

# **STRATEGY TO ACHIEVE WORLD-CLASS PRODUCTION THROUGH RELIABILITY**

**By John Day PE  
Alumax Mt Holly Smelter (currently Alcoa Mt Holly)**

## **INTRODUCTION**

Alumax of South Carolina is an aluminum smelter that produces in excess of 180,000 MT of primary aluminum each year. It began operation in 1980 after a 2-year construction phase. The plant is the last greenfield aluminum smelter constructed in the U.S. Alumax of SC is a part of Alumax, Inc., which has headquarters in Norcross, Georgia; a suburb of Atlanta, Georgia. Alumax, Inc. is the third largest producer of primary aluminum in the U.S. and the fourth largest in North America.

The vision of general management was that the new smelter located on the Mt. Holly Plantation near Charleston, SC, would begin operations with a planned maintenance system that could be developed into a total proactive system. At the time in 1978-79, there were no maintenance computer systems available on the market with the capability to support and accomplish the desired objectives. Thus TSW of Atlanta, Georgia was brought on site to take not only the Alumax of S.C. maintenance concepts and develop a computer system, but they were to integrate all the plant business functions into one on-line common data base system available to all employees in their normal performance of duties.

Since the development and initial operation of the Alumax of SC maintenance management system, it has matured and rendered impressive results. These results have received extensive recognition on a national and international level. The first major recognition came in 1984 when Plant Engineering magazine published a feature article about the system. Then in 1987 A.T. Kearney, an international management consultant headquartered in Chicago, performed a study to find the best maintenance operations in North America. Alumax of S.C. was selected as one of the seven "Best of the Best". And in 1989, Maintenance Technology magazine recognized Alumax of SC as the best maintenance operation in the U.S. within its category and also as the best overall maintenance operation in any category.

## **MAINTENANCE APPROACHES**

From a basic point of view there are two maintenance approaches. One approach is reactive and the other is proactive. In practice there are many combinations of the basic approaches.

The reactive system (see Figure 1.1.1) responds to a work request or identified need, usually production identified, and depends on rapid response measures if effective. The goals of this approach are to reduce response time to a minimum (the computer helps) and to reduce equipment down time to an acceptable level. This is the approach used by most operations today. It may well incorporate what is termed as a preventative maintenance program and may use proactive technologies.

