OMDEC
Optimal Maintenance Decisions Inc.

Case Studies

Mine Loader Failure Predicted by OMDEC EXAKT

"Intervene Immediately" after 10,000 trouble free hours

SUMMARY:

In a joint project with its Australian partner, FIRM Solutions Pty Ltd in 2010, OMDEC's EXAKT failure prediction analysis tool accurately identified a critical impending failure in a large front end loader for a mining giant. Starting with an incomplete data set, the joint team successfully refined the data to the point where the failure modeling produced a startling prediction: a 90% probability of failure in the main engine bearing within the next 500 operating hours in a unit that had no history of similar problems for 12,500 operating hours. By analyzing multiple equipment conditions, EXAKT developed an easily measurable formula to accurately predict whether any of the equipment was in danger of immediate failure. The answer was "Yes".

BACKGROUND AND OBJECTIVES:

The mining company operates a fleet of loaders as a key part of its continuous production operation. Downtime is both critical and expensive: a ratio of 4:1 is used to compare run to failure costs with preventive replacement.

The key objective was to determine whether smart data analysis could produce meaningful results relating to the probability of failure and remaining useful life of the fleet.

A second objective – which turned out to be even more significant in the short run – was to apply the fleet model to individual units to predict and prevent expensive impending failures. Where failure was predicted, management needed to be confident of the probability within a given time frame so that spurious results did not cause unnecessary maintenance.

METHODOLOGY:

Multi-year condition data was available for the fleet and was used as the basis for the analysis. 31 failures were analysed covering 10 failure modes for the fleet of 64 engines. Main engine bearing failure was the dominant failure mode accounting for about one third of critical failures. This became

the focus of the detailed analysis, using a variety of condition measurements to determine which combinations had the best predictive capability. Among the possible conditions such as vibration, engine operating temperature, fuel burn etc, two specific measurements met the standard 95% test for confidence levels. These were derivatives of the Lead and the Antimony measurements obtained gained from oil sample analysis. This was integrated with event data such as oil changes, operating starts, out-of-service intervals and actual failure dates extracted from the EAM work history database.

From this data, an EXAKT statistical model was developed to correlate the condition monitoring data with actually experienced failure or potential failure events. The model was then applied to the individual units in the fleet. Two very timely output reports were produced for one loader:

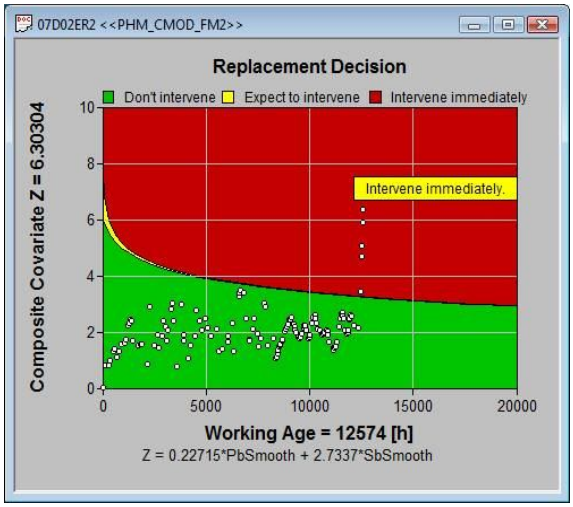

Figure 1: EXAKT Replacement Recommendation

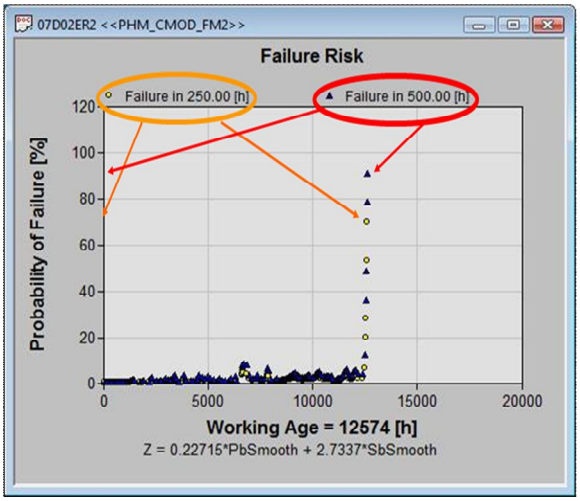

Figure 2: EXAKT Probability of Failure

Figure 2 shows that for the engine main bearing failure mode being analysed, the unit has operated without significant risk of failure for its working life of 12,500 operating hours. However:

- The probability of failure within the next 250 hours is 75%
- The probability of failure within the next 500 hours is slightly over 90%.

These results are confirmed in Figure 1 with the recommendation to intervene immediately to prevent costly damage to the equipment.

CONCLUSIONS:

Three important conclusions were reached:

1. EXAKT failure prediction and decisions models were successfully developed and tested for the fleet's key failure modes at the 95% confidence level
2. A readily applicable formula was developed to enable tracking of multiple equipments
3. By applying the modeling to individual equipment, a critical impending failure was predicted with a probability of over 90% within the next 500 operating hours on a unit that had no history of this failure mode.

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