Session 1
Paper 2

Risk Based Decisions at the Heart of a Modern Asset Management structure

Andrew Bower, Harvey Jones, Andrew Scott, Mike Hammond, Phil Jones

1. Introduction

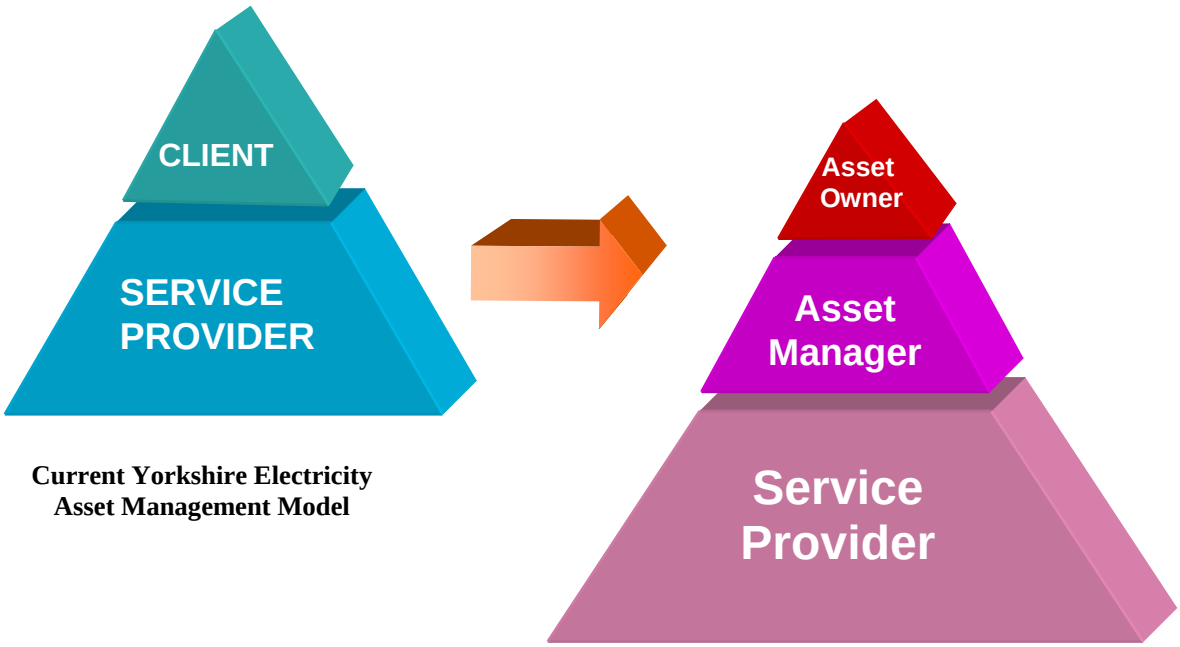
The vision of Yorkshire Electricity's Distribution business is ***"…to be the UK Leader in Utility Asset Management and Services "*** . To achieve this it has sought to develop, over the past seven years, a best in class asset management business employing expert staff and using advanced systems and processes to ensure that it maximises value from its 12 million assets. Best in class asset management centres around effective decision making through understanding and managing risk. Yorkshire Electricity recognised early the need for a sophisticated decision making tool and moved to actively support and sponsor the MACRO project. This paper seeks to demonstrate the role that the MACRO tool has already and will continue to play in Yorkshire Electricity's future value creating asset management regime.

2. What is a Modern Asset Management Structure ?

It is useful to understand the way in which a modern integrated asset management business needs to be structured in order to comprehend the need for and the significance of the MACRO tool.

When the electricity industry was first privatised and came under regulation in the early 90s there was a pressure put upon the new Regional Electricity Companies (RECs) to become commercial entities, operating in a competitive environment. In response to the changing market place Yorkshire Electricity were the first REC to adopt a Client - Service Provider business model, separating out the owners of the distribution system (making decisions about the asset's fitness for purpose and investment requirements) from the service providers (carrying out physical work on the asset). This model moved the business from being resource led to it being driven by decisions based on the performance of the asset and an understanding of risk exposure. It is the ability to make quality decisions which is the lifeblood of asset manager's work and the key differentiator between value creation and destruction. Other UK RECs have since adopted the client-service provider model, which has become ingrained in the culture of Yorkshire's Distribution business. As Yorkshire strive

for continuous improvement and respond to a constantly changing market and business environment, it is positioning itself to manage its organisation through an even clearer business model.



