

ON-CONDITION MAINTENANCE

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In order to develop a successful On Condition Asset Maintenance system, a few key considerations must be kept in mind.

No two organisations are exactly like each other as they have their own context, physical location and cultural environment. Nevertheless, there are common challenges, experiences to be learned and pitfalls to be avoided that can be identified beforehand.

Key issues explained, and why they are important.

1.1 The Case for On-Condition Asset Maintenance

In his book “Reliability-centred Maintenance” (Moubray, 1997) John Moubray introduces the concept of Reliability-centred Maintenance (RCM) and defines RCM as:

Reliability-centred Maintenance: a process used to determine the maintenance requirements of any physical asset in its operating context.

The word “maintenance” is defined and understood as the act of preserving the desired operating state of a physical asset.

It would not be possible or fair to this book to try to summarise it in a few lines. Suffice to say that through the rest of the book Moubray establishes the concept of RCM and the Failure Mode and Effect Analysis as a means of determining the most adequate maintenance tasks applied to any specific piece of equipment.

Within this framework, three types of Proactive (Maintenance) Tasks are recognised:

1. Scheduled restoration tasks,
2. Scheduled discard tasks, and
3. Scheduled on-condition tasks.

The first two types of tasks (1 and 2 above) entail either the refurbishment or discarding of the equipment before a defined life limit, regardless of its condition at the time. Moubray explains that “collectively, these two types of tasks are now generally known as preventive maintenance”.

Many of the modern maintenance systems are built around the preventive maintenance idea. In essence, assets are intervened whether they actually require the intervention or not, based on a site-wide analysis and a typification of the assets life-cycle behaviour and expectations.

On the other hand, on-condition tasks are defined as “identifiable physical conditions which indicate that a functional failure is about to occur or is in the process of occurring”.

Rather than fixing a time-based set of maintenance tasks based on a (not always evidence based) failure probability, the on-condition tasks aim at detecting **potential failures**.

We call the systematic mechanism by which these potential failures are identified as an “On-Condition Asset Maintenance” strategy.

The application of this strategy carries added value to the organisation because the condition monitoring activities are normally less intrusive than traditional preventive maintenance activities. This has positive benefits in reducing the overall maintenance costs and improving the safety of maintainers and operators.

We envisage the implementation of this process as a continuous and self-reinforcing virtuous cycle, in which the maintainers are able to focus their energies in those assets that most require their attention. A visual depiction of this concept is shown below.

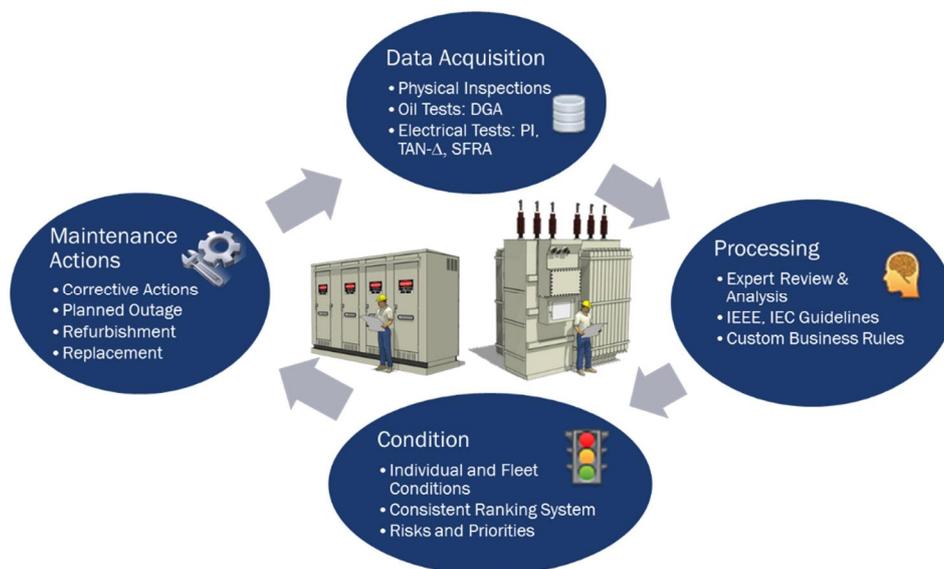


Figure 1. A systematic approach to implement an On-Condition Asset Maintenance programme.

1.2 The Importance of Asset Condition to Evaluate Risk

Within the practices of an Asset Management framework, a well-known method of prioritising and targeting the efforts of the Operations and Maintenance teams is to base decisions on a Risk based evaluation system.

