Budgeting for Maintenance: A Behavior-Based Approach

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This resource highlights the three factors that most significantly drive maintenance cost and then explains how to evaluate, using benchmark data, where you are and where you should be in your spending on maintenance.

Recently I was asked the question: *"How much should I be spending on maintenance?"* This question is easy to ask, less straightforward to answer, and much more complicated to understand. We all know it is equally bad business to spend too much as it is to spend too little on maintenance, but how much is just right? We also like to use convenient rules of thumb, defined as "a means of estimation made according to a rough and ready practical rule, not based on science or exact measurement." This is often confused with benchmarking. However, benchmarking implies more exact measurement and the existence of at least some knowledge of underlying cause and effect relationship. To become the best, we must benchmark and learn from it.

The question that naturally follows is: *"What are appropriate benchmarks for maintenance costs?"* All of us can use the tools and information readily available to calculate where our spending will be next year. But the most important question for a business regarding maintenance spending is not where will I be on my present course, but what should I be aiming for? What is the optimum spending level for my business? The following explains not only how you can evaluate, using benchmark data, where you are, but more importantly where you should be, and also give you some indication of how you can get there.

First you need to understand the factors that affect the optimum cost level for your business. The three factors that most significantly drive your maintenance cost at any time are your asset Life Cycle Cost strategy, planned asset utilization and your organization's behaviors.

1) Your asset Life Cycle Cost strategy. Are your assets being depleted over time (wasting assets), being maintained in a steady state and basically maintainable level (neither improving nor deteriorating and performance is at least acceptable), or are you having to restore your assets to a maintainable level due to a period of neglect or under-maintenance?

If your assets are not at a steady-state, maintainable condition or do not have adequate replacement cost reserves built into the budget, for a short period of time your costs will be either in excess of or below a calculated standard value. Why a short period of time? If you are restoring abused or neglected assets, there is a planned end in sight to the restoration or replacement. Then steady-state maintenance takes over. Rebuilding an entire wasted plant is not in the scope of this discussion, but a new one certainly is. On the other hand, if you persist in under-maintaining your assets, then there is also an end in sight – the end of your business. It can be either a deliberate and planned business exit strategy, or it can be an unintentional way to go out of business. It is the end of your job, and your business too, when operating as a wasting asset is done repeatedly either unintentionally or as a way to force "the numbers to look good". Let me repeat this: Wasting your assets is a business exit strategy, whether an intentional act or not.

2) Planned asset utilization also has a small impact on spending, however not as significant as you at first would think. In general if your facility falls within a typical industry level of planned utilization of 75% or better, then the method of calculating target costs we will discuss is valid. If your site runs in a campaign mode only six months per year or less and sits idle the remainder (as in some food processing plants and peaking power generation stations), then the results are a little different. Likewise if it is a "corner drug store" production operation with product lines that run sporadically at 50% or less utilization, (such as tolling operations and some seasonal products) the costs might be slightly lower.

If a large asset group runs only half of the year, should the annual cost to maintain them in a non-wasting condition be one half? Certainly not! Many maintenance costs do not really go away just because the asset is idle, unless it is mothballed and placed in long term storage. If you intend to maintain your idle assets so that they do not deteriorate and are always ready for service on demand, the maintenance costs hardly go down at all. And if you do not maintain them while they are down, you will most certainly have to spend excess money to repair them when you try to put them back into service. There is some limited data to indicate that variable maintenance costs for a well-maintained idle asset are 30% of the running cost of the asset and fixed costs are not reduced. So utilization within a reasonable range has some, but not a dominant, impact on your optimum maintenance cost target. Poor utilization requirements can mask a wasting asset strategy for a while, but not indefinitely.