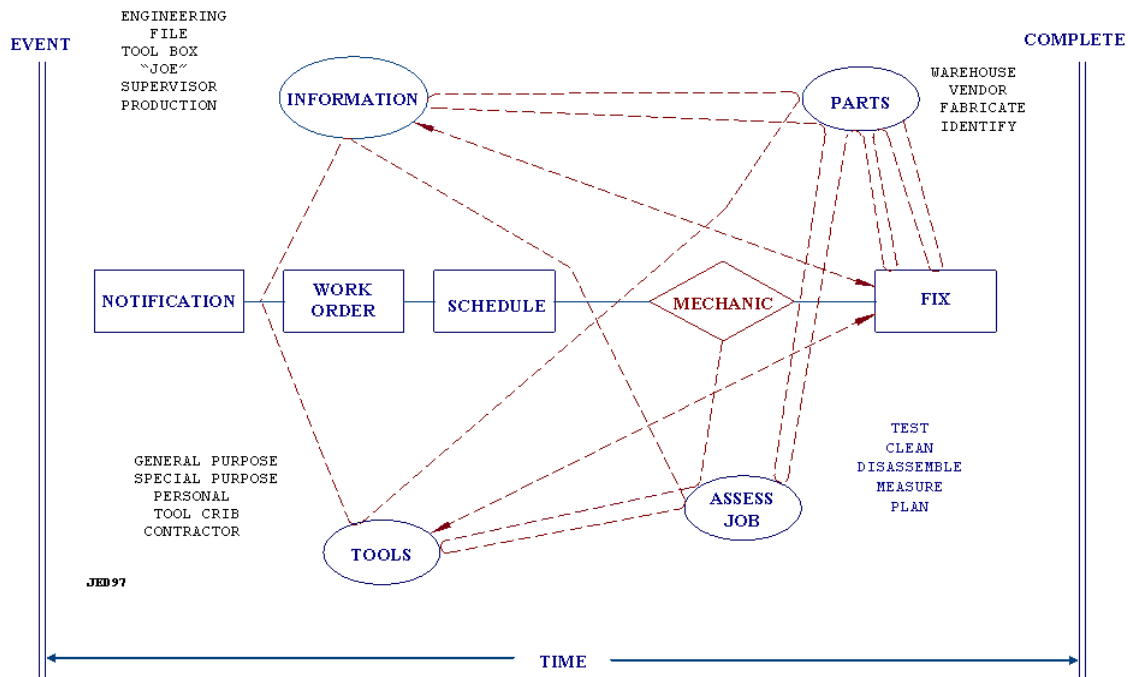


Figure 1.1.1. Reactive Maintenance Model

The proactive approach (see figure 1.1.2) responds primarily to equipment assessment and predictive procedures. The overwhelming majority of corrective, preventative, and modification work is generated internally in the maintenance function as a result of inspections and predictive procedures. The goals of this method are continuous equipment performance to established specifications, maintenance of productive capacity, and continuous improvement. Alumax of SC practices the proactive method. The comments which follow are based upon the experience and results of pursuing this vision of maintenance.

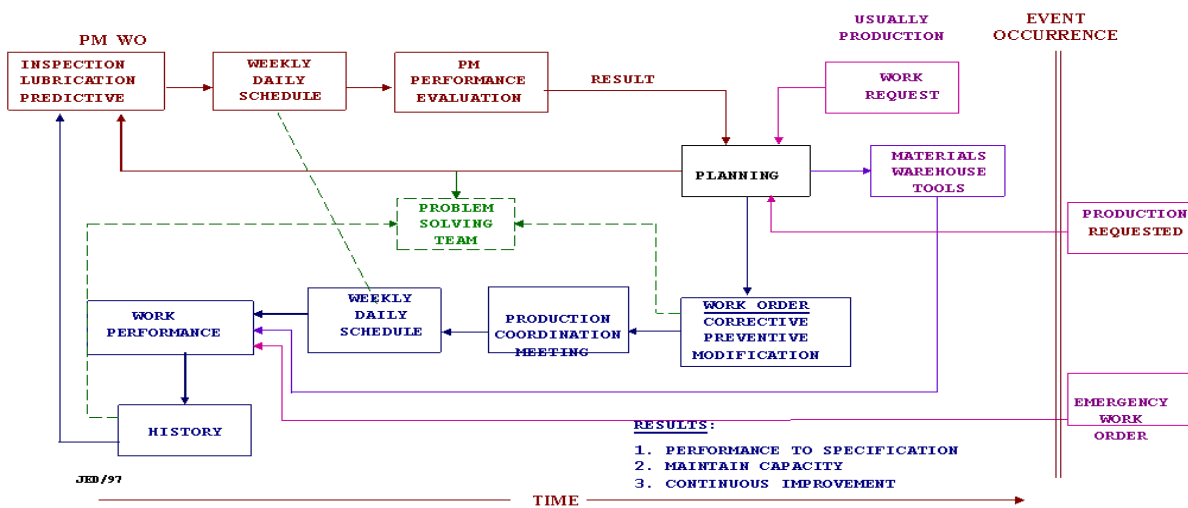


Figure 1.1.2. Mt Holly's Proactive Maintenance Model

## **MAINTENANCE MANAGEMENT PHILOSOPHY**

Alumax of SC began development of the maintenance management concept with the idea that maintenance would be planned and managed in a way that provides an efficient continuous operating facility at all times. Add to this that maintenance would also be treated as an investment rather than a cost, and you have the comprehensive philosophy on which the maintenance management system was built. An investment is expected to show a positive return, and so should maintenance be expected to improve the profitability of an operation. The management philosophy for maintenance is just as important as the philosophy established for any business operation. For most industry, maintenance is a supervised function at best, with little real cost control. But it must be a managed function employing the best methods and systems available to produce profitable results that have a positive effect on profitability.

The development of a philosophy to support the concept of proactive planned maintenance is important. It is believed that many maintenance management deficiencies or failures have resulted from having poorly constructed philosophies or the reliance upon procedures, systems, or popular programs that have no real philosophical basis.

