Prevention is better than cure

Reliability Centered Maintenance (RCM) reduces the risk of equipment failure to a more than satisfactory level

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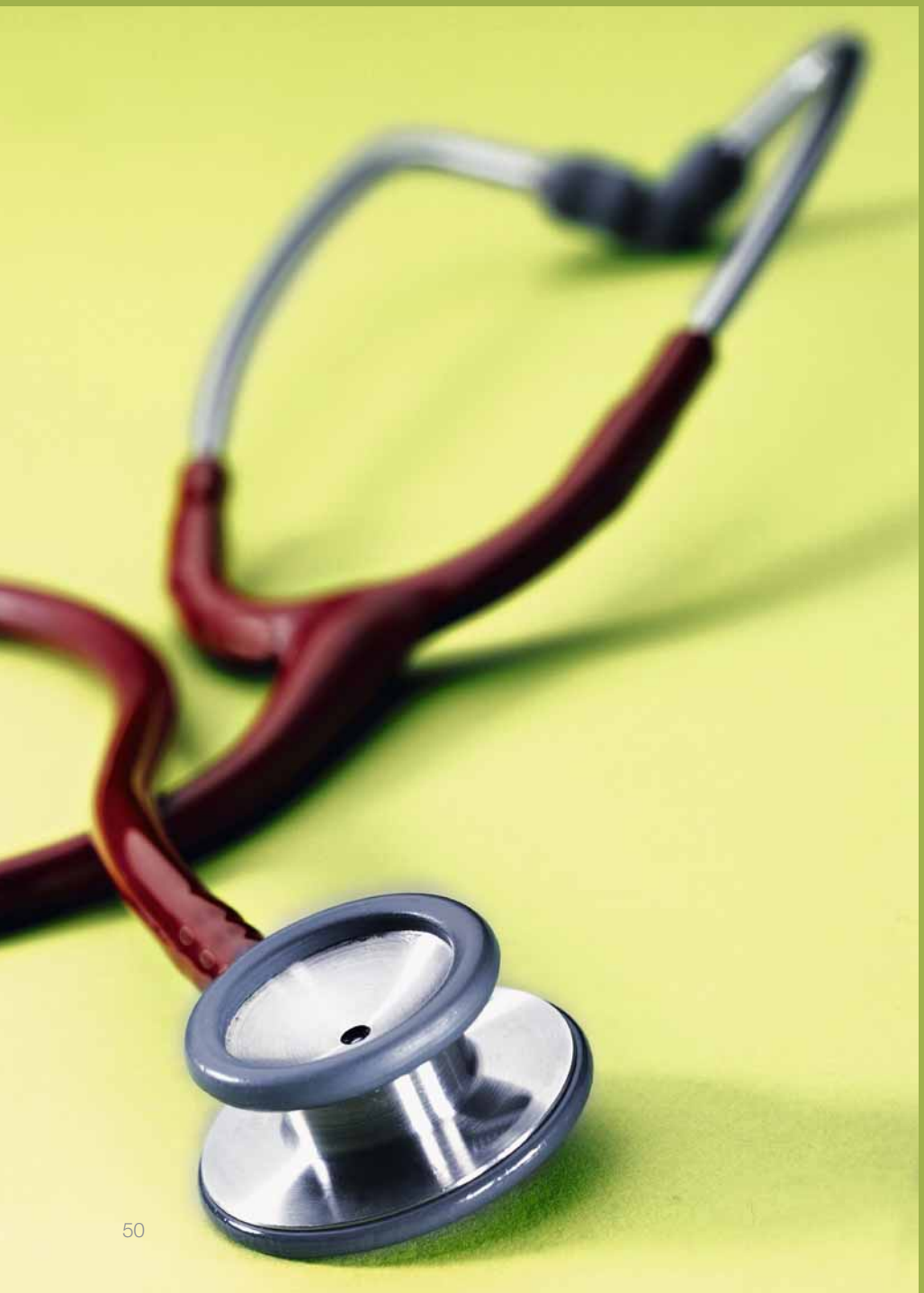

Most people, especially those who come from a family in which there is a history of a particular illness, ensure that regular checkups are scheduled throughout the year. Knowing the weaknesses in one's system means that certain measures can be taken to prevent the occurrence of serious and possibly long-lasting human "down-time." Even if something does go wrong, a well-documented patient history may mean the difference between life and death.

