MRO spare parts stock level setting

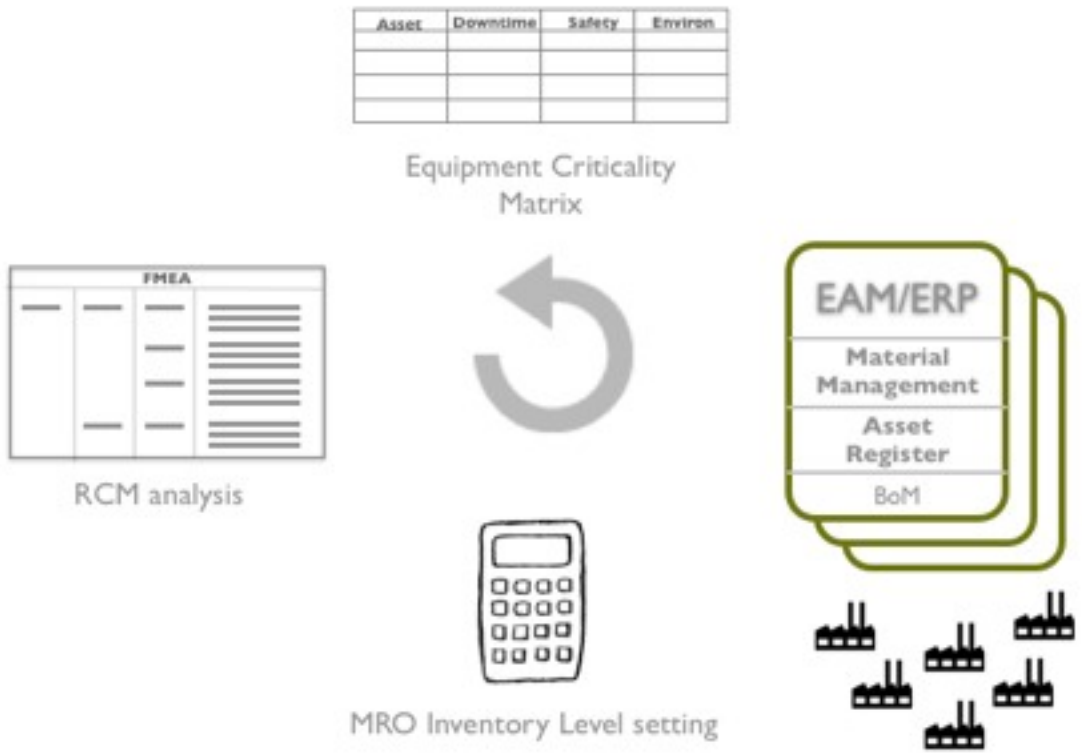
and

Reliability-centred Maintenance

Introduction

Reliability-centred Maintenance (RCM) is a mature, universally recognised methodology for optimising physical asset maintenance. RCM has its roots in the aviation sector, where the MSG (Maintenance Steering Group) approach has been used for the development of aircraft maintenance schedules since the late1960s. These techniques were adapted and brought into widespread industrial use by the work of John Moubray in the 1990s. Continuing pressure on maintenance costs, expectations of higher output, and society's lower tolerance of safety and environmental incidents, have now made RCM the methodology of choice in almost every industrial sector. This paper describes how RCM analysis work and MRO stock level setting activity are intrinsically linked.

Interrelationship between RCM, MRO stock levels and EAM/ERP



RCM and MRO Stock Levels

The Failure Modes & Effects Analysis (FMEA) work carried out at the start of an RCM review develops a deep understanding of the nature of an asset's failure modes, and ultimately it drives the maintenance task requirement. A typical RCM analysis finds that a high proportion of failure modes in modern equipments occur effectively at random, so it is surprising that many of these failure modes have previously been addressed by fixed-interval restoration or discard tasks. Not only are these tasks completely ineffective, they also drive up direct costs and may even reduce asset reliability and availability through maintenance-related failures and outages.

Maintenance schedules derived by RCM analysis work typically differ significantly from traditional schedules in a number of ways.

- The number of scheduled restoration and discard tasks is reduced
- There are more scheduled condition-based monitoring tasks
- Failure-finding tasks are more widely applied to reduce risk
- It is found that some failure modes can only be successfully managed by redesign or by changing the way in which the assets are operated
- Run-to-failure is adopted as a legitimate approach to the management of failure modes in some cases, possibly increasing the total number of unscheduled defect repairs.

Following RCM analysis initiatives, the focus of maintenance often shifts away from preventing failures and more towards eliminating or reducing the *consequences* of failure. Managing consequences of failure goes beyond what RCM (in its purist form) can contribute: the RCM process focusses on whether a technically feasible and worthwhile scheduled maintenance task can be identified that either prevents a failure or predicts it before it occurs.