## **THE FUNCTION AND CONTROL SYSTEM**

Today there is little disagreement that the function and control system of a good maintenance management program must be computer based.

Using the philosophy that maintenance management is to be considered in the same way that all other business functions are considered. It is difficult to justify any other approach other than complete integration of maintenance management functions with total organizational management functions. The computer is the tool to use to accomplish this difficult and complex task.

The computer, in an integrated operation, must be available for use by every member of the maintenance organization as well as all other plant employees who have a need. It is an essential part of the maintenance employee's resources for accomplishing his work. It is just as important to a mechanic or electrician as the tools in his toolbox or the analysis and measurement instruments that he uses daily.

The computer must supply meaningful and useful information to the user as opposed to normal computer data.

A successful integration of data systems will tie together maintenance, warehouse, purchasing, accounting, engineering, and production in such a way that all parties must work together and have the use of each other's information. This is part of the answer to the question being asked almost universally, how do you break down the barriers between departments and get them to work as part of the whole or as a team. The computer system must be on line, available, and time responsive. A batch system or semi-batch system will not provide the support needed for a dynamic, integrated, maintenance management system.

In the integrated system with a common data base, data is entered only once and immediately updates all other files so that its use is immediately available to all functional areas. This means that anyone in any functional area can use or look at data in any other area, unless it is restricted. Some have referred to this effect as the "fish bowl effect" since everything is visible to all. This stimulates cooperation, in fact, it dictates cooperation.

## **WHAT IS MAINTENANCE?**

Everyone knows what maintenance is; or at least they have their own customized definition of maintenance. If the question is asked, words like fix, restore, replace, recondition, patch, rebuild, and rejuvenate will be repeated. And to some extent there is a place for these words or functions in defining maintenance. However, to key the definition of maintenance to these words or functions is to miss the mark in understanding maintenance, especially if you wish to explore the philosophical nature of the subject. Maintenance is the act of maintaining. The basis for maintaining is to keep, preserve, and protect. That is to keep in an existing state or preserve from failure or decline. There is a lot of difference between the thoughts contained in this definition and the words and functions normally recalled by most people who are "knowledgeable" of the maintenance function; i.e., fix restore, replace, recondition, etc.

## **SPECIFICATION**

If we shift our defining thoughts to maintenance in the pure sense, we force ourselves to deal with keeping, preserving, and protecting. But what are we to keep, protect, or preserve? You may think that it is the machine, equipment, or plant, and that is true. But how are you to define the level to which the machine, equipment, or plant is to be kept. One way would be to say - "keep it like new". At face value the concept sounds good, but it is more subjective than objective. The answer to maintenance levels must be defined by a **specification**.

A specification is a detailed precise presentation of that which is required. We must have a specification for the maintenance of equipment and plant. In actual usage today the specification, if it exists, is not detailed or precise. A specification usually does exist informally in the mind of the mechanic or management member even though they may be unable to recite it. This means that at best, it is a variable, general -type specification. This kind of specification is defined in terms of and is dependent upon time available, personnel training level, pressure to produce a current order now, money allocated or available, or management opinion. Obviously, a specification like this will not qualify as a true specification, nor will it qualify as a supporting component of the act of maintaining. The true maintenance specification may be a vendor specification, a design specification, or an internally developed specification. The specification must be precise and objective in its requirements. The maintenance system and organization must be designed to support a concept based on rational specifications. Detailed work plans and schedules may be constructed to provide the specification requirement at the maintenance level. In the maintaining context, the specification is not a goal. It is a requirement that must be met. The maintenance system must be designed to meet this requirement. The specification must be accepted as the "floor" or minimum acceptable maintenance level. Variation that does occur should be above the specification level or floor. The specifications will probably be stated in terms of attributes and capacity.

In reference to maintenance specifications, included are individual equipment specifications, process specifications, and plant performance specifications.

