Mutual Consultants

Maintenance Myths, Mindsets & Mistakes
Part 3 – The Maintenance Arena

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1. Abstract

This paper sets out some of the most common myths, mindsets and mistakes[1] that are made in the maintenance arena.

Successful reliability growth and performance improvement is all about 'doing the *right* maintenance' on the equipment. Determining the '*right* maintenance' takes time and resources.

Experience has shown that the only way to make real, lasting improvement in the maintenance arena is by:

- Changing the way in which people think (ie dispelling all the myths, mindsets and mistakes that have been ingrained in maintainers' thinking over their working life)
- Providing an approach (such as RCM[2]) that encompasses a structure whereby the changed thinking can be brought to fruition.

The most common myths, mindsets and mistakes that are made in the general maintenance arena are summarised in the following paragraphs; a full explanation is given in the subsequent sections of this paper.

The maintenance department has many and various responsibilities. Usually there are one or two responsibilities that will dominate; a common mistake is to lose sight of the other responsibilities (particularly if there is pressure to reduce spend).

Generic maintenance generates unnecessary maintenance in many instances and often leads to inappropriate maintenance being specified (which may in turn result in costly or dangerous failures).

Generic maintenance is only appropriate if the equipment condition, operating context and equipment criticality is very similar from one piece of equipment to another.

Once an organisation has purchased condition monitoring equipment, it is often mistakenly applied wherever possible, with little or no thought as to whether its application is actually *worth doing*.

Most people believe that equipment is more likely to fail as it gets older. This is not the case in modern assets where the level of automation and amount of technology used is high. Classical 'preventive' maintenance (ie preserving the asset condition by overhauling or replacing equipment and returning it to an 'as new' condition) has only a limited role for modern assets.

Many maintainers need to have their mindset changed from the desire to opt for periodic overhauls or replacements when the consequences of failure are particularly severe. Condition-based maintenance is the 'safer' option and should be selected (where possible) because it will predict premature failures.

Many maintainers need to have their mindset changed from the desire to opt for periodic overhauls or replacements. It is often more cost effective to opt for a condition-based maintenance task (where possible) because of the disparity between "life" and MTBF.

Time and resources have to be invested in determining the right maintenance for assets in order to achieve reliability growth and performance improvement. It is a mistake to be reliant on OEM specified maintenance and/or subcontract the process of determining equipment maintenance to a third party. In the long term, neither is cost effective nor will the necessary operational reliability and availability be achieved.

Quick fixes do not work in the maintenance arena; if they did, you would have done them by now. The only way to make real, lasting improvement is by changing the way in which people think (ie dispelling all the maintenance myths, mindsets and mistakes) and providing an environment where their changed thinking can be brought to fruition.

[1] See also Maintenance Myths, Mindsets and Mistakes Parts 1&2, *Establishing Maintenance Task Intervals* and *Improving Operational Reliability & Availability* respectively

[2] RCM – Reliability-centred Maintenance. Short-form definition: *"A process used to determine the maintenance requirements of plant and equipment in its operating context"*

2. Introduction

The last 20-30 years have been characterised by massive technological change and most industries have responded by investing heavily in automation and technology to reduce headcount, improve product quality, reduce unit price and improve safety and environmental integrity etc. The net result is that organisations are increasingly reliant on their assets to perform when required.

In some organisations, equipment failure is becoming increasingly intolerable and the consequences of failure can seriously affect safety and the environment or be expensive in terms of lost production or customer service. Some failures are sufficient to threaten the financial stability of the organisation or even force it out of business.

In other organisations equipment failure is much less severe but can still adversely affect profitability or customer service.

Regardless of the industry sector, organisations are striving to increase cost effectiveness – in most organisations improving equipment reliability is the key to overall performance improvement and cost effectiveness. Successful reliability growth and performance improvement is all about 'doing the right maintenance' on the equipment.

The maintenance arena is littered with an assortment of myths, mindsets and mistakes which often mean that the resulting equipment maintenance does not achieve the desired outcome, is frequently flawed (sometimes fatally!) and is sometimes plain wrong.

Current management styles demand 'instant results' preferably via a 'quick fix'. Frankly, it is a myth to think that quick-fixes work in the maintenance arena. Achieving reliability growth or performance improvement is neither quick nor easy; if it was, you would have done it by now!

Reliability-centred Maintenance [RCM] is an approach for determining the right maintenance for plant and equipment in its operating context. RCM is not a 'quick fix' but applied correctly, it can transform an organisation's approach to maintenance and hence lead to substantial improvements in equipment reliability, overall performance and cost effectiveness.

