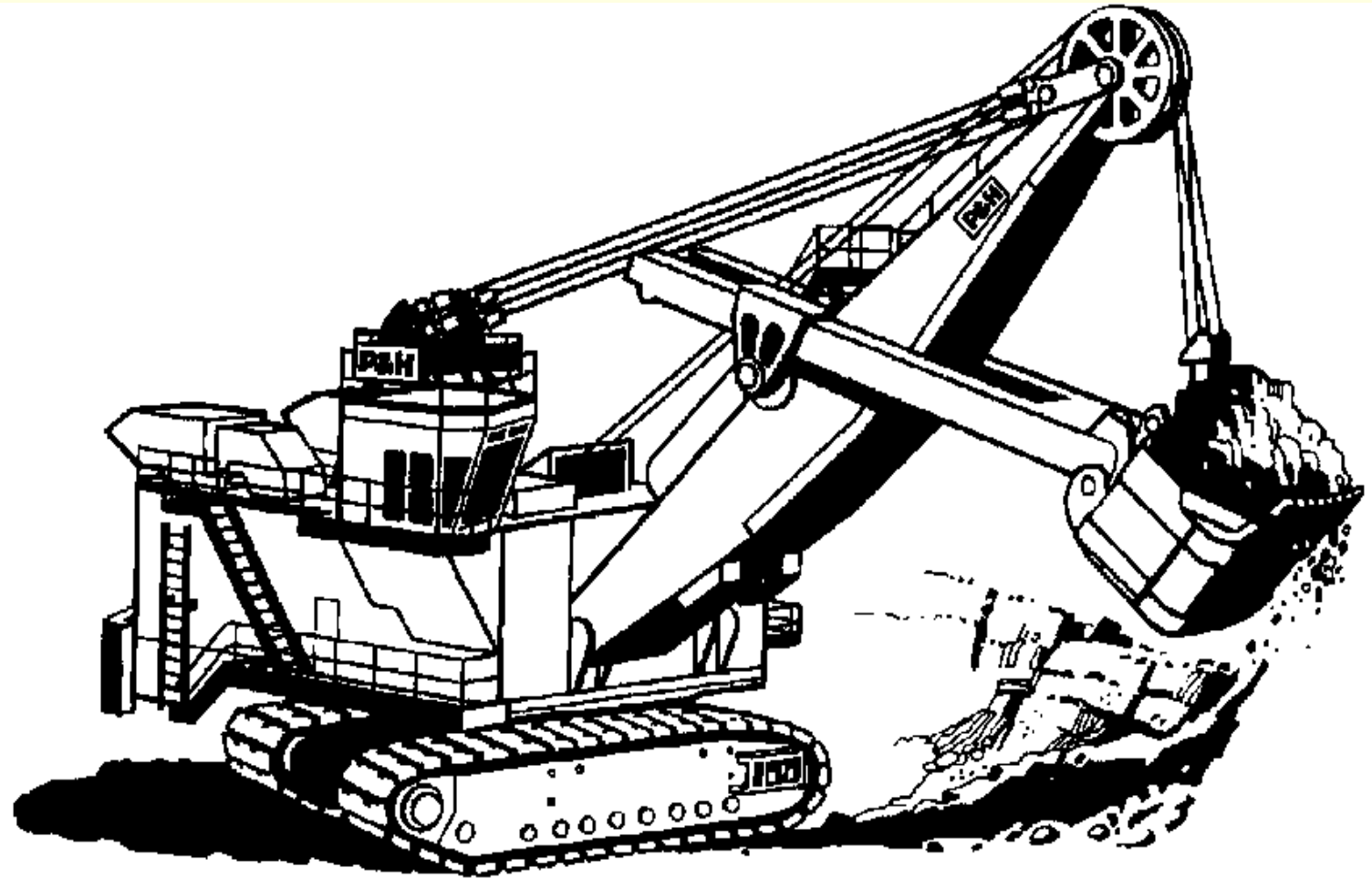
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PREDICTIVE DIAGNOSTICS ON MINING EQUIPMENT



Why Use Predictive Diagnostics?

- *Not Meeting Production Requirements*
- *Exceeding Budget on Repair Costs*
- *Excessive “Breakdown” Maintenance*

Not Meeting Production Requirements

- *1st half of 1998, availability plummeted*
- *Large production deficit*
- *If continued, excessive \$ million by year end*

Exceeding Budget on Repair Cost

- *In Excess of \$1 Million Over Budget*
- *No End in Sight*
- *Budgets Will Be Decreasing in Future*

Excessive Breakdown Maintenance

- *Running at High % Breakdown Mode*
- *Preventive Maintenance Suffering*
- *Hourly People Getting Tired*
- *Safety Taking A Beating*



*SOMETHING HAD TO BE
DONE*

But What?

