EVOLUTION OF ASSET MANAGEMENT AT EASTMAN CHEMICAL COMPANY

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Abstract:
Setting the vision is difficult but is often easier than determining the most efficient path to reach it. One visionary manager at Eastman Chemical Company set the vision to proactively manage ALL assets by providing condition based maintenance. It has taken 6 years, the formation of a new department, and the continual support of upper management to finally clarify the vision and document a corporate strategy to attain it.

The proactive management of assets requires industry established tools such as predictive technologies and information systems, but also requires the less talked about resources such as money and man-power, training programs, opportunity assessment tools and management champions. This presentation will attempt to present a series of learning's that conclude by showing how all these tools interlock to provide a comprehensive Reliability Strategy for Asset Management.

INTRODUCTION

It is easy to become over saturated with information when looking to pursue "asset management." Reliability and asset management seem to be beloved industry buzzwords for the maintenance, production, and management communities. It has become a very popular topic at conferences and has even spawned a series of new technical associations and certifications. How is the term "asset management" usually defined? Most literature or presentations tend to center around the one missing link, technique, process, or technology on which a program's success hinges.

Can asset management be achieved by a single process or technology? Ten years of experience supporting plant engineering and reliability responsibilities within Eastman Chemical Company say NO. Achieving "Reliability" and "Asset Management" takes a number of industry tools organized around a clearly stated goal and followed up with simple hard work! There is no "one" tool, which can create success but rather each tool integrated with the others to support a common strategy. It has taken Eastman 6 years, the formation of a Reliability Department and the support of upper management to finally clarify a vision and document the tools and strategies to achieve this integrated solution to equipment and process health.

Eastman Chemical Company's Asset Management and Reliability efforts have been concentrated at its largest manufacturing site located in Kingsport, TN. The Kingsport site includes five manufacturing divisions and one utilities division with approximately 9000 employees. Site equipment range from small air conditioning fans to multi-million dollar turbine generators, from electrical room starters to high dollar control systems, along with all manner of piping and fixed equipment. Contrast this with Eastman's recent acquisition of several smaller manufacturing sites employing fewer than 50 employees.

Eastman Chemical Company is currently a 5.5 billion dollar chemical company with 15,000 employees supporting manufacturing sites located in more than 30 countries. Primary products are the marketing and production of chemicals, fibers and plastics. Within this diverse span of equipment and many discrete organizations, Eastman began its reliability journey 15 years ago with the development of a vibration analysis program. The effort has steadily grown into a profit center with plans to sell technologies, processes, and knowledge to other companies needing reliability solutions.

THE CASE FOR CHANGE

The 1980's initiated a wide spread trend of industry bench marking. Specifically, Eastman, along with 40 other manufacturing companies, participated in Solomon's Plant Reliability and Maintenance Effectiveness study. The Solomon's study served as a wake up call, highlighting an opportunity to redefine maintenance from a cost center into a profit center. The most discussed standard used to translate between the different manufacturing industries was "Maintenance Cost as a percent of Asset Replacement Value." Suffice it to say that Eastman was not content with their standing in the study. With the Chemical industry beginning their traditional cyclic down side, cost cutting became a common theme and this benchmarking data presented a very ready target.

A site Vice President & World Wide Maintenance Manager drove the Solomon benchmarking study from within Eastman. This level of management support proved to be instrumental to the success of Eastman's efforts. This Vice President brought three vital components to the initiative. 1.) He owned the Vision, 2.) Had the authority to command results, and 3.) Enjoyed a career stable enough to afford him the luxury of assuming the risk necessary to support a new initiative. His first act was to create a new Reliability Department and to communicate his vision.

1) The Vision 1996

This vision was communicated in two parts. The discussion began with the display of three charts. The premise centered on Predictive, Preventative and Condition-based maintenance. The cost to perform Predictive Maintenance is very high at the beginning due to the capital investment, training, and manpower required at the initiation of such programs. However, once absorbed, this cost decreases and stabilizes unless an additional need for labor occurs. Eastman was in a good position having already absorbed the steep portion of this curve.

The cost to perform time based Preventative Maintenance is fairly low in the beginning since potentially defective parts are being changed before causing catastrophic equipment failure. However, costs steadily increase as the preventative maintenance program begins to reach optimum deployment. Since set time intervals and previous history are the only inputs directing program decisions, it becomes difficult to limit the deployment of this strategy. With over-deployment, the company begins to incur unnecessarily high spare part costs and takes on the added risk of causing additional equipment faults due to unneeded human intervention.