Applying RCM correctly takes both time and resources. However, for an organisation with high value assets, the investment required to get the maintenance *right* is often a drop in the ocean compared with cost of getting it *wrong*. Sadly, few maintainers are praised for getting maintenance *right* – many, however, are lambasted for getting it *wrong.*

3. The Role of the Maintenance Department

Few organisations can continue to operate without some form of maintenance department; often unseen (that is until something goes wrong) they are sometimes regarded purely as a 'cost' to the business (ie not adding value to the business) or as a necessary 'evil'. Sometimes the maintenance department is a sub-set of production or engineering and occasionally a standalone entity; in some organisations the maintenance function is partially or even fully sub-contracted to a third party.

There is no one maintenance model that works for all industries or businesses.

It is, however, often the case that the maintenance department's function is viewed very narrowly within an organisation – in a production environment the maintenance department is thought of as primarily responsible for equipment availability; in other industries the maintainers are thought of primarily as 'fixers' when there is a breakdown etc. Depending on the industry, there will be one or two responsibilities that will dominate the organisation's perception of the role of the maintenance department.

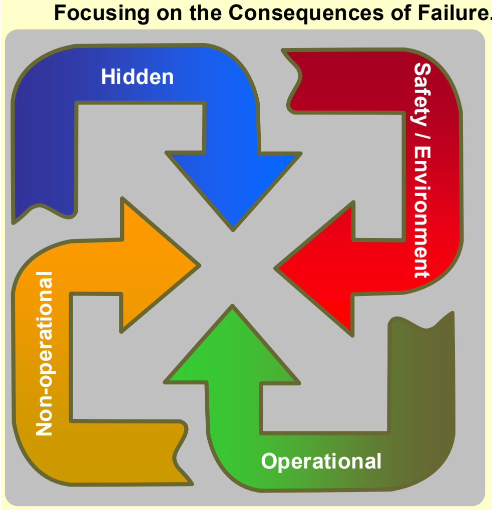
The mistake that is often made is for the maintenance department itself to focus on the one or two responsibilities where the perception of the role of the department is strongest. This is particularly the case when organisations are under financial pressure to reduce spend.

In reality, like other departments in an organisation, the maintenance department will have many and various responsibilities which can include equipment availability and reliability, safety and environmental integrity, product quality, customer service, mandatory maintenance and regulatory responsibility etc.

Clearly some areas (eg safety and environmental integrity) should never be neglected but it is a sad fact that many of the world's biggest accidents are directly attributable to organisations losing the necessary focus. Some companies have been forced out of business as a result of the maintenance department losing the focus on responsibilities other than plant availability and reliability at minimum cost.

RCM is holistic in its approach and the resulting maintenance is determined according to the consequences of failure; in this way RCM covers all the responsibilities that the maintenance department has to manage). This approach means, therefore, that the resulting maintenance is focused on ensuring that the maintenance spend is targeted at where it will do the most good.

Focusing on the Consequences of Failure...



Maintenance departments often limit their focus (mistakenly) on the one or two responsibilities where the perception of the role of the department is strongest (particularly if budgets are tight).

*RCM is holistic in its approach and focuses on the **consequences** of failure. This ensures that the maintenance spend is targeted at where it will do the most good.*

4. Generic Maintenance

Establishing the 'right' maintenance for equipment is the key to achieving high levels of operational reliability and availability; to do this correctly takes time and resources, done incorrectly it can lead to very costly or dangerous failures. Few maintenance departments have unlimited time and resources available in order to establish the 'right' maintenance and so the temptation is to derive generic maintenance for key components (such centrifugal pumps) and apply it to all similar equipment on site.

With 'generic' maintenance it is usual to develop conservative maintenance requirements (often based on manufacturer's recommendations) assuming 'typical worst case' equipment condition, operating context and equipment criticality. This may be appropriate for some components on site that are operating under the assumed conditions but for other similar components that are operating in much more benign situations it often results in un-necessary maintenance. At the other end of the scale where the equipment condition, operating context and/or equipment criticality exceeds the assumed/generic parameters, it is likely that such components will not be maintained appropriately.

Consider the situation where an organisation has four identical centrifugal pumps on site; if the site applies generic maintenance to identical pieces of equipment, then all four pumps will receive the same maintenance. RCM looks at the situation differently and considers the operating context of each pump as follows:

Pump A supplies chilled water to a cooling system on a piece of process equipment – if it fails, the absence of chilled water means that production will stop.

Pump B supplies chilled water to a similar cooling system on a piece of process equipment but in this instance, there is a standby pump (Pump C) which is used if pump B fails.

Pump C (as described above) is a protective system that is provided as a standby to pump B in order to keep the process going if pump B fails.

Pump D is fitted adjacent to the bund of a large outside fuel tank to remove rain-water that collects in the bund. Pump D is started and stopped manually by an operator as required.