3) The overwhelmingly dominant factor in the cost of maintenance (as well as the other side of the coin, operational efficiency) is your organization's behaviors and how they affect the adoption of best practices regarding reliability and maintenance. Best practices are really a set of standardized, validated behaviors. For brevity we will just use the term "behaviors" going forward. What sort of behaviors drive cost down? Here's a partial list of behaviors that have been documented time and time again:

A. The presence of the proper culture, which drives good decision making. Are you reactive or proactive?
B. The presence of effective and efficient PM and PdM programs.
C. Use of effective and efficient processes for identifying, planning, scheduling, and executing work and the CMMS system necessary to support them. If processes are ineffective or not used, the result is worse than not having them.
D. The presence of a strong partnership between the operations and maintenance organizations.
E. Good metrics are used to drive improvement, and are tied to performance management.
F. Solid and effective failure elimination and loss elimination programs are in place and functioning.
G. Good design practices based on life cycle cost, not just first cost, are standard practice.
H. Good operating procedures and standard practices exist that prevent unnecessary asset damage.

When looking at maintenance costs, the most important concept that you must remember is that your organization's behaviors change the resulting cost numbers. Forcing the cost numbers will not change behavior. And in fact it is impossible to "force" the cost numbers (or reliability numbers for that matter) to change on a sustained basis without changing either the basic assets themselves or changing your behaviors. If you change the numbers but not your behaviors it will soon result in excessive cost, wasted assets, or unintended consequences for asset reliability levels. And inevitably the equilibrium will re-establish itself. However it might be under the direction of a new maintenance manager who has been given the mission to fix it at all costs. The take-away concept here is that cost is the dependent variable in the equation; behaviors are the independent variables.

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Next, to an even bolder statement: if your assets are held at a relatively consistent state of maintainability then the age of your facility and the type of industry you are in have virtually no impact upon how you calculate what your maintenance spending could or should be. What? The age does not matter? Not really. Old facilities that have been maintained steadily, using "good" behaviors, often have lower overall maintenance costs than newer facilities. Unlike people, plants do not have to wear out. Often their life span is determined by process economics, product obsolescence, and economies of scale, not wear out.

Doesn't industry type matter? For the most part, not really. It makes only a small difference, only about 10% or less than all of the variation introduced by behaviors. Industry type really does matter only in as much as it defines the initial cost of the equipment. Well then, how about location? Again it matters only so much as it drives the delivered, installed, and ready-to-run cost of the facility. Of course this is assuming that the asset group or facility has been designed for the intended service and environment. And if it has not been properly designed and installed? Well, that is a behavior isn't it? Item G above, as I recall. So what maintenance cost measure can we use that is virtually immune to industry type, age, location, and to some extent utilization?

Now that I have shared the key points, it is time to tell the story behind it all and how you can practically apply this. Let's start by defining some terms.

First, a term that some of you are familiar with: Replacement Asset Value (RAV), sometimes called replaced asset value. RAV is the present cost to replace the asset if it were removed tomorrow. For example the RAV of a one year old one-half ton brand X pickup truck and one that is similarly equipped, but 10 years old, is the same: the cost of a new truck. It can be difficult to calculate and maintain an RAV number, but worthwhile to do if you want to be able to benchmark properly. For trending you do not have to be concerned so much about the absolute accuracy of the baseline number, but you do have to keep it up to date for changes in plant configuration.

A few things besides the present cost of a new asset affect the RAV of an asset. Asset location and industry type affect the RAV of an asset because they define the specifications and the cost of labor and materials to install that asset. If that truck in the example will be used in the desert or the arctic it will cost initially much more than one purchased for urban service, due to delivery and the tougher specifications necessary for the intended service. Note that the cost of the real estate property that an asset sits on is not a part of the RAV, but the basic cost of preparing the immediate site to build upon (such as final grading prior to foundations) are generally considered to be a part of RAV as are all maintainable improvements.

The next element of the equation is annual maintenance cost which consists of all expenditures for materials, labor and services expended to perform maintenance of the site, its improvements (such as roads and tracks) and the maintainable assets (buildings, utility infrastructure, mobile and fixed equipment). It does not include capital for new assets or replacement assets. Nor does it include minor projects that frequently come under the category of expense projects, except those that are specifically directed towards periodic restoration (such as a five-year refractory change out in a kiln). If the site has significant major assets that have periodic, repeatable, high-cost activities, such as the kiln above, there may have to be some averaging to avoid spikes.

