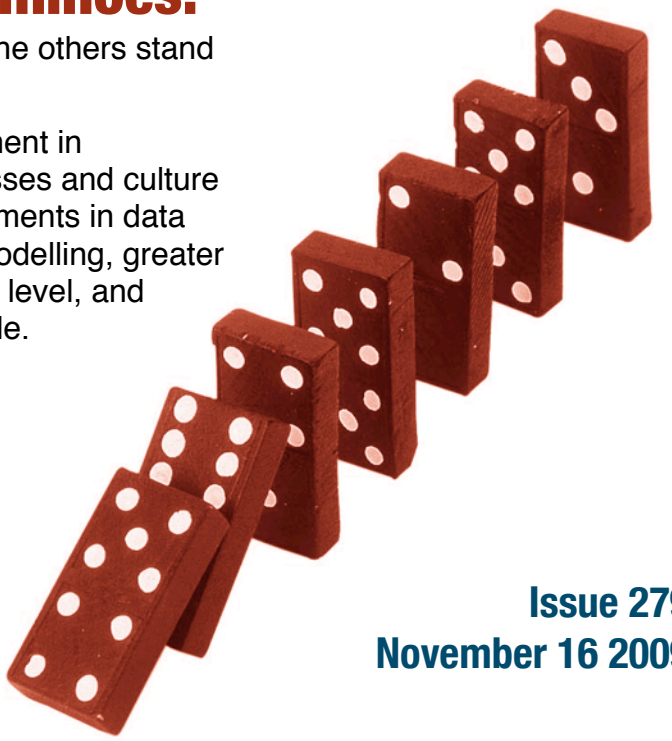
AMQ INTERNATIONAL
STRATEGIC ASSET MANAGEMENT

Reverse Dominoes:

Stand up one, and the others stand stronger, too!

- how an improvement in maintenance processes and culture can lead to improvements in data quality, better AM modelling, greater confidence at Board level, and improved staff morale.



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I have had occasion before to speak favourably of **Energy Australia**. At a time when recruiting and retention of skilled staff was becoming increasing difficult for all organisations, EA was able to significantly increase its skilled staff numbers. Yes, they paid well. And yes, they treated their staff well. But after listening to a presentation by John Hardwick at the Adelaide launch of the AMC's Certification Program, I found myself thinking that maybe good maintenance and operations processes could have equally as much to do with their staffing success. Good processes produce sounder more reliable data leading to AM modelling that carries greater confidence - and board success! And for staff, what can be a greater morale boost?

What can we learn from Energy Australia? Not everyone has the same asset intensity and the same need for asset reliability as EA whose transmission and distribution network serves 1.5m customers over an area of 22,000 sq km, an area that includes the greater Sydney area and out to the Hunter Valley. Not everyone has the same access to finance and highly skilled resources, and not everyone has the same need for the rigour over cost decisions that is imposed by a need to respond to the Australian Energy Regulator.

But many aspects of Energy Australia's maintenance and asset management processes could be adopted, with benefit, by others. Here I look at how they changed their maintenance culture, improved the quality of their data and of their AM modelling and generated board approved AM policies.

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Are your KPIs helping or hindering?

You may recall the story of the quality control manager who tried to implement a change that would have reduced cost, increased product quality and enhanced worker amenity - but was frustrated at every turn by the KPIs applied by each section within his organisation (SAM 271, p.3). Well, something similar was occurring with Energy Australia.

EA had adopted the FMECA/RCM approach which identified what really needed to be maintained and what tasks needed to be carried out. They could now produce a yearly detailed worklist for maintenance. But maintenance did not have a high profile and it was considered that if a 'good attempt' was made to address the list, say 80%, then everything was fine. (After all, 'the lights are still on') Why can an effective KPI of 80% completion be a problem?

Where the 80:20 Rule can lead you astray

Well, as Rod Smith points out [1] "A problem with an acceptance of the numbers game was that the 20% not completed were the assets for which "access to work" was difficult to arrange. This meant that for the next year the problems compounded because the bulk of the same difficult assets were again not maintained. But it was OK because the lights were still on and 80% of the work was again achieved. There was an incredible lack of focus on these "time bombs" just sitting there with no inspections being carried out on known failure modes.

We were now producing lots of wonderful worklists, reports and statistics which looked really nice but did not achieve any real change because the overall cultural approach to asset maintenance was still firmly locked-in to the old paradigms [that said that building new was more important than maintaining existing].We had addressed the technical issue with the introduction of FMECA/RCM, but we still needed a strategy to address the very real issue of company culture with respect to actually completing the maintenance."