In the RCM process, maintenance is only selected if a maintenance task is *worth doing*, which will depend in turn on the consequences of failure:

If pump A fails, production will be lost and so it is likely that some form of routine maintenance (to predict or prevent the failure) will be worth doing to this pump.

If pump B fails, production is not lost because its failure is protected by pump C; for pump B, therefore, the consequences of failure are much less severe than those for pump A and so routine maintenance is much less likely to be worth doing. Maintenance on pump B will only be justified if there is a risk of substantial secondary damage to the pump if it is allowed to run-to-failure or if the combined probability of pump B failing and pump C being in a failed state is intolerable.

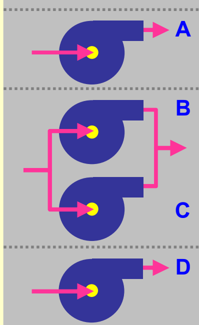
If pump C fails, the problem is that no one knows it has failed unless pump B also fails; a routine maintenance task to confirm whether or not pump C has failed is probably worth doing. The routine maintenance that is carried out on pump C is, therefore, likely to be very different from the maintenance carried out on pump A.

If pump D fails there will be no loss of production but it will be necessary to repair the pump (ie carry out corrective maintenance). For this pump, routine maintenance is not likely to be worth doing (unless there is a risk of substantial secondary damage to the pump if it is allowed to run-to-failure).

The above example illustrates the mistakes that maintainers can make by applying generic maintenance to all four pumps:

- Generic maintenance generates un-necessary maintenance in many instances – in the example above it many well be a waste of resources to carry out maintenance on pumps B & D
- Generic maintenance can lead to inappropriate maintenance being specified to certain equipment. – in the example above pump C will almost certainly have different routine maintenance requirements from pump A. Furthermore the risk of production loss for pump A may well justify very focussed routine maintenance – ie in excess of that specified in a generic maintenance task.

Generic Maintenance rarely works…



Pump	Operating Context	Consequences of Failure	Maintenance *worth doing*?	Maintenance Type
A	Supplies downstream process	Operational	Probably	Proactive
B	Duty pump supplying downstream process	Non-operational	Possibly	Proactive
C	Stand-by for Pump B	Hidden	Yes	Failure-finding
D	Manually operated de-watering pump	Non-operational	Probably not	Corrective

Generic maintenance is based on a 'typical worst case' operating context. The result is either unnecessary or insufficient/inappropriate maintenance

In summary, therefore, generic maintenance is only appropriate if the equipment condition, performance expectations, operating context and equipment criticality is very similar from one piece of equipment to another. Generic maintenance will result in either unnecessary maintenance being carried out on some equipment or insufficient/inappropriate maintenance being carried out on other equipment (which may in turn result in costly or dangerous failures).

A recent development of generic maintenance is the application of condition monitoring equipment (such as hand-held vibration monitoring equipment).

Applied correctly, condition monitoring equipment can predict an imminent failure well in advance of it occurring (provided, of course, that the equipment being monitored is checked at intervals which are less than the P-F interval as described earlier in this paper). In the example of the four pumps described above, it may be worth, say, monitoring the pump bearings for vibration on pump A, it might also be worth doing on pump B but it will almost certainly not be worth doing on pumps C and D.

Experience shows, that once an organisation has purchased condition monitoring equipment, it is often mistakenly applied wherever possible, with little or no thought as to whether its application is actually *worth doing*. It is a waste of scarce resources to use condition monitoring equipment generically to predict the onset of equipment failure if the ultimate consequences of failure are either low or trivial.

5. Preserving Assets

Going back 20-30 years, the focus of maintenance was to overhaul equipment periodically (often annually to coincide with plant shutdowns) and bring it back to an 'as new' condition. Most organisations have moved on from such invasive (and often unnecessary) maintenance and the annual shutdown is either a distant memory or on a much different scale than was the case previously.

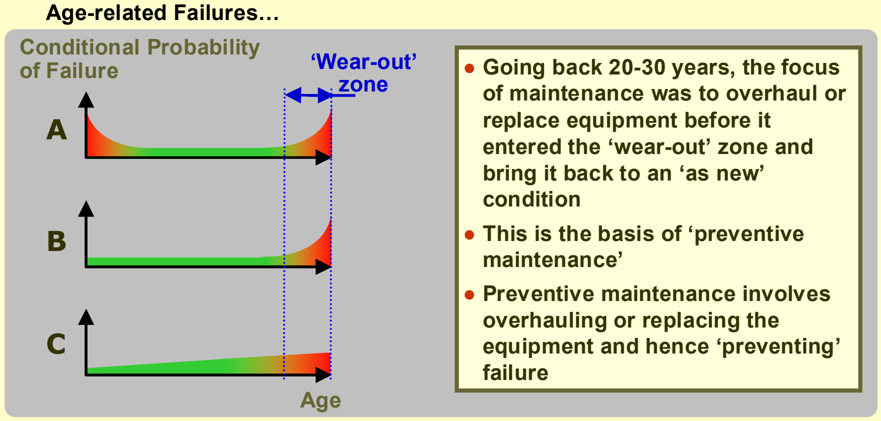
There remains, however, a mistaken belief in some maintainers that they should focus their efforts on *preserving* the assets – the rationale being that an asset in 'good' condition will perform well and give little or no trouble.

