THE GRIM BUDGET REAPER!

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Abstract

This paper aims at justifying a budget that enables the execution of a properly developed maintenance management plan. This plan must include only essential operational and maintenance tasks to maintain asset functions at required performance levels. We strongly believe that a budget, based on such a plan, will optimise output (revenue) and minimise costs and risk, over the life of the assets. Commonly, we don't have a comprehensive plan and we barely cover the 20% of assets that cause 80 percent of problem costs. If this is the basis of our budget request, we leave ourselves open to budget cuts, as we cannot justify our budget needs. We will analyse the dramatic consequences of a seemingly small budget cut. We recommend spending to make assets more reliable and introduce smart asset management methods first, then save costs as a result. This in contrast to cutting the budget and resources first, to dramatically undermine the future of an organisation.

Background Information

We define maintenance as the combination of all tasks that retain an asset's functions at the needed performance levels. This is different from maintaining an asset. This approach has some consequences.

First, a failure reduces revenue and profits. However, a failure is not only a total breakdown and stoppage of an asset, but any deterioration of the asset or its output, in quantity and quality. In this light, we prefer the term fault for performance less than required. A failure is still a breakdown or asset stoppage.

Secondly, operators have just as much, if not more, effect on functions and performance levels as maintainers and others. Hence, we include operational tasks in the maintenance management plan. A related consequence is that we envisage facility or process-based teams, made up of former operators and maintainers, who take ownership of the performance of their process or facility. In various maintenance literature, we regularly find mention that, without training, operators could take over up to 40% of tasks performed by maintainers. The same sources mention that, with training, operators could take over another 40% of maintenance tasks. We assume that this results in 40% + 40% of the remaining 60%, or 64%. Not a bad innings and a prime opportunity to make your budget go much further.

With a centralised maintenance group, there is always a chance that a breakdown in one process has to wait for several hours before a maintainer finishes work on another process. This is another reason for involving operators in recognising early signs of deterioration and performing minor maintenance to restore the asset to perfect operating condition.

The Annual Budgeting Panic

On What Do You Base Your Budget Request?

Most maintenance managers have a good grasp of what they want to do in the next financial year, especially if this view fits well in a picture of the longer term. However, in most organisations, this plan does not cover all assets or it is an evolution of plans from past years. In both cases, the plan cannot withstand scrutiny and probing by finance managers to find a foothold for budget cuts.

Hopefully, you will ensure the survival of your most critical assets, but you must not forget that all your assets might require some pre-emptive attention, requiring resources and part of the budget. Under pre-emptive maintenance, we include preventive or count-based maintenance, predictive or condition-based maintenance and pro-active maintenance, which tries to identify and remove root causes for possible faults and failures.

What Happened to Last Year's Budget Request?

Last year you submitted a similar request, supported by intended work plans that covered preventive and predictive maintenance, with an allowance for repairs on breakdown. It is unlikely that your request included any pro-active tasks, as you didn't have enough human resources for root cause analysis work, after 'the razor gang' went through your group earlier.

Let's assume that your budget has been cut for a few years now. Therefore, you couldn't prevent faults and failures. You spent money on other non-planned activities, because you had to return the affected assets to service as quickly as possible. You did this on overtime and you called in many people, just in case you needed their trade or expertise. You had delays due to obtaining permits, organising mobile cranes and finding spares.

When you review last year, you'll find that your actual spending did not match your original plan very well at all. The finance manager also notices this and will probably see this as prove that you are not in control. The finance manager will rarely or never realise that the budget cuts caused this outcome.

When you compare actual spending against budget, you might find that you actually spent more than what you originally asked for. Begrudgingly, finance managers always have to accept your over-spending, as you needed to return the assets to service. This may go on year after year and one wonders why nobody wakes up and stops budget cuts. All it needs is asking 'why did those failures happen' and the answer could be 'because we didn't have the money to prevent them, because of the budget cut'.

