Optimal Maintenance Decisions Inc.

Case Studies

Municipal Electricity Utility: Pilot Project on Use of Living RCM Software Module

SUMMARY:

In this Pilot Project, a Municipal Electricity Utility teamed with OMDEC to explore the value of Living RCM in actual operation using live client data. The LRCM module was quickly linked directly to the client’s CMMS, which contains valuable historical and current knowledge. With LRCM in live mode, the rich suite of analytical tools allowed LRCM users, with very limited training, to examine assets by class, location, or down to an individual component. Work tasks by year, month, top 10 bad actors, trends, reports showing corrective and emergency failures, a planning mode, and more can be accessed via the dashboard. By integrating LRCM with the client data, the EXAKT decision support tool can be installed to predict equipment failure, estimate useful remaining life and achieve an optimal risk/cost/ reliability balance. LRCM and EXAKT take the guesswork out of failure prediction, and provides a reliability analysis RCM program which is both affordable and easily managed.

The User’s Management team pronounced themselves very satisfied with the results and plan to proceed to a full roll-out of the project.

BACKGROUND AND OBJECTIVES:

A large Municipal Electrical Utility (MEU) has been carefully collecting data related to the many assets in its CMMS for a number of years, but was dissatisfied with the value that was being generated. This conversion from data to usable information is a significant and growing issue with many businesses. The MEU approached OMDEC to assist in the key objective, namely to test the integrity and adequacy of the data for the purposes of Reliability Analysis (RA). Clearly the RA questions being asked will determine the array of data required; the MEU settled on the Living RCM module of Bi-Cycle’s product suite for the core analysis. Objective #2 was to demonstrate the effectiveness of the Living RCM software module.

METHODOLOGY:

The steps involved in this Pilot Project were as follows:

1. Brief Introductory Training Presentation on Living Reliability. This was designed to familiarize the users with the terms, concepts and technology, and also to set the acceptance criteria for the Pilot. The session covered the fundamentals of reliability as well as the operation and use of the LRCM module.

2. Data Selection. Data related to critical equipment and critical failures are typically the most appropriate for Reliability Analysis as they provide the maximum opportunity for both

reliability improvement and cost savings. For the purposes of this project, a wide range of equipment was analysed – from poles to transformers to the vehicle fleet.

3. Data Cleansing. The selected data was analyzed for completeness, accuracy and relevance. As a result, many records were discarded and others completed by interpolation. Records were discarded for two main reasons – either they were incomplete and had insufficient data for manual completion, or the records had no bearing on the equipment reliability. Interpolation was used when the records were lacking data that could be accurately added based on the existing recorded data. For future analysis for failure prediction by EXAKT, particular attention was paid to the required data for the Event Table. This requires definition of Events as representing a Potential Failure (PF), a Functional Failure (FF) or a Suspension (S - during which time no degradation occurs). As a result of the data cleansing process, sufficient data of adequate quality was available for the analysis.

4. Data Transfer. The relevant data was then transferred using data definitions and triggers contained in the LRCM module. Once accepted into the LRCM module, the data was inserted into data marts which are automatically created for that purpose. These data marts are the source of data for the analytical tools which perform the Reliability Analysis.

5. Running of LRCM software to Extract and Demonstrate Results (see below).

6. Analysis and Discussion of Results – The Pilot concluded with an open forum among the users to review and discuss the results. The consensus was that the functionality and ease of use of the LRCM module greatly enhanced the Users' ability to access source data, undertake meaningful analysis and derive valuable results.

RESULTS:

A sample of the results from the analysis is shown below:

1. CBM decision optimization

The user examines the incidences of a failure mode together with condition monitoring data preceding those failure events. Through statistical correlation analysis the user will discover predictive patterns in the CM data (if they exist) for optimal decision making. Figure 1a applies an optimized maintenance decision. Figure 1b provides failure probabilities and confidence intervals.

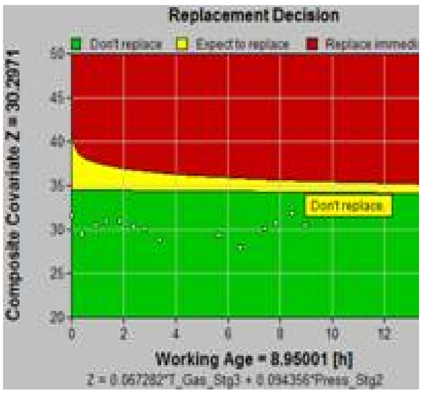

Figure 1a Optimal CBM decision

Probability	Interval
50%	[133.65, 214.27]
60%	[127.58, 227.58]
70%	[121.65, 243.87]
80%	[115.81, 265.38]
90%	[109.82, 299.09]
95%	[106.64, 329.91]
99%	[102.13, 393.64]

Figure 1b Failure probability in intervals

2. Capital replacement decision optimization

From an analysis of the replacement costs and the repair costs of a fleet of capital items subject to periodic replacement, the user can calculate an annualized cost for various replacement scenarios. The lowest annualized cost, represents the optimal economic replacement age. The cost difference from any other given age, shows the annual savings derived from implementing the optimum decision.

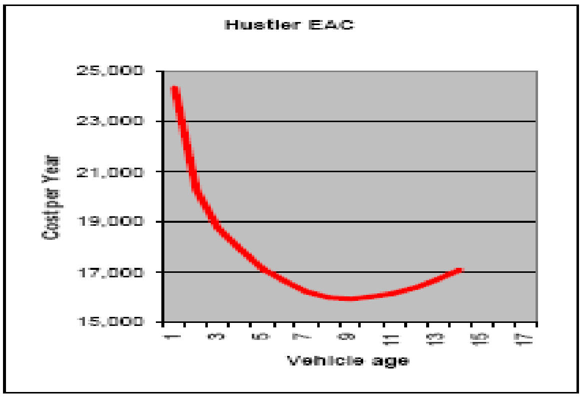

Figure 2 optimal replacement age

3. Simulation accuracy

The Reliability Continuous Improvement Procedure automatically updates parameters used in simulation models for predicting equipment availability. LRCM ensures that decisions from simulation studies can benefit from the latest data as recorded in the CMMS.