Current Yorkshire Electricity Asset Management Model

Yorkshire Electricity New Generation Asset Management Model

The new model separates the **asset owner** from the **asset manager**, leading to a clarification of a third tier in the business model, where the engineering decision making processes, and the management of the asset related risk exposure sits in a business unit that is entirely focussed on managing an asset base to meet the requirements of the asset's owners. But why would a geographically bounded, traditional utility company want to separate out the critical skill of managing the risk of its assets from the processes that are associated with owning those assets? The answer lies in future opportunities for business growth.

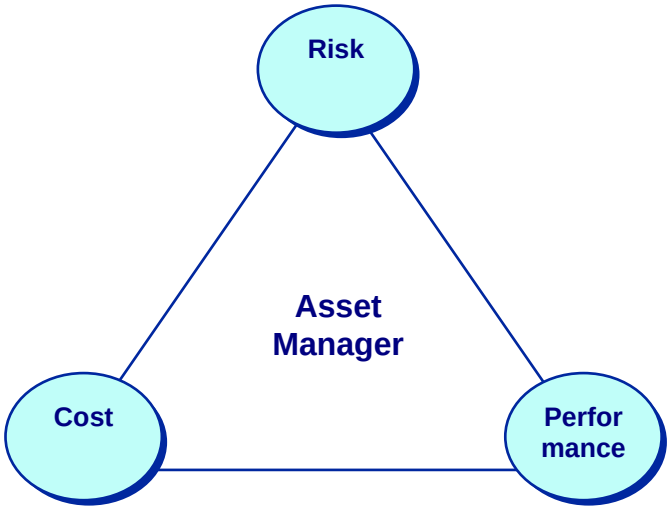
The utility market sector is now rife with company acquisitions and mergers. The influence of new foreign owners bringing multiple RECs together has put a different complexion on business drivers. As a matter of survival, infrastructure companies are left with a stark choice, change or be changed. Large steps have been made in the past five years in making individual companies streamlined, especially in the area of service providers. Cost cutting can only extend so far and so in a bid to grow business some service providers have expanded to offer their services on a cross Utility basis.

The service provider market is a cutthroat one containing many players. As a business with a vision to grow, Yorkshire Electricity's new business model concentrates on the aspect of the electricity utility industry that has the potential to create most value – 'asset management'.

This model allows the asset management organisation not only to use best practices to return maximum value to an asset owner, but to leverage its capabilities and resources across the wider spectrum of the **asset management industry**, managing large and potentially diverse asset infrastructures. There are large synergistic benefits in asset management skills, capabilities, IT investment and enabling technology provision for the asset manager who is able to manage more than one asset population.

3. The Importance of Risk Based Decision Making

The focus of asset management in Yorkshire Electricity lies in the understanding and management of risk associated with building and operating an asset base and the realisation that sound **risk based decision making** holds the key to release **value creation**. The asset manager, therefore, needs to understand the risk profile and exposure of the infrastructure being managed. More than this he has to understand the owners aversion to risk and marry the owners expectations of cost (which will be that the costs be low) against the expectation (which will also be low) of having an incident which will affect the value of the company – all this whilst maintaining the service performance of the asset. This could be said to represent core business values. Metrics can then be applied to these values to give a feel for the performance benefits, risk reduction and - of course - enable cost evaluation.



The essence of the asset managers role, therefore, is to complete the complex equation of resolving the conflict between Risk Management, Asset Performance and Life-cycle cost.

An important factor to bear in mind is that the scales of Performance, Risk and Cost are not linear for any given proposal. A small increase in risk could mean disproportionate increases in cost or a dramatic reduction in performance.

Our commitment to being one of the core collaborating companies in the development of the MACRO suite has been as a direct result of our focus on risk management and our recognition of it as a key skill set that will differentiate asset management companies. These tools are now being used to great effect by our asset managers as a way of resolving the three way equation of risk, performance and cost and ensuring that optimum decisions are reached. The following case study shows that with the use of structured data, the capable people and the application of the MACRO tool such an achievement is possible.