ALTERNATIVES

- *Three alternatives led to a fourth*
- *Replace 2800XP class*
- *Improve work practices, existing fleet*
- *Predictive diagnostics, existing fleet*
- *Combination of alternatives*

EVALUATION METHOD

- *Used an incremental analysis based on \$ value / percentage point*
- *Best, worst, most likely cases based on historical data from Dispatch system*
- *Improvement percentages based on P&H historical data from other projects*
- *Availability data from Modular Mining*
- *Parts costs and usage from MIMS*

2800XP REPLACEMENT

- *Availability running low*
- *Oldest shovels (17 years)*
- *High maintenance costs*
- *Rest of fleet can be maintained at 88 - 90 %*

2800XP REPLACEMENT

- *High \$ million replacement cost*
- *NPV - High*
- *IRR - High*
- *Payback - 19 months*
- *Decreased parts requirements bring savings - High*

EVALUATION

- *Alternative achieves 89.7%*
- *Required Capital approval is unlikely*
- *Still life left in the 2800XP fleet*

IMPROVED WORK PRACTICES

- *Increase manpower, add four RG machinists*
- *Put on a graveyard shift*
- *Around-the-clock supervision*
- *Enforce contractual rights*
- *Continuous improvement program*
- *Experts say a 30% decrease in unscheduled downtime possible*

IMPROVED WORK PRACTICES

- *Relatively low capital investment*
- *NPV - High*
- *IRR - Extremely High*
- *Payback - 4 months*
- *Parts savings - High*
- *Staggering NPV & IRR*

EVALUATION

- *Investment is realistic*
- *Most likely improve to 87.8%*
- *Best case improve to 89.4%*
- *Does not meet goals in either case*

PREDICTIVE DIAGNOSTICS

- *High Tech Solution*
- *Vibration, oil, thermographic analysis*
- *Computer diagnostics*
- *Reduce unscheduled by 60%, OEM*
- *Increase scheduled by 20%, OEM*
- *50% savings on parts, non catastrophic*

PREDICTIVE DIAGNOSTICS

- *Realistic capital investment*
- *NPV - High*
- *IRR - Extremely High*
- *Payback - 4 months*
- *Parts savings - High*

EVALUATION

- *Investment is realistic*
- *Most likely to improve to 88.8%*
- *Best case improvement 90.5%*
- *Meets goals only under best case scenario*
- *Look a little further*

IMPLEMENTING BOTH PREDICTIVE AND IMPROVED WORK PRACTICES

- *Capital investment - Realistic*
- *NPV - High*
- *IRR - Extremely High*
- *Payback - 3 months*
- *Parts savings - High*
- *Most likely scenario improves to 89.7%*

DECISSION

- *Implement a combination of*
 - *Improved work practices*
 - *Predictive diagnostics*
 - *Most economically reach goal of 89.7%*
- *Track savings*
 - *MIMS for parts*
 - *Modular Mining for availability*

HOW TO IMPLEMENT IMPROVED WORK PRACTICES

- *Increase manpower, add four RG machinists*
- *Put on a graveyard shift*
- *Around-the-clock supervision*
- *Enforce contractual rights*
- *Continuous improvement program*
- *Experts say a 30% decrease in unscheduled downtime possible*

HOW TO IMPLEMENT PREDICTIVE DIAGNOSTICS

■ *Alternatives*

- *Use the Services of the OEM*
- *Use the Services of a 3rd Party Vendor*
- *Do it Yourself*

USING THE OEM

■ *ADVANTAGES*

- *Equipment Knowledge*
- *Equipment History*
- *Resources*

■ *DISADVANTAGES*

- *Expensive*
- *Inflexible & Arrogant*
- *Poor Percentage of Success*

USING A THIRD PARTY VENDOR

■ *ADVANTAGES*

- *Flexibility*
- *Lower Costs (15% of OEM)*
- *Results Equal OEM*

■ *DISADVANTAGES*

- *Limited Resources*
- *Equipment History Dependent*
- *More Time Consuming for Mine*

DO IT YOURSELF

■ *ADVANTAGES*

- *Full Control*
- *Equipment Knowledge*

■ *DISADVANTAGES*

- *Requires Substantial Capital Investment*
- *Time Consuming*
- *Requires More Manpower*

AT KUC THE FIRST TWO HAVE BEEN TRIED

- *OEM PROGRAM*
 - *P&H MinePro*
- *THIRD PARTY VENDOR*
 - *Energy Machine Service*

OEM PROGRAM

■ *SUCSESSES*

- *Swing Transmission*
- *Loose Swing Case Bolts*
- *Motor Bearing*

■ *FAILURES*

- *Swing Motor Failures*
- *Hoist Drum Bearing*
- *Oil Analysis Inflexibility*
- *Covered Only P&H Equipment*

OEM PROGRAM

- *Six Month Trial*
- *After Five Months Cancelled*
- *Analytic Equipment Failures*
- *Lack of Flexibility*
- *High Costs*
- *Low Success Ratio*
- *Bucyrus Equipment not Addressed*

THIRD PARTY PROGRAM

■ *SUCSESSES*

- *Crowd Output Bearing*
- *49R Compressor*

■ *FAILURES*

- *Has not Missed One Yet*
- *Slow in Getting Program Under Way*
- *Inexperience with Specific Equipment*

THIRD PARTY PROGRAM

- *In Second Month*
- *Excellent Results*
- *All 12 Shovels and 10 Drills Serviced*
- *Low Cost*
- *High Quality Equipment*
- *High Quality Reports*
- *Will Continue with this Program*

RECOMMENDATIONS

■ *OEM PROGRAM*

- *If the money is available, the Mine is isolated, and there is a good relationship w/ the OEM, the OEM program is easier.*

■ *THIRD PARTY PROGRAM*

- *If cost savings are a prime concern, have access to a third party vendor, and a willingness exists to put in some time with that vendor, this is the way to go.*

RECOMMENDATIONS

■ *RESULTS ORIENTED?*

- *By my experience, either way, results are about the same.*

■ *IN THE END, DECIDE FOR YOURSELVES!!!!*

QUESTIONS