One reason for this entrenched belief is that Many people believe that equipment is more likely to fail as it gets older and so returning it to its 'as new' condition must, therefore, improve reliability.

Equipment age and likelihood of failure

The periodic overhaul or replacement of equipment (to bring it back to an 'as new' condition) is often referred to as 'preventive maintenance'; this approach is founded on the belief that equipment is more likely to fail as it gets older – hence, by overhauling or replacing the equipment periodically failures will be 'prevented'.

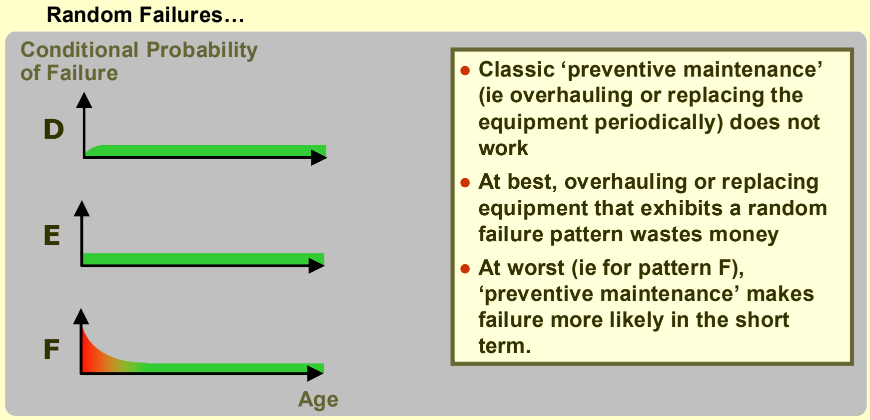
Age-related Failures…



Failure patterns A, B and C generally apply to simple items of equipment or complex items that have a ***dominant*** *failure mode. The failures are usually characterised by erosion, corrosion, wear or fatigue etc.*

Undoubtedly some equipment is more likely to fail as it gets older or with use and these failures are usually associated with erosion, corrosion, wear and fatigue etc and exhibit failure patterns A, B or C. This is, however, not the whole story as some equipment exhibits random failure characteristics – ie the likelihood of failure (or, more precisely, the conditional probability of failure) remains constant as the equipment gets older.

Random failures are characterised by patterns D, E and F and tend to be associated with more complex equipment such as electronics, hydraulics and pneumatics. The problem with random failures is that overhauling or replacing the equipment periodically (ie 'preventive' maintenance) does not work as it does not improve the conditional probability of failure. At best, overhauling or replacing equipment that exhibits a random failure pattern wastes money; at worst (ie in the case of pattern F) it actually makes failure more likely in the short term.



Random failures are characterised by patterns D, E and F and tend to be associated with complex equipment such as electronics, hydraulics and pneumatics.

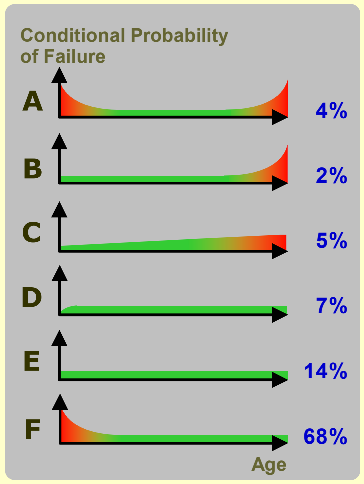
The last 20-30 years have been characterised by massive technological change and most industries have responded by investing heavily in automation and technology to reduce headcount, improve product quality, reduce unit price and improve safety and environmental integrity etc. The net effect is that organisations have increased substantially the amount of equipment that exhibit patterns D, E and F; this means that classical 'preventive' maintenance (ie overhauling or replacing equipment) is not a suitable approach for maintaining most modern assets.