The point at which these two curves intersect is called condition-based maintenance. The Reliability Department was told that there is a system called an "asset manager" that would allow Eastman to perform condition-based maintenance. Management did not know where to find this system, companies who might be in business to support it, or whether it should be designed in-house. The vision had been communicated …. It became the Reliability Department's job to find a way to align maintenance with the vision. While this concept is not new today, it was a very progressive approach in 1996.

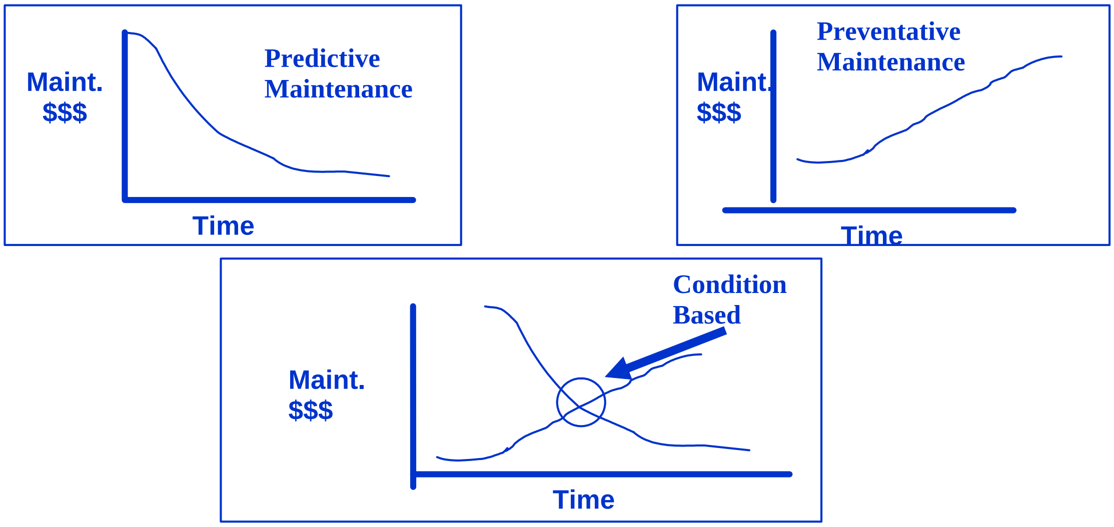


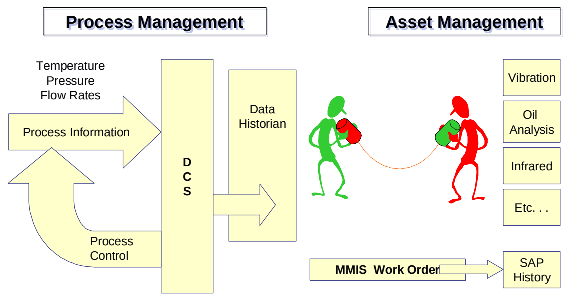
Diagram 1

The second half of the discussion followed with a sketched version of Diagram no 2. Chemical processes are managed by sending process information (pressure, temperature, etc.) to a distributed control system. The DCS then sends corrective signals to the field to keep the process operating properly. Operations learn of a field problem when those pressures and temperatures cease to be controllable or acceptable. Operation's next step is to immediately pick up the phone and notify maintenance that "something" is wrong.
Maintenance, on the other side of the manufacturing house, has a number of predictive tools available. Tools, like predictive technology reports, work order history, etc…, but information systems are not linked allowing mechanics, planners, and schedulers to have early warning of the problem. As a result, mechanics snatch toolboxes and hustle to the field to diagnose the equipment. Once diagnosed, maintenance sets about the repair, hoping parts and tools are available to complete the job. Reliability was challenged to find an IT tool that must exist somewhere which could continuously monitor equipment and notify of the mechanical, electrical or performance degradation associated with internal wear. Reliability was given the command: Go find it! This tool would allow Eastman to perform optimal condition based maintenance, known internally as "Asset Management."
Management's vision was in place…. The Reliability Department possessed no firm knowledge of how to attain it, but at least the destination was known!

