The True Cost of Maintenance

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The increasingly expanding practice of outsourcing (sending jobs offshore) manufacturing operations has created an even greater than normal need to identify and reduce American industries' costs of manufacturing. One of the largest controllable manufacturing costs is in maintenance operations. But what is the true cost of our maintenance systems? The first step in determining the true cost of your maintenance efforts is to determine – and understand – what type of maintenance system you have. Dr. W. Edwards Deming had an interesting viewpoint for understanding systems, maintenance or otherwise:

"Your system is perfectly designed to give you the result that you get."

What is the result that your maintenance system is designed for? Is your maintenance system producing predominantly reactive activities? Then it must be designed for a reactive result. The up-side of having a maintenance system designed to produce reactive results is that you have a tremendous opportunity to improve your business and reduce costs.

Where maintenance systems are predominantly reactive, up to fifty percent – and occasionally even more – of maintenance spending can be eliminated! How? Simply redesign your reactive maintenance system into one that results in proactive activities.

Eliminate fifty percent of my maintenance costs? Can that possibly be true? The truth of this statement can be verified if you'll begin by examining a recent, major failure that you experienced. What was the cost of the repair? What was the value of the product not produced…the value of lost business opportunity while repairs were made… the value of customer dissatisfaction when his order was short or late?

Statistics show that the cost of a typical repair is 5 to 15 times greater than the cost of the (proactive maintenance) effort that would have prevented the failure from occurring. When the cost of the loss of product, business opportunity, client rapport and similar indirect costs are added to the cost of the repair we can begin to see how the true cost of reactive maintenance practices can quickly add up. Compounding this already costly situation is the fact that – especially in reactive maintenance operations - many maintenance systems do not identify failure root causes and, as a result, suffer the same failures repeatedly. This not only escalates maintenance costs even more, it results in a downward spiral of system and equipment reliability and ultimately the viability of the business itself.

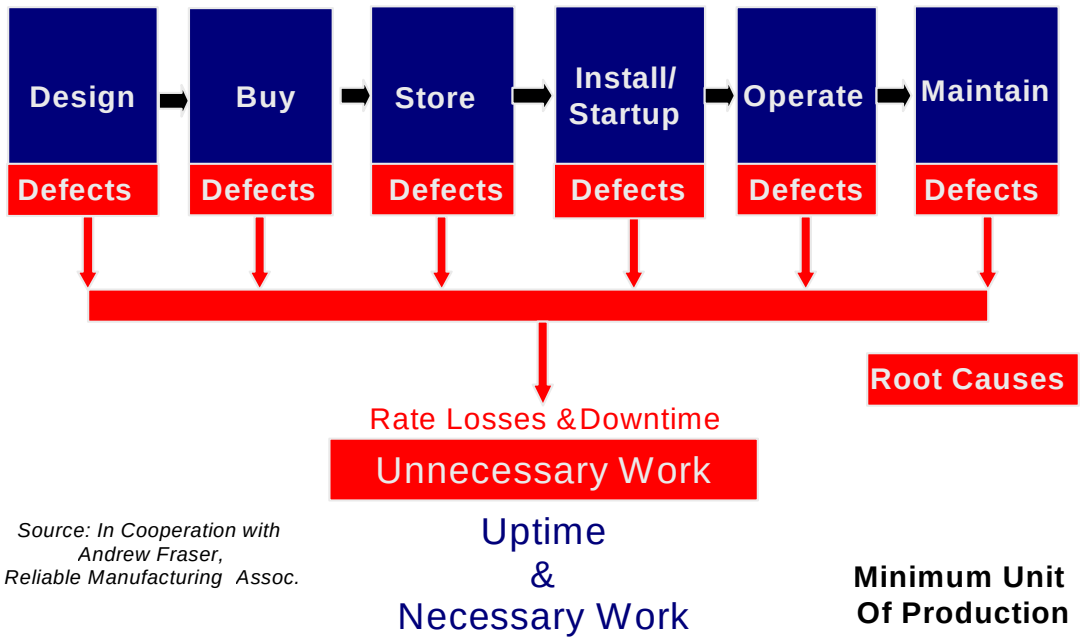
Many executives and senior managers believe that the maintenance operation is solely responsible for the reliability of a manufacturing operation. Maintenance, of course, plays a major and leading role in equipment reliability but the maintenance process alone cannot deliver optimum reliability. High levels of equipment reliability can only be established through the deployment of plant wide disciplined and integrated processes. Ron Moore of the RM Group, Inc. identifies elements that are essential to establishing optimum levels of reliability:

- appropriate specification and design practices
- professional purchasing practices
- appropriate storage facilities
- precise installation methods
- well defined and consistent start-up and commissioning procedures
- consistent operating practices, and
- proactive maintenance processes.

"Reliability, just like safety, is <u>everyone's</u> responsibility"

Any deficiencies in these processes create defects that result in excessive downtime, rate losses, and unnecessary work. Ron also states that defects resulting from deficiencies in each of these elements are not necessarily proportional. Defects introduced during design, start-up and commissioning, and the operating process have significantly more influence on reliability than the remaining elements (See Figure 1).

Figure 1.



Source: In Cooperation with Andrew Fraser, Reliable Manufacturing Assoc.

Examine the results of the defects created by inconsistent or inappropriate practices and how they influence the true cost of maintenance. During design of the plant or facility, defects are introduced by poor design practices and failure to employ "life cycle costing" analysis. For example, failure to select appropriately adequate materials or application of inadequate components during design will introduce inherent defects. These defects contribute to premature equipment/system failure, resulting in unnecessary work throughout the life of the asset. Understanding and analyzing failure modes and causes and applying "life cycle costing" techniques will help to determine the optimum materials, components, energy, maintenance and operating costs over the life of the asset. It is important to recognize that the purchase price of rotating equipment represents only about 10 to 25% of its ***total cost of ownership***, while energy, maintenance and operating costs represent 75 to 90%. Therefore, rigorous analysis using these concepts offers a significant long-term cost savings opportunity.