The aircraft industry observed (and subsequently confirmed with detailed research into failures across the industry) that classical 'preventive' maintenance was not working on aircraft and was actually a significant contributor to aircraft crashes. Detailed research into failures across the industry confirmed that patterns A, B and C generally apply to simple items of equipment or complex items that have a dominant failure mode; in both cases, the failures are usually characterised by erosion, corrosion, wear or fatigue etc. The research also showed that patterns D, E and F usually apply to more complex equipment (such as electronics and hydraulics – and in other industries, pneumatics) - and that these equipment types are very prevalent in an aircraft. So prevalent, in fact, that the distribution of failures across the six failure patterns is heavily skewed in an aircraft to random failures (notably pattern F). This discovery forced the industry to re-think their approach to maintenance and introducing a forerunner[3] to RCM as the industry standard approach for determining the maintenance requirements for aircraft.

Other industries have conducted their own research into how their failures fit the six failure patterns and confirm that failures exhibiting patterns A, B and C are in the minority (and falling) in 'modern' assets, whereas patterns D, E and F are in the majority (often significantly so) and rising. Unfortunately, many maintainers still think (mistakenly) that equipment is more likely to fail as it gets older and so returning it to its 'as new' condition will improve reliability – if the equipment exhibits pattern F it is likely that their actions will increase the number of failures.

[3] The approach adopted by the aircraft industry is referred to as MSG3 - the term 'RCM' was used in a report written by Nowlan & Heap (two of the original co-authors of the MSG approach) in 1978 which established the first form of RCM. Both MSG3 and RCM have evolved over the years in light of experience but they both originate from the same thinking about how to determine appropriate maintenance for 'modern' assets

Failure Patterns for Modern Industry…



- **In the last 20-30 years there has been massive technological change and investment in in automation**
- **This has increased substantially the amount of equipment that exhibit patterns D, E and F; the result is that classical 'preventive' maintenance (ie overhauling or replacing equipment) is not a appropriate for most modern assets**
- **Research shows that failures exhibiting patterns A, B and C are in the minority (and falling), whereas patterns D, E & F are in the majority (often significantly so) and rising (figures quoted are for civil aircraft)**
- **Many maintainers *still* think (mistakenly) that most equipment is more likely to fail as it gets older.**

In conclusion, therefore, classical 'preventive' maintenance (ie preserving the asset condition by overhauling or replacing equipment and returning it to an 'as new' condition) has only a limited role in modern, complex equipment where the level of automation and the amount of technology installed is high.

RCM provides the structure and process for determining the optimum maintenance for the assets and takes into account the six failure patterns A to F. In this way RCM reduces significantly the number of failures that are induced by unnecessary, intrusive maintenance actions.

The way forward

RCM is not about preserving assets - the focus of the RCM process is to preserve the *functions* of the assets. It does so by focusing on what the user or owner of a physical asset wants the equipment to do in its current operating context. RCM is applied on a 'system' basis (rather than a component-by-component approach); this ensures that the correct maintenance is determined for equipment within the system according to the operating context of the system. In this way the resulting maintenance is very focussed and excessive maintenance is avoided.

6. Equipment Overhaul/ Replacement versus Condition-Based Maintenance

As discussed in previous sections, there remains a legacy of maintainers who either date back to the years when 'preventive' maintenance (in the form of overhauls or replacements) was considered to be the best approach or they worked for/with other maintainers that took such a view (which has subsequently been passed on). Given the choice, they would opt for returning the equipment to an 'as new' condition via a periodic overhaul or replacement rather than chose to do condition-based maintenance. This mindset is particularly strong where safety is concerned.

Managing the Consequences of Failure

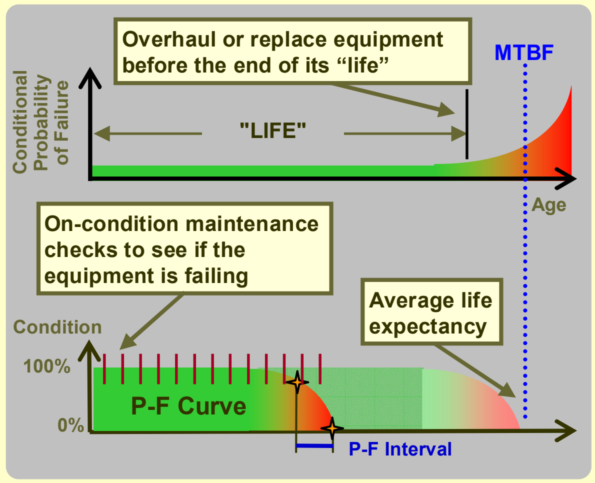
An important role of the maintenance function is to manage failures that have safety or environmental consequences so that the risk of the consequences occurring is tolerably small.

Many maintainers believe that either restoring or replacing equipment is the best way to maintain equipment that has safety-related failures. This mindset can mean that other, better maintenance approaches are discounted.