You will notice that although the 'maintenance performance' appeared to be constant at 80% of tasks accomplished, under these circumstances, the assets were actually deteriorating - and those most at risk of deterioration (the 20% that could only be accessed with difficulty) were ignored. Risk was increasing.

Changing the Culture

"We knew communication was paramount in whatever direction we took, so the decision was made to meet separately with all involved workgroups by way of 3 monthly "road trips". The approach used with each of these groups was varied as we thought appropriate, considering their own unique location and history. This is where an appreciation for the variation in culture between certain workgroups became invaluable. Even though many of them became convinced of the credibility of the FMECA/RCM process – after all many of them had been involved in the initial analysis – their hands were tied because they had different drivers, ultimately linked to Management KPIs, being

forced on them from within their own Division. It would be less than truthful to say all workgroups embraced the new approach. But at least by talking to the workgroups individually, we became very aware of where we were confronting significant cultural resistance.

The required approach then became a little clearer …. “Encourage” management to focus on maintenance achievement by the inclusion of relevant KPIs into the Performance Agreements of key managers. This simple variation ultimately forced a change to our Internal Service Provider’s management structure to include the vital positions of “Maintenance Managers”. This change has provided a focus on maintenance previously unseen within our company.

First get their attention

At this point, continues Rod, EA decided to find a way to keep the monitoring and reporting simple and very relevant to all levels of management. “The 3 main drivers in the development of their reporting were:

1. The report format needed to be simple, colourful, relevant and take very little time to absorb .. which is of paramount importance to the higher levels of management.

2. The missing compounding 20% needed to be addressed

3. The ultimate driver for our actions was to identify and address the highest “RISK” exposure of our assets.

The final outcome was to publish a simple stacked bar chart with no more than 3 colours.

The list of tasks to be carried out during the year was split into 2 groups.
The first was the number of tasks falling due in the current year. For this we picked a non-threatening “Blue” colour.

The second, and this turned out to be the cruncher which primarily addressed the missing 20% and our highest risk exposure,was the number of tasks carried over from previous years. The colour for this group became our now infamous and much dreaded “REDS”.

The third colour representing the number of completed tasks was of course Green.”

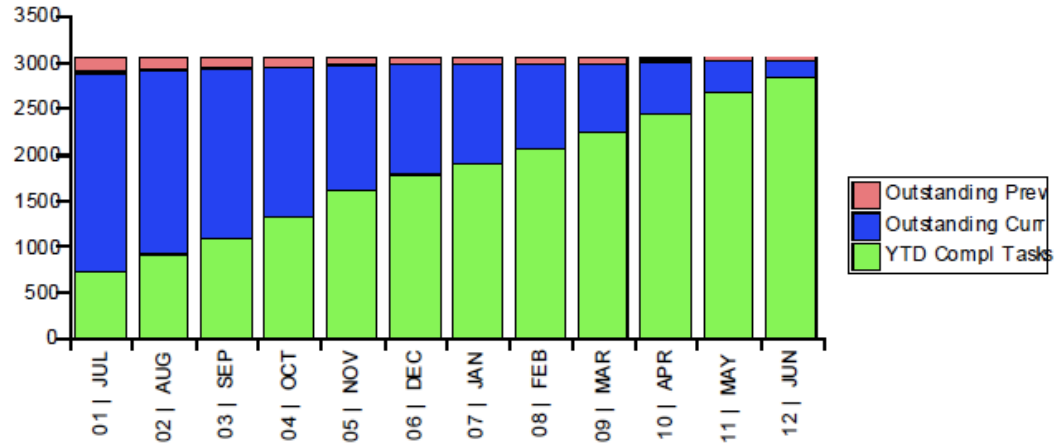
If this sounds confusing, let’s look at the final product.

> As you look at these charts [next page] remember .. Green is Good … Blue is OK and still within the periodic latitude for maintenance … but Red is considered potential risk.

Which would you be most concerned about?

