AN RCM APPROACH

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Have you considered implementing Reliability Centered Maintenance (RCM), in your plant but have continued putting it off because it seems like far too much effort in terms of resource allocation? If so, then consider a streamlined approach that is tailored to your plant operations and plant culture. A good asset reliability approach does not have to be a resource hog for you. Just remember:

The *ultimate goal of an RCM Program is to maximize equipment life and minimize scheduled and unscheduled downtime.*

This article will present an approach to asset reliability that relies on the current resources you have in your plant operations: people, money, software, and some basic building blocks of any good maintenance organization.

PROGRAM CONCEPTS

A key part of an asset reliability/RCM program is the basic foundation upon which it is built. That foundation includes some of the base building blocks of any good maintenance organization. Before proceeding to asset reliability as a program, let us review some of the key building blocks of maintenance: Lubrication, Preventive Maintenance, and Predictive Maintenance.

Lubrication Programs are the single best investment for any business. While preventive and predictive technologies are admirable undertakings, they are of little benefit when the bearing they identify to fail fails instead due to a lack of lubrication. Interestingly, many organizations fail to recognize the importance of establishing or reassessing basic lubrication programs. There are advanced lubrication technologies available and many companies that can assist in setting up an effective lubrication program as well as companies that can perform the various oil analysis required of such a program.

Preventive Maintenance (PM) can become stagnant and ineffective over time. It can often be overshadowed by new and exciting technologies. PM programs in themselves do not provide the necessary tools to evaluate their own effectiveness. A limiting factor is that PM inspections are based on 'Run Times' or 'Calendar Frequencies'.

Many organizations, also, do major overhauls as part of a PM program, which in most cases involves downtime, work time, and unnecessary costs. Interestingly, the DuPont Company states that in excess of 30% of overhauled machines fail at start-up, often causing collateral damage, while Forbes Magazine states that one out of every three dollars spent on preventive maintenance is wasted.

So the fundamental rule is keep preventive and repetitive programs simple and focus on the basics first! Then use predictive technologies for condition monitoring and determining needs for corrective action.

Predictive Maintenance (PdM) is applying appropriate technologies to measure equipment operating characteristics and analyzing this data against established characteristics and trends of "like equipment". Some examples are:

- Misalignment
- Mechanical looseness
- Worn or spalled bearings - (single largest contributor to equipment failure)

Predictive maintenance requires that critical measurements are set up on a route and taken periodically or continuously. This information is downloaded for analysis and immediate planning and scheduling if required. In some very special cases it might be more cost effective to "run-to-failure". This however, is not the norm, and accomplishing corrective measures must be carefully coordinated to offset a negative impact on plant capacity.

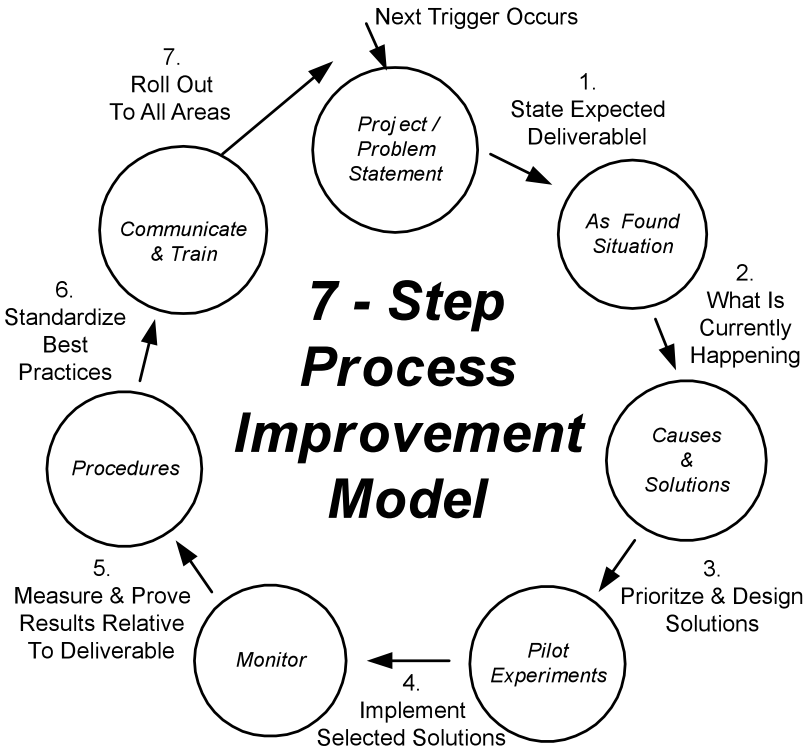
Some technologies for consideration for a predictive maintenance program are:

- Oil analysis (Tribology)
- Vibration Analysis
- Laser Alignment
- Thermography
- Nondestructive Testing
- Ultrasonic Emission
- Motor Surge Testing
- Insulation Monitoring
- Boroscopes
- Eddy Current Testing

Asset Reliability combines all of the above stated programs and measures their effectiveness. Asset Reliability alone will not have an immediate or direct effect unless combined with an overall Process Improvement effort. The requirements for such a program vary depending on the business, people and culture, information systems, current maintenance programs, and technology. The one key element for such a program is the formation of a small core group of reliability engineers, facilitating a cross-functional group of employees on an
"as needed" basis.

The reliability engineers focus on maximizing overall plant capacity as their primary mission. The engineers and the others in the reliability group are highly trained in Root Cause Failure Analysis (RCFA), Failure Modes and Effects Analysis (FMEA), Statistical Process Control (SPC), and process improvement techniques.

Specific "triggers" are used to identify the need for the reliability to go into action. The triggers, also, initiate the 7-step process improvement process. This concept successfully utilizes this 7-step *process improvement approach* toward implementing changes within maintenance operations. This systematic approach is shown in the diagram below and can be followed in almost all instances of implementing process improvement changes.



These tools (RCFA, FMEA, SPC, and Process Improvement) are applied to problem areas that are causing a negative impact on desired safety, throughput, and quality. Many organizations fail simply by not focusing on the proper areas at the proper time. There is a systematic approach, which will be outlined in the Program Development section of this article that can be applied to any business or organization, which will guarantee success with Asset Reliability.

INITIAL ASSET RELIABILITY PROGRAM CONSIDERATIONS

When implementing an Asset Reliability/RCM Program, the following issues should be considered:

- Where can the Asset Reliability process begin? (Are there limitations due to new design issues or tentative equipment/process changes?)
- What data codes will be added, changed, or used?
- Who will make these changes and when?
- Are there any existing data problems affecting Asset Reliability?
- Can resources be provided to bring equipment up to original standard if necessary?
- What “triggers” will be used for Asset Reliability?
- Who will determine if and when actions will be taken based on Asset Reliability data?
- How will business decisions be made relative to cost-effectiveness of recommended improvements or “run-to-failure”?
- When will the maintenance schedule be available for the Asset Reliability process?
- Are there existing corporate reliability programs that require consideration?
- What Key Performance Indicators (KPI’s) & Measurements will be used?

- Who needs to be kept in the information loop and how will this be accomplished?

Every plant site has its own dynamics. The considerations listed above should provide some food for thought when implementing an Asset Reliability Program that is unique to the plant equipment, processes, people, culture, technology, etc. Just implementing a new program from a textbook or seminar is one of the major reasons why so many Asset Reliability Programs fail. A cookie cutter approach should not and cannot be used if success is desired. However, the basic structure and approach for a successful Asset Reliability Program are similar for all plants.

PROGRAM DEVELOPMENT AND STRUCTURE

1. Define Asset Reliability program:
The Asset Reliability Approach is established on the most effective mix of Reactive Maintenance, Preventive Maintenance, and Predictive Maintenance for each piece of equipment, considering its criticality, availability, and operating environment. If reliability issues are identified, a reliability engineering team may require a redesign.

2. Target specific equipment & processes (80/20 approach):
Use historical data to identify last year's and year-to-date work orders by actual hours, total cost (labor-material-contractor). Sort according to criticality and pick the top 20% for analysis.

3. Select current data from equipment documentation and history:
- Equipment identification
- Number and location of unit(s)
- Equipment description (include components & assemblies)
- Equipment function & control (process & ancillary)
- Age of equipment
- Original specification for equipment
- Operating environment for equipment
- Capability for data acquisition
- Work performed by type (PM, PdM, Corrective, Breakdown, Service, Routine)
- Maintenance work frequency
- Parts used (Manufacturer specifications)
- Identification & quantity of each repair/modification part used
- Maintenance-related downtime
- Non-maintenance related downtime
- Any rework required
- Vendor or contractor requirements for repair or rebuild
- Identify all levels of current maintenance (Operators, Maintenance, Safety/Environmental, Engineering, Calibration, Service)
- Availability of work steps or preplanned work orders (Vendor & Plant procedures)

4. Format code tables:
- Failure codes
- Part causing failure codes
- Work order type codes
- Maintenance Type codes

- Priority codes
- Completion codes

5. Establish Asset Reliability core team to include reliability engineer(s):
It is more beneficial to dedicate a small group of engineers rather than assigning reliability as "other related responsibilities" to a large group.

6. Train on Asset Reliability tools:
- Mean Time Between Repair (MTBR)
- Pareto chart
- Weibul analysis
- Root Cause Failure Analysis (RCFA)
- Failure Modes and Effects Analysis (FMEA)
- Statistical Process Control
- Process Improvement

7. Documentation:
- Supporting procedures for Asset Reliability program

8. Corrective actions:
- Work management system to correct and track deficiencies
- Budget requirements

9. Tracking mechanical reliability:
- Failure rate run charts
- Failure rate vs. maintenance costs
- Reliability study of PM program

10. Communicate results:
- Develop Key Performance Indicators (KPI's) and standard reports to monitor performance
- Provide report information as necessary for all business decision makers

SUMMARY:

A very effective Asset Reliability Program that takes into consideration the plant, processes, equipment, people, culture, and technology can be developed specific to any plant. A cookie-cutter approach will not work for all plants, and those that try to take that approach often fail.

Following the best practices outlined in this article for Asset Reliability will help to ensure:

- Reliability and machine condition are measured to provide machine dependability during operation and help ensure optimum capacity and quality.
- Maintenance accepts responsibility to help ensure equipment is running optimally to allow for quality and delivery requirements being met.
- Machine standards are established and understood by Operations and Maintenance Teams.

- In some very special cases it might be cost effective to "run to failure". This, however, is not the norm and accomplishing corrective measures must be carefully coordinated to offset a negative impact on plant capacity.
- Reliability audits are conducted to ensure all inspection and repetitive maintenance programs are effective.
- Maintenance Representatives attend manufacturing meetings to address problems and answer questions. This is where operator-related maintenance downtime can be communicated and addressed.
- Failure Modes & Effects Analysis (FMEA) is performed on major processes to determine failure conditions and collateral damage before they happen.
- All equipment is identified and has the ability to build historical information.
- All maintenance work performed on equipment and processes is recorded on work orders.
- All work orders capture accurate historical data about labor, material, and contractor costs when closed.
- RCM teams are formed as needed to seek out root cause variances as they occur.

When implementing Asset Reliability, keep in mind what the end goal is:

The ultimate goal of an Asset Reliability Program such as RCM is to maximize equipment life and minimize scheduled and unscheduled downtime.

What may work for one plant may not be applicable to another, but all plants can be very successful in their Asset Reliability approach.

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