Periodic overhauls or replacements attempt to prevent failures occurring by either restoring or replacing the equipment before an age-related failure occurs. To this end the equipment is restored or replaced towards the end of its "life". The key assumption made is that the equipment will not experience failure before the end of its "life"; this is a pretty bold assumption to make (particularly if the consequences of failure are severe).

Condition-based maintenance, however, checks to see if equipment is failing by checking for potential failures at intervals that are less than the time taken from when the onset of failure can be detected and the failure itself (in RCM this period of time is referred to as the PF interval). In this way condition-based maintenance identifies failures that are about to occur and will identify a failure regardless of when it occurs. A correctly selected condition-based maintenance task will, therefore, have a better chance of reducing, avoiding or eliminating the consequences of failure than a periodic overhaul or replacement because it will predict any failures which occur before the equipment gets to the end of its "life".

Condition-based Maintenance versus Overhaul/Replacement...



For a periodic overhaul or replacement, the assumption is that the equipment will not fail before the end of its "life".

Condition-based maintenance is the 'safer' option as it will predict premature failures.

In summary, many maintainers need to have their mindset changed from the desire to opt for periodic overhauls or replacements when the consequences of failure are particularly severe. In practice it would be 'safer' to opt for a condition-based maintenance task (where possible) because condition-based maintenance will maximise the chances of reducing, avoiding or eliminating the consequences of failure that could occur if an asset fails prematurely. RCM gives precedence to condition-based maintenance over periodic overhauls/replacements.

Cost Effectiveness

Many maintainers believe that either restoring or replacing equipment is the most cost effective way to maintain equipment. This mindset can mean that other, better maintenance approaches are discounted.

As discussed in the previous section, periodic overhauls or replacements attempt to prevent failures occurring by either restoring or replacing the equipment before an age-related failure occurs. To this end the equipment is restored or replaced towards the end of its "life". The "life" is rarely known with precision and so maintainers usually make a cautious estimate (ie underestimate) of the figure.

Condition-based maintenance, however, checks to see if equipment is failing by checking for potential failures at intervals that are less than the time taken from when the onset of failure can be detected and the failure itself (in RCM this period of time is referred to as the PF interval). In this way condition-based maintenance identifies failures that are about to occur and so the equipment will remain in service until the onset of failure is detected (at which time the necessary corrective maintenance will be carried out). On average, the equipment will continue in service until the equipment reaches its average life (ie MTBF).

The MTBF is clearly longer than the "life" (possibly by 25% or more) and, therefore, the corrective maintenance necessary to address the failure mode will be carried out (on average) less frequently if the condition-based maintenance is carried out (compared with opting for a periodic over-haul/replacement task). This means that condition-based maintenance has several advantages over periodic overhauls/replacements:

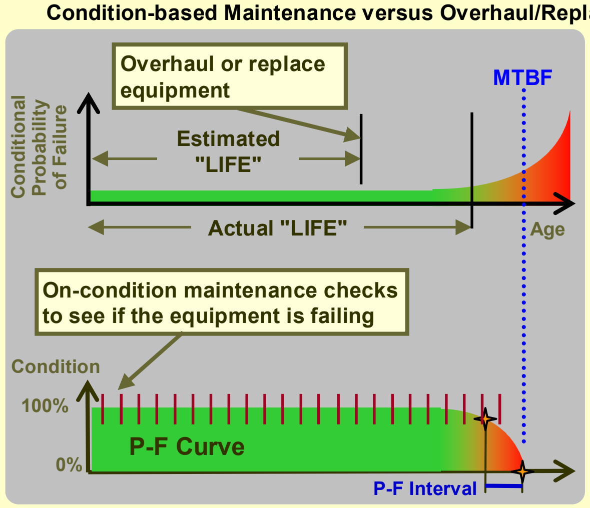
- Infant mortality may be an issue if the periodic overhaul/replacement and corrective maintenance (following identification of the onset of failure) is invasive. This will occur less frequently for condition-based maintenance than for a periodic overhaul/replacement – ie overall equipment reliability is likely to be higher with condition-based maintenance than for a periodic overhaul/replacement

- The periodic overhaul/replacement and corrective maintenance (following identification of the onset of failure) may involve downtime (which may be significant). This will occur less frequently for condition-based maintenance than for a periodic overhaul/replacement – ie overall equipment availability is likely to be higher with condition-based maintenance than for a periodic overhaul/replacement
- The periodic overhaul/replacement and corrective maintenance (following identification of the onset of failure) will involve the use of spare parts (which may be costly). This will occur less frequently for condition-based maintenance than for a periodic overhaul/ replacement – ie overall equipment spares consumption is likely to be less with condition-based maintenance than for a periodic overhaul/replacement. Note, however, that with condition-based maintenance it may be necessary to hold the spare parts in stock (the time from the onset of failure to the failure itself may be much shorter than the leadtime to procure the necessary spare parts) whereas for a periodic overhaul/replacement, spares only need to be ordered and available in time for the task to be carried out.

