What is Asset Management?

by

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Abstract

Asset management has become the new corporate buzzword in the power generation industry. What does asset management mean, how are assets managed today, what are the observed characteristics of current asset management approaches, and how should they be managed in the future, particularly in an industry undergoing structural and regulatory changes? An insurer's and consultant's perspective to these questions is presented along with those attributes which are considered essential to successfully managing power generation assets.

1. Introduction

Asset management has become the new, new-economy buzzword for the power generation industry. Is it an oxymoron like risk management? Maybe! Depending on what industry you work in, it will have several different meanings. If you are a broker or financial planner, you worry about the value of your client's stocks, bonds, and annuities that make up his portfolio. If you are in the real estate business, you worry about the value, revenue, and salability of your holdings in office buildings, store spaces, and apartments. Financial and real estate holdings are relatively easy to measure and evaluate. But how do you measure and evaluate holdings in the power generation business, particularly in a post Enron era? And if you acquire a new title, asset manager or global asset manager, what does that mean and what really is your job function? If you are running a plant, making a profit, and sustaining a high level of reliability and availability, are you an asset manager, just the plant manager or both. In the next several sections, several approaches to defining asset management and their attributes will be presented from both an insurer's and industry consultant's viewpoint.

2. Back to Basics

According to Webster, asset management (i.e., asset + management) can be defined as the judicious use of property which has value to accomplish an end goal. From this relatively simplistic definition, there are three key phrases that are fundamentally important – property which has value, accomplishing an end goal, and judicious use. From my perspective in the power generation industry, this means the following:

Property (Assets) Which Has Value

To properly value property, property or assets need to be defined. For the power generation industry, the total assets should encompass plant equipment, buildings, land, people, infrastructure (maintenance practices, O&M procedures, planning and cost management tools), inventory, and fuel. The equipment values may be adjusted by their physical condition and plant maintenance practices, O&M procedures, implemented repairs and upgrades, and modernization/capitalization policies. The intellectual capital of plant personnel, the supplier base that supports the plant, and the customer base to which products are delivered add value to the plant and should be included as an integral part of valuating plant assets.

Accomplishing an End Goal

While there are many goals and performance metrics defined in the power generation industry for various aspects of plant operation (scheduled availability, reliability, cost of electricity, forced outage rates, etc.), the fundamental goal of power plants is to make a sustaining profit by producing and delivering electricity to their customer base. While the industry goals and performance metrics may indicate how well a power producer is performing in these areas, the bottom line measure of success is profitability in today's highly competitive, deregulating marketplace. Inherent in achieving plant profitability are the needs for plant equipment to perform reliably and to be available to meet customer and market needs.

Judicious Use of Assets

Defining the assets and goals to achieve with the assets does not seem to be as difficult a task as judicious use of assets. It would seem the critical role of asset management is being able to use the assets in a productive manner to meet established goals but not reduce or degrade the value of the assets nor degrade the ability of the assets to meet sustaining profitability requirements. Hence, the difficulty facing the asset manager is to balance the income potential of assets with the costs of producing power to make a sustaining profit and to maintain the value of the assets.

3. Major Issues for Asset Management

In attempting to balance revenue potential versus costs, the asset manager has to recognize the risks and consequences of losing his critical equipment. In today's changing environment, maintenance budgets are shrinking, plant staffing levels are being reduced, and equipment knowledge at the plant level and with the equipment manufacturers is decreasing due to downsizing and retirements. Compounding these issues are the facts that most power generation equipment is old and continuing to age and that newly designed equipment has no reliability history and their initial operating experience has been less than desired. These issues have resulted in more significant and catastrophic failures that have to be avoided in management of the plant assets.

Examples of these types of failures are shown in the next several figures. Figure 1 shows the result of a boiler explosion. Figure 2 shows an overheated 100 MVA transformer. Figure 3 shows melted generator windings. Figures 4 and 5 show advanced combustion turbine compressor and turbine section major damage. Figure 6 shows advanced steam turbine flowpath damage and wear. And Figure 7 shows the result of a steam turbine overspeed event with the generator field embedded in the stator windings.