A finance manager, looking at the detail of your spending, might suffer heart palpitations, as you spent a lot of money on old assets. They often need extra money

to keep them in optimum condition or to repair. This goes against accounting rules of not spending much money on assets that are about to be written off. Finance managers seem to prefer a linear relationship between diminishing asset value (depreciation) and diminishing maintenance budget for aging assets.

In summary, the finance manager believes that maintenance managers are not in control, spend money on different things than planned, waste good money on old assets and spend more than their budget allowed. The reality is that the maintenance manager performed miracles with an insufficient budget and tried to contain the cost escalation as much as possible. Obviously, there is a lack of common interests points between maintainers and other managers, who still substantially underestimate the contribution of maintenance to business results and profit. Maintenance is essential to keep the assets performing their functions at the required performance levels. We need a common approach. Maintenance, operations and others, must develop the maintenance plan and decide on tasks, frequencies, duration and needed resources. Maintenance then uses correct techniques to minimise task duration and risk. If maintenance would cease its activities, the assets would soon stop producing.

What Happens During Budget Negotiation Time?

Everybody learns from the past, so this year (again), the maintenance manager produces a plan that includes some 'essential' jobs that are not essential and, each budget component is inflated by, say 15%.

The finance manager knows that and will immediately reduce the request by a percentage that he estimated you added. If it is 15%, you are lucky, if it is more, you have your first cut. In most cases you will not get what you think you needed.

During this 'shuffling for positions' we lose valuable time, during which we could be doing things that are more important. In reality, this may be 'fire-fighting' but we would prefer following a purpose developed maintenance plan. In any case, the yearly period of budget development and negotiations, which could take up many resources for up to two months, is totally wasted, compared to developing a proper life cycle plan, once and for all. This in itself would give you the opportunity to spend a larger proportion of your budget on assets, rather than 'administration'.

The finance manager may want to cut your budget request by 10%. Is this bad? In the negotiations, many maintenance managers come prepared and can respond to a budget cut by indicating how much the risk figure would increase as a result of this. Some of them say 'if management still want to cut the budget, I have at least covered my backside'. In principle, this is true, in principle. However, if a disaster was to happen and the whole organisation goes bankrupt, there is little solace from 'having covered your backside' or being able to say 'I warned you'.

What are the Effects of Cutting a Budget?

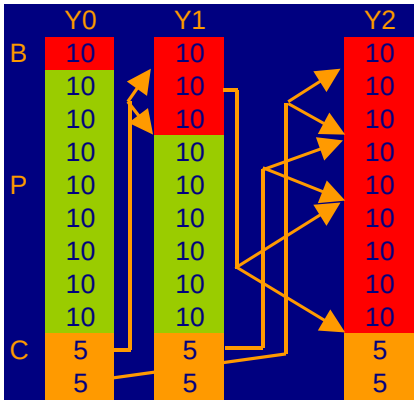
Breakdown tasks will soon replace pre-emptive tasks

If a budget consist of a large proportion of pre-emptive tasks and a small proportion of breakdown contingency, then what happens if your budget is cut? The only part you can cut back on is the pre-emptive maintenance part. You cannot reduce the contingency for failures and breakdown repairs. When failures happen, you must repair them. Let's look at a budget request that consists for 90% of pre-emptive tasks

and 10% breakdown contingency. What is the effect of an artificial budget cut of 10%?

The same literature sources that provide figures for operators being able to take over 40% of maintenance tasks, state that, on average, a repair under panic conditions (i.e., unplanned) may cost up to four times the cost of doing the same task under planned conditions.