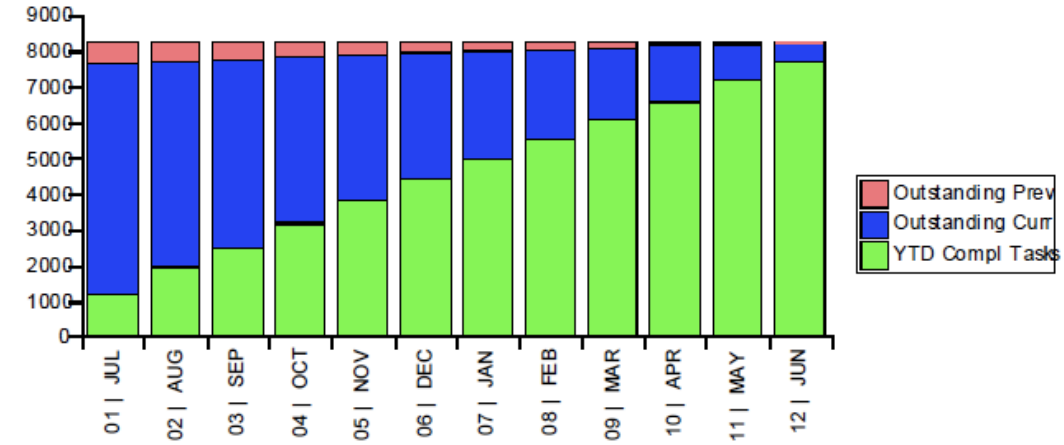
Transmission Substations

Inspections – 2004-05



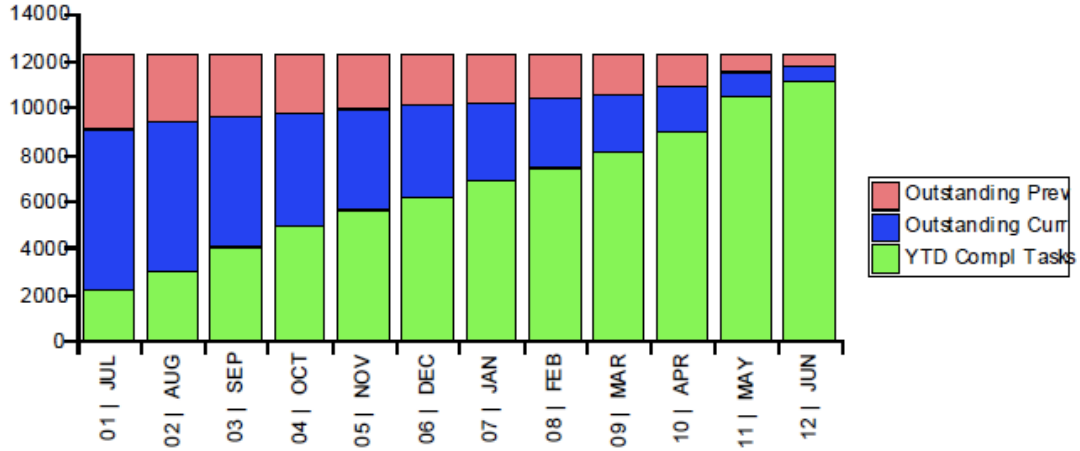
Zone Substations

Inspections – 2004-05



Distribution Substations

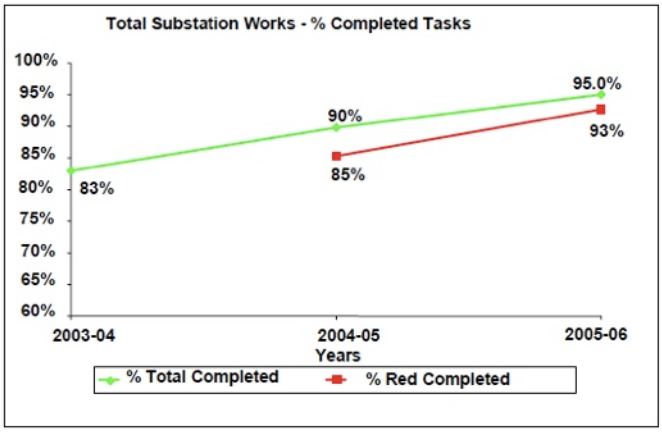
Inspections – 2004-05



You probably did not attempt to read off the axis. Like the maintenance folk in Energy Australia, you probably just looked at the pattern. And that is all you need to do. The pattern tells the story.

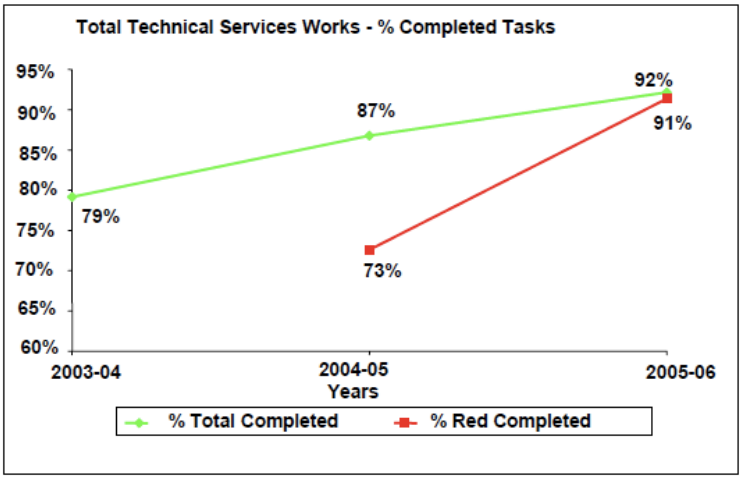
Having got their attention, keep it!

