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An update on information systems for reliability techniques, including software that supports management strategies from RCM (Reliability Centered Maintenance) to FMEA (Failure Modes and Effects Analysis)

Once an organization has basic maintenance strategies in place, such as preventive maintenance, inventory and purchasing practices, work processes and computerization of the maintenance business, it begins to consider how to further improve maintenance processes. One commonly-used strategy is to increase equipment reliability. Such organizations will begin to focus on equipment or assets that, if they fail, will have significant negative impact on:

- Asset and employee safety
- Environmental safety & compliance
- Regulatory compliance (FDA, EPA, OSHA, etc.)
- Plant throughput
- Plant efficiency

Reliability-centered maintenance (RCM) is a systematic approach to developing a focused, effective and cost-efficient preventive and predictive maintenance program. The RCM technique is best initiated early in the equipment design process and should evolve as the equipment design, development, construction, commissioning and operating activities progress.

This technique, however, also can be used to evaluate preventive and predictive maintenance programs for existing equipment systems with the objective of continuously improving these processes. The goals for an RCM program are:

- Achieve maximum reliability, performance and safety of the equipment.
- Restore equipment to required levels of performance when deterioration occurs (but before failure).
- Collect the data (during the life of the equipment) to change design of the equipment to improve its reliability.
- Accomplish the above while minimizing life-cycle costs.

RCM methodology was developed in the 1960s primarily through the efforts of the commercial airline industry. The essence of this technique is a series of structured decision trees, which

lead the analyst through a tailored logic in order to outline the most applicable preventive and predictive maintenance tasks. There are two main applications for RCM: equipment in the design phase and equipment already installed and in operation. For the purpose of this directory only RCM, RCA, and FMEA on existing equipment will be considered.

RCM, RCA and FMEA for existing equipment

As mentioned previously, conducting an RCM analysis for existing equipment centers around an RCM decision tree. While decision trees can be very complex, most organizations will begin by utilizing a simple approach, increasing the complexity as the analysts become more proficient.

Using basic decision trees to start will allow analysts to gain insight into the RCM decision process if a failure occurs. Based on previous discussion of RCM for design, there are two types of information that may be considered at this point. The first information relates to theoretical failures. These are failures that have not yet occurred, but through a study of the design of the equipment are potential candidates.

The second type of information (typically used with existing equipment) uses historical data about the equipment in question or similar equipment. This information indicates what failures have occurred in the past, as well as their frequency.

Three key questions

The first question to ask is, "Will safety, environmental or other regulatory issues be compromised?" If the answer is "yes," then appropriate preventive or predictive maintenance tasks are developed.

Preventive maintenance tasks are developed for situations in which failures can be prevented with proper lubrication, inspection, and adjustments.

Predictive maintenance tasks are developed for situations in which failures cannot be prevented and, therefore, must be detected before they occur.

If the answer to the first question is "no," then the decision tree leads to the second question.

The second question is "When the failure occurs, is there a loss of production or availability of the equipment that impacts the operation?" If the answer is "yes," then the appropriate preventive or predictive maintenance tasks should be developed as outlined previously.

If the answer to the second question is "no," then the decision tree leads to the third question.

The third question is, "Is the repair expensive, i.e., is there collateral damage?" This question is not just concerned with the component being examined; it wants to know if auxiliary equipment will be impacted. Consider a drive train, if a bearing fails—there may be more of a problem than bearing damage. The drive shaft could be scored or otherwise damaged, rendering it unsuitable for future use. Similarly, if a motor or generator is damaged, that could overload the electrical circuit, causing damage to the control system. Or there might be stoppages of other equipment due to shared electrical distribution. In considering a failure, it is important to take into account all related equipment.

If the answer to the third question is "yes," then the appropriate preventive or predictive maintenance tasks are determined.

If the answer to all three questions is "no," then running the component to failure is an acceptable option. Run-to-failure is acceptable in such cases because the decision tree analysis reveals, per the following criteria, that there will be little or no impact caused by the failure:

- Regulatory or safety issues are not compromised.
- Expensive loss of capacity is not incurred.
- Life-cycle cost is not inflated.
- Probability of failure is low.

Root cause failure analysis
The key to making RCM analysis effective is the ability to perform a root-cause failure analysis (RCFA). As previously described, the RCFA must be performed at two levels. The first is the theoretical level, which involves asking "what if" questions. The second is the historical level,

which examines equipment histories for actual failures. In other words, root-cause failure analysis analyzes theoretical failures or actual failures to find their root causes so they can be eliminated. Without RCFA, improvements in equipment reliability by eliminating failures (either in the design or operating phase) could not take place.

Up until this point, this article has focused on RCM software. It is important to note, however, that RCA and FMEA software is typically used during an RCM analysis—when the true root cause of failure must be identified. FMEA software also is used to determine the specific mode and effect of the failure.

Reliability software
The information about the software listed on the last two pages of this article was provided by the suppliers of the products and checked with their websites.

Each description begins with a notation of whether the software developer intends the package to facilitate RCM, RCAs, FEMAs or all of these processes. (It should be noted that many of the CMMS/EAM software packages available today are already interfaced to these software packages.)

As evidence of the evolution in this technology, we note Meridium and SAP addressing the fundamental challenge of integration of RCM software with RCMO—a new RCM solution tightly integrated with SAP (and built with the latest SAP technology). RCMOTM simplifies the process of implementing RCM with SAP, and it allows the analyst to measure performance and make adjustments over time.

If you are currently utilizing other software not mentioned in your RCM, RCA or FMEA analysis, please contact us. E-mail editors@mt-online.com so we can include it in the next edition of this directory.

What Is An RCM Process?

According to SAE standard JA1011, to be called "RCM," a process must obtain satisfactory

answers to the seven questions below, which must be asked in the following order:

1. What are the functions and associated desired standards of performance of the asset in its present operating context (functions)?
2. In what ways can it fail to fulfill its functions (functional failures)?
3. What causes each functional failure (failure modes)?
4. What happens when each failure occurs (failure effects)?
5. In what way does each failure matter (failure consequences)?
6. What should be done to predict or prevent each failure (proactive tasks and task intervals)?
7. What should be done if a suitable proactive task cannot be found (default actions)?

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