

# PLANT MAINTENANCE: CHANGING FROM A NECESSARY EVIL TO A PROFIT CENTER

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*PROVEN STRATEGIES FOR CONTINUOUS IMPROVEMENT  
CAN TURN PLANT MAINTENANCE INTO A SOURCE OF PROFITABILITY.*

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**E**VERY MANUFACTURING FACILITY REQUIRES PLANT maintenance. To many people, plant maintenance usually equates to production downtime, schedule interruptions, and labor and material costs for repairs. Plant maintenance is commonly accepted as an added cost of doing business or a necessary evil.

Plant profit is the difference between sales revenue and the cost to manufacture and market products. When effective plant maintenance increases the number of salable products and decreases the maintenance cost per unit, no one can deny that maintenance contributes to improved plant profit.

Maintenance must be more than just a service function. The actual product that plant maintenance sells is equipment reliability. Plant maintenance becomes a profit center when it can economically and successfully provide process uptime.

What is plant maintenance? It is the business of keeping machinery, buildings, and infrastructure in operating condition. It is also producing a product for a profit. Moreover, it involves accomplishing these objectives safely. Plant maintenance is one of the remaining major opportunities to improve company profits.

Surveys of maintenance in industry reveal some alarming statistics. Maintenance costs are rising between 10-17.5% annually (US \$100-200 billion). Of that amount, US \$60 billion is wasted annually.

Savings of 15-30% are realistic with successful maintenance improvement programs. Among survey respondents, 50% say they have such programs, but only 5% feel they work.

The ratios of cost of lost production to repair cost range from 2:1-15:1. The average is 4:1. The ratio of indi-

rect costs to direct costs for a lost time plant injury can be 40:1. The average is 20:1.

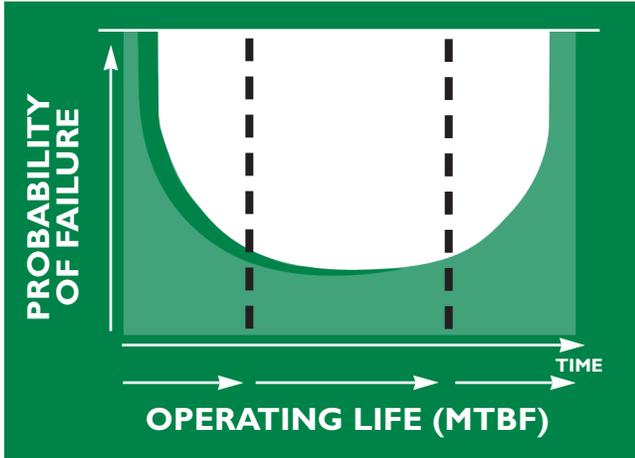
Where is your plant in a competitive global market? If you were to plot the rate of improvement vs. time for your plant compared with industry practice, how would it compare today? How will it compare in the future? Is there a benchmark gap or a competitive advantage? Is the gap widening or closing?

These are some of the common perceptions of plant maintenance:

- It's dangerous—people get hurt.
- It involves downtime, with lots of production losses.
- It results in lower profits due to additional costs of labor and materials.
- It produces stress and urgency to make the repairs.
- Someone is to blame—why did maintenance let it fail?
- It's cold, dirty work in the winter.
- It's hot, dirty work in the summer.
- It requires lots of overtime.
- It's a thankless job!

By contrast, here are some of the desired perceptions of plant maintenance:

- It's safe—people don't get hurt.
- It improves reliability and increases production.
- It results in higher profits and reduced labor and material costs.
- It can be managed to design out repairs.
- Operations and Maintenance are a winning team.
- Each day is filled with enthusiasm.
- One can return home with a sense of accomplishment.
- Overtime is minimized.
- A wonderful job!



1. Pattern of machine failure probability

Is plant maintenance at your facility a necessary evil or a profit center? The choice is yours!

## THE VISION: PLANT MAINTENANCE AS A PROFIT CENTER

### World-class maintenance indicators

Key performance indicators that should be decreasing include the following:

- Maintenance cost per unit produced
- Electrical contact temperatures
- Vibration levels
- Process downtime, both scheduled and unscheduled
- Unplanned, unscheduled or emergency maintenance work
- Maintenance material usage
- Required work-hours to perform repetitive work.

Key performance indicators that should be increasing include:

- Equipment reliability (uptime)
- Life-cycle cost (LCC) used in equipment calculations
- Fast access to data
- Natural work team utilization
- Operators performing inspections and minor maintenance
- Always a five-year plan for continuous improvement.