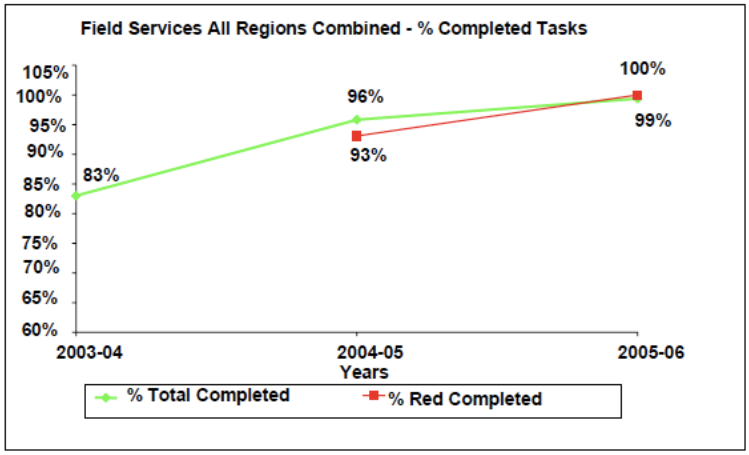
The next step was to make sure that this monitoring information was kept in view. Energy Australia developed a dashboard version, showing the maintenance status as it applied to each individual work group on their desk top. They saw only their own, not the others. Nevertheless a certain amount of healthy, unofficial, competition developed between work groups.



And the Results?

Impressive, what! (And Rod Smith tells me that since this was written in 2007, the focus has been maintained with 'incredibly pleasing results')





What started off at around 80% completion in 2003-4 had, within just a few years, improved to around 95% and the very risky 'reds' cleared up faster than anything else.

I don't know, but I would suspect that the element of competition, even if unofficial, for it was not promoted by Energy Australia, also made life a bit more fun, and added to the sense of achievement.

Ask yourself, how much fun tennis would be if there were no net and no scoring? Without good monitoring, you may be depriving your maintenance folk of satisfaction - and your organisation of good processes and good data.

Now that you have stood up your first domino, watch the others rise too

With almost 100% of the critical tasks, determined by FMECA and RCM, now being accomplished on a routine basis, what follows? Amongst other things:

greater asset reliability

lower maintenance costs

better quality data!

and that better quality data can now contribute to more reliable outputs from asset planning and yield better quality practices to support the repair/replace decision and the critical cost/reliability equation involved in determining the level of spares.

The Repair/Replace Decision

According to Gary Winsor and Steve Buncombe [2] "The decision to repair or replace an asset can be an easy or difficult decision. Minor low cost failures on young assets and major failures of assets, particularly aged assets, are often very clear and easy decisions to make. But how should we address failures on assets that may be considered 'mid-life'? An issue for the asset or plant manager is "How much can we justifiably spend on repairing the asset or equipment before replacing it?". There are often a number of technical issues involved, which as engineers we have become competent to address, and deliver a range of possible technically feasible solutions. But how do we assess the financial impacts of our solutions to arrive at a decision, particularly in terms of the asset economics and future risk costs?"

The repair/replace decision can have critical cost and reliability consequences and Energy Australia have spent a lot of time refining their model, even calling in a firm of consultants who had been previously used by the ACCC to review their 2004-2009 regulatory submission, and independently check and challenge the model as if they were working for the regulator.

In essence, the question is how much to spend on the repair of an existing asset before it becomes more cost effective to replace it.

This spend limit = the remaining life of the old asset x (annualised cost of the new asset - annualised cost of the old asset).

The trick is in calculating the annualised cost (EAC) and EA have put a lot of thought into this. And the critical element in the equation is the risk profile of the asset at any given age.

The establishment of a linear risk profile starting at a given age was initially proposed and tested, with the analyst providing 1,2 and 5 year future risk estimates which were then subject to linear regression to project a future risk. Whilst this approach was found to be relatively simple, the problems with this method were it is very subjective, it was difficult to objectively support the risk points used, and the risks into future years could end up un-realistically high . Multiply this high degree of subjectivity with the large risk costs, and

it clearly would be a significant component in the EAC determination. Therefore better means of incorporating the future risk of the asset needed to be established, and it was decided to base this upon the statistical failure rates of the transformers."