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Now, to the bottom line. The annual maintenance cost for a facility or large group of assets expressed as a percent of the RAV (%RAV) is the most scalable, transportable, benchmark-able index or metric for measuring maintenance spending that is in wide use. It varies only minutely because of age and only a very small amount by industry type or location, and somewhat if the utilization of the assets is extremely low. Don't take my word for it. Check the benchmarking data available from so many sources. What makes it so important to you is that it is driven almost entirely by organizational behaviors or competencies. You can compare site to site across industries and measure the effectiveness of your strategies and behavior using this number. No excuses need be made or can be made for age, for market upturns and downturns, for size of the facility. It all boils down to you and your organization's behaviors. What simpler metric to know where you are and how far you are from success? And once you internalize this concept then you begin to understand that your costs are so much more in the control of you and your leadership than either of you believed that they were.

I have to admit that when I was first exposed to this data and concept back in 1996, I did not accept it at first. Especially since I thought we were much better than good and our annual cost per RAV was nearly 6%. More is better – right? And anyway, we were "different", right? Well, I was wrong. It turns out that there is some good %RAV benchmarking data out there that has been confirmed by many besides my own experience or that of my associates. Check out the SMRP benchmarking data. At face value %RAV is valid for facilities that are at a consistent level of performance, neither actively moving to or from a condition of wasting assets. If your business is rebuilding from neglect or has just changed from a maintain strategy to an exit strategy based on wasting assets, the results will be skewed. It has some limitations in that it should not be applied to single assets, but rather to whole facilities or large groups of assets. It has not been validated at the single asset level. If you look at the data available it appears that there is an optimum point or "sweet spot" for %RAV. The entire range of optimum appears to fall between

1.75% and 2.5% per year. Some of the variation is due to industry type, and probably a lot of it is due to variations in how the numbers are derived. The range of the spread of the data for the population lies generally between 1% and 6% with the occasional 8%. As always there are some outliers due to reporting error and truly unique conditions.

I think many experienced people recognize that the "sweet spot" exists, but few know and can objectively support where it should be for their business or site. It is common knowledge that spending too little is to operate a wasting asset. Do that for very long and you go out of business. Likewise if you are spending above optimum, not only are you hurting profitability but most likely you are in a highly reactive environment where maintenance cost is high and equipment availability is poor. This is also not a position to be in and one which can lead to slow extinction. The take-away message here is that more spending in excess of the optimum does not improve performance. It is a sign of poor systems, culture, management, and waste. Spending less than optimum is rapid extinction.

You can play games with the accuracy of the numbers, but if they are anywhere close to accurate, you can bet if it is either 1% or 6% you are in the process of putting yourself out of business. If it is at 4% you are at long term risk and need to slim down by changing behaviors.

Experience has shown that it is safer to err on the high side and work your way down to the target spending "sweet spot" than to be too low and try to work upward. There is a steep drop off below the optimum and only a thin gap between optimal and wasting asset. There are a few brand new facilities running in countries with cheap labor that claim to be operating as low as 1.75% of RAV per year, but neither I nor my colleagues have ever seen it sustained without serious problems. Think of performance at the "sweet spot" as like being a surfer on a wave. If you are behind the crest (too high %RAV), it is safe and it is comfortable, but you are going to be left behind. If you go beyond the crest (too low %RAV) the drop off is sudden and you are going to take a beating and have to start all over – if you can survive the fall. Being on the crest is one exhilarating ride. It is the winner's circle, but you have to remain vigilant. If poor behaviors borne of complacency creep in, you will be out of the contest, either wallowing in mediocrity or pounded by the surf and rocks.