Furthermore, the maintenance backlog should be down or flat, and maintenance overtime should be no more than 5% of total maintenance hours.

Mean time between failures (MTBF) for key equip-

ment should be:

- 20 years—electric motors
- 12 years—bearings
- 10 years—pumps
- 8 years—mechanical seals.

The important thing is that the key performance indicators for plant maintenance continue to improve (1).

### World-class performance targets

Targets for world-class performance can be quantified as overall equipment efficiency (OEE). It is defined as follows:

$$\text{OEE} = (\text{Availability})(\text{Quality})(\text{Capacity})$$

Target performance is 90%

where

$$\text{Availability} = (\text{total time} - \text{total downtime for operations and maintenance} / \text{total time}) \times 100$$

Target performance is 97%

$$\text{Quality} = (\text{total salable product} / \text{total salable product} + \text{reject product}) \times 100$$

Target performance is 97%

$$\text{Capacity} = (\text{actual equipment speed for product} / \text{budget speed for product}) \times 100$$

Target performance is 96%.

## THE REALITY: PLANT MAINTENANCE AS A NECESSARY EVIL

Most plants are in the reactive or response-driven maintenance mode. Often the customer's wants, needs, and why these wants and needs are important are not understood.

Many plants are confused regarding the objectives of the plant maintenance business.

While some plants have predictive and preventive maintenance programs, equipment reliability (uptime) that plant maintenance provides to operations is insufficient, and costs are excessive. Their operating philosophy sounds like this:

We run it until it breaks!

Maintenance fixes it!

We run it until it breaks!

Some managers approach plant maintenance with the attitude that all things fail; it's just a matter of time. Equip-

ment life is like a poker card game—it's all in the luck of the draw.

Breakdown maintenance is seen as the curse of plant operations.

An organization mirrors its leader. Each person looks at his or her immediate leader to understand the leader's expectations and work results that the leader will accept. The degree of the individual's performance is usually based on this perception.

Does your plant maintenance organization solve or avoid addressing problems? Many managers don't like to face problems head on. They say the best way to solve problems is to avoid them. Some managers' philosophy is that no problem is so big or so complicated that it can't be run away from. "Pay now or pay later" is generally accepted as a way of life.

World-class thinking teaches that it is less costly to address problems head on, identify the root cause, and take corrective action to prevent a recurrence. This approach results in plant maintenance being a profit center.

Does your plant maintenance maintain communications? Fix obvious problems? Look upstream? Document progress and productivity? Monitor changes? A world-class plant maintenance function performs all of these activities and more.

Does plant maintenance have a quality improvement plan? It should, and the plan should include these elements:

- Vision/mission
- Objectives
- Critical success factors
- Core process strategies
- Process improvement projects
- Documented results.

### **Benchmarking**

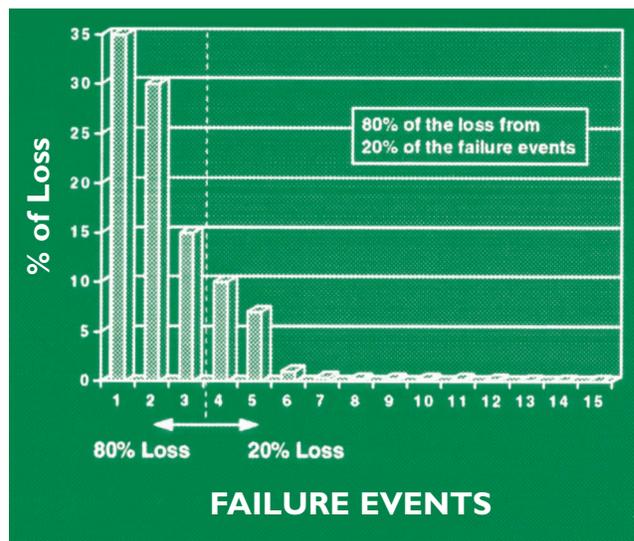
Benchmarking is the practice of being humble enough to admit that someone else is better at something and wise enough to try to learn how to match and even surpass them at it.

Benchmarking is a continuous process. It will assist the plant to increase equipment reliability and production and to decrease repair labor and material costs.

There are four phases of benchmarking: plan, collect data upon execution, analyze results, and adapt changes and improve the plan.

### **Equipment failure**

There are three phases of equipment failures. **Figure 1**, called the bathtub curve, shows three phases of equip-



**Pareto chart (the 80/20 rule)**

ment failures: start-up, random, and wear-out.