## **THE MAINTENANCE FUNCTION**

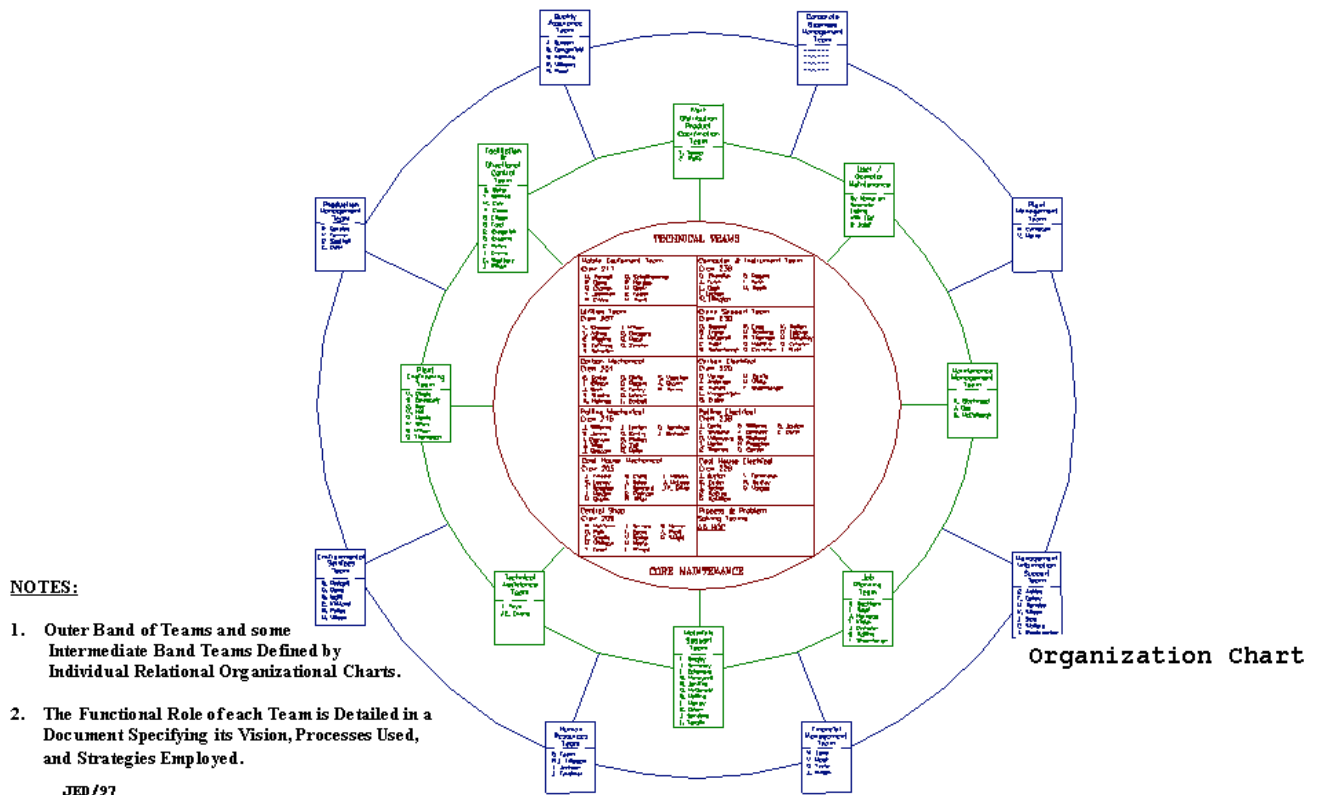
The maintenance department is responsible and accountable for maintenance. It is responsible for the way equipment runs and looks and for the costs to achieve the required level of performance. This is not to say that the operator has no responsibility for the use of equipment when in his hands - he does. The point is that responsibility and accountability must be assigned to a single function or person whether it be a mechanic or operator. To split responsibility between maintenance or any other department where overlapping responsibility

occurs is to establish an operation where no one is accountable. Alumax of SC considers this a fundamental principle for effective operation of maintenance.

The maintenance function is responsible for the frequency and level of maintenance. They are responsible for the costs to maintain, which requires development of detailed budgets and control of costs to these budgets.

Just as the quality function in an organization should report to the top manager, so does the maintenance function for the same obvious reasons. This allows maintenance problems to be dealt with in the best interest of the plant or company as a whole. Maintenance efforts and costs must not be manipulated as a means for another department to achieve its desired costs results.