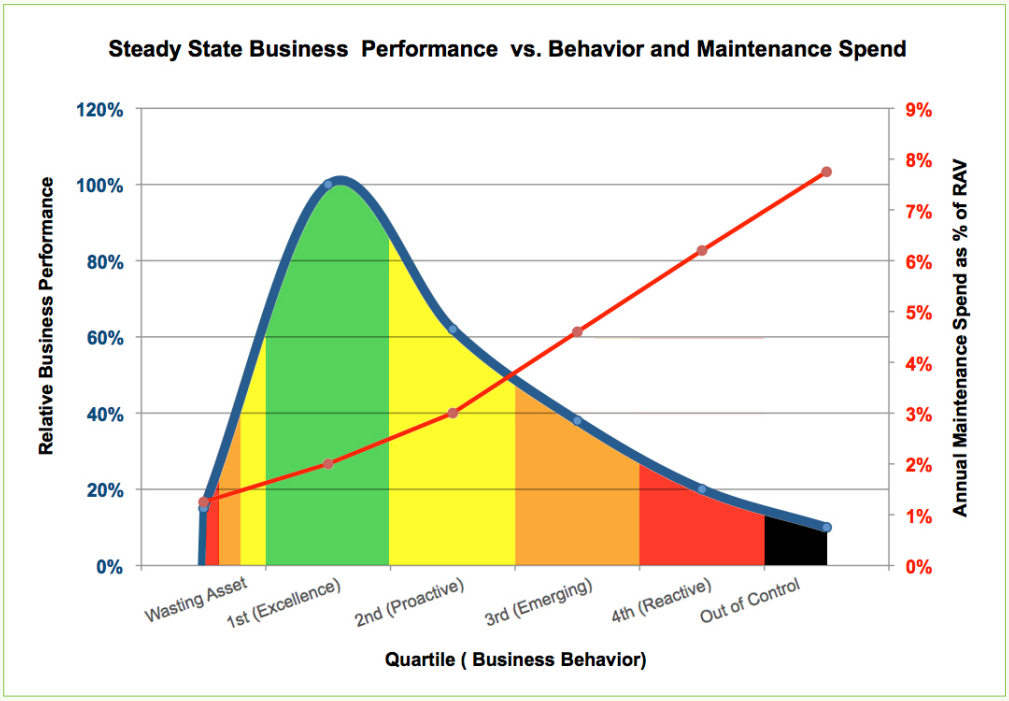

Figure 1

So how do you spend less (to a point) and perform better? You design and execute the proper business systems and best practices for improving reliability and managing maintenance efficiently. Go right back up there to those behaviors previously listed. You can't do it in a sustainable manner any other way. You cannot sustainably cut cost without changing your behaviors and culture. Remember, if you cut cost but do not implement the necessary changes to operate effectively at that cost, you just create a wasting asset faster. The next figures show this for an actual plant site, which had spending in the "sweet spot" but with behaviors that did not support that level of spend. The result was a significant performance gap in product waste, asset availability, and quality issues. They were, in fact, cost-cutting themselves out of business.