Energy Australia then used their data to determine for each of their major asset groups, the probability profiles of failure by age. This was then converted to cumulative risk by age. And finally to cumulative cost by age.

> Note that the statistical failure rate of the transformers is, itself, a function of the quality of the maintenance process that is carried out to avoid such failure! So the better the maintenance process, the more reliable is the failure rate data for future planning purposes.

Sidebar: Do you know the quality of the data you are using? And do your analysis techniques take this into account? Many years ago, as an economist, I was analysing some ABS labour statistics when my (then new) husband asked what I was doing. When I told him, he laughed "If you knew how those figures were compiled, you wouldn't bother". He then went on to explain that what I was assuming were accurate and scientific figures were actually guesstimates by harried paymasters responding to ABS staff. As the paymaster for the entire Australian workforce of Bridgestone Tyre Company, I figured he knew what he was talking about. Guesstimates are better than nothing, and a lot of good use can be made of them - but they won't support fine, 6 decimal analysis!

But Beware - There is no place for "AM Robots"

No matter how good your data, and how good your modelling, there will always be a need for considered assessment and judgement. Take the case of deciding on repair or replace for the Surrey Hills sub transmission station. The modelling looked at the do nothing, repair and replace options. But, in addition to all of the standard considerations, the evaluation team needed to take into account the difficult access issues. "The substation is built on a long block with a downwards sloping access road. On the opposite side of the street are light commercial premises mixed with terrace style domestic residences. The street is lined with trees and vehicles are parked both sides of the street. There has not been a transformer replacement carried out at this substation since it was built. During the time Energy Australia has owned the substation there have been civil variations carried out which has changed the levels of the transformer entrance roadway and all the transformers have been enclosed behind sound enclosures.

The difficult logistics of replacing a transformer on the site became a significant factor in the repair / replace decision. The immediate problem was the risk of an oil leak escaping the interception tank so a short-term solution was a primary objective. In developing the logistics required in replacing

the transformer it became clear that it was going to take a number of years to undertake and co-ordinate this work, and as such provide no immediate relief to the current problems and associated risks. The sensitivity checking undertaken with the model provided us with a clear indication that the repair option was cost effective solution. This recommendation was presented to the Transformer Committee and the project approved. The repairs were carried out and the leaks have now been addressed. The development of a model as a tool to assist making the repair/replace decision has proved valuable from both an academic and a practical perspective. It has provided a more detailed understanding of the asset risks and assisted us to predict the future in a way which can be objectively reviewed by our internal stakeholders, and our industry regulator. [2]

Spares Policy

As with any agency where asset reliability is critical, the question of spares is a tricky one. The more you have, the greater the reliability (other things constant) but also the greater cost that you impose on your organisation. The problem, of course, is one of getting the balance right. Alexander Dean presented an excellent paper on this topic looking at need and examining failure recovery strategies [3]

And with the spares policy, I have come full circle, back to the presentation by John Hardwick [4] which so impressed me with the need for good maintenance data and the potential it yielded for AM progress. Because of the quality of the data as well as the rigour of the modelling, Energy Australia were able to present a considered report to their board showing the following. They had initially thought that the board would reject column 3 (three spares) and opt for either column 1 (one spare) or column 2 (two spares) but they didn't. The decision of the board was for 3 spares. And the Spares Policy became ' The appropriate number of spares shall be set where (1) the probability of having a spare available for the base case is **greater than 99%** and (2) the spread of probability values for that stock level, over all sensitivity factors, is **less than 10%,** Such a decision by the board has greatly added to the level of certainty within EA.

No. Spares Held	0	1	2	3	4
Probability	48.2%	83.4%	96.2%	99.3%	100%
Additional Confidence	-	35.2%	12.8%	3.1%	0.7%
Total Cost	$0	$1.5M	$3.0M	$4.5M	$6.0M

References:

[1] Rod Smith, Energy Australia, 'Monitoring and Reporting for Success' Presentation to ICOMS 2007

[2] Gary Winsor & Steve Buncombe, Energy Australia, 'Repair/Replace Decision Making Practices' Presentation to ICOMS 2007

[3] Alexandra Dean, Energy Australia, 'Developing & Implementing a Spares Strategy' Presentation to ICOMS 2007

[4] John Hardwick, Energy Australia, 'Strategic Asset Management' Presentation to the launch of the Competency Certification Program of the Asset Management Council, Adelaide, 2009.