

Reliability and Accountability

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The recent electricity outage in North America brought "Reliability" issues to the surface, this time not only for engineers but also for politicians, as it was devastating for as many as 50 million people. President Bush, the most powerful man on earth, expressed his concern and emphasized that utility companies should be held "accountable" for the reliability of their committed power supply. The solution to the problem, according to North American Electric Reliability Council (NERC) is reliability enforcement through legislation. According to NERC, "reliability rules must be made mandatory and enforceable" and "legislative action is needed to maintain Electric System Reliability". This is not surprising, because unreliability is truly costly. The 29-hour blackout that hit New York City, according to city officials, cost its economy about \$1.05 billion or \$36 million per hour!

This blackout could be considered as a rare one-time event. However, we should not forget that the world constantly loses billions of dollars every year as a direct consequence of the unreliability of industrial plants: cost of production or capacity loss, huge cost of fixing or replacing equipment as a result of major forced failures, and of course the loss of human life that cannot be measured in dollars. Environmental disasters, which could create trouble for several generations, should also be pointed out. Billions of dollars are also spent annually on the planned maintenance of industrial systems and assets in order to maintain certain levels of reliability or dependability. Reliability is not only a hardware issue; it's also a critical issue in software. Imagine operating systems or application software crashing in the e-business environment, or stock exchanges, and banking systems going down.

TWO MAJOR RELIABILITY FRONTS

Reliability issues should be confronted on two major fronts. The first is the design of equipment, which is a vital element contributing to inherent reliability and total life

cycle cost. The other is how the equipment is run and maintained over the long term. This is the focus of this article. While the design stage is mostly involved with proper *engineering* functions, the latter is about highly technical *management* decisions and business policy. Nothing is free. Each level of reliability, which varies in different industries, has its own price tag! So we should deal with reliability management rather than engineering; still not only reliability management alone but also management of both reliability and performance/availability. A maintenance management policy that maximizes reliability of a system will not necessarily maximize the availability/performance.

What are the right proactive decisions in a certain working environment and how do maintenance decisions affect the reliability of industrial assets, their availability/performance, lifespan, and life cycle cost? They can all be quantified, predicated and evaluated. In business if we cannot quantify, something might be wrong somewhere. We should be able to confirm the validity of the proposed maintenance tasks and make sure that their intervals are compatible with life cycle costs and with both reliability and availability requirements of the plant. The lack of focus on reliability-availability assessment is a serious problem in many plants. A large percent of asset reliability problems are often attributed to improper maintenance policies and improperly determining appropriate maintenance tasks. One can imagine how profitability of a plant could suffer as a result of the compound effect of inappropriate maintenance tasks, which are performed improperly and at wrong intervals! It goes without saying that the overall goal is maximization of plant profitability.

MAINTENANCE MANAGEMENT: BOTH ART AND SCIENCE

The bottom line of any proactive maintenance program is to find answers for the following questions: WHAT PM, WHEN, WHY, and HOW? Among these questions the HOW is the art of management; for instance Total Productive Maintenance (TPM) is very strong in this area. The rest all involve analysis and optimization. For example, in a condition-based maintenance policy we want to know the optimal interval of an inspection or condition monitoring task and what we should do based upon the current condition of the system or equipment following an inspection. Should we do some minor corrective maintenance, perform a major overhaul on the equipment or

leave it as until the next scheduled inspection? Each inspection itself involves cost. In what degree are we sure about the true condition of the system following an inspection? In other words, how do we make decisions where we have partial information about the true condition of a system? What would the risk be of doing, or not doing, a maintenance job? If we have to shut down the system for inspection what would be the cost of lost production?

Our ultimate goal is to develop a business model to optimize our maintenance and reliability decisions. Based on different metrics such as cost, reliability or performance, the optimal maintenance interval will vary (the WHY question). In some cases, a run-to-failure policy could be the best policy. But an analysis is needed to determine if time and money should be spent on any preventive maintenance, including inspections and subsequent major or minor tasks.

INFORMATION TECHNOLOGY, OPTIMIZATION, AND BUSINESS INTELLIGENCE

Most companies spend a lot of money and resources on computerized maintenance management system (CMMSs). But the payback will depend on these systems gathering the right data, and converting information into business intelligence. Many companies gather a huge data bank, but don't know what they want to do with it. Data itself is nothing more than numbers, which provides the basic building blocks of information. How we process, store, and manipulate numbers determines the data's value. Information is data that has been arranged into meaningful patterns or put into context. It is worth mentioning that in the 1950's and 60's, the focus was data processing, in the 1970's and 80's information management, in the 1990's knowledge management, and now business intelligence. As we move up from a data processing level to producing business intelligence, we will increase value for the organization per measure of effort invested in maintenance management. This wouldn't be possible without maintenance optimization.

RELIABILITY AND ACCOUNTABILITY

There has been more than half a century of research and development done by academic and industrial institutions on the effects of various maintenance decisions

and policies on equipment reliability, performance and maintenance costs. Yet few of them have been put into real practice. Why is that so? Some possible reasons are:

- Until recently, optimization models used to deal with individual components operating in isolation, and it was assumed *replacement* was the only path to restoration. Now people want to know the impact of maintenance and reliability initiatives on the bottom line profitability and performance of an organization. This requires that the traditional analytical approach to maintenance optimization and reliability management be revisited and revised. In fact the paradigm from maintenance optimization of isolated “components” should be shifted to optimization of integrated and distributed “operational systems”. Fortunately right now models and tools are available for this approach
- Unfortunately there are a lot of noise and fluffy approaches in this profession, even by some big names who have a great deal of lobbying power. Some of these approaches to reliability are nothing more than a personal opinion. But the good thing is that more and more companies come to the realization of the fact that they should come back to substances rather than exciting buzzwords of the day!
- Often people think that optimization and reliability analysis means understanding at least one book full of complicated formulas. This is not the case at all. We need to understand the basic concepts and fundamentals; the rest will be done by technology. Optimization is not a scary function!

In conclusion, no matter which industry we are in, who or which department is accountable for reliability or how we “enforce” reliability, the bottom line is that we are doing business and the goal of any business is maximization of profit. Sometimes two different maintenance policies can result in the same level of reliability, but the cost of adopting one policy is ten times lower than the other. A maintenance department may perform thousands of preventive maintenance tasks annually. We can easily guess the magnitude of cost savings where we implement optimal maintenance policies.