The disparity between MTBF and "life" means that condition-based maintenance is often more cost effective than a periodic overhaul/ replacement when measured over the equipment life-cycle (despite the need to carry out the condition-based task at intervals which are less than period from the onset of failure to the failure itself ie the P-F interval).

The disparity between MTBF and "life" is often exacerbated by the lack of hard data – what usually happens is that the estimate of "life" is a cautious figure which means that the overhaul/replacement is carried out early. This (unintentional) increased disparity between MTBF and "life" strengthens the economic argument in favour of condition-based maintenance compared with a scheduled overhaul/replacement.

Condition-based Maintenance versus Overhaul/Replacement...



For a periodic overhaul or replacement, the "life is usually estimated cautiously which means that the task is carried out too early.

In practice it is often more cost effective to opt for a condition-based maintenance task (where possible) because of the disparity between "life" and MTBF.

Many maintainers need to have their mindset changed from the desire to opt for periodic overhauls or replacements. In practice it is often more cost effective to opt for a condition-based maintenance task (where possible) because of the disparity between "life" and MTBF. RCM gives precedence to condition-based maintenance over periodic overhauls/replacements (unless it is clearly more cost effective to carry out a periodic overhaul/replacement); in this way, RCM ensures that money spent on maintenance is spent where it will do the most good.

7. Determining the Maintenance Requirements

Rarely does a maintenance department have enough resources to keep up with day-to-day routine and corrective maintenance (let alone time to determine the maintenance requirements of the plant using an orderly and logical approach).

Maintainers often make the mistake of being over-reliant on OEM specified maintenance. Whilst this is a quick and easy solution to the problem of determining the maintenance requirements of the on-site equipment it is rarely the most cost effective approach in the long term (and often fails to achieve the necessary operational reliability and availability).

Perhaps the worst solution to the problem of determining the maintenance requirements is to use an outside contractor to write the maintenance schedules for the equipment. It is the worst solution for a number of reasons:

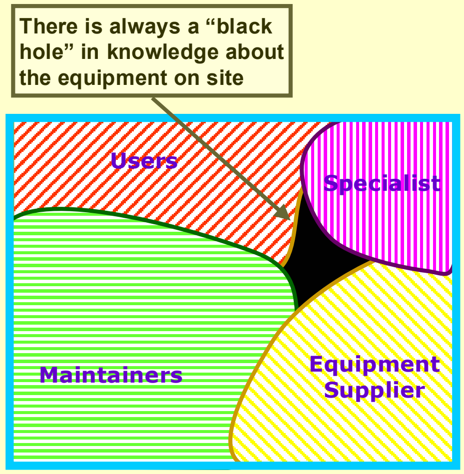
- An external contractor will probably have even less knowledge and hands-on experience than the OEM – it is extremely unlikely that they will have sufficient understanding of what can go wrong with the equipment, the consequences of failure, the operating context or the maintenance skills/facilities available on-site. At best, they will use the OEM recommendations as a starting point
- A third party contractor does not have a vested interest in the resulting maintenance schedule that they prepare (apart from the short term need to be paid for their efforts). The resulting schedule may look good and appear thorough but it certainly will not be optimum nor will it focus on the system requirements of the equipment. Furthermore, a third party does not have any particular interest in ensuring that money spent on maintenance is spent where it will do the most good
- The resulting maintenance schedule from a third party contractor will be a clean and tidy document drawn up by a junior engineer (with little or no hand-on experience of the equipment) or a seasoned maintainer (who has many of the maintenance myths, mindsets and mistakes engrained in his or her thinking). This is not a formula for achieving reliability growth or improved performance
- There will be no on-site ownership of the resulting maintenance schedule. Mistakes and shortcomings in the schedule will soon become clear to the technicians and maintainers who have to follow the maintenance instructions and there is a good chance that they will actively disown the schedule. Ultimately the organisation may abandon the externally prepared schedule, pull something together in-house (encompassing another set of myths, mindsets and mistakes) or even resort to manufacturers recommendations. In short, it will all have been an expensive waste of money.

Successful reliability growth and performance improvement is all about 'doing the *right* maintenance on the equipment'; sufficient time and resources must be invested in determining the right maintenance for the plant and equipment if reliability growth and performance improvement is to be achieved. As is discussed in the next section, there is no 'quick fix' for this problem - so how does RCM approach the problem?