2) The Authority

Solomon Benchmarking highlighted Eastman's need to reduce maintenance cost as a percent of asset replacement value in order to compete as an industry leader. Study results were shared at the executive level but not well publicized in lower levels of the organization. Resistance to change was strong, especially in production areas where production initiatives were easier to understand and embrace. Upper Management's elevated position forced Reliability to become a company driven initiative, on equal footing with increased production, and second only to safety. Reliability programs driven from the bottom up had failed numerous times, especially when driven by the maintenance organization. Eastman needed a top down approach, if for no other reason, to communicate the benefits to middle managers who would not have slowed down to listen otherwise.

Non-Integrated Condition Guesswork



3) Risk Assumption

Doing things differently incurs a level of risk that can be absorbed by a number of individuals lower in the organization or by one person sheltering those underneath from higher in the organization. The Vice President position was able to absorb the risk so that the company could experiment, within reason, and either succeed or learn from failure.
During a two-year period, company investment exceeded over a million dollars directed at piloting various “asset management” systems. Of these pilots, the first two returned $0.0 on investment. Had the risk been absorbed lower in the organization, all efforts would have ceased and the initiative would have been labeled a failure. Continued Upper Management support for efforts that attempted to attain the vision was successfully rewarded with the third pilot effort. The third effort returned a NPV of $.5 million deferred Maintenance Costs and a $1.3 million NPV increased production.

LEARNINGS FROM THE PILOT PHASE

General Learnings

Equipment tends to be well instrumented in support of process control, however, is usually poorly instrumented in order to support the physical asset’s health. It was found that in most cases, this is sufficient. Eastman found that most machine trains are instrumented adequately to proactively identify the equipment’s most prevalent failure modes.
Support from the Top Down is important, especially during initiation, but eventually, Buy-In from operations and lower ranks must occur for the effort to be sustainable. Allow the program or system to sell itself based on the value it provides to the user. Upper management tends to move frequently and cannot be counted on to sustain the effort.
Engineering costs and time requirements are a high percentage of implementation costs of Asset Management Systems during the early deployment stage. Capital alone will not resolve problems; an investment in human resources is key.
Black Box processes, where the dynamics are not clearly understood, make excellent candidates. Even if the effort is ultimately unsuccessful, understanding of the process/system/equipment has most likely occurred to the point that a number of smaller improvements can be implemented.
Time based trends are very limited for general equipment diagnostics. Most trends need to be qualified by process run conditions so that similar events can be compared.

Asset Management Systems are too expensive to apply to all processes and equipment.
The Goal should be to identify Chronic Problems, not the sporadic problems. Most things degrade with age. Unfortunately, the human sensory system cannot detect the subtle daily changes associated with “wear and tear” in equipment. On-line systems are great at keeping track of these small changes. If programmed properly, these systems can notify the equipment owner of the most cost effective time to intervene and bring the equipment into acceptable operating range. (This learning highlights a significant difference between an asset management system and a DCS system. A DCS is typically designed to disguise small deviations until they can no longer be compensated for. An asset manager captures these deviations so that causes can be determined and corrected.)
Leverage the vendor’s knowledge; good vendors know how other companies are managing some of the same problems.

On-Line System Expectations

OPC compliance is important, both server AND client.
Data Collection Methods are critical to long-term success. Systems must be configurable, eliminating nuisance alarms, so that system observers know when to take action.
The system supplier must have web-based, net-workable system. PC Client Software can work in very small companies but again, limits accessibility to the information.
Whichever systems are selected, should, in general, be user friendly and not require extensive training for casual use.

Most Important Learning:

Asset Management is not a computer system, a toy or a technology
Asset Management should be a strategy for managing assets!

STATUS UPDATE: WHERE IS EASTMAN TODAY?

Today, Eastman has learned to approach asset management by breaking equipment down into manageable groups. Once equipment has been divided into categories, i.e. Electrical and Instrumentation, Fixed Equipment, or Rotating Equipment, a set strategy can be applied. It doesn’t matter how categorization takes place as long as it provides an organization for strategies to be developed.
Rotating Equipment will be discussed as an example. Eastman calls its strategy for managing Rotating Equipment, the Asset Management Index (AMI) process. All rotating equipment has been ranked using three components:
A Criticality Ranking – The Criticality Ranking is a measure of how important the equipment is to producing a product
Estimated Asset Replacement Value Ranking – This is a measure of risk. For example, with current process definitions, two spared pieces of equipment would each have a production criticality ranking of 3. The company is willing to take more risk with a $5000 spared centrifugal pump than with a spared multi-million dollar turbine generator. Due to the cost of catastrophic failure and time to repair, the turbine generator requires more predictive and preventative management than does the relatively inexpensive pump.
Net Present Value of Average 3 year Maintenance Cost – This component is a measure of historical reliability. Three years average is selected to average out cost spikes due to shutdowns, etc. If certain equipment is costing a disproportionate part of the maintenance budget and/or manpower, this is a flag to intervene with a management strategy.
AMI indexing results in rotating equipment falling into one of four buckets which allows an appropriate strategy to be applied from each of the individual buckets. Obvious to this

