Arrelic Insights

Reliability Centered Maintenance

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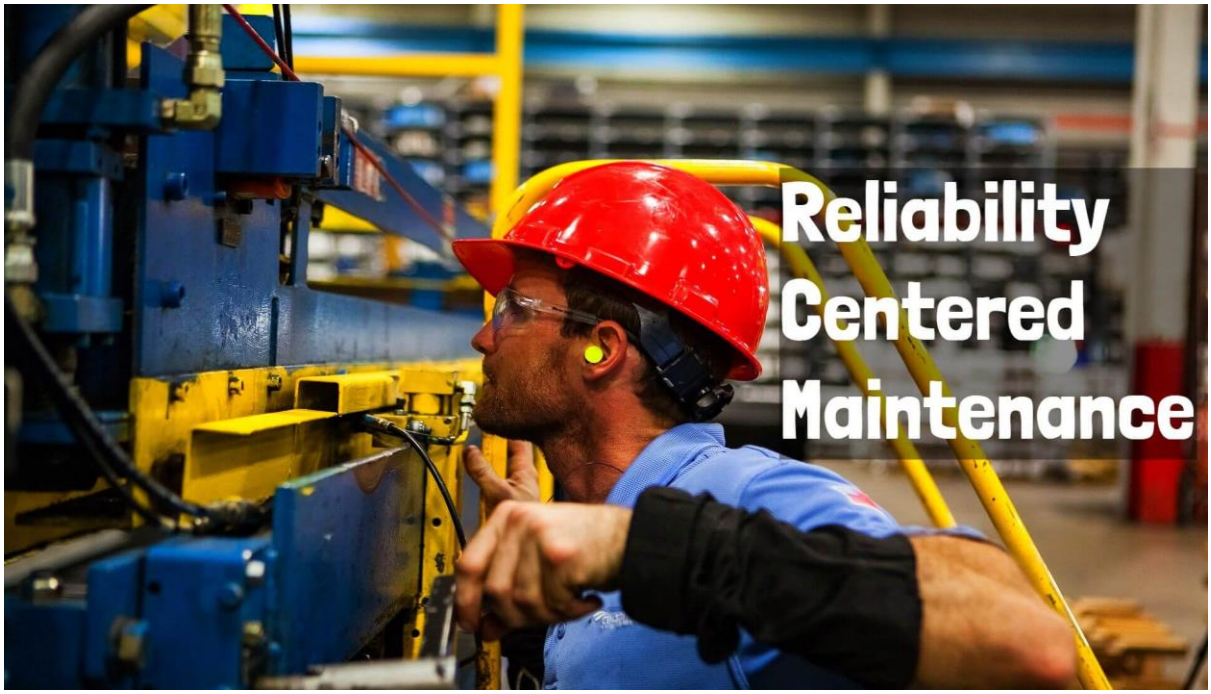
Overview

Most large plants invest hundreds of millions of dollars in capital assets. Effective management of these assets has a significant impact on both the balance sheet and profits. Reliable running of plant equipment is the foundation of achieving maximum profit. While many organizations today are beginning to realize the massive amount of untapped value hidden in plant assets, until recently, maintenance was often overlooked during the corporate business planning process. With the rapid improvement of equipment technologies, varieties and the number of physical assets, higher expectations of the management for increased asset utilization combined with several internal and external challenges, Plant maintenance as a niche discipline has evolved with great expertise in the past twenty years.

Introduction

Reliability Centred Maintenance (RCM) is a method of ensuring that maintenance activities are completed in a timely, reliable, cost-effective, and secure manner. Maintenance activities may be proactive, predictive, or require non-destructive inspections to detect and monitor defects. RCM is just one part of a cradle-to-grave asset reputation protection strategy. Similarly, a successful RCM program would record the entire process for any asset in the facility during the system, equipment, or component life-cycle. The aim of RCM is to ensure that maintenance and inspection activities are focused on improving equipment reliability and protection.



RCM is a corporate-level maintenance technique that is used to improve a company's or facility's maintenance program. The introduction of a complex maintenance plan on each of the facility's properties is the end product of an RCM program. Maintenance strategies are optimized to ensure that the plant's efficiency is preserved by using cost-effective maintenance methods.