To accept the view that equipment failure is the "luck of the draw" is a serious mistake. The key to success is to extend the mean time between failures (MTBF) or equipment operating life using maintenance best-practices methods. This will increase equipment reliability and production while decreasing maintenance repair labor and material costs.

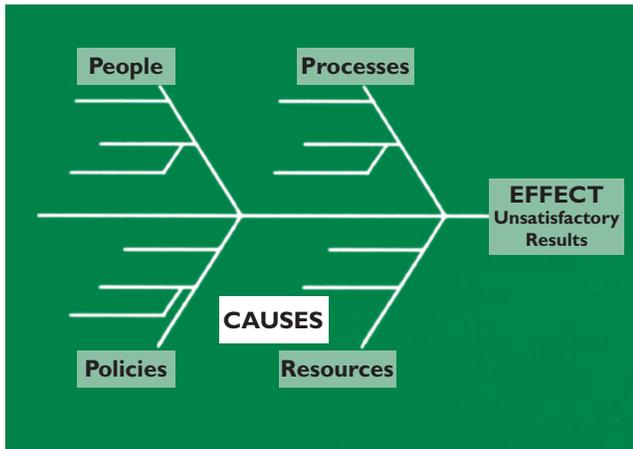
Is your plant proactive? Proactive means "doing things right and doing the right things." Are people spending time and energy on the things that bring the most value to the plant? Is the integrity of the operating process improving? Are maintenance costs per unit decreasing?

Everything you need to know about improving your business is contained in your failures. Everything! Most plants document lost production, causes, costs, quality problems, and other data associated with their business. It is surprising that many plants do not effectively use the data and established methods for analysis, and they do not implement strategy to become more proactive.

### **The 80/20 rule (Pareto chart)**

One effective method to analyze data is the Pareto chart, shown in **Fig. 2**. A Pareto chart is a series of bars with heights reflecting the frequency or impact of problems. These bars are arranged in descending order of height from left to right. This means the categories represented by the tall bars on the left are relatively more important than those on the right.

The name of the chart derives from the Pareto Principle ("80% of the trouble comes from 20% of the problems"). To be proactive (working on the right things), this method suggests that you concentrate on the



3. A cause and effect diagram

“vital few” sources of problems and not be distracted by those of lesser importance!

### The 85/15 rule

There is a widely held belief that an organization would have few, if any, problems if only workers would do their jobs. Joseph M. Juran of the Juran Institute says that this belief is incorrect (2). According to him, the potential to eliminate mistakes and errors lies mostly in improving the systems through which work is done, not in changing the workers. This observation has evolved into the 85/15 rule: At least 85% of problems can be corrected by changing systems (which are largely determined by management), and fewer than 15% are under a worker's control.

Understanding quality leadership is not just rethinking where you are going; it's looking at how you will get there. Paying attention to method as well as results is one of the distinguishing features of a better way of doing business.

The core of quality improvement methods is summed up in two words: scientific approach. Though this may sound complicated, a scientific approach is really just a systematic way for individuals and teams to learn about processes. It means agreeing to make decisions based on data rather than hunches, to look for root causes of problems rather than reacting to superficial symptoms, to seek permanent solutions rather than relying on quick fixes.

### The cause and effect diagram

The cause and effect diagram, shown in Fig. 3, is a proven method for process improvement. Also called a “fishbone diagram” because of its appearance, it provides a pictorial display of a list of factors thought to affect a problem or desired outcome.

Each diagram has a large arrow pointing to the name of the problem. The branches off the large arrow represent main categories of potential causes (or solutions). Typical categories are equipment, personnel, method, materials, and environment. Smaller arrows, representing subcategories, are drawn off each branch.

### Plant maintenance and operations partnership

A partnership between plant maintenance and operations with support from others will produce results that show an increase in equipment reliability and production and a reduction in repair labor and material costs once the process methodology is in place and people are trained.

The plant must be a highly competitive and efficient market-driven facility that can successfully compete in a changing world marketplace. It must maximize its capacity and product quality and minimize manufacturing costs. It must have plant maintenance that is world class. It can accomplish this by providing process equipment reliability such that overall equipment efficiency is above 90% and maintenance costs per unit produced are less than the competition.

Success is a team activity and responsibility. When operations and plant maintenance attempt to function independently, failure will result.

### The breakdown maintenance habit

The philosophy of “we're making repairs” and a “patch and run” attitude regarding plant maintenance continues to prevail in some plants. The results are high costs and low productivity.