discussion is that Eastman has a significant amount of data readily available. This was true for most of the 50,000 rotating equipment trains indexed at the Kingsport Site. This indexing of rotating equipment has also been applied at numerous small sites without requiring mounds of historical data. A series of simple questions can be asked of knowledgeable people for similar results.

The corresponding strategies for each of the AMI levels are:

Level 4 – Preventative Maintenance tasks and frequencies are established per Eastman's Preventative Maintenance Standard. Focus is on devising the most cost effective means for maintaining equipment, adopting a Run to Failure strategy where appropriate.

Level 3 – Predictive Maintenance activities and frequencies are established per Eastman's Predictive Maintenance Standard. Focus is on devising the most cost effective means of maintaining equipment, using Predictive or condition monitoring activities, when applicable. Equipment falling in the Level 3 category is evaluated for standard walk around analysis using Vibration analysis, Motor analysis and Oil analysis.

Level 2 – Focus is on devising the most cost effective means of maintaining equipment, including the use of on-line technologies where economically justified. This includes on-line systems capable of scanning equipment and storing on-line trends of performance combined with walk around methods.

Level 1 – Predictive Maintenance activities should be designed through the application of some disciplined reliability maintenance approach to determine a least cost maintenance strategy, doing the right maintenance to the right equipment at the right time. This includes on-line continuous monitoring systems with built in intelligent alerts to notify the user when corrective actions should be taken as well as less expensive technologies where appropriate.

An internal assessment of AMI Indexing produced the following summary:

Results of AMI Workshops	
Asset Mgt. Level	% Of Rotating Equipment Assets *
Level 1	0.5 – 2 %
Level 2	2 – 4 %
Level 3	24 – 30%
Level 4	65 – 75%
* The Kingsport site contains approximately 50,000 rotating equipment trains with slight variation in results for the various operating divisions.	

Table 1.

The results can be loosely interpreted as: 65 – 75 % of equipment should have the oil changed and bolts tighten on some frequency but should other wise adopt a run to failure strategy. Approximately 25 – 30 % of Eastman rotating equipment should be monitored at a set frequency using the walk--around technologies of vibration, oil and motor analysis. 2 – 4% of rotating equipment warrants creating trends using the plant historian for performance monitoring or scanning type device for mechanical monitoring and less than 2% of the plant's equipment warrants a high level of monitoring with protection and on-line analysis. Level 1 equipment is the heart beat of the plant and may include mechanical on-line monitoring for machinery protection and trouble shooting, 1st principles, engineering models monitoring for process and mechanical efficiency. Protecting this equipment at such high cost must be justified by impact of failure.

Vision 2001 Update for Rotating Equipment:

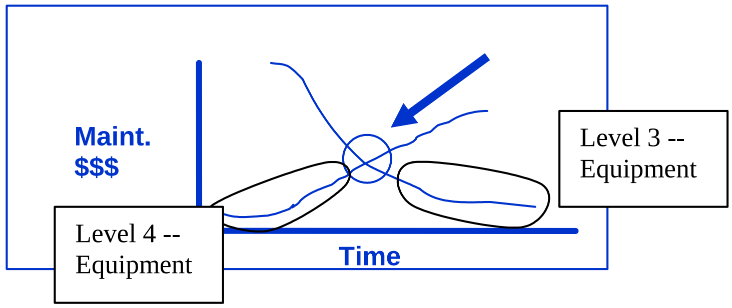


Diagram 3.

The 1996 vision has been revised for Rotating Equipment in order to reflect the knowledge gained during the previous 5 years. See Diagram # 3. The original vision of condition based maintenance for all equipment is not practical with the tools and technologies currently available. Eastman now applies the AMI strategy and invests where it makes the most business sense. Similar approaches and strategies either exist or are being developed for the remaining two categories of manufacturing equipment within Eastman.