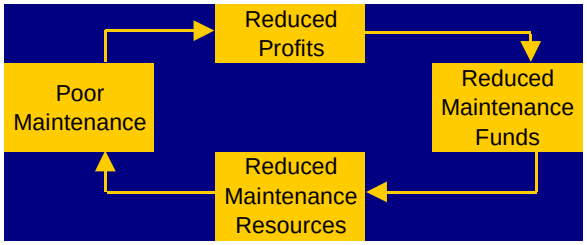
> Let's look at a budget request in year zero (Y0 in picture below), that consists of 90% pre-emptive maintenance (PM) and 10% breakdown maintenance (BM). Let's assume that you receive a budget cut of 10%. This cut can only be in the PM area. Compared to your budget request you get only 80% for PM (all percentages will link back to your original request). Remember that we stated that all your planned maintenance is essential. This means that not performing it will result in faults and failures. Due to built-in safety margins, the assets may go on for a while and there is a delay between budget cut and reduced performance. Let's further assume that only half the budget cut results in a breakdown in the next year, due to in-built safety margins.
>
> This means that in year 1 (Y1) you have your standard 10% for BM, plus the first 5% of your original budget cut results in 20% worth of your budget spending on BM. Your actual spending in year 1 will be 50% on BM and 40% on PM (and a 10% cut).
>
> Lets now assume that they don't cut your budget again, which still means that you will get 10% less inY1 than you required in Y0. The second 5% of the cut in Y0 takes away 20% of your PM budget in Y2 but half of the budget that was not spent in Y1 on PM (20%) also results in failures and BM in Y2. This equals 40%. Then, because you still get 10% less than you originally requested, 5% of that gap takes care of another 20% of your budget for BM. So, in year 2 we have 10% (standard) + 20% (second 5% of cut in year 0) + 40% (as a result of half of the 20% lost to PM in Y1) + 20% due to the ongoing effect of getting 10% less than you need) =100% for BM in 2 years. This is the first justification for getting the budget that the assets need.



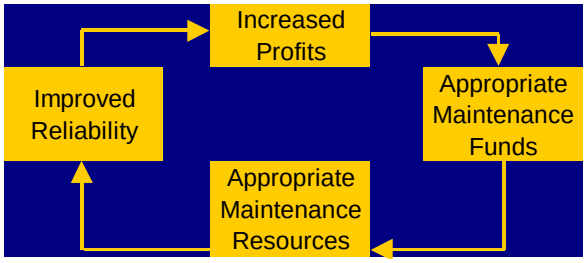
In reality, the replacement of pre-emptive maintenance by breakdown maintenance, because of a 10% budget cut, may take place faster than we described. For a start, your standard breakdown maintenance level may be far greater than 10%. Perhaps the failures happen in the same year and not for half the cut percentage. This should be the case, if we have taken the definition of 'essential tasks' to the letter. Had we been spot-on in selecting task frequencies, then we should not be able to delay the performance of the task at all. If we do find that only half the eliminated tasks result in a failure in the next year and the second half only has an effect in the second year, then this means that we have not set our frequency accurately enough. In the case where you don't have a plan that reflects the needs to maintain asset functions and performance levels, you may also be wasting part of your budget on tasks that don't

add much value, further reducing the effectiveness of your pre-emptive maintenance budget component.

The story above shows that a relatively small cut in a maintenance budget results in a rapid downwards spiral, from good intentions to spending 100% of your budget on breakdowns. This would be a vicious circle.