Where the maintenance department or group is held responsible and accountable for maintenance, the relationship with other departments takes on new meaning. The maintenance department can't afford to have adversary relationships with others. They must have credibility and trust as the basis of interdepartmental relationships. This is an essential element for the successful operation of a maintenance management system.



**Figure 1.1.3. THE MAINTENANCE ORGANIZATION**

The organizational chart or better yet the organizational graphic (Figure 1.1.3) is constructed on the basis that the central functional element for core maintenance is the Technical team. The relational (syntax) aspects of the organization are shown with concentric bands of teams. The nearer band of teams represents the tighter relationship to the core teams. Radial connecting lines show a direct relationship to a team or band of teams. Concentric connecting lines show a more indirect relationship between teams. The outer band of teams requires a RELATIONAL ORGANIZATIONAL CHART similar to the maintenance team's chart to define their

close relationships and full relationship to other plant teams. This particular chart is predicated on the relationship of all teams to central core maintenance teams.

Technical Teams - Core Maintenance - These teams perform core maintenance for the plant. They are composed of qualified electricians, mechanics, and technicians. The teams are assigned based on a functional requirement plant wide or on the basis of a geographic area of responsibility. The focus, direction of the team, and individual team member needs are provided by an assigned member of the facilitator and directional control team.

Facilitator and Directional Control Team - Members of this team have been trained and qualified to provide team organizational dynamics and traditional supervisory functions as required. With the facilitator, the team must address work performance by categories, administrating, training/safety/housekeeping, budgeting and cost control and information reporting as well as the technical requirements of the team. These members perform the necessary traditional supervisory functions, especially related to personnel functions, for the technical teams.

Work Distribution and Project Coordination Team - This team works with the Facilitator, Planning and Engineering teams to staff technical teams to meet work load requests, inventory requirements, contractor support, and field superintendence of engineering projects.

Job Planning Team - This team works closely with the Technical teams and the Facilitator team to plan and schedule maintenance, overhaul, and contractor work. Where operators are doing maintenance functions, the same applies.

In addition, information and reports are prepared by this team for all other teams as required or requested. Quality control of the data input is a responsibility of this team. Coordination of production requirements must also be performed.

Technical Assistance Team - This team is a resource to the Technical teams and Facilitator team for continuous improvements, modifications, trouble shooting, and corrective action.

Materials Support Team - This team works with the Planning team, Facilitator team, and the Technical teams to meet planned job requirements and emergency material requirements.

Maintenance Management Team - This team provides overall coordination of maintenance and material functions to meet the plant capacity requirement. Overview of budget and cost control is also provided.

User/Operator Maintenance Team - This is a team of designated operators who perform assigned and scheduled maintenance work. They must be selected, trained and qualified prior to being assigned to this team.

Plant Engineering Team - This team provides projected management for the Plant capital budget program. They provide consulting and troubleshooting to the Technical Teams on an as requested basis.

Other teams in the outer band of the organizational chart must be specifically defined by individual relational organization charts.

For each of the above teams, a detailed performance requirement document must be developed. Individual team members are guided by a specific job performance document. These documents detail the vision, mission, processes used, and strategies employed.

Does the maintenance function provide a service or produce a product? Again, definition is important in the development of this part of the philosophy. Service is defined as a useful labor that does not produce a tangible commodity. A product is something that is produced, usually tangible, but definitely measurable. In the case of the maintenance function and the development of this philosophy, both a service and a product are considered as an output of maintenance. The current thinking which is related to traditional maintenance (reactive maintenance) suggests that the maintenance function is for the most part a service function. But the philosophy being developed here considers the maintenance function as the provider of a product with a small but limited service component. Consider the product produced by maintenance to be capacity (Production/Plant capacity). Writers on the subject of maintenance have suggested this concept in the past, but little has been made of developing the idea to date. A predominate service approach to maintenance, as is currently practiced, is a reactive mode of operation, and is typical of most t maintenance operations today. React means response to stimulus. Most maintenance operations today are designed to respond to the stimulus of breakdown and the work order request, except for small efforts related to preventative maintenance and predictive maintenance, usually less than 25% of man-hours worked. This simply means that the maintenance function must be notified (stimulated) of a problem or service requirement by some means, usually by someone outside of the maintenance organization, then maintenance reacts. Rapid response is the "score card" of this system.