There are four principles that are critical for a reliability centred maintenance program:

1. The primary objective is to preserve system function
2. Identify failure modes that can affect the system function
3. Prioritize the failure modes
4. Select applicable and effective tasks to control the failure modes

As the name implies, reliability-centered maintenance (RCM) is a highly successful technique for identifying all potential causes of device failure using cause-and-effect relationships. After determining all potential reasons, the best maintenance plan approach to eradicate failure can be determined. The preferred approach should be to ensure that equipment and processes operate in a secure and reliable manner. It essentially defines all failure modes, or all potential ways for equipment or systems to fail, as well as different ways for a particular piece of equipment to fail.

Failure can manifest itself in a variety of ways, each of which can have similar negative consequences for the system. These failure modes for the overall system can be defined by simply breaking it down into sub-parts or sub-systems. These sub-parts are broken down further before a failure mode is discovered.

Advantages of effective RCM

If RCM is implemented successfully and effectively in program, then it provides following advantages.

1. **Increased Efficiency:**
   RCM improves overall system productivity by focusing solely on system management, increasing output operation by removing failure, increasing asset usage by simply rendering them error-free, and maintenance triggers, and so on.

2. **Reduced Cost:**
   RCM also saves money on repairs by preventing unwelcome failure before it happens, as certain failures take more money and time to repair. As a result, RCM lowers the total cost of maintenance and resources.

3. **Improved Productivity:**
   RCM improves customer loyalty and reliability by effectively managing systems and reducing any unexpected failures.

4. **Replacing Asset:**
   If an asset fails for some cause or is destroyed, it is necessary to replace it with a new asset that has features that are capable of performing the same role.

5. **Reduces failures:**
   RCM decreases the chances of a sudden loss of equipment or an asset by maintaining the asset and minimizing all potential failure modes.

Disadvantages

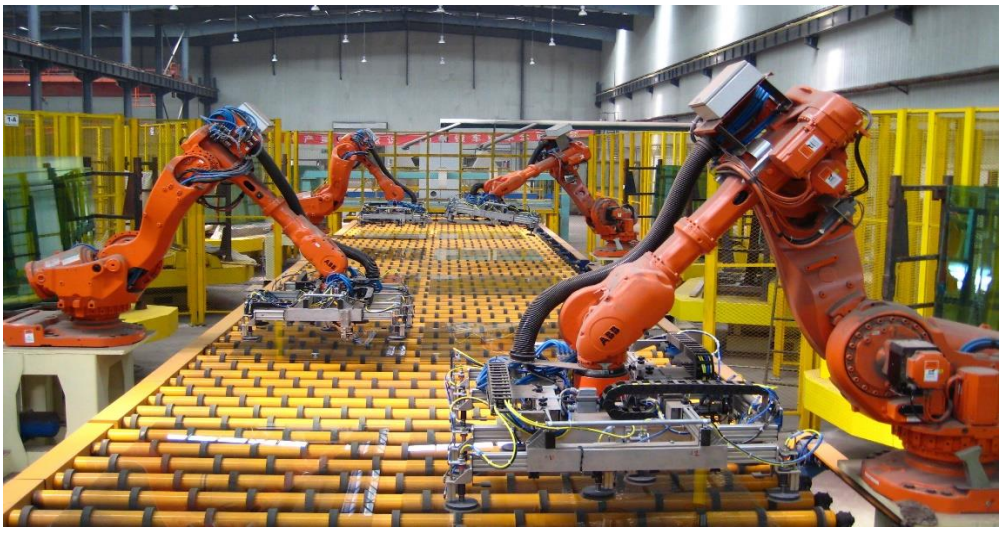
1. **Continuous Maintenance:**
   One of the most significant drawbacks of RCM is that it necessitates ongoing and routine maintenance in order to keep assets secure from loss and more reliable.

2. **Requires Training and start-up cost:**
   RCM needs preparation before it can be performed, and the initial cost of RCM can be very high.

3. **Requires Time and resources:**
   To perform RCM Analysis successfully, more time and resources are needed, which is critical for maintaining priorities.

4. **Complexity:**
   RCM is a very complex procedure that is not easy to perform, despite its effectiveness.

5. **Don’t consider maintaining cost:**
   RCM is a mechanism that necessitates ongoing maintenance, but it ignores the added costs of asset ownership and maintenance.



Phases

The RCM process can be divided into three primary phases:

1. Decision
2. Analysis
3. Outcomes and Feedback

Decision Phase

It may be a basic part or a complex system that you are interested in. Simple components have a limited number of failure modes, whereas complex systems can fail in a variety of ways. First, equipment with a high risk of failure or significant consequences of failure is targeted. This phase of RCM focuses on identifying the equipment or device that plays a critical role in the facility's development, as well as the factors that affect it, such as safety, operational, and non-operational factors.