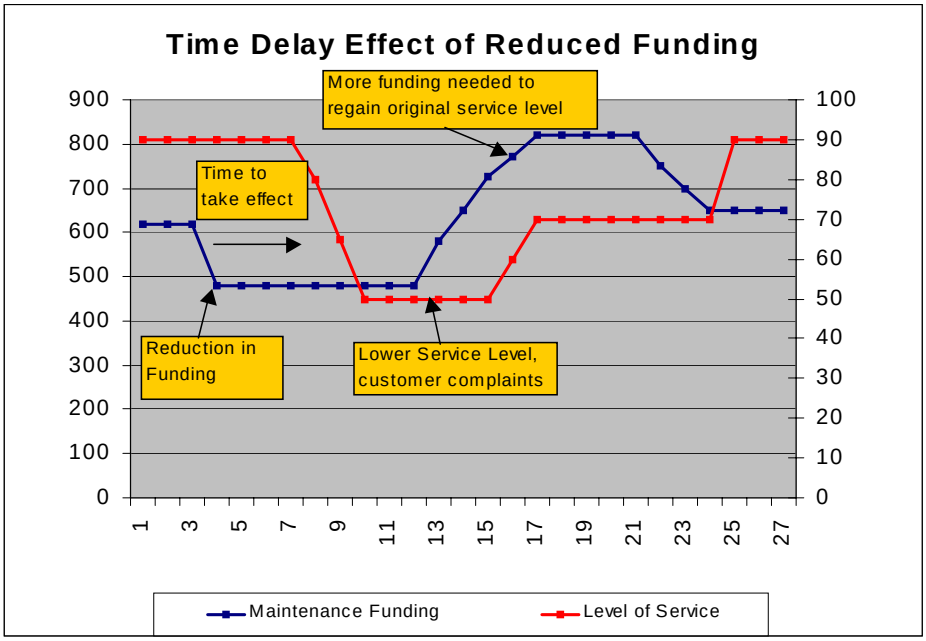


An the other hand, receiving a budget that aims at maintaining function and performance levels, may allow for maintenance improvement and designing out the need for maintenance. If you perform Total Productive Maintenance (TPM) and Reliability Centred Maintenance (RCM) analyses, you will save money. You also contribute to more revenue and profit as there is less lost production and waste (we eliminate waste in addition to losses in TPM). The value for money is much greater in this case. Instead of a downward spiral into oblivion, your organisation's sales and profits may spiral upwards.



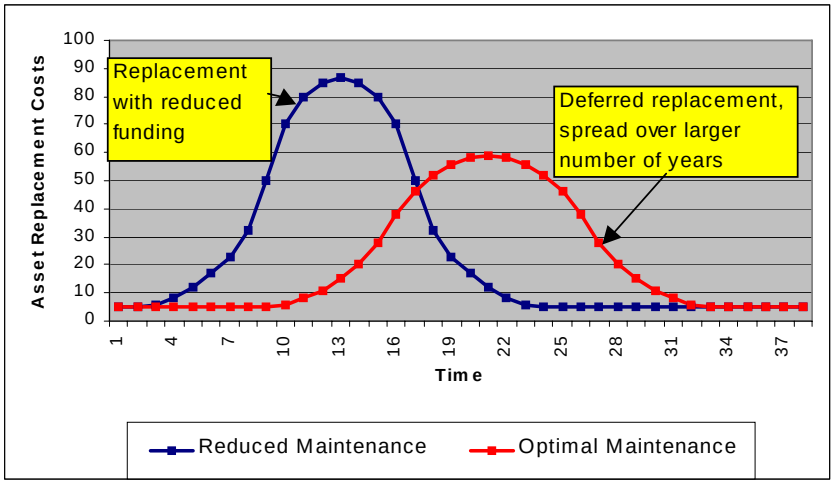
Spending more as a result of budget cuts

After a budget cut, performance may not fall straight away. There will often be a delayed response, due to in-built safety margins and you may have been following conservative asset supplier's capacity ratings. When the budget cuts result in failures and probable public outrage, the finance manager might decide to restore the budget. After all he didn't find that the cuts actually saved much, if anything, due to the increase in faults and failures. In a similar manner, asset performance will show a delayed effect. Often, because the asset deteriorated during the period of reduced maintenance, you may not be able to achieve the original performance. There are several instances where the asset owner had to spend excessive amounts of money to reach that original performance. It would have been cheaper to let you have your needed budget all those years.



Reduced asset life

A third justification is formed by the fact that, neglected maintenance may reduce asset life, requiring capital costs earlier than would have been the case with appropriate maintenance.