In this context Risk can be thought of as a measure of the liabilities that the organisation would incur should a certain event occur. These liabilities can manifest themselves by impacting any of the Health and Safety, Operational, Financial or Reputational objectives of the organisation.

Although Risk cannot be completely eliminated as it is an inherent characteristic of any operating environment, it can certainly be understood, managed and mitigated to within acceptable levels as defined by the company.

The starting point of managing Risk is to break it down into its components, namely Consequence and Probability. A visual depiction of this concept is shown below.

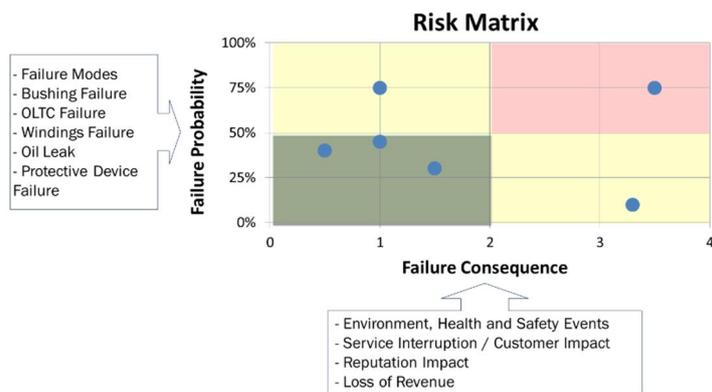


Figure 2. Typical Risk Matrix

For any given event, for example the Functional Failure of a particular Asset, these two dimensions can be evaluated in order to assess the Risk that this particular event represents to the company and the successful achievement of its goals.

Consequence is a measure of the impact that an event would have on the company's operation from any of the dimensions mentioned above (Health and Safety, Financial, Operational, etc.). For any given event a score can be assigned to the consequence of such event, i.e. injuries to personnel, amount of lost revenue, forced outage time, reputational impact, impact to direct customer's metrics, etc.

Typically, once a particular plant design, processes definition, asset configuration, etc. has been chosen or defined, the consequence is a somewhat "static" element of this equation and changing the consequence of a particular event in order to impact the overall risk generally entails significant levels of organisational effort and investment.

The second element that comprises and impacts Risk is the Probability of the event happening.

Probability, as the word implies, is a measure of the likeliness that the event takes place and the consequences of it are manifested.

In many scenarios, determining the precise probability of failure of any particular asset is a difficult and sometimes impossible task with the data available to the analyst.

However, the failure probability has a very direct and firm link to the condition of the asset on which the event could occur. The better the condition of the asset, the lower the probability of failure at that point in time.

This relationship, condition to failure probability, then lends itself to be a good "lever" that the Operations and Maintenance teams can utilise in order to manage the Risk.

The condition of the Asset can be assessed and scored to aid in the calculation of Risk, by replacing probability of failure with a current condition score. This score is also referred to as Asset Health Index.

The condition assessment represents a more "dynamic" component of risk as the condition of the assets rarely remains at a fixed point for an extended period of time. The condition of any particular

asset is in a constant state of fluctuation as it responds to its normal ageing processes as well as the stresses imposed by the operational conditions of the time.

1.3 Knowledge Generation

All the data collected about the assets does not hold much intrinsic value for the organisation. In other words, the data itself does not enable the company to react to changing asset conditions in a timely fashion.



In order to create value for the organisation all the collected data has to be turned into knowledge. In this context, knowledge generation can be seen as the process of assigning meaning to data.

A simple analogy would be to think of personal health data. During a routine check-up your doctor would probably take a number of readings that reflect how well your body is functioning, blood pressure, white cell counts, and heart rates are a few of the “data points” that your doctor might take from you. All this data however does not represent a lot of value to the patient until it is interpreted by the doctor and given meaning. By assigning meaning to this data, your doctor is creating knowledge about your current health condition. It is this knowledge that will enable you to determine whether you need to take any action in regards to your eating habits, you should exercise more or are in need of any immediate medical intervention.

This is akin to the process used to manage assets. Without denying the importance of the data acquisition phase of this process, this stage represents just the start of the asset management process.

The value to the organisation is realised when this data is transformed into knowledge about the condition of each asset and timely, meaningful and targeted business decisions.

The more agile an organisation becomes at executing the steps of this process, the more effective, efficient and therefore competitive it will become.