Analysis Phase

RCM experts collaborate to determine the root causes of failure during the review process. Equipment malfunction or failure, human error, and/or deficiencies in the organizational strategy may all be contributing factors. A root cause analysis or a failure modes and consequences analysis are two of the most common types of analyses.

Outcomes & Feedback

The findings of an RCM program can be used to inform subsequent decisions and evaluations. At this stage, stakeholders should look for ways to change the situation. The goal of RCM is for it to be done all of the time, not just when it's needed. Furthermore, RCM provides value to many organizations by maintaining the integrity of components, extending the life of equipment, eliminating unplanned shutdowns, and reducing overall maintenance costs. The desired outcomes for many RCM programs include:

- Performing repair and inspection functions that are in line with the company's priorities and goals.
- Ensuring regulatory enforcement as well as real protection and environmental stewardship.
- Determining the true performance objectives of and plant, unit, operation, system, and piece of equipment in order to accomplish the above-mentioned tasks and responsibilities.
- Identifying the risks involved in achieving the success goals.
- Identifying the dangers posed by the hazards (equipment, process, people, environments, etc.).
- Identifying the most reliable and effective methods for reducing unacceptable risks.
- Validating, implementing, and executing the mitigation tasks.
- Documenting the entire process in a manner that allows for ongoing performance evaluation and enhancement of the process over the asset life cycle.

Implementation Process

The RCM process has 7 steps to implement reliability centred maintenance. There are several different methods for implementing reliability centred maintenance that are recommended, summarized in the following 7 steps.

Step 1: Selection of equipment for RCM analysis

The first step is to choose the equipment that will be subjected to reliability-centered maintenance review. The equipment chosen should be crucial in terms of its impact on operations, previous repair costs, and prior preventive maintenance costs.

Step 2: Defining boundaries and function of the systems

The equipment is part of a device that performs a critical role. The device may be large or small, but its purpose, as well as its inputs and outputs, must be understood. The goods and mechanical energy that power the belt are its inputs, and the goods at the other end are its outputs.

Step 3: Defining Failure modes

The aim of step 3 is to create a list of all possible ways for the system's operation to fail. The conveyor belt, for example, could fail if it is unable to transport goods from one end to the other, or if it does not transport goods quickly enough.

Step 4: Identify the root causes of the failure modes

The root causes of each failure mode can be found with the assistance of operators, skilled technicians, RCM experts, and equipment experts. A lack of lubrication on the rollers, a bearing malfunction, or a loosened belt may be the root causes of the conveyor's failure.

Step 5: Assess the effects of failure

The results of each failure mode are considered in this stage. Failures in equipment can have an impact on protection, operations, and other equipment. Each of these failure modes' criticality can also be considered.

There are various recommended techniques that are used to give this step a systematic approach. These include:

- Failure modes and effects analysis (FMEA)
- Failure, mode, effect and criticality analysis
- Hazard and operability studies (HAZOPS)
- Fault tree analysis (FTA)
- Risk-based inspection (RBI)

Importantly, the failure modes that are retained include only those that have a real probability of occurring under realistic operating conditions.

Step 6: Select a maintenance tactic for each failure mode

The most effective maintenance tactic for each failure mode is decided at this point. The chosen maintenance strategy must be physically and financially feasible. When it is theoretically and economically feasible to detect the onset of the failure mode, condition-based maintenance is chosen. Where it is theoretically and economically feasible to reduce the risk of failure using this approach, time or usage-based preventive maintenance is chosen.

If there are no satisfactory condition-based maintenance or preventive maintenance solutions for a failure mode, the system should be redesigned to remove or change the failure mode. Failure modes that were not described as critical in Step 6 could be good candidates for a run-to-failure maintenance schedule at this stage.

Step 7: Implement and then regularly review the maintenance tactic selected

Importantly, the RCM approach would only be effective if the guidelines for maintenance are followed. After that, it's important to keep the guidelines under continuous review and renewal as new information becomes available.

Impact

The effect of a well-executed RCM review is an overall increase in efficiency since an acceptable maintenance plan would be chosen for each piece of equipment. RCM seeks to cut costs, increase protection, and remove maintenance activities that are ineffective or inappropriate for a particular piece of equipment. Implementing RCM processes allows you to avoid a one-size-fits-all mind-set that could waste valuable time and resources.