In many industries, managers work hard to reduce equipment downtime. What better way of doing this than by ensuring their plant equipment, like people, are subject to regular "check-ups." Some equipment may be prone to more problems than others and so will require greater attention. To help them determine what must be done to ensure that any physical asset continues to do what its users want it to do in its present operating environment, managers utilize a process called Reliability Centered Maintenance (RCM). RCM enables the definition of a complete maintenance regime and is a process that can form a vital part of a company's preventive maintenance program.

Reliability Centered Maintenance (RCM) is a term that is widely used in industry today. However, it is not always well understood. RCM requires plant personnel to monitor, assess, predict and generally understand how their physical assets work. By doing this, certain failure modes can be identified, thereby enabling appropriate maintenance tasks to be established. In [1], RCM is described as "a systematic approach to defining a routine maintenance program composed of cost-effective tasks that preserve important functions."

RCM history

The RCM process has its roots in commercial aviation, and the acronym was first coined in a 1978 report titled "Reliability Centered Maintenance," which was authored by F. Stanley Nowlan and Howard Heap – two employees of United Airlines – and sponsored by the US Department of Defense (DOD). This report embodied the latest technologies developed and utilized by commercial aviation over a period of time dating back to the early 1960s.

The commercial airline industry worked closely together with the Federal Aviation Administration (FAA) to establish a well structured RCM process, which was necessary to meet the FAA requirements of ensuring more reliable commercial aircraft and better safety performance. Until then the performance records of the commercial airline industry were poor. However, their involvement in the development of the process demonstrated a clear understanding of the consequences[1)] of not using a sound approach such as RCM.

The results of their efforts are evidenced by the fact that commercial airline travel is now a much safer mode of transport than driving on a public road. The commercial airline industry continues to use the RCM process to ensure the continued safe and reliable performance of their aircraft.

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Verifying a true RCM process

Since the late 1980s and early 1990s, there has been a move by many companies to utilize the RCM process for their own assets. In answer to this demand, a number of RCM derivatives, each claiming to be as good as or better than the original RCM process, have materialized. Unfortunately, some of these have modified the process to such an extent that it no longer provides the same benefits as the original version of RCM.

As a result and in an effort to verify a process as an RCM process, the Society of Automotive Engineers (SAE) was asked to develop a standard that would verify if a process was truly an RCM process. This standard was published in 1999 as SAE standard JA 1011 and is now used by many companies. It requires that for a process to be considered RCM, it must satisfactorily answer a set of seven questions in sequential order. In addition, it must provide the basis for satisfactorily answering these questions.

The main players

The classical RCM process begins with a review of the individuals involved in an RCM analysis. To effectively conduct an RCM analysis, the participants must have knowledge about the system or equipment under review. In other words, participants are those who work with the system on a daily or frequent basis, such as operators and those who maintain the system. In addition, front-line supervision in both the operating and maintenance areas, ie, the individuals who work with the system from a managing perspective, would also be involved in the RCM process. Others, such as OEM representatives and subject matter experts, are brought into the analysis as needed. The subject matter experts may not have in-depth knowledge of the system but are typically experts in areas such as engineering, safety and quality management. A key player in an analysis is the RCM facilitator who orchestrates the group during the analysis.

ABB has experienced RCM practitioners available to conduct training at a client site. This training is conducted

To conduct an effective RCM analysis, all participants must have knowledge about the system or equipment under review.

over a three-day period during which attendees participate in practice exercises and case studies. ABB also offers a 10-day RCM facilitator course for companies who wish to have their own internal RCM facilitator resources. In the facilitator course, candidates learn how to guide a group in the application of the RCM process, as well as enhance their own knowledge of the subject. Under the guidance of an ABB RCM practitioner, candidates work as a group on a series of exercises. They each take turns acting as a facilitator by conducting an RCM analysis. The exercises include a case study of an actual system selected from the client's facility where the course is held. Upon completion of the facilitator training, the participants are further supported with an additional one to two weeks of mentoring and coaching provided by ABB practitioners. ABB also provides RCM facilitator services to conduct an analysis at the client site.

The RCM process

The cornerstone of the RCM process is the understanding that there are six different failure patterns to be considered when defining maintenance strategies for physical assets 1. When the commercial airline industry conducted an extensive analysis of failures, it determined that 20 percent of equipment failures are a result of time-based failure patterns (as seen in the three graphs to the left in 1) while the remaining 80 percent are not time-dependent (right three graphs). Even though the majority of maintenance work was primarily performed after a set number of run hours – where typically 85 percent of components were taken through overhauls – the failure issue was not solved since the majority of failures were not time dependent. As a result infant mortality was introduced as components were overhauled, leading to the realization that condition-based maintenance was the best solution to a company's asset failures.