4. Case Study: Application of the decision making process to review the maintenance frequencies of the electrical protection system

This study explores how the concept of a risk based decision making process has been applied in Yorkshire Electricity to the process of reviewing the maintenance frequencies of the protection systems applied to the HV system.

4.1 Summary of the Decision Making Process

There are several distinct stages to the process:

First you must decide whether the problem is actually worth solving at this time. This sounds obvious but if you don't ask the question up front it is possible to carry out a lot of work to make little or no improvement in your performance. In making the decision whether the problem is worth solving it is necessary to establish the scope of the problem being explored.

Having determined that the process is worthy of further examination you need to collect together the data for the analysis. This stage of the process may involve a great deal of detailed analysis.

i. Determine the failure modes of the asset and the effects of these failure modes on the performance of the asset.
ii. Determine the reliability of the asset base under consideration.
iii. Determine the cost of doing the maintenance/inspection task to discover a hidden failure.
iv. Determine how the hidden failure may be exposed before discovery.
v. Determine how frequently an event that may lead to exposure is expected to occur
vi. Determine the consequences of a failure being exposed.

Once the data has been collected the analysis stage can be carried out. The analysis phase is about taking all the data and information that you have gathered about the asset base under examination and using it to develop an output that effectively balances the effects of the

different influences to produce the optimum maintenance cycle. As part of the analysis phase the sensitivity of the outputs to variations in the input data should be tested. This process highlights any areas where either the accuracy of the data needs to be verified, or, where benefits improvements may be easily achieved.

Implementation of the outputs from the analysis is easier said than done. Making a change in the maintenance regime, and in particular making a change that results in a reduction in maintenance frequency, will inevitably lead to questions about the impact of this change on the safety and reliability of the system. The implementation phase must include an opportunity for the staff and/or their nominated representatives to understand the procedure that has been followed. During this dialogue it is possible to address these concerns and demonstrate that the changes being made to the process are not solely about reductions in cost.

Completion of the implementation phase is not the end of the process, merely a stopping off point. The effect of the changes in maintenance frequency should be monitored and fed back into the model. Continual monitoring of the asset performance and the methods and effectiveness of the maintenance process will allow the optimum maintenance strategy to be reviewed as an iterative process.

Having summarised the process that is to be followed to enable an informed decision based on resolving the conflicting influences of Cost Risk and Performance into a balanced economic optimum, how did we apply this in Yorkshire Electricity.

4.2 The Decision – Is it worth it ?

Our expenditure on maintenance and inspection of protection equipment was of the order of of hundreds of thousands of pounds per annum. Any reductions in the level of maintenance/inspection necessary to cost effectively maintain the performance of the asset base under examination could clearly offer significant savings. It was therefore worthwhile to explore this activity to establish the optimum maintenance/inspection cycle.

The activity represented by this expenditure involved the trip testing of every protection system annually, in excess 2300 events per year. A more extensive maintenance process was carried out in place of trip testing every four years resulting in an additional 800 events per year over the whole of the system.

The complexity of the systems under test increases as the voltage level of the system protected increases. The largest number of tests carried out are at the 11kV level although the time taken by each test is much less. So both the direct costs and the potential indirect penalty costs per inspection at this voltage level are lower.

4.3 Data Gathering – The hard work

Determining the cost of a maintenance/inspection task was easily achieved by establishing the number of units maintained/inspected per year and the total cost of that work to the business.