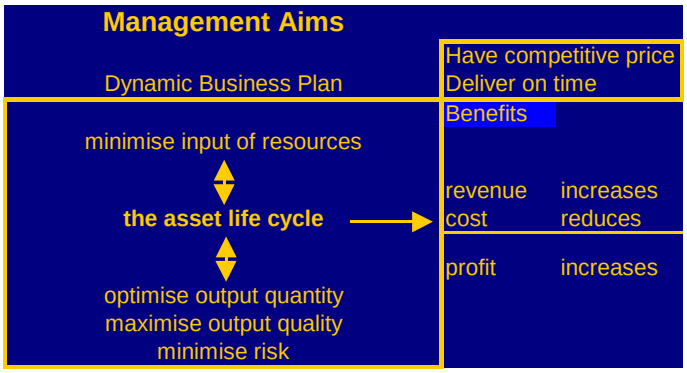


How Do You Justify the Budget You Need?

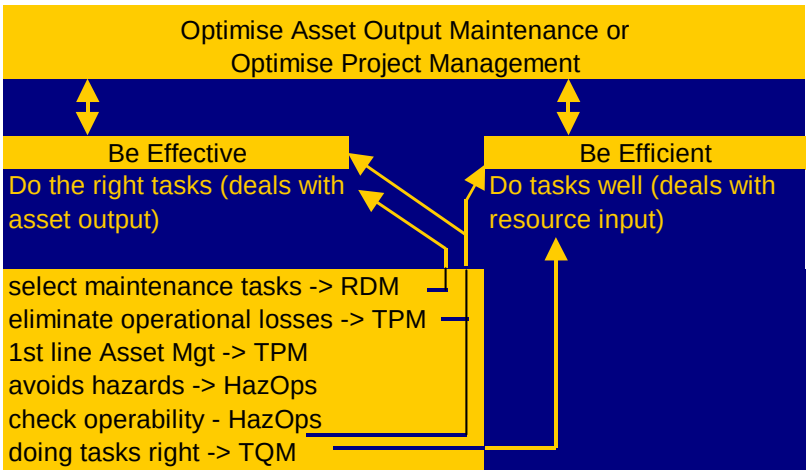
In the background information, we suggested the development of a maintenance management reference plan, which must contain all necessary operational and maintenance tasks to keep assets in the best condition. In fact, we believe that this plan will not just keep your asset in the best condition, but actually improve it. This is because we should continuously improve standard task instructions, frequencies, etc. An asset is not in the best condition when it is new but shortly before it is retired.

We start from the premise that our objectives are to optimise asset output in quantity and quality. We choose the word 'optimise' as it links to what you can sell. There is

no benefit in maximising output if you can't find buyers for it. You then want to achieve this optimised output at minimal cost and level of risk. Risk covers safety, the environment, production and the assets. We believe that these three objectives apply equally to any organisation and to any level within the organisation.



To achieve these objectives, you must be effective and efficient. Being effective means doing the right tasks. Then you must be efficient, which means doing the right tasks in the best possible way. Being effective comes first, as there is little benefit in being very efficient in doing the wrong or unnecessary tasks. We select the right tasks with TPM and RCM analyses.



In our approach to TPM, we first changed the name to Asset Operations Optimisation (AOO). After all TPM aims at maximising asset effectiveness by reducing the 'six big losses'. When you consider these losses, you'll find that they all fall under the effect of the operator. Then TPM promotes the introduction of operator-maintenance, which has the clear effect of improving asset operations. The operator achieves this by recognising early signs of deterioration and performing minor maintenance tasks to halt and reverse the deterioration. We also add management and authority induced losses. Examples of the first ones are meetings, decisions to only operate one shift a day, for 5 days per week and 48 weeks per year only. An example of an authority-induced loss is statutory inspections of boiler tube internals and thickness. These inspections are required, regardless whether the boiler is brand-new or 56 years old. Surely, we should be able to predict with some level of confidence when a first inspection would be necessary. As it stands now, most inspections only confirm that all tubes are in good condition. After the inspection, we weld the tubes together, start the boiler and find a few leaks. Not only does the inspection cost many weeks of lost production income, it can do more harm than good.

In addition to losses, we analyse a process for sources of waste. Waste can include lost energy (as process input or output), waiting for permits, spares, transport, the use of qualified trades persons for greasing only, double handling etc. The six big losses won't address these.