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The RCM process begins with an understanding of how the system under review is being used, or in other words, what is the operating context of the system. This is followed by the seven questions:

- What are the functions and desired standards of performance?
- In what ways can it fail to fulfill these functions?
- What can cause each function failure?
- What happens when a failure occurs?
- In what way does each failure matter?
- What should be done to predict or prevent the failure?
- What should be done if a suitable proactive task cannot be found?

The RCM process – analysis meetings

A typical RCM analysis meeting lasts around four hours, and five to 15 meetings are required to complete an analysis. To be more specific, conducting an RCM analysis requires a significant commitment of resources. To illustrate this point, consider doing an RCM analysis of a pump station where there are two identical 50 HP centrifugal pumps, one duty and one stand-by pump. A typical analysis would require approximately seven days plus or minus a day. In performing such an RCM analysis, the functions, functional failures and likely failure modes that could cause some of the system functions to fail would be reviewed. Some examples of function statements for the pump station include:

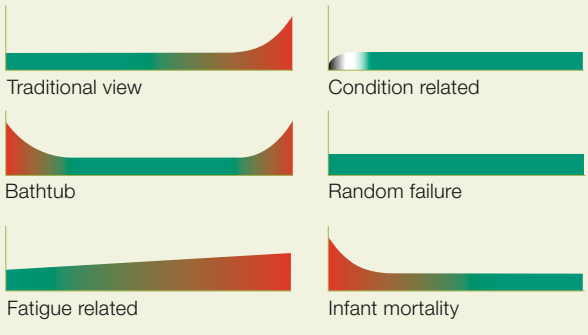
- To supply oil to the generator bearings and gearbox at a minimum pressure of 50 psi and temperature between 15 and 50°C
- To contain the oil
- To be capable of supplying oil to the generator bearings and gearbox in the event the duty pump fails
- To be capable of redirecting the oil back to the suction line in the event the oil pressure exceeds 90 psi
- To maintain the oil at a temperature not exceeding 50°C

However, time is needed to identify the functions and functional failures,

Footnote

[1)] These consequences included unreliable equipment with the possibility of a catastrophic failure while in the air, resulting in multiple fatalities.

1 Failure patterns: The commercial airline industry determined that only 20 percent of equipment failures are a result of time-based failure patterns.



As well as providing participants with a better understanding of how critical assets within an organization operate, the RCM process can be a vital part of a company's preventive maintenance program.

followed by a listing of the likely failure modes – for this example there could be as many as 100 failure modes.

Why perform an RCM analysis

An RCM analysis requires resource and time commitments if it is to be properly conducted. If a typical pump RCM analysis needs approximately seven days to complete, the time and resources required to conduct an analysis for all on-site systems and equipment is enormous. So the question centers on whether the benefits are really worth the effort.

One way of answering this question is to ask if the failure of any system or equipment can result in either serious injury to people or a breach of environmental regulation. Failures that result in negative safety consequences are simply not an option. If there is a risk, no matter how small, then the RCM process should certainly be considered. Even systems or equipment covered by protective devices or controls should also be considered for RCM analysis since the RCM process can then verify if these devices or controls will eliminate or mitigate the consequences.

In all cases where ABB practitioners conducted an RCM analysis, several participants expressed their appreciation of the knowledge gained, and the safety and environmental solutions developed to mitigate the consequences of failure. It can be said then that the value an RCM analysis brings to a company cannot be overstated.

Benefits of performing an RCM analysis

There are a number of benefits of performing an RCM analysis:

- Development of a comprehensive equipment maintenance program; in this program, maintenance strategies with defined tasks and frequency are evaluated against technical feasibility and cost effectiveness
- Identification of physical and procedural redesigns
- Greater maintenance cost effectiveness
- Identification of assets that will be allowed to run to failure
- Identification of key training opportunities
- Improved process knowledge across an organization
- Ability to generate troubleshooting guidelines

The RCM process can be a vital part of a company's preventive maintenance program, and it can provide participants with a better understanding of how critical assets operate.

An additional benefit to the process is the gathering and documenting of the knowledge and experience gained by those who participated in the process. This in itself could be a means of capturing information from those within an organization who may be retiring but whose knowledge remains undocumented.

Preventive maintenance component

The RCM process can be a vital part of a company's preventive maintenance program. In addition, it can provide participants with a better understanding of how critical assets within an organization operate, and an understanding of the necessary tasks to ensure reliability by migrating failure consequences associated with the safety of people and/or breach of environmental regulations.

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Reference

[1] http://en.wikipedia.org/wiki/Reliability_centered_maintenance (January 2008).