It is being suggested by this proactive philosophy that the maintenance function be addressed as the producer of the product- **capacity**. Capacity is measured in units of production or output (or up time). A total proactive system must specifically be designed to produce capacity (product). If the maintenance function is to be classified as proactive, it cannot stand by and wait for someone to call or make a request. In a total proactive approach, maintenance must be responsible and accountable for the capacity and capability of all equipment and facilities. The function must provide a facility and equipment that performs to specification and produces the product (capacity). Stated again, the maintenance function is a process that produces capacity which is the product. See Table #2 for a more detailed analysis of service vs. capacity. The results of this model created benchmark that hundreds of companies followed and many continue to adopt all the time. In figure 1.1.4 you will clearly see the "World Class Benchmarks" of Alumax, Mt Holly.

	<u>Mt. HOLLY</u>	<u>TYPICAL</u>
<b>Planned / Scheduled</b>	<b>91.5%</b>	<b>30-50%</b>
<b>Breakdowns</b>	<b>1.8%</b>	<b>15-50%</b>
<b>Overtime</b>	<b>0.9%</b>	<b>10-25%</b>
<b>Inventory Level</b>	<b>1/2 Normal</b>	<b>Normal</b>
<b>Call-Ins</b>	<b>1/Month</b>	<b>Routine</b>
<b>Off-Shift Work</b>	<b>5 People</b>	<b>Full Crew</b>
<b>Backlog</b>	<b>5.5 Weeks</b>	<b>Unknown</b>
<b>Budget Performance</b>	<b>Var. 1-3%</b>	<b>High Var.</b>
<b>Capital Replacement</b>	<b>Low</b>	<b>High</b>
<b>Stock outs</b>	<b>Minor</b>	<b>Routine</b>

Figure 1.1.4.

Companies who have adopted John Day's philosophy and strategy have achieved results beyond what was known within a company. One company of many companies who were successful was a large manufacturing company. Once senior management understood and adopted John's philosophy and approach it resulted in:

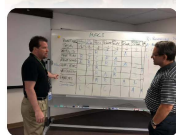
1. Increase plant capacity by \$12 million dollars in the first year
2. Deferred a large capital project because the capacity it was to provide was found as part of what is called the "hidden factory"
3. Eliminated the need to hire a projected 12 additional maintenance staff members
4. The plant maintenance staff was reduced by 20% over the following three years because of attrition

The approach to proactive maintenance is not magic however implementing the process is very difficult but the results are worth the effort. In order to develop a true proactive maintenance process a company must have commitment from senior management to floor level personnel and the discipline to follow a known "best practices" which have been proven and work.

World Class Maintenance – Alumax Mt Holly was one of three plants in the World to be validated as having a World Class Maintenance Organization. This certification was awarded in 1997. In 2012 a similar evaluation was conducted by Allied Reliability Group assessing the same requires as in 1997. These two sets of scores are shown in **Figure 1.2**

### Alumax Mt Holly (1997) vs. Alcoa Mt Holly (2012)

Category	Alumax-1997	Alcoa-2012
Maintenance Spending / RAV	3.4%	2.0%
Budget Compliance	-0.5%	+3.7%
Overtime / Straight Time	1.0	7.1%
Number of Crafts	4	3
Planners per Tradesperson	1:20	1:19
Absenteeism	1.6%	1.8%
Backlog in Crew Weeks (Per Tradesperson)	4.4	6.8 Total/6.25 Ready
Schedule Compliance	95%	85.7%
Percent of Urgent (Interruption) Work	10.5%	3%
Percent of PM / PdM to all Work Orders	32%	47.2%
PM Accomplishment	96%	85.7% (10% Rule)
Inventory Accuracy	96%	97.6%
Inventory Turns	3.31	2.86
Maintenance Training \$'s as % Total Payroll \$	4.2%;	1%
Wrench Time	62.3%	58.8%



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