PREVENTIVE MAINTENANCE

THE COST OF DOING NOTHING

VERSES THE COST OF DOING TOO MUCH!

It's an age old dilemma that has no prejudices and it's not just the business owner that is forced to choose between, it's all of us. Whether you own a car, a house, and toys for entertainment or are responsible for the protection of your employer's assets, you are going to be forced to choose between doing preventative maintenance (PM) or not doing it.

In this article we'll talk about understanding Preventative Maintenance (PM)., what are some of the benefits, and help to in determining proper PM activities and frequencies. What is Preventive Maintenance? I believe it can be best described as "any activity performed on a certain schedule that is intended to preserve and prolong its original intentions" (rlp). Activities can include routine inspections with minor repairs to more intrusive inspections where disassembly may be required along with solving any discovered problems and part replacement.

With a logical explanation and definition of PM, those of us that understand its benefits see the importance of doing it right. However despite its obvious benefits, it is often labeled as the necessary evil and not performed when scheduled and short term economic goals are at risk. It's easy to do nothing as it serves two conditions: I) labor is redeployed to revenue driven activities and 2) support material costs (cost avoidance) stay low creating higher margins. However, the cost of doing nothing and maintaining this status quo can be enormous. More importantly, this status quo affects each and every one of us every hour of every day, at work and at home. We have come to accept doing nothing as a safe and acceptable alternative making it the default solution.

"Doing nothing is the management equivalent of a baby's soother". It may make us warm and fuzzy inside but what is the real cost for doing nothing? Economists and accountants frequently refer to these costs as "opportunity costs;" or redeployment of your resources (what you could be doing if you weren't doing the thing you're doing now). So how should we decide if PM should be done or not done? We arm ourselves with knowledge and processes so we'll know the cost of the decision. If I don't PM, the cost could be this. If I do PM the cost should be this! The difference between the two numbers is the long term savings a PM program will provide. The savings from PM is because finding and fixing things before you have a catastrophic failure and are forced to repair them will typically return 3-10 times your original investment.

If you just get returns at the lower end of this range on your 401K, your initial $10,000 investment in just 5 years the value would be $12,960,000, with no further contribution. Additionally, some of the long-term benefits are:

- Decreased cost of replacement.
- Decreased system downtime
- Better spares inventory management
- Improved system reliability.
- Reliable capacity planning
- Prolong equipment life.

So then the questions become, what should I PM, when should I PM, how often do I PM and when is it time for a more drastic countermeasures.

You should have 2 conditions to whether or not preventive maintenance is a logical choice:

- Condition #1: The component in question has an increasing failure rate. In other words, the failure rate of the component increases with time, thus implying wear-out. But doesn't make sense to have preventive maintenance on components or systems where in its performance costs are unnecessarily accumulated because usefulness has been shortened. A light bulb is a good example. They are replaced when they have blown. They are designed to run to failure as their failure impacts no other component.
- Condition #2: The overall cost of the preventive maintenance action must be less than the overall cost of a corrective action. Be sure to include tangible and/or intangible costs, such as downtime costs, loss of production costs, lawsuits over the failure of a safety-critical item, loss of goodwill, etc. in your evaluation. Understanding the cost of consequence of failure and total cost of PM will lead to proper business decisions.

So now that we know the benefits as well as the conditions usually present that warrants routine care, we now need to know the when and how often. Now that we have an understanding of what PM is and its positive benefits let's look at the when and how. The when and how is often overlooked because, after all, PM is getting done, the assets are being taken care of what more do we really need, but at what cost? Furthermore, more is not always better. Take an electric motor that has the unfortunate installation of grease fittings for its end bearings. Over greasing these bearings often lead to blowing out the seals that protect the internals of the motor causing it to overheat, short and eventually fail.

So how do we determine the proper preventative maintenance? Data. There are many tools that assist business owners and individuals today some highly recognizable and some more specific. Mathematical equations, charts and trending part life cycles some with the help from manufactures and others that are of our own devises. The important point here is to use **data** to make the PM decision. Data will reveal what to PM, frequency of PM, when to PM and its economic impact. Data will also yield better resource allocation as planning and scheduling becomes routine.

The intent here is to use data to determine the minimum resources that yield results in terms of preventing catastrophic failures while maintaining intended performance levels. Or in other words small inexpensive problems don't become large expensive ones, causing delays and unwanted conditions.

For example:

To determine the optimum time for such a preventive maintenance action (replacement), we can use a mathematical model that describes the associated costs and risks. In developing the model, it is assumed that if the unit fails before time *t*, a corrective action will occur and if it does not fail by time *t*, a preventive action will occur. In other words, the unit is replaced upon failure or after a time of operation, *t*, whichever occurs first.