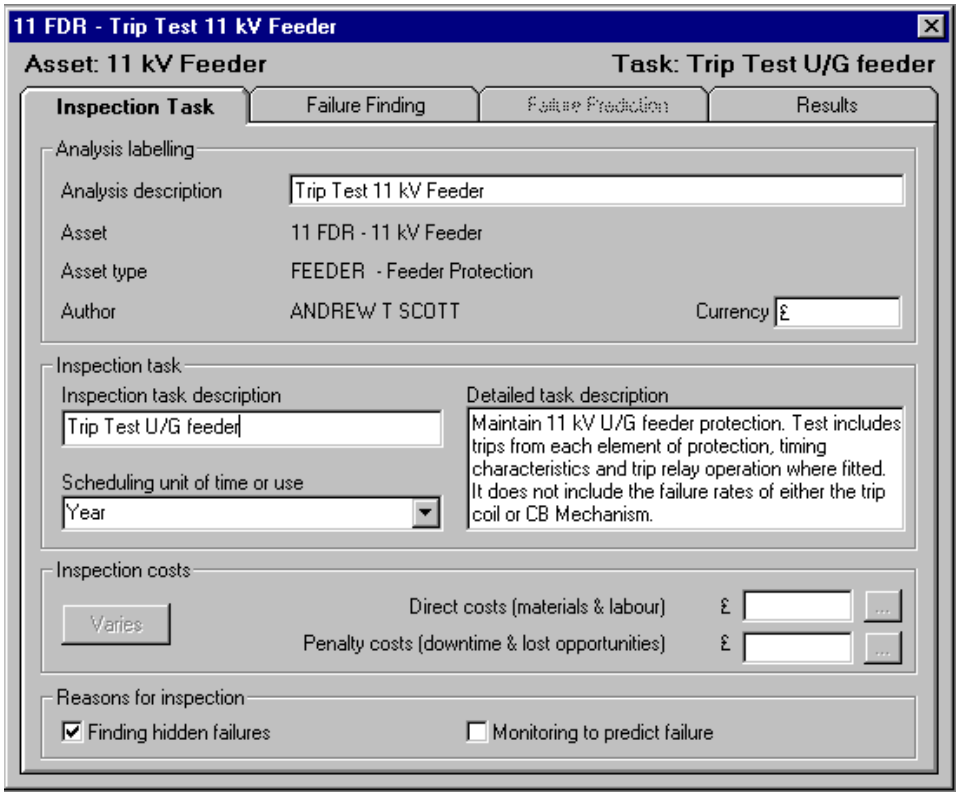
A group of experienced field engineers were gathered together to conduct a Failure Modes and Effects Analysis (FMEA). They identified possible failure modes of the equipment with which the maintenance/inspection tasks are concerned and the consequences of that failure on the operation of the equipment. Having identified possible failure modes of the equipment they were asked how often they had experienced each of the identified failure modes. This number of experiences when moderated by the individual opportunity to experience each failure gave an average number experienced per year. When considered against the population of circuits examined per year this provides a probability of a relay being discovered in a failed state.

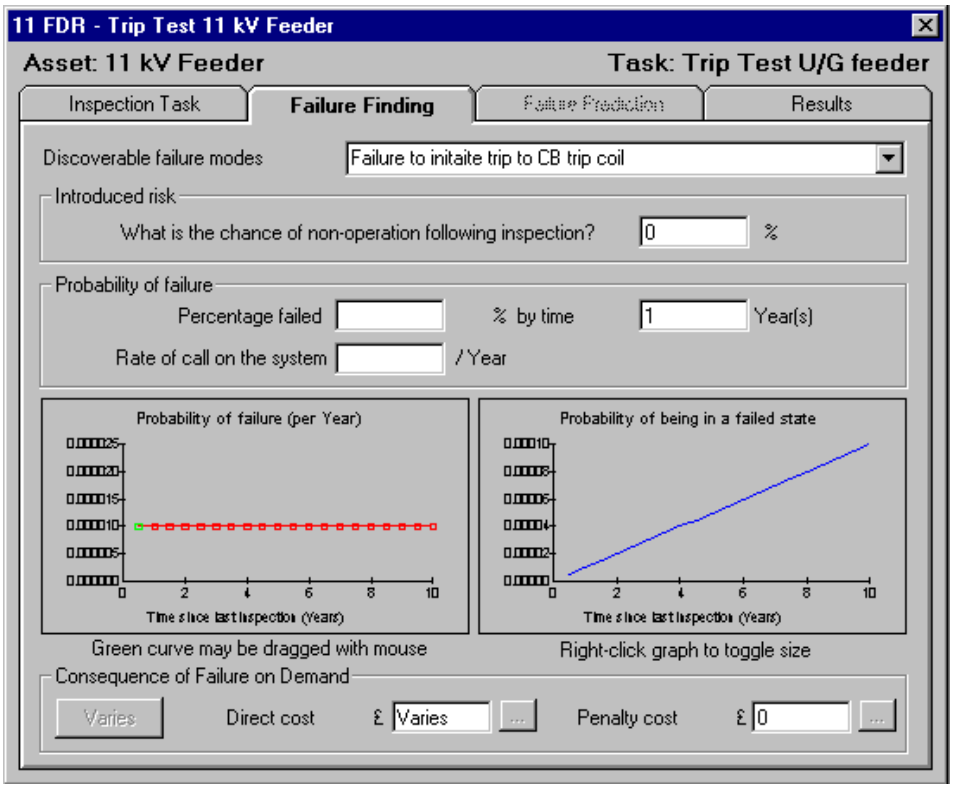
By examining the failure rate of the primary equipment on the system the rate of call on the protection system can be established. The rate of call is the frequency with which an event that would cause exposure of a hidden failure can occur. This is used within the MACRO tool to establish the probability of a piece of equipment being in a failed state and this failure being exposed rather than discovered.