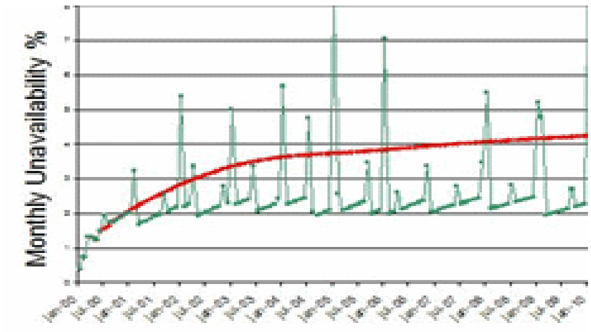

Figure 3 Projected unavailability

4. Priority analysis

The Jackknife plot places failure modes that have occurred in a specified time period on a logarithmic grid. The vertical axis measures severity, for example downtime. The horizontal axis measures frequency. The failure modes that fall in the red region require immediate managerial attention. The Reliability continuous improvement procedure monitors the desired movement of failure modes towards the origin.

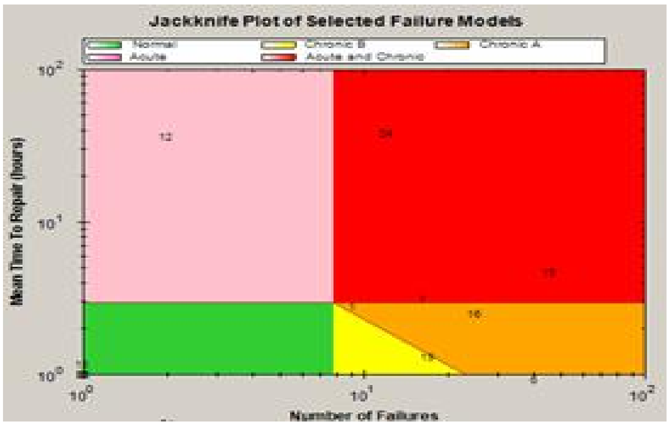

Figure 4 Jackknife (scatter chart) for priority analysis

5. Failure rate (Weibull) analysis

The age reliability relationship can be expressed in many ways. Figure 5 illustrates the failure rate (hazard rate). It is the probability of failure in the next relatively short time interval since the last renewal of the item. This analysis answers the questions: Is preventive maintenance technically feasible? Is there a materials quality or installation problem? What is the "useful life" of the item? Is the MTBF (reliability) of a randomly failing item acceptable?

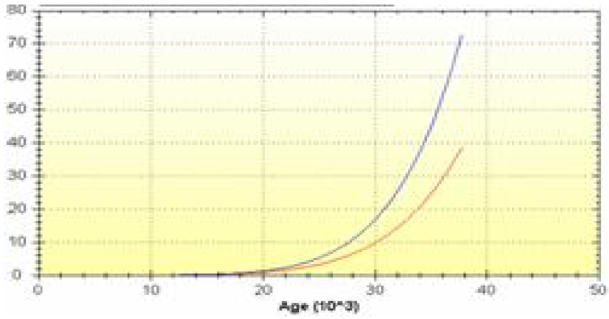

Figure 5 Weibull (failure rate) analysis

6. Top 10 analysis

Rank the failure causes with the greatest impact on profitability in any class category or group and in any time window.

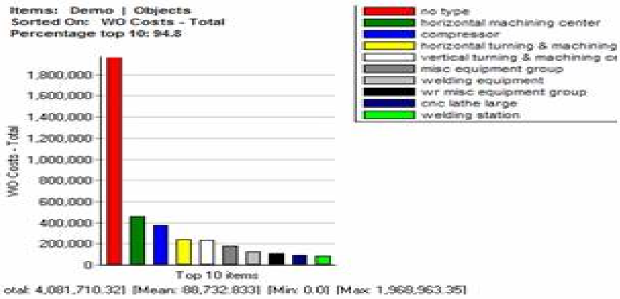

Figure 6 Top 10 analysis

7. Spares analysis

A critical issue in spares management is the appropriate level available spares when a critical long-life component fails, based on required plant availability and cost. Such components would include transformers in an electrical utility or electric motors in a conveyor system. The question to be addressed is: "**How many critical spares should be stocked at what cost?**"

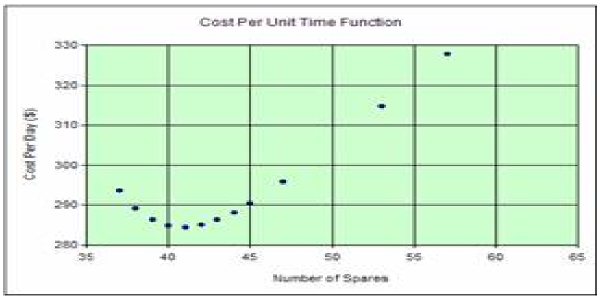

Figure 7 Spares analysis

Other analytical results such as risk and cost analysis were also available to be shown.

MANAGEMENT'S COMMENTS:

The Users were enthusiastic about the functionality and ease of use of the software. "We now have ready access to useable information that was not previously available. It has opened our eyes to new and different reliability improvement opportunities." The next steps are to expand the application to more equipments, and to include LRCM in a more-broadly based Living Reliability project.

Omdec Inc – April 2009