DEVELOPMENT OF THE RELIABILITY MANAGEMENT MODEL

The depth of knowledge gained by having gone through the exercise of pursuing upper management's vision eventually resulted in the development of a Reliability Management Model. The following management model summarizes how to approach reliability from a comprehensive business perspective, including infrastructure, predictive technologies, or any other process or tool thought to be related to reliability.

Diagram # 4 is a pictorial view of Eastman's Reliability Management Model or fondly referred to as the "Tank Model." It has become an effective tool for communicating the "big picture," illustrating how each aspect of reliability ties into one solid approach to moving Maintenance and Reliability into a profit center!

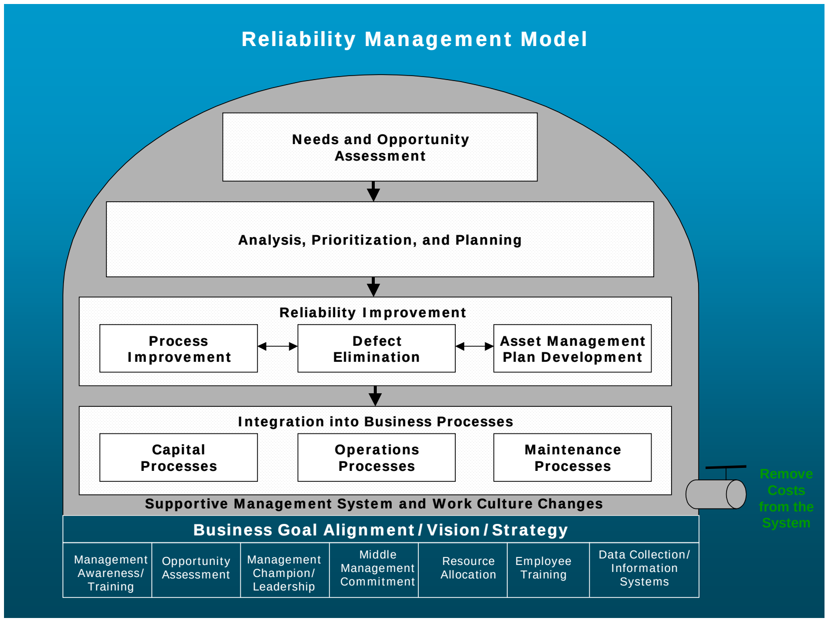


Diagram 4.

EXPLANATION OF THE RELIABILITY MANAGEMENT MODEL

Each sustainable effort must have a solid foundation or the effort will crumble when faced with challenges. It is believed that before a step change occurs within an organization, the following foundational areas must be addressed:

Management Awareness/Training – Does "upper management" support the effort? Have they received adequate training so that they are not only aware of, but can communicate the reasons and benefits of supporting this effort? If Upper Management does not understand the impact and project time frame for financial return, support will erode and will either crumble or be crushed from the top down. Never assume "they should know."

Opportunity Assessment – What will the organization gain from this effort? Are we looking for increased production, reduced maintenance costs, consistent meeting of shipment deadlines? What is the big picture? What opportunity exists? This needs to be simple so it can be held up to the troops. There will be many details that will side tract the effort unless the one objective is clearly stated.

Management Champion/Leadership – Someone within the organization must be assigned the responsibility of championing the effort. It is often said that if no one is asking about progress, how important can it be? When there are so many urgent things crowding the work plate, the "important" tasks can be pushed aside unless someone in management is tracking and driving the plan.

Middle Management Commitment – It is not enough to have buy in at the top and support at the bottom; middle layers of management must be included in the training so that there is a consistent message throughout the organization. Middle management can kill the effort by simply ignoring it. Middle managers are typically pulled in so many directions that the new reliability initiative could get lost when stacked against the everyday task of shipping product through the door.

Resources Allocation – Reliability pays for itself! True, but like any new venture, there are often up-front investment costs in order to enjoy the pay back. In addition to the capital required to acquire predictive monitoring technologies, correct defects, or reschedule production to make a process improvement, there is the need for manpower. Asking someone to work on reliability issues, in addition to their regular workload, will almost always fail. Reliability, by definition has long-term payback, unlike most of the urgent-less important things dealt with daily. The reliability initiative will not achieve desired payback unless the organization counts the costs up front and plans for the required resources.

Employee Training – A reliability department was formed in 1996 with the directive of “go forth and make Eastman reliable.” Members of this new department required training in the various technologies and problem solving techniques. Management required training to understand the new language associated with “Reliability.” Operators, mechanics, and others required training to understand reasons for doing tasks differently.