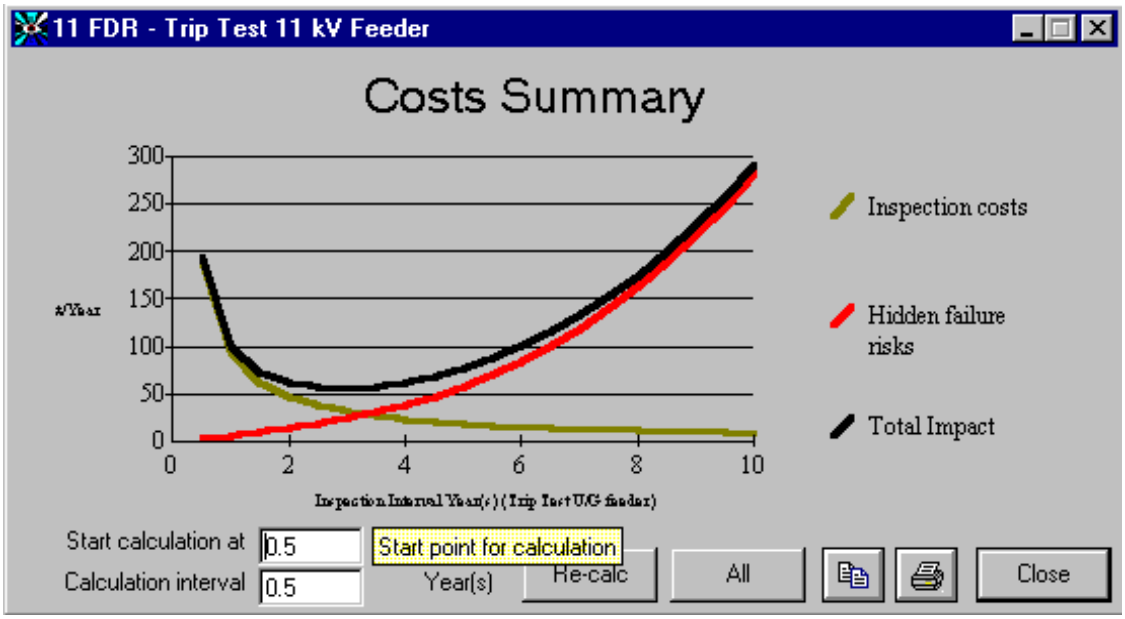
4.4 Data Entry & Analysis – Gaining confidence

The MACRO project has delivered a suite of applications to augment the Asset Manager's toolkit. Each application contains a complex calculating engine. This takes the basic building blocks of risk analysis in the form of the information gathered about the asset performance, the cost of inspection and the cost and probability of an exposed failure to produce an informed decision about the optimum balance between Cost, Risk and Performance.

The tools developed allow the variables applicable to each type of task to be entered into this mathematical model representing the mechanism of failure and exposure. The screenshots below show the data entry points for this analysis engine and the output that clearly and simply illustrates the optimum overall cost solution to the situation described by the inputs.