When purchasing equipment and components, care must be taken to procure items that comply with the design specification, considering ***total cost of ownership*** not just procurement price. Avoid the age-old practice of purchasing based solely on the lowest price; low price rarely translates into lowest cost of ownership. Input on the performance and quality of equipment and components, as well as vendor performance and support, should also be solicited from maintenance and operating personnel. Ask prospective suppliers to provide you with references and check those references out. Ensuring that you receive the component life, quality, and service you expect from suppliers is a paramount concern. Defects created by improper equipment, low quality component selection, and poor vendor performance inevitably result in premature failure, rate losses, downtime and unnecessary work throughout the life of the asset, again heavily escalating the true cost of maintenance.

Storage practices of assets prior to their use are also significant contributors of ***self-induced*** failures. Treat storage facilities as a store from which you would be comfortable buying components, say for your own automobile. An appropriate question the next time you enter your storage facilities is: "Would I shop here for parts for my car?" Components should be kept clean, orderly and in good condition while in the storeroom. Categorize and manage components based upon usage. While parts inventory represents a substantial cost and should be minimized, do not remove insurance or critical spares from stock due to slow turnover unless you have a supplier guaranteeing rapid delivery. Any spares that require preventive maintenance while in storage, i.e., periodic shaft rotation to prevent bearing flat spots and shaft brinelling from constant vibration in the facility, should be clearly identified and provided with sign-off sheets for verification of storage maintenance actions. Items that have not been properly stored generally fail prematurely with significant impact on the true cost of maintenance.

According to a study conducted by Rohm & Haas "you are 7 to 17 times more likely to introduce defects during startup than normal operations." It was also reported at the Machinery Reliability Conference held in Phoenix in April of 2001 that as much as 92% of systems and equipment have defects at startup that may result in premature failure and/or higher than normal maintenance costs. Careful inspection prior to startup is critical. Also noted was the fact that most equipment operates more reliably when not stopped and started excessively. Use diligence about only stopping equipment when absolutely necessary.

With the advent of reliable and affordable predictive, performance and condition monitoring techniques, i.e., vibration measurement and analysis, infrared imaging technology, oil analysis, and many other techniques, the need for strictly time-based replacement and/or rebuild planned maintenance routines is significantly reduced. Moreover, most of these condition-monitoring techniques are performed while the equipment is running, thereby reducing excessive stopping and starting of equipment and incurring production downtime. If faced with stopping, starting or installing new equipment, employ well-defined, standardized commissioning and startup procedures carried out with great precision. When employed successfully, these technologies and techniques significantly reduce the true cost of maintenance.

Operating practices also have a tremendous impact on reliability. When operated with known deficiencies or out-of-tolerance conditions, the likelihood of equipment failure rises exponentially. In many cases, the decision to perform or defer needed maintenance is made for all the wrong reasons. Many operating departments decide to run their equipment to meet production requirements with total disregard for equipment condition or scheduled maintenance requirements. This thought process and behavior will certainly drive a reactive maintenance environment and drive up the true cost of maintenance.

Creating a proactive maintenance culture and achieving optimum equipment reliability requires that operating parameters are well defined and documented through Standard Operating Procedures (SOP). It is imperative that operators follow these procedures and are effectively trained to the standards. Operator care and execution of simple maintenance tasks is also a fundamental requirement to achieve reliability. When operators are asked to perform tasks like cleaning, inspections, lubrication, or any other procedure, they must be adequately trained for these procedures and the associated safety requirements. Operators are the most effective condition monitors that we have and we need to encourage their participation in continuously monitoring production equipment and identifying abnormal conditions before they become breakdowns.

When most managers in reactive maintenance environments are asked to state the first word that comes into their minds when they hear the word ***maintenance***, the most common response is ***cost***. This is an indicator of the lack of control that management has over maintenance budgets in these environments. The traditional approach of management to resolve this problem is to cut the maintenance budget or reduce the headcount in an attempt to control the budget. This approach is counterproductive because it basically reduces costs in the short term by deferring the required maintenance, which creates more defects in the system, thereby increasing costs in the long term. The real answer to this dilemma is to work hard to eliminate the defects that cause unplanned downtime, rate losses and unnecessary work.

"You cannot cost cut your way to profitability"

Reliability engineering techniques can identify solutions for many of the defects that cause these issues through the effective use of Root Cause Failure Analysis (RCFA). For this process to be effective everyone has to work together to collect the evidence surrounding the failure, determine the state of the process when the failure occurred, analyze the evidence to determine the root

cause, develop the business case to justify elimination of the failure, and then to plan and execute the mitigation.

A logical conclusion from this discussion is that the maintenance department alone cannot deliver optimum reliability. Like safety, reliability is everyone's responsibility. Another conclusion is that the true cost of maintenance is not reflected in the maintenance budget alone. When reliability is not evident, the entire business is at risk. Management commitment and leadership are key ingredients in making the transition to a proactive maintenance environment and establishing optimum equipment reliability. The process of change begins with education as a key element to identify the proactive tools and methodologies required for proactive maintenance and to change the view of the maintenance function and its influence on overall reliability and profitability of the business. Remember, if you are not getting the result you want you must redesign the system into one that will provide the results you want. At that point you begin the journey to minimize the true cost of maintenance.