Several strategies for applying RCM have been tried over a number of years. The questions that RCM asks are challenging to answer and require hands-on knowledge of the equipment; no one person working on their own will have sufficient knowledge of both the equipment and RCM to apply the approach successfully.

An 'RCM Analysis Group' applies RCM under the guidance of an RCM Facilitator (who has a firm grasp of the RCM approach and how it is applied). The 'RCM Analysis Group' is made up of people who know the equipment best; between them, the operators and maintainers usually have sufficient knowledge about the equipment to apply RCM successfully. Occasionally, however, the OEM or someone with specialist knowledge about some aspect of the equipment or process is required to reduce the 'black hole' in knowledge.

Determining the Maintenance Requirements of Equipment…



- *Successful reliability growth and performance improvement is all about 'doing the **right** maintenance on the equipment'*
- *Determining the **right** maintenance takes time and resources (OEM specified maintenance is rarely the most cost effective approach)*
- *For an organisation with high value assets, the investment required to get the maintenance **right** is often a drop in the ocean compared with cost of getting it wrong.*

Applying RCM correctly takes both time and resources; there is a real risk that RCM derived maintenance will be superficial (and, depending on the equipment, possibly dangerous) if the approach is not applied correctly or if the maintenance myths, mindsets and mistakes are not avoided. The risks and costs associated with a superficial/dangerous RCM analysis can be huge - far exceeding the upfront cost and effort required to apply RCM correctly. For an organisation with high value assets, the investment required to get the maintenance *right* is often a drop in the ocean compared with cost of getting it *wrong*. Sadly few maintainers are praised for getting maintenance *right* – many, however, are lambasted for getting it *wrong.*

8. Quick Fixes

Current management styles demand 'instant results' preferably via a 'quick fix[4]'. Frankly, it is a myth to think that quick-fixes work in the maintenance arena. Achieving reliability growth or performance improvement is neither quick nor easy; if it was, you would have done it by now!

RCM is not a 'quick fix'; applied correctly is can transform an organisation's approach to maintenance but only if the traditional ways of thinking about maintenance (ie the maintenance myths, mindsets and mistakes) have been shifted/challenged by appropriate training. The level of knowledge and understanding required cannot be achieved just by reading a book – training, which involves a hands-on RCM case study analysis, is necessary. It is false economy to embark on an RCM analysis without training the analysis group members properly.

Experience has shown that the only way to make real, lasting improvement is by changing the way in which people think (ie dispelling all the myths, mindsets and mistakes that have been ingrained in maintainers thinking over their working life) and providing them with an approach (such as RCM) that encompasses a structure whereby their changed thinking can be brought to fruition.

[4] A dictionary definition of 'quick fix' is: - *an expedient, temporary solution, especially one that merely postpones having to cope with an overall problem.*

9. Conclusion

The drive to improve cost effectiveness has led organisations to focus on increasing equipment reliability so as to improve overall performance (and hence cost effectiveness). Successful reliability growth and performance improvement is all about 'doing the *right* maintenance on the equipment'. There is a great temptation to improve cost effectiveness by reducing maintenance budgets – this works in the very short term but not in the medium and longer terms.

The maintenance arena is littered with an assortment of myths, mindsets and mistakes which often mean that the resulting equipment maintenance does not achieve the desired outcome, is frequently flawed and is sometimes plain wrong. In particular, it is a myth to think that quick-fixes work in the maintenance arena. Achieving reliability growth or performance improvement is neither quick nor easy; if it was, you would have done it by now!

Reliability-centred Maintenance [RCM] is a proven approach for determining the *right* maintenance for plant and equipment in its operating context. With its beginnings in the demanding civil aviation industry, RCM is not a 'quick fix' but applied correctly, it can transform an organisation's approach to maintenance and hence lead to substantial improvements in equipment reliability, overall performance and cost effectiveness. RCM optimises the maintenance for the on-site equipment and in so doing ensures that money spent on maintenance is spent where it will do the most good.

Applying RCM correctly takes both time and resources. However, for an organisation with high value assets, the investment required to get the maintenance *right* is often a drop in the ocean compared with cost of getting it *wrong*. In brief, the return on investment for RCM is substantial provided that the assorted maintenance myths, mindsets and mistakes are dispelled and the *right* maintenance is implemented.

10. Further Information

This paper was written by Simon Deakin and Steve Bailey of Mutual Consultants Ltd. See also Maintenance Myths, Mindsets and Mistakes Parts 1 & 2, *Establishing Maintenance Task Intervals* and *Improving Operational Reliability & Availability* respectively.

Please do not hesitate to contact either of us for more information on how RCM can transform equipment performance and achieve desired operational reliability and availability:

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