Uptime at Minimum Cost in the Process Industries

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INTRODUCTION

For any connoisseur of maintenance, the publication of Reliability Centered Maintenance (RCM) in 1978 heralded a new dawn. Not only did it provide an answer to the " Hard Time Paradox" but it also provided the Engineer with logical tools to determine "What should be maintained", "Why it should be maintained" and "How it should be maintained". Coupled to the release of the Air Transport Association maintenance planning document (MSG-3) in October 1980 with its improved rigor for maintenance task identification, treatment of hidden function failures and improved focus on lubrication and servicing, the scene was set for Preventive Maintenance to come of age.

Twenty years later as we march into the new millenium, it is apparent that relatively few companies have been successful in implementing this reliability approach to preventive maintenance programs, or for that matter recognizing that an in-depth understanding of the failure process of significant production equipment, is a pre-requisite for any manufacturing company to attain and sustain World class standards.

This paper attempts to share some of the key learning points, realized over a period of twenty years in the Brewing/Paper and Pulp industry with implementation experience at nineteen plants on a wide range of continuous process equipment.

OPERATING CONTEXT DIFFERENCES

Many articles have been written about RCM and the need to rigidly follow the analytical approach developed by Nowlan and Heap of Eastern Airlines for new aircraft . Proponents of this rigid approach ignore the significant differences that exist between the various industries

Commercial Airlines

The realization in the Airlines that many types of failures could not be prevented or effectively reduced by the traditional approach to maintenance, led Aircraft design engineers for many years to develop design features that mitigated failure consequences. That is they learned how to design aircraft that were in many respects " failure tolerant". Practices such as replication of system functions, multiple engines and damage tolerant structures are the order of the day. This has resulted in tens of thousands of items in a transport aircraft, whose failures have no impact on the equipment as a whole. It is less expensive to leave them in service until they fail, than it would be to prevent the failures. In addition, the percentage of human error type failures has been significantly reduced by the entrenchment of a disciplined "Best Practice" culture. This coupled to the fact that RCM is a prior to service approach to developing a maintenance program for new aircraft, invariable means that funds, time and access to specialist resources to perform these time consuming analysis are not deemed a problem.

Continuous Process Industry

If we compare some of the differences between the Airlines and the Continuous Process Industry, some notable differences come to mind. Our design practices generally lag far behind in that functional replication is rare, time and resources are at a premium, support documentation is deficient in many areas and most equipment is in use and operating in a non-best practice environment, resulting in many different types of root causes. In addition, production at all costs tends to be the driving force for many maintenance decisions, with a lack of understanding of modern maintenance philosophies and practices at most levels of the industry.

MAINTENANCE TASK ANALYSIS PROCEDURE

If we accept that the design characteristics coupled to the operating context and the age reliability characteristics determine the preventive maintenance program, then the prescribed RCM functional analytical approach, used in Aviation to safeguard the essential functions of new aircraft (until we have learned enough about the failure process to maintain it correctly) is in-appropriate in its pure form for "in-use equipment" in the process industry, where operating data is available.

Given the differences identified, a customized method for non-aviation application was developed (Refer to attached diagram: 'Customized Analysis Procedure') to realize the inherent reliability of in-use equipment at minimum cost. At the outset, given the operating data available, the lack of functional replication for the majority of in-use equipment and the need to accelerate the analysis phase, the up front pre-identification of equipment functions and functional failure modes was dispensed with.

In its place, following the normal steps of Process mapping (Partitioning), benchmarking, and identification of the maintenance significant items, a powerful screening process based on a customized form of Fault tree analysis is used to screen the failure causes for root causes. Resolution of these 'non-machine parts root causes' identified, namely Man, Method, Material and Measurement, in many cases often had a greater impact on bottom line profits than the implementation of the new preventive schedules. This was particularly true in the paper/pulp industry.

For the 'machine parts root causes' namely wear and other normal forms of deterioration, the loss of function associated with these root causes is taken through a customized version of the MSG-3 decision logic to establish the appropriate effects category. The root causes are then further subjected to a questioning process to select the appropriate task or tasks for implementation. This part of the logic diagram has been modified to accommodate the significant advantage we in the process industry have, namely the ability of the manufacturing team to visually inspect our equipment in its dynamic mode (For a craftsman in aviation to perform a daily check whilst the aircraft is in flight, would do little for morale).

Adopting this customized approach as permitted a rapid implementation of reliability based maintenance programs for in-use equipment. In the brewing industry, annual shut down maintenance periods of four to six weeks have been reduced to ten days with a sustained improvement in Packaging Line efficiences and reduction in maintenance costs. A similar pattern is emerging in our Paper/Pulp plants. Other benefits that have accrued are a change in culture from Reactive to Pro-active Maintenance, the emergence of a powerful continuous improvement ethic based on locally developed root cause analysis techniques and the ability to realise a quantifiable return on our SAP R/3 Computerized Maintenance Management System (CMMS). In addition a reliability based maintenance program cannot add value unless its associated synergistic elements are in place to support (Refer to attached diagram: Maintenance and Logistics).

CONCLUSION

In conclusion, to achieve the desired behavior changes in the organization to accept this new way of doing business, particularly as one expands the "silo based approach of RCM " to accommodate focus on the other major machine loss areas, the needs of autonomous maintenance and accurate capture / use of reliability information requires a major paradigm shift by all concerned. Companies need to challenge traditional training methods. Action based learning linked to "real life" equipment assignments, followed up by no warning "simulation" type audits, are vital if we are to be successful in reaping the benefits of modern maintenance in the continuous process industry of the new millenium.