Symptoms of the breakdown maintenance habit include:

- Insufficient work-force capability
- Breakdowns
- More emergency work
- Equipment failures
- Less planning
- Confusion
- Postponed preventive maintenance
- Urgencies
- More failures
- More emergency work
- Deferred preventive maintenance.

This habit is also called “the breakdown maintenance spiral.” It can be initiated by a combination of circumstances, such as a surge of failures brought on by an insufficient quality or quantity of the work force, postponing PMs heading to more urgent situations, resulting in a deviation of the planning aspect, bringing on more break-

downs that necessitate the work force being designated for more repairs, and allowing a lapse of preventive maintenance work that ultimately greatly increases costs as a result of low worker and equipment productivity (3). The resulting production losses, equipment downtime, labor and material costs, injury potential, and personal stress contribute to the notion of plant maintenance as a necessary evil.

A survey of plant maintenance at 10 plants reveals that one or two are terrible (necessary evil) and one or two are excellent (profit center), while most plants fall in between. A bell-shaped curve describes the distribution. If your plant maintenance is world class and meets all of the criteria necessary to be a profit center, congratulations! Continue your present plan and execution strategy. However, most plants have plant maintenance functions that are not world class. There are considerable improvement opportunities at these locations.

The primary barrier to process improvement is changing people's mindsets. Why change? "If you always do what you did, then you will get no more than you got!"

We say that most people resist change. This is not the reality of the situation. To be more accurate, we should say that most people resist being changed (4). You must have an open mind if progress is to continue!

### **THE PATH TO SUCCESS: CHANGING PLANT MAINTENANCE FROM A NECESSARY EVIL TO A PROFIT CENTER**

For years, managers have struggled with the questions of how to measure plant maintenance performance and how to make it a profit center. The conclusions that have been reached often take completely different directions.

#### **Which path?**

The work force waits while managers decide whether to take the easy path to quick returns (and ultimate disaster) or to use quality leadership to travel the road to long-term prosperity.

#### **Elements of quality leadership**

The kind of thinking that led to past success may not lead to future success. Share information with everyone. Vision comes alive when everyone sees where their contribution makes a difference.

Create autonomy through boundaries. Replace the hierarchy with high-performance work teams. Recognize that empowerment takes more than a minute.

#### **Development of quality leadership**

Quality leadership requires the education of top management. Create a two-year improvement strategy. Develop a network of support and guidance. Make quality part of the company culture. Provide for the training and education of all. Conduct improvement projects.

#### **Empowerment**

Every "mistake" is an opportunity to increase competence. Empowerment comes from teaching others things they can do to become less dependent on you.

People without information cannot act responsibly. People with information are compelled to act responsibly.

#### **The elements of empowerment.**

Share information with everyone. Share performance information about the plant to help people understand the business.

Build trust through sharing. Set up self-monitoring possibilities. View mistakes as learning opportunities.

Break down hierarchical thinking. Help people behave as owners of the company.

#### **Create autonomy through boundaries**

Clarify the big and the little pictures. Clarify goals and rules. Define values and rules that underline actions. Provide needed training. Hold people accountable for results.

#### **Replace the old hierarchy with high-performance work teams**

Provide direction and skills training for empowered teams. Provide support and encouragement for change. Use diversity as a team asset. Gradually give control to the teams. Recognize there will be some tough times.

#### **Empowerment isn't magic**

It consists of a few simple steps and a lot of persistence. People already have power through their knowledge and motivation. Empowerment is letting this power out. Give people the information to act, then look for magic to happen (5).

#### **The primary requirement for success**

The senior manager at the facility holds the key to the success of a plant maintenance program. Improvement won't happen without the plant manager's commitment, statement of expectations, communication, and support.

#### **Process improvement results**

The first significant change is in people. Next come increases in plant production, followed by a reduction in maintenance costs per unit produced. The final result is an increase in plant profit.

#### **Paradigm shifts**

The paradigm shift is from catching people doing things wrong to catching people doing things right; ultimately, to catching people doing the right things right (4).

#### **Winning**

Winning is not a sometime thing. It is an all-time thing. You don't win once in a while, you don't do things right once in a while; you do them right all the time. There is no room for second place. There's only one place, and that's first place (6).

## SUMMARY

The information presented is not new, just forgotten. It is my hope that the information offered will contribute to plant maintenance becoming a profit center and your facility being a winner in the competitive global market. **TJ**

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