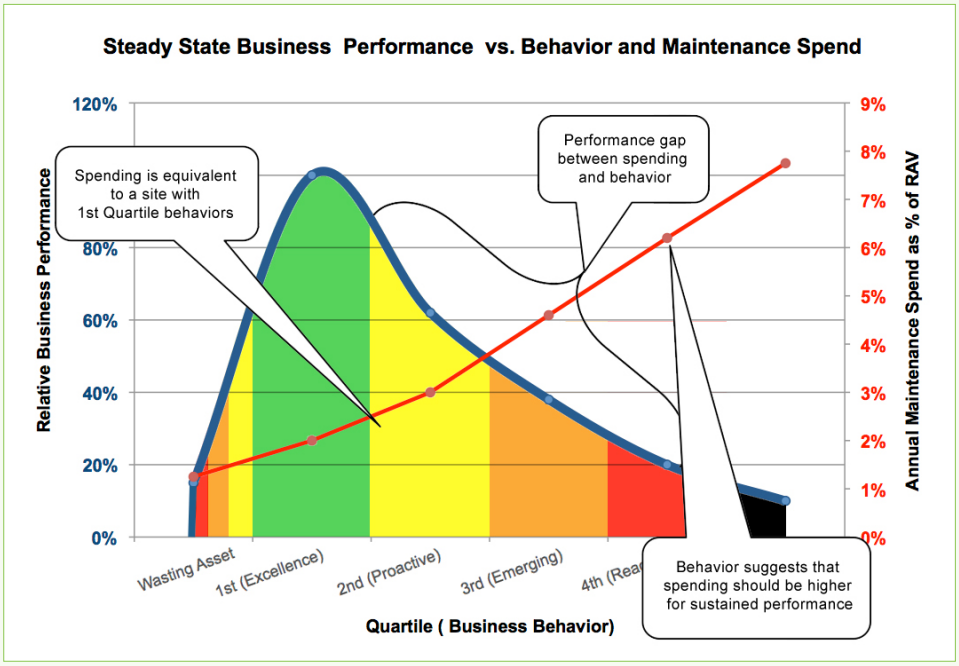

Figure 2

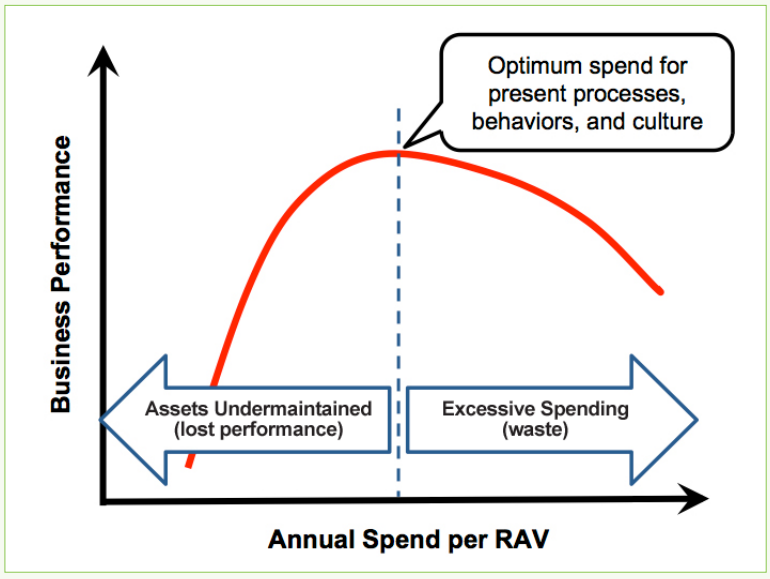

Figure 3

So rather than forcing the cost dollars to be what you want them to be (never a sustainable tactic), make your organization behave as it should (largely proactive and with continuous improvement) and it will achieve and sustain not only the lowest cost for maintenance but also the highest OEE. That is right - the right behaviors reduce cost and increase production. Conversely the wrong behaviors increase cost and decrease production. So even if your business can afford to pay maintenance costs in excess of the "sweet spot" amount, you cannot long afford the accompanying low reliability that always goes hand in hand with such poor behaviors.

I am sure that somewhere there is some remarkable situation that is the one exception that shifts the scale grossly and justifiably to the left or right, but I haven't seen it yet. So I urge you, instead of looking for justification as to why your costs should be higher (or just being OK with higher costs), ask yourself: "What best practices or behaviors is my facility lacking such that I cannot deliver highest reliability at a cost around 2- 2½% of RAV per year?"

Along with this somewhat universal, portable, scalable means of measuring your overall performance, I want to leave you with advice on the accompanying tool set that you will need to use if you are to significantly and sustainably improve. That tool set consists of change management skills. Since it is the various behaviors that are the key controllable factors driving maintenance cost and operational performance at a site, change management is the key element for driving that cost and performance change. (If you want to know more about learning change management skills, I'd recommend that you visit www.LCE.com or send an email to changemgmt@LCE.com.)

About the Author
Sam McNair is a senior consultant with Life Cycle Engineering (LCE). A Professional Engineer and Certified Maintenance and Reliability Professional, Sam has more than 34 years of experience in discrete manufacturing, chemical process industries, mining, machine processes, automation, aviation, construction, and utilities. Sam specializes in reliability engineering with a focus on the integration of maintenance and manufacturing functions. You can reach Sam at smcnair@LCE.com.