We developed an analysis spreadsheet, along the lines of our RCM analyses sheets, as discussed in a Maintenance Journal article in the May 2005 edition. It includes many of the same questions, such as 'how do you know that a loss or waste is occurring?' If you don't know but you should know, modify the design to include some new monitors, oil take-off points, alarms, etc.

We also assess risk as a multiplication of values for severity of loss or waste consequences, their likelihood and detectability. To the task and frequency selection, we add questions regarding duration and needed resources, as this completes the information you need to develop a maintenance plan.

In our approach to RCM we don't take any short cuts but try to avoid certain 'obscure paths'. We changed the name to Reliability Driven Maintenance (RDM), as it seems better to have maintenance driven by reliability than 'running around in circles' or centering on it. In our practical application of RDM, we pay quite a bit of attention to describe functions and performance levels as complete as possible, because if the descriptions are incomplete, we will overlook fault and failure causes that may require pre-emptive tasks. For each function and performance level, we systematically check for six standard possible faults or failures. This ensures comprehensive coverage during the analysis.

As with the TPM/AOO analysis sheet we ask how do you detect deterioration and include the same risk assessment. Then we include a task decision flow diagram and include seven questions that quickly guide the analysing team to the required type of maintenance. One of those questions sorts out the tasks that trained operators could do. This means that, not only do we get a comprehensive maintenance plan, we also allocate the tasks to obtain the best value for our maintenance budget.

If your process-based team analyses their process functions with TPM/AOO and RDM you would get a complete maintenance management reference plan, with all operational and maintenance tasks, together with their frequencies, duration and needed resources. You could easily translate this plan into a life cycle cost forecast, as well as annual budgets. Of course, certain assets may change their behaviour and you may have to change a task, frequency, duration or needed resources. In the overall annual plan and budget, these will be relatively minor changes, so in global terms, the annual budget will not undergo a drastic change.

What this means is that you would only need to get the life cycle maintenance plan and budget forecast approved and the annual budgets would be covered by this overall approval. Consequently, there is no more need for annual budget negotiations. Your computerised maintenance management plan can monitor daily actual spending and compare it to the budget to date.

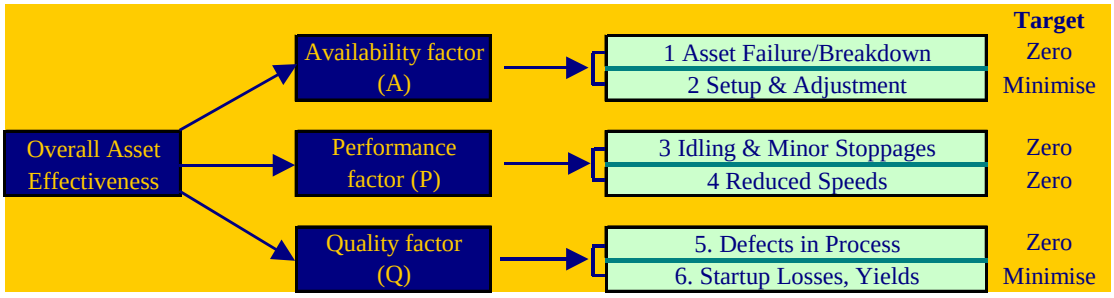
How to sell this to the finance manager? When you pointed at the increased risk, linked to a reduction of budget, did you allow for the fact that panic repairs cost four times as much as planned work? Did you allow for lost production? Alternatively, you could calculate how much more you can produce and by how much profit would increase if you could eliminate faults and failures by having the correct budget available.

Of course, you would still be handicapped, even with an appropriate budget, if you have responsibilities to meet but haven't got matching authorities. Although having the correct budget removes the major hurdle towards achieving the organisational aims, do you have authority to obtain all required skills in sufficient numbers to develop the maintenance plan in the first place? Do you have the authority to use spares for smart replacements of larger subsystems, instead of repeated downtime to replace one component at a time?