11 FDR - Trip Test 11 kV Feeder
Asset: 11 kV Feeder
Task: Trip Test U/G feeder
Inspection Task
Failure Finding
Failure Prediction
Results
Analysis labelling
Analysis description
Trip Test 11 kV Feeder
Asset
11 FDR - 11 kV Feeder
Asset type
FEEDER - Feeder Protection
Author
ANDREW T SCOTT
Currency
£
Inspection task
Inspection task description
Trip Test U/G feeder
Detailed task description
Maintain 11 kV U/G feeder protection. Test includes trips from each element of protection, timing characteristics and trip relay operation where fitted. It does not include the failure rates of either the trip coil or CB Mechanism.
Scheduling unit of time or use
Year
Inspection costs
Varies
Direct costs (materials & labour)
£
Penalty costs (downtime & lost opportunities)
£
Reasons for inspection
Finding hidden failures
Monitoring to predict failure


11 FDR - Trip Test 11 kV Feeder
Asset: 11 kV Feeder
Task: Trip Test U/G feeder
Inspection Task
Failure Finding
Failure Prediction
Results
Discoverable failure modes
Failure to initaite trip to CB trip coil
Introduced risk
What is the chance of non-operation following inspection?
0
%
Probability of failure
Percentage failed
% by time
1
Year(s)
Rate of call on the system
/ Year
Probability of failure (per Year)
Time since last inspection (Years)
Probability of being in a failed state
Time since last inspection (Years)
Green curve may be dragged with mouse
Right-click graph to toggle size
Consequence of Failure on Demand
Varies
Direct cost
£
Varies
Penalty cost
£
0



4.5 Implementation – Spreading confidence

It is important that when the informed decision has been made that the communication of the changes present it as just that an informed decision. Part of this stems from the process and the effective explanation of this. However, one of the key benefits of the MACRO process is that it provides a clear result, where the optimum solution to the Cost, Risk, Performance conflict can clearly be seen. The information required to feed the calculation engine enforces a consistent approach leading to a robust process. Before we introduced the changes to the maintenance frequencies suggested by the MACRO tool, the trade unions, representing the staff involved with this work, had the process explained to them so that they were able to see the rationale behind, both the process we had followed and the results of that process. This approach was key to taking the service provider forward with us in implementing the necessary changes.

4.6 Monitoring and Evaluation – Checking our confidence

This is a phase of the process that we are just embarking upon. Effective asset management is about the continual search for improvement. As the asset base changes over time with the introduction of new technology, the possible failure modes change, the failure rate will be different, improvements in the application of this new technology will vary the consequences of the failure being exposed, perhaps virtually eliminate that possibility. As this happens the optimum cycle will clearly alter also. The continual monitoring of the performance of the asset base will provide the information for future reviews. This information will be collected and stored within the integrated suite of applications in the Yorkshire Electricity Distribution

Asset Management System (DAMS). This system holds all the data concerning the diverse range of asset types that make up the Yorkshire Electricity distribution system. Collecting and storing this data represents a massive investment, it is the use, within this environment, of decision support tools such as MACRO that allows us deliver a benefit from this investment.

5.0 Conclusion

Yorkshire Electricity aims to be recognised for excellence in asset management and continues to drive itself in search of best in class philosophy, strategy, tactics and capabilities. Our early belief for the need of a sophisticated tool to assist in decision making in the risk management arena lead to our whole-hearted support of the MACRO project, even when the concept was at its inception.

Yorkshire Electricity is seeing radical improvements in capital efficiency through the application of analytical capabilities such as those represented by MACRO tools. These tools are leveraging the investment that has been made in the quality of the asset data through our high-profile DAMS investment. The decision making process is now robust and defensible and will withstand external scrutiny. Once understood the process enables decisions to be made and articulated in a visual manner which enables the debate to be more informed and structured.

Yorkshire Electricity's Distribution business is seeing the vindication of their belief that capital and operational expenditure efficiency can be greatly enhanced given the right set of skills, capabilities and tools in a risk focussed environment. The MACRO tool has already proved its worth to us in that arena and will continue to form a cornerstone of Yorkshire Electricity's best in class asset management regime for a whole range of asset based decisions driving the business's replacement, maintenance, repair and reinforcement strategies.