The training program should address the appropriate audience and should be flexible enough to meet various work schedules. Note also that is does not always need to be formal classroom instruction; informal mini-topics during team meeting are a very cost effective alternative.

Data Collection/Information Systems – Data should drive decisions. Data should drive where root cause studies are conducted, how predictive technologies are deployed, and how resources are allocated. Some infrastructure to be considered: A Maintenance Management Information Systems (MMIS) to track equipment histories and aid the planning and scheduling function, a system to support the consolidated reporting of predictive technologies, a plan or system to track cost versus savings attributed to the program, a database to track root cause findings, etc…

It is not necessary to have all these foundational elements in place before initiating a comprehensive reliability effort but know that their absence will make progress more difficult. Manpower and frustration will replace the investment of infrastructure. Address these issues as early as possible and proactively decide the manner in which they will be addressed. This approach will minimize confusion and frustration and will help to sustain the effort.

With these foundational elements in place, one thing is lacking. Reliability initiatives should be tied directly to both the long and short term business goals and have a vision and strategy to drive them there.

Example: Eastman Chemical Company promised shareholders to shrink cost structure by the year 2000. Portions ($$$) of that promise were assigned to various organizations. Correspondingly, Maintenance received a significant portion. The Reliability Department worked with Maintenance to develop a targeted strategy for the reduction. Operations received a portion ($$$) with the direction to produce more product with existing assets. The Reliability Department worked with operations to define a plan to improve processing reliability. These plans were unified and were then communicated throughout the department and presented to all the various business units for understanding and support. All parties knew how their assignments specifically linked to the business goal and were met with full support by both operations and maintenance.

Needs and Opportunity Assessment

With a foundation in place, the process begins at the top of the tank. A “needs assessment” is required at the business unit, process line, or component level. An example might be a combing of process XXX production line to determine sources of lost product. Corporate Reliability measures may be used to highlight the organizational need. A maintenance assessment may pinpoint the need.

Analysis, Prioritization and Planning

Once needs are know, they should be prioritized according to their ability to support the business goal. If the business goal is to increase production, that should drive the prioritization, if elimination of shipment delays, then process down time should be used to prioritize, etc…

Reliability Improvement

What is needed to make the improvement? Does the process require an operational change? Is defect elimination needed for the equipment, a production line, or an administrative process? Does the asset have a management plan? The answer to these questions will determine which tool to use in the resolution.

Integration into Business Process

Once solutions are known, they should be integrated into the associated Business Processes. This step often includes crossing organizational and functional boundaries.
Example: A manufacturer's pump currently causing problems in one area of the plant may be causing problems in other areas. If so, the solutions should be integrated throughout all affected systems. Results: Purchasing receives modified purchasing specifications. Component modifications become integrated into the stores process so that existing bad stock is cleared. The repaired equipment is temporarily placed on routine vibration monitoring to assess effectiveness of solution. Etc…
Integrate the solution into all affected business processes! This block highlights the resources issue mentioned previously. If an employee is asked to add reliability to their current job description, it is doubtful they will have the time to follow all the integration issues to completion. This makes for a very frustrating job and only localized improvements.
Determine the need. Prioritize according to the business goal and plan resources accordingly. Use the most appropriate tool to solve the problem! Build the solution into the way you do business. The only note is that Reliability is not just a maintenance issue. This model works whether trying to drive customer complaints down or increase pounds produced. If the steps are observed, the process will result in draining unnecessary costs from your organization.

CONCLUSION

This is how Eastman Chemical Company, at the Kingsport site, manages Reliability. Rotating equipment and Fixed equipment are both managed by these processes and a strategy for E&I is under development. These strategies are being shared with all new sites via a corporate integration team as part of the 2001 cost reduction plan. Tennessee Eastman Division has seen a step change in maintenance cost and a corresponding increase in production output with the added difficulty of having fewer employees.
It works! The difficulty for Eastman was getting organized to drive all the tools from a single business goal. Perhaps this rings true for your organization as well. If you have questions about any of the technologies, processes, assessments or strategies discussed in this paper, please contact Eastman Reliability Services at Eastman Chemical Company.

This paper was written by Gina A. Lewis, Manager, Reliability Engineering & Rotating Equipment Group of Eastman Chemical Company and was excerpted from
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