The Right Sequence of Achieving Maintenance Cost Savings

Based on the foregoing, we strongly believe that the right sequence is to develop a maintenance management reference plan first, including standard task instructions for all necessary operational and maintenance tasks. Perhaps there will be a need to modify assets to improve their reliability, operability and maintainability. Some additional tasks may result from a thorough inspection of existing assets, to bring them back to the correct condition. Most likely, this will require a temporary increase in the budget, but the result will be ongoing reduced cost afterwards.

Another method is to use the Overall Asset Effectiveness factor (a new name for Overall Equipment Effectiveness), which finds its origin in TPM/AOO. The OAE is the multiplication of availability, efficiency and quality factors that each cover two of the six big losses. It calculates the overall effect of the losses. A simple model follows below.



If an asset runs 70% of the time, operating at 75% of design capacity (flow, cycles or units per hour) and producing quality output for 99% of the time, the OAE is 51.97%. Separately, the indicators for availability, performance and quality seem good, but the effective marketable output is only 51.9%.

When two assets have an availability of 90 per cent, one can have a single shutdown and the other can have ten shutdowns. If each shutdown is followed by a start-up loss, the asset with the single shutdown produces much more than the one with the ten shutdowns and start-up losses. In addition, one asset needs one repair and the other ten. This indicates that measuring availability alone, as many organisations do, is far from adequate to measure business performance. Measuring availability would also not pick up speed reduction losses, or quality losses.

The OAE improves when you reduce any of the six losses. The reduction of a speed problem might be a lot cheaper than modifications to reduce faults. The aim is to maximise the OAE at the lowest possible costs.

When you regularly work out OAE figures, you will soon understand what an increase or reduction in OAE means. If the OAE reduces, the factors of the OAE will

indicate if the asset or facility experienced more down time or minor stops, was running at a slower speed or produced more defects. Improper or inefficient operation can cause lower availability (set-ups, tool, or part changing) as can improper maintenance (breakdowns). You can calculate the profit at an OAE of 80 per cent and the revenue loss when the OAE reduces to 62 per cent. This will tell you the value of maintaining the OAE at the required level. Conversely, if you know how much profit the organisation makes at an OAE of 60%, you can calculate the increase in profit, if the OAE increases from 60 to 70 per cent. If the increase in profit would be $200,000 per month, you should be able to justify a temporary budget increase to eliminate the loss. This may be reduced speed or set-up and adjustment, which may mean an asset modification. Even if this were to cost $500,000, you would earn this amount back in 2.5 months. Regularly, requests for asset modifications are turned down because 'there isn't any money' or 'we can't spare anybody to do it'. Again, this is looking at the request in the wrong sequence. Instead of not making the money available, it is much more profitable to increase the budget, even borrow the money or hire extra people to implement the modification and reap the benefits for the rest of the life of the asset.

The current and widespread approach of budget cuts and staff reductions first, will make life a lot harder for operators and maintainers alike. Not only will you start sliding down the vicious spiral, you will not have any resources available to ever stand back, analyse, improve and survive. You will experience the effect of the grim budget reaper!

Finally, if the budget is not going to be sufficient to perform the tasks as per the maintenance management reference plan, there must be a method of prioritising the work to be performed. You should base this on the risk of not doing the work on each asset type. The risk level is the multiplication of values for severity, likelihood and detectability of faults and failures. Severity can be assessed against safety, environment, lost production, repair cost only, public perception, meeting codes in regulated industries, etc. If the information is available, you should also consider asset condition. This approach indicates the importance of each asset type to revenue earning potential. You can express likelihood in number of failures over the asset life or per year. You can allocate a weighting factor against each considered issue. To involve the whole management team, the team members should set the weighting factors, as they are of strategic importance. Without going into too much detail regarding individual assets, the management team will have to investigate the importance of maintaining their assets. Hopefully, this will make the team realise that they can't just cut a budget by an arbitrarily set percentage.

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