Thus, the optimum replacement time can be found by minimizing the **cost per unit time**, *CPUT*(*t*). *CPUT*(*t*) is given by:

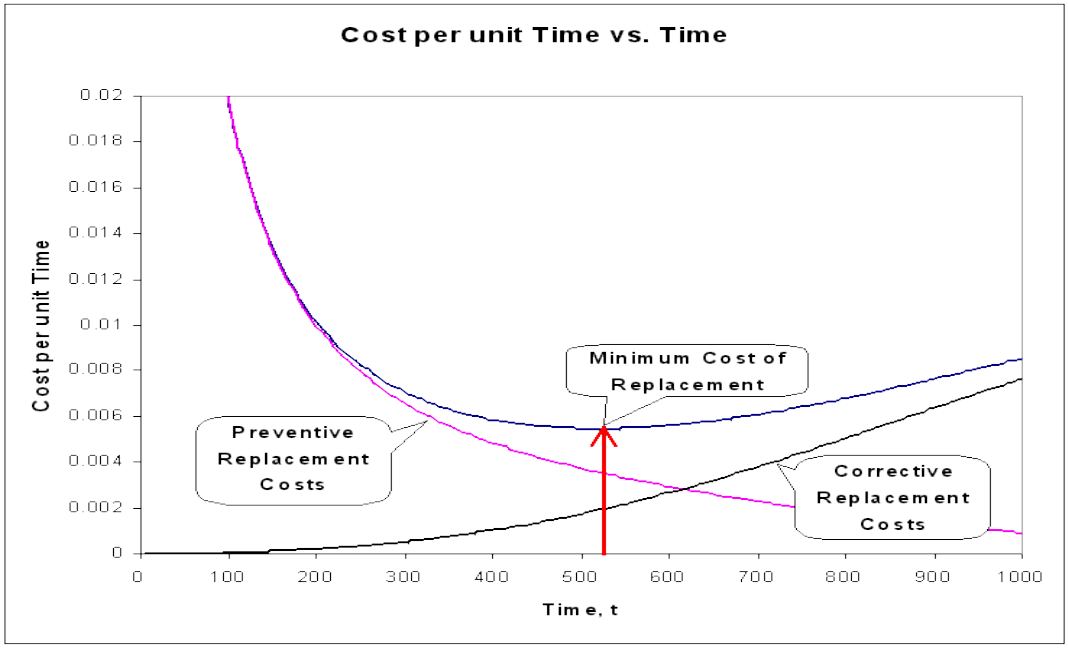
$$CPUT(t) = \frac{\text{Total Expected Replacement Cost per Cycle}}{\text{Expected Cycle Length}} = \frac{C_P \cdot R(t) + C_U \cdot [1 - R(t)]}{\int_0^t R(s)ds}$$

Where:

- $R(t)$ = reliability at time t.
- C_P = cost of planned replacement.
- C_U = cost of unplanned replacement. (rws)*

Cost curve for preventive and corrective replacement where history or input from a manufacture's part life cycle is known and applied to your application.

This example shows the Cost Per Unit Time vs. Time plot. In this figure, it can be seen that the corrective replacement costs increase as the replacement interval increases. In other words, the less often you perform a PM action, the higher your corrective costs will be. Obviously, the longer we let a component or equipment operate, its failure rate increases to a point that it is more likely to fail, thus requiring more corrective actions. The opposite is true for the preventive replacement costs. The longer you wait to perform a PM, the less the costs; while if you do PM too often, the higher the costs. If we combine both costs, we can see that there is an optimum point that minimizes the costs. In other words, one must strike a balance between the risk (costs) associated with a failure while maximizing the time between PM actions.



These and many more like them can be used in assisting you in deciding appropriate levels of PM. Your preventative maintenance activities, if determined by using the data and tools available to you, will yield economic, efficient and effective results. In addition, it can help change culture if we take the time to determine the risks/costs to perform preventative maintenance vs. the risks/costs if you don't.

With procrastination seeming to be the dominant management style and "doing nothing", a long standing practice for a disturbingly large number of people and organizations, how do we change culture? People change because they see value in the change. So create a positive change because as you have read the value is defiantly there. Solutions do exist and are surprisingly easy to implement with examples in front of us every day. With data, the tools to analyze it, together with the above-mentioned philosophy, you'll begin to refine your preventative maintenance activities and beliefs so the decision becomes abundantly clear.

So what is the cost of doing nothing or doing too much? Ask anyone how often they change their oil in their car? More often than not they'll be able to tell you as it's been a car owner standard for years. So change the culture. Maybe you propose that for any projects that may require a PM activity, a rule that the cost of doing nothing be quantified and considered! I believe that once "the cost of doing nothing" is established as a factor, you'll become comfortable at approximating and considering it, using data to determine the proper amounts all the while changing culture which will sustain it you'll be surprised on how easy it is. After all, your job, your safety and your future may depend upon it.

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