Figure 1 – Boiler Explosion

Figure 2 – Overheated 100 MVA Transformer

Figure 3 – Melted Generator Windings

Figure 4 – Advanced Combustion Turbine Compressor and Turbine Blade Damage

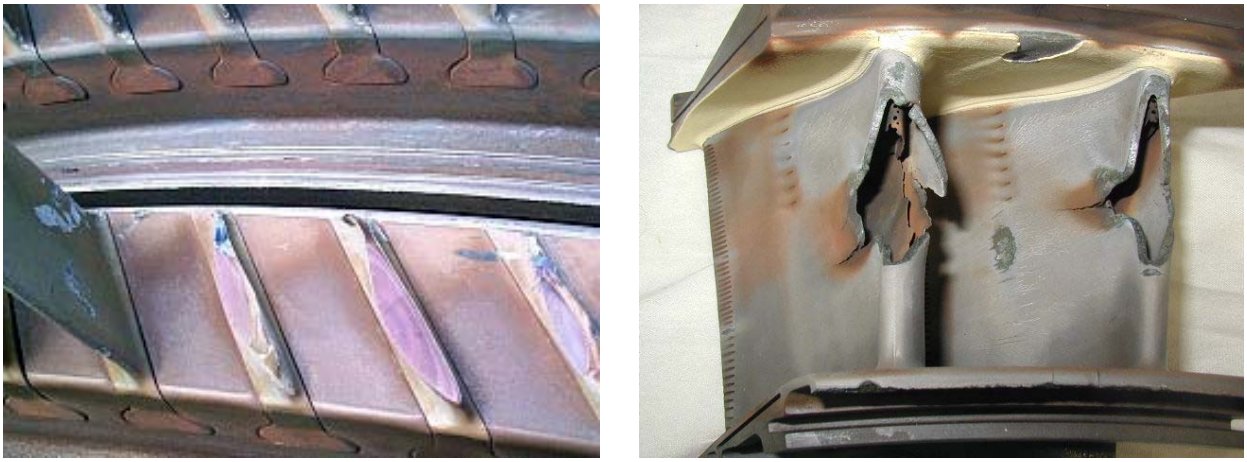

Figure 5 – Advanced Combustion Turbine Compressor and Turbine Vane Damage

Figure 6 - Advanced Steam Turbine Flowpath Damage/Wear

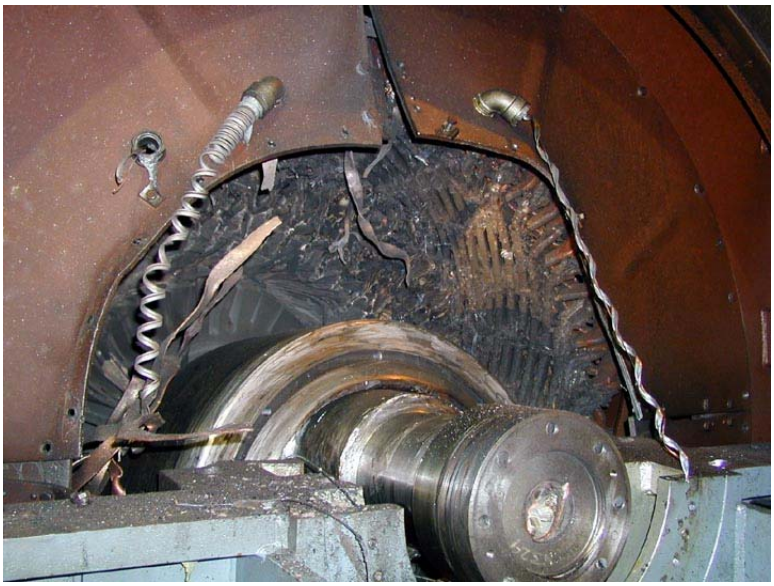

Figure 7 – Steam Turbine Overspeed Resulting in Generator Rotor Imbedded in Stator

There were several common threads in most of these catastrophic or major failures:

- Major plant equipment was involved
- Repair or replacement times was significant (months to 2.5 years)
- Plant or supplier personnel contributed to the failures
- Operating or maintenance procedures were not followed
- Design issues with the equipment or supporting systems were involved

As such, effective management of plant assets has to deal with several key issues. These include the following:

1. Preventing catastrophic failures (explosions, fires, overspeeds, etc.)
2. Preventing unscheduled outages for major repairs (burned or melted windings, damaged turbine flowpath components, design deficiencies, etc.)
3. Providing protection for dealing with design deficiencies in new and upgraded equipment design with the manufacturers
4. Scheduling major inspections, repairs, and overhauls with the proper workscopes at the proper intervals
5. Scheduling minor inspections, repairs, and overhauls with the proper workscopes at the proper intervals
6. Utilizing/preparing proper O&M procedures
7. Training operators and maintenance personnel
8. Utilizing/establishing plant monitoring capabilities that are effective in determining and trending equipment condition and health
9. Accomplishing necessary maintenance without delay
10. Replacing or upgrading obsolete, unreliable, high maintenance, aging, and end-of-life plant equipment

How these issues are dealt with is not a simple task, particularly when you deal with critical, high-dollar, long-lead equipment including turbines, generators, boilers, and transformers. Premature failure of any of this equipment has a major economic effect on the plant's profitability. While insurance provides protection for catastrophic and some major damage, the deductibles are paid by the plant. Insurance does not pay for lost customers or lost opportunities. In addition, costs for design related failures are typically excluded by insurance companies. As such, asset management requires balancing projected income with expected O&M and capital expenditures to address the 10 issues listed above.

4. Asset Management Approaches Observed Today

In visiting plants for risk assessments and due diligence evaluations, several different asset management approaches have been observed. In principle, the practices range from reactionary or ineffective practices to vision-based or highly effective practices. These are indicated in the chart in Figure 8.

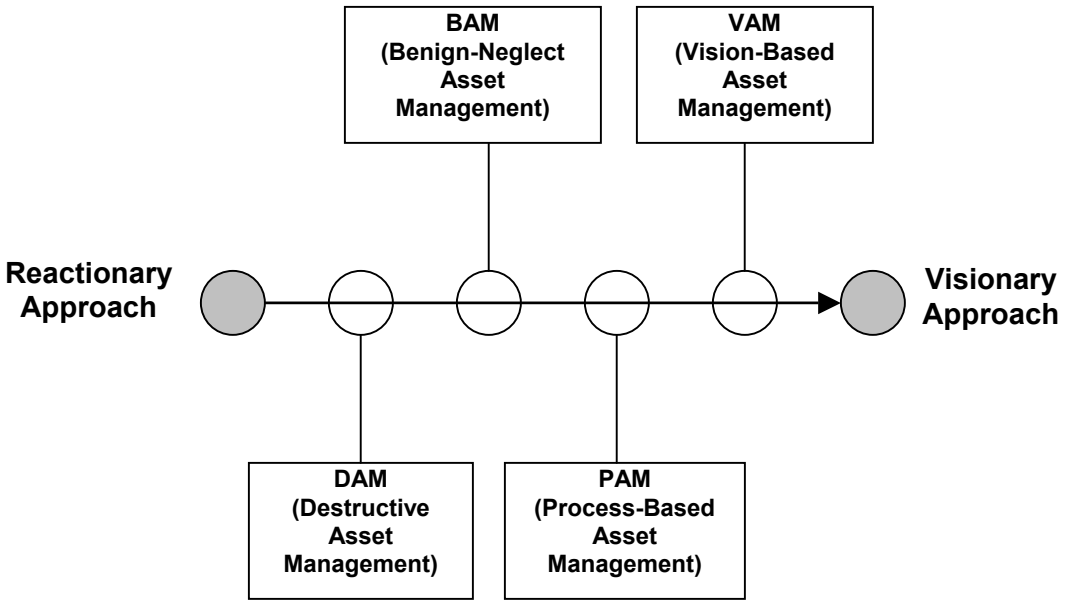

Figure 8 – Range of Observed Asset Management Practices

Destructive Asset Management (DAM)

This approach is characterized by conducting little or no maintenance, investing little in equipment or staff, and a implementing a conscious decision to let the equipment run to failure. Further characteristics include as a minimum:

- The frequency of failures is high
- Major equipment failures are typically greater in severity and require substantially more time to repair
- Practices to prevent catastrophic or major equipment damage are barely adequate at best
- Overhauls and repairs are often incomplete or inadequate
- The maintenance infrastructure is non-existent or badly lacking
- Equipment monitoring and trending of condition/health are non-existent
- Operating and maintenance procedures are not available or not followed
- Personnel training does not exist and morale is poor
- Equipment exists as it was originally installed with no improvements or modernization

In essence, the plant and associated equipment is a disaster waiting to happen. These practices are not only observed in plants with older equipment but also plants where the expense-cutting to achieve a level of profitability has been extreme. Unfortunately, such an

approach, regardless of the age of the equipment, tends to spiral downward to even poorer profitability.

Benign-Neglect Asset Management (BAM)

This approach is characterized by conducting the minimal maintenance that can be accomplished within the allocated budget. There is a sincere desire to not have the equipment fail, but the expense-side of the business drives the allowable maintenance. There is no incentive to reduce failures and hence actions which could in fact improve profitability are neglected in spite of good intentions. Further characteristics include:

- The frequency of failures is relatively high compared to other approaches
- Major equipment failures are large in severity and require more time to repair
- Practices to prevent catastrophic or major equipment damage are minimal at best
- Overhauls and repairs are often incomplete or inadequate
- A maintenance infrastructure exists but it is usually outdated and characterized by a large maintenance backlog that never gets addressed
- Equipment monitoring and trending of condition/health may be present to a limited extent
- Operating and maintenance procedures are poor, incomplete, or not followed
- Personnel training is very limited, if present, and morale is poor
- Equipment exists primarily as it was originally installed with little or no improvements or modernization

In essence, the plant and associated equipment is a minor disaster waiting to happen. The BAM approach is observed in plants with older equipment but also in plants with newer equipment where the personnel skill level and maintenance budgets have been substantially reduced because it is perceived that new equipment should not require much maintenance.

Process-Based Asset Management (PAM)

This approach is characterized by conducting required maintenance, improvements, and upgrades consistent with established budgets and a review process that evaluates the cost/benefits of planned work to validate plant decisions and budgets. Processes in plants using this approach are usually mature and include primary goals of avoiding unscheduled major repairs, reducing O&M costs, and maintaining availability and reliability at high levels. Further characteristics include:

- The frequency of failures is moderate to low
- Major equipment failures are typically not large in severity
- Practices to prevent catastrophic or major equipment damage meet industry standards
- Overhauls and repairs are usually complete or adequate
- The maintenance infrastructure, which is usually computer based, is utilized extensively to manage and plan work. The maintenance backlog, which may be quite large, is continually tracked and worked.

- Equipment monitoring and trending of condition/health is present but is implemented with varying levels of sophistication
- Operating and maintenance procedures are generally good, complete, and followed
- Personnel training is generally important and morale ranges from average to good
- Equipment has been improved and upgraded in varying degrees to improve reliability and availability of problem equipment. Forward planning of major upgrades and end-of-life components, however, is lacking.

As compared to other approaches, this approach has many good benefits as discussed above. The down side, however, is that even these plants are affected by shrinking budgets and staffs. As a result, everyone is extremely busy dealing with the day-to-day problems, maintenance, or planning for the next minor or major outage. Unfortunately, there is little time for evaluating plant or equipment trends and conducting forward planning efforts for upgrades or end-of-life replacement of critical major equipment

Vision-Based Asset Management (VAM)

This approach has the same characteristics of PAM but at a higher level and with several major refinements. First, major emphasis is placed on continually assessing the condition and health of major equipment. Secondly, maintenance, inspection, and overhaul efforts are pro-active to avoid unscheduled outages for either major or minor problems. And lastly, investing in both short term and long term improvements is strongly encouraged to improve efficiency/output, reduce O&M costs, eliminate obsolete designs, and replace end-of-life equipment. Even in this approach there are budget and staffing constraints, but the plant has established a vision for the future where their efforts are directed toward short and long term improvements and improving competitiveness and profitability, while maintaining availability and reliability at high levels. Further characteristics include:

- The frequency of failures is low
- Major equipment failures are typically not large in severity
- Practices to prevent catastrophic or major equipment damage meet or exceed industry standards
- Overhauls, repairs, and inspections are complete and strategically planned
- The maintenance infrastructure is computer based and utilized extensively to manage and plan work. The maintenance backlog, which is typically not large, is continually tracked and worked.
- Equipment monitoring and trending of condition/health is complete and sophisticated. Outside expertise is commonly utilized to assess trends.
- Operating and maintenance procedures are excellent, complete, and followed
- Personnel training is a priority, simulators are used, and morale ranges from good to excellent
- Equipment improvements and upgrades are continuously identified, implemented, or planned for implementation to meet both short and long term needs.

This approach is close to the ultimate in asset management even though these plants are also affected by shrinking budgets and staffs. Everyone is also extremely busy dealing with the day-to-day problems, maintenance, or planning for the next minor or major outage. However, the plants, by using internal and/or external resources, have made evaluating plant and equipment condition/health trends and conducting forward planning efforts for upgrades or end-of-life replacements a major priority and integral part of their planning processes.

5. The Preferred Practice

Given the observations of different asset management approaches from an insurer's and consultant's viewpoint, which approach is best? Obviously, there may be different approaches or combinations of approaches for different equipment types, ages, sizes, and duty cycles. While a visionary approach has the most progressive features and essentially retains the value of the plant and associated equipment better than any of the other approaches, it surely is not a one-shoe-fits-all approach for all plants or all equipment. What is essential in asset management is the following:

- Knowing how your major equipment will fail and what the current failure drivers for your equipment are, based on past experience
- Knowing what the expected lives of your major equipment are and overhauling, upgrading, or replacing them before failure.
- Knowing when there is a change in the health and condition of your major equipment
- Knowing that your plant maintenance efforts are concentrating on the areas and equipment of highest risk
- Knowing that you have adequate equipment O&M procedures and practices and that they are being followed
- Knowing that you have trained your personnel to safely and reliably start, operate, and shutdown the plant or equipment under normal and casualty conditions
- Knowing that your personnel will make the correct decision when faced with abnormal circumstances because they know the "why" as well as "what" needs to be done
- Knowing that you have contingency plans and spares in place to minimize the recovery time should an unplanned repair or inspection become necessary.

To address these issues, it is suggested that a formal asset management review be conducted which includes the following tasks and attributes:

1. Quantify the goals for plant and major equipment in terms of measurable performance (output and efficiency), availability, reliability, expected life, and costs for both short and long term operation
2. Conduct a detailed condition assessment of plant major equipment to determine the short and long term needs and budgets (new maintenance, repairs, improvements, upgrades, replacement) to meet the quantified goals
3. Identify the risk drivers (i.e., equipment with high probability and high consequences of failure) and failure mechanisms for major plant equipment that could jeopardize meeting the goals

4. Identify improvements in plant monitoring consistent with the requirements of Items 1-3 to provide a broader range of proactive detection/inspection capabilities and condition based measurements
    - Automate more monitoring/inspection functions (replace gages with transducers; add new instrumentation; utilize borescopes, remote cameras and microphones, etc.)
    - Trend equipment health and condition continuously
        - Performance monitoring (detect changes/deterioration on-line)
        - Spectral analysis vibration monitoring (level, phase angle, frequency) on-line) with trend/change alarms
    - Use advanced alarms (levels, rate of change, instantaneous changes, and time-trend changes) with timely mitigating action capabilities to prevent/minimize damage
5. Conduct a detailed infrastructure assessment of plant processes in the following areas:
    - Skill sets and training of operation and maintenance personnel
    - Staffing levels
    - Operation and maintenance procedures
    - Maintenance practices and performance
    - Budgeting and execution processes
    - Spares and supplier support practices
6. Develop mitigating solutions to minimize major equipment risks and infrastructure shortcomings that adversely affect equipment risk or O&M costs
7. Develop a continuous feedback system from all areas of the plant to identify problem areas
8. Implement the short and long term investments in plant assets (equipment, people, and processes) to meet the defined goals while meeting changing customer and market needs
9. Reassess risks and mitigating actions on a continuous basis
10. Reward performance to all

There are industry tools and approaches available that can be used to address a number of these issues. Common examples include reliability-centered maintenance (RCM), predictive maintenance (PdM), preventive maintenance (PM), reliability-based maintenance (RBM), computer maintenance management (CMM), enterprise resource programs (ERP), and risk-based or risk-informed decision making. These are not substitutes for asset management but rather are computer-based programs or approaches that can assist in the asset management process.

Typically, these are shell-type programs that have to be populated and customized for specific plants and types of equipment. Accordingly, it should be recognized that implementation of such programs requires a substantial amount of work by the plant to input data to support the programs. The cost and benefits of implementing these programs should be carefully evaluated

because the program's impact on plant operation is substantial and usually grossly underestimated.

7. Conclusions/Closure

So what do we conclude from the previous discussions? Asset management, at least from an insurer's and consultant's perspective, means going back to the basics – making judicious use of property which has value to meet an end goal. Or simply stated – know what you have, know how it performs, keep it from failing, and continually improve it.