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Wednesday, 01 November 2000 15:36

Significant cultural changes, cost savings, and increases in mechanical availability can be achieved by the implementation of this model.

As many asset-intensive companies have increasingly searched for a competitive advantage, maintenance and reliability of assets have evolved as major contributors. Organizations are being challenged to improve efficiency and work with less. Various processes, such as reliability-centered maintenance (RCM), have been implemented throughout the years as part of improvement initiatives with varying degrees of success. Many of these initiatives result in some progress toward enhanced reliability of assets, but, to achieve world-class performance, a fundamental shift in the mindset of workers and the nature of work is needed. A holistic and evergreen approach to asset management processes provides the capability to change the nature of work and drive a reliability-centered culture.

The model presented here integrates "best" processes to create a world-class approach to asset management. It is illustrated in the accompanying diagram, which is divided into separate processes and sub-processes and shows the high-level flow between each. Criticality ranking, front-end failure analysis, equipment reliability strategy development, equipment reliability strategy implementation, work management, reliability analysis, and external processes comprise the model.

Elements of the model

The Asset Management Best Process Model provides the elements necessary to support a world-class asset management program. Many organizations have done a reasonable job at defining and executing standard business processes for work management. This is most often driven by a computerized maintenance management system (CMMS). The majority of new processes implemented by world-class performers have been proactive, reliability-focused processes and post-execution reliability analysis. Some organizations may find improvement by focusing on traditional work management, but to see quantum and long-term improvements, companies must implement these other processes.

A reliability-centered model for asset management seeks to better understand assets before failure, put in place proactive equipment reliability strategies to cost-effectively eliminate the likelihood and consequence of failures, and move toward an environment where the only equipment failures will be pre-determined and due to wear-out.

The **Criticality Ranking Process** is used to better understand and identify assets that are truly critical to the business. This process is essential to a cost-effective approach to implementing the model.

This provides the basis for focusing personnel and other resources on the equipment that has the most direct impact on the business. For instance, as a company prepares to roll out its RCM process or any other improvement initiative, this process guides the organization to that area of the facility where it should focus its efforts, along with the specific assets within that area that deserve the most attention.

Equipment identified as "critical" then enters into the **Front-End Failure Analysis** (FEFA) process. The FEFA process includes traditional RCM elements including identifying functional definitions for equipment (or groups of "like-kind" equipment), functional failures, failure modes and causes, and the expected functional life. The FEFA process is not dependent on equipment history, although comprehensive performance history and analyst experience will allow for better analysis and results.

Equipment Reliability Strategy Development is the natural extension of the Front-End Failure Analysis process. Equipment Reliability Strategies (e.g., one-time tasks, preventive maintenance (PM), predictive maintenance (PdM), etc.) then are developed for "critical" equipment and focus on the detection, mitigation, and/or elimination of the expected failure modes. The strategy's intent is to ensure the equipment continues to perform its intended functions for the expected functional life, within its current operating context.

Existing PM/PdM tasks, original equipment manufacturer (OEM) maintenance recommendations, and regulatory constraints will provide the basis for the strategies, but they often are improved based on a better understanding of the equipment gained through the analysis. For "non-critical" equipment, "template" equipment reliability strategies can be developed that provide a base strategy for optimal performance (most often defined by equipment type).

A key element of this model, which is often overlooked, is the **Equipment Reliability Strategy Implementation** process. A considerable amount of work is required to perform the front-end analysis and to develop equipment reliability strategies. Depending on the scope of assets involved and how well technology is leveraged, there also can be a sizable amount of work involved with implementation of the strategies' tasks. Once a strategy's tasks have been determined, the best implementation approach must be selected.

For instance, if the strategy calls for a recurring type of condition or process monitoring, a decision must be made whether it can be automated or not, whether it could or should be performed as part of an operator's round, or whether it should be part of a PM or other mode of implementation. There also will be opportunities to bundle tasks with consistent scheduling intervals so they can be handled more efficiently as one work effort.

The **Work Management** process in this model is extremely critical. Many organizations have focused on work management excellence, but in a "reactive" environment. The philosophy in a "reactive" environment is to "fix it when it breaks." This philosophy usually rewards personnel for making quick repairs at the sake of preserving evidence, understanding the cause, and updating the strategy to prevent the occurrence of that failure in the future. Elements of a traditional maintenance organization such as high percentage of reactive work, constant breaking of the schedule, little if any root cause investigation, minimal amounts of PM/PdM tasks, etc., are undeviating and perpetual. The prospect for breaking this "reactive" cycle is poor until an integrated process, focusing on proactive work, is established.

There is and always will be a place for fast and efficient repairs. However, the work management process in this model places the focus on other elements. Better work order prioritization methods based on criticality can be deployed. Proper analysis of the situation using nonintrusive condition monitoring can eliminate or delay unnecessary work. Inventory and spare parts can be forecast better through the understanding of equipment criticality. Forward-looking schedules can be planned and met. More PM/PdM tasks will be performed replacing "reactive" work. Better equipment history can be documented, providing valuable information necessary for failure and reliability analysis.

The **Reliability Analysis** process utilizes observed equipment behavior and compares it against the expected failure effects and modes identified as part of the FEFA, thus creating a continual or "evergreen" improvement process. This results in "evergreen" reliability strategies that are continually customized to ensure optimal performance for equipment.

The ultimate result of the "evergreen" process is to move toward an equipment-specific reliability strategy for each equipment item based on its actual performance. It is not likely that anyone would ever get to that point nor would it necessarily be prudent or cost effective, but the process provides a path to continually evaluate the actual observed conditions and create the optimal equipment reliability strategy for each asset.

This process enables the equipment reliability strategies to continually move away from a theoretical model to a realistic one based on actual performance. In other words, equipment covered by a template or equipment-group strategy will utilize the template strategy tasks as long as they are providing optimal performance. As observations are recorded, whether good performance, failures, degradation, or any other relevant information, the process provides a path to further customize the template or equipment-group based tasks to the individual equipment they are supporting, migrating from template to equipment-group to equipment-specific reliability strategies.

There are various types of reliability analyses that can be utilized. The "evergreen" process most often is triggered by a failure or other event. However, another aspect is to perform continual "ad hoc" reliability analyses. These can include the basic types of reporting such as Pareto or worst actor charts. As observed history becomes more accessible and accurate, advanced statistical modeling, such as distribution and trend analysis, can be used.

The Asset Management Best Process Model also identifies a number of important **External Processes**. These processes can (and many do) operate regardless of the status of this model. Each is considered important to the reliability of assets. The more integration with the external supporting processes, the better the overall enterprise asset management program.

Throughout the life of a facility, there are various **Environmental/ Operational Factors** that impact the Asset Management Best Process Model. The model must be flexible to respond to these factors, which include changes to business strategy, production targets, feedstock/raw material, regulatory compliance, etc. The entire model, its processes, and resulting data should be evaluated for validity upon the introduction of these factors.

For example, it is not uncommon for petroleum refiners to change their crude slate over time. In most cases, the plant was built originally to refine a "sweet" crude. If they make a decision to start using "sour" crude (indicates changing chemical composition of the crude), this has an effect on the type and frequency of deterioration expected by the equipment. With that in mind, equipment reliability strategies should be reviewed and optimized based on the expected impact of the different factors.

Implementation

The model provides the vision and the processes required to support a leading-edge asset management program based on our experiences in various asset-dependent industries and organizations. It is crucial that the implementation of this model be based on the individual needs of each organization. Each organization must evaluate how to best leverage the processes indicated in the model to meet its own strategies, goals, and objectives for asset management.

Implementation of this model also must take into account the effort required to optimize value as quickly as possible. The model, as represented, indicates a continual process, which over the long term can provide significant benefits. To see a quicker realization of benefits, implementation of certain prerequisites is necessary. These prerequisites include a short-term focus on work management basics and initial performance of the proactive elements of the model (e.g. criticality ranking, front-end failure analysis, and equipment reliability strategy development and implementation). Without the proactive elements in place for "critical" equipment, the value of the "evergreen" process is diminished.

Critical factors for successful implementation of this model include:

- Progressive vision for excellence
- Long-term commitment
- Short- and long-term objectives and goals (Key Performance Indicators)
- Build up basics while extending the model
- Leadership
- Communication
- Training
- Ownership and empowerment throughout the organization
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- Technology

Benefits of the model

Significant cultural changes, cost savings, and increases in mechanical availability can be achieved by the implementation of the Asset Management Best Process Model. Short- and long-term benefits can be expected. Adoption of this model will provide the following representative benefits:

- Common vision for world-class asset management
- An excellence model to train all personnel involved with asset management
- Breakdown of departmental barriers and elimination of conflicting priorities traditionally found in organizations with a "reactive" culture
- Migration from "reactive" to "proactive and planned" reliability-centered work and culture
- Avoidance of significant events due to preventive tasks and predictive monitoring
- Increased mechanical availability/ decreased lost production opportunities
- Decreased maintenance and production costs
- Identified areas of focus for reliability improvement

Enhanced reliability of assets is a critical element in the survival of today's organizations. This recognition has brought forward the question of how to improve maintenance and reliability of assets while simultaneously freezing or trimming the maintenance budget. There are many sound methods and technologies that individually can provide significant incremental cost savings.

However, to reach quantum and long-term improvement, a change in mind-set and work is required. The reality is that this is a journey, not a destination, and unfortunately, there is no "holy grail" which will work for everyone. World-class performers are continuously pushing the envelope. Therefore, all organizations must continuously search for long-term improvement opportunities. Organizations that adopt a holistic and evergreen model such as the one presented here will set the marks for asset management excellence as we move into the 21st century.

Future articles will deal with the processes presented in this model, their interactions, and the controls an organization must provide to facilitate progress. It is our opinion that the key to world-class performance is to select and integrate the best practices available and adapt them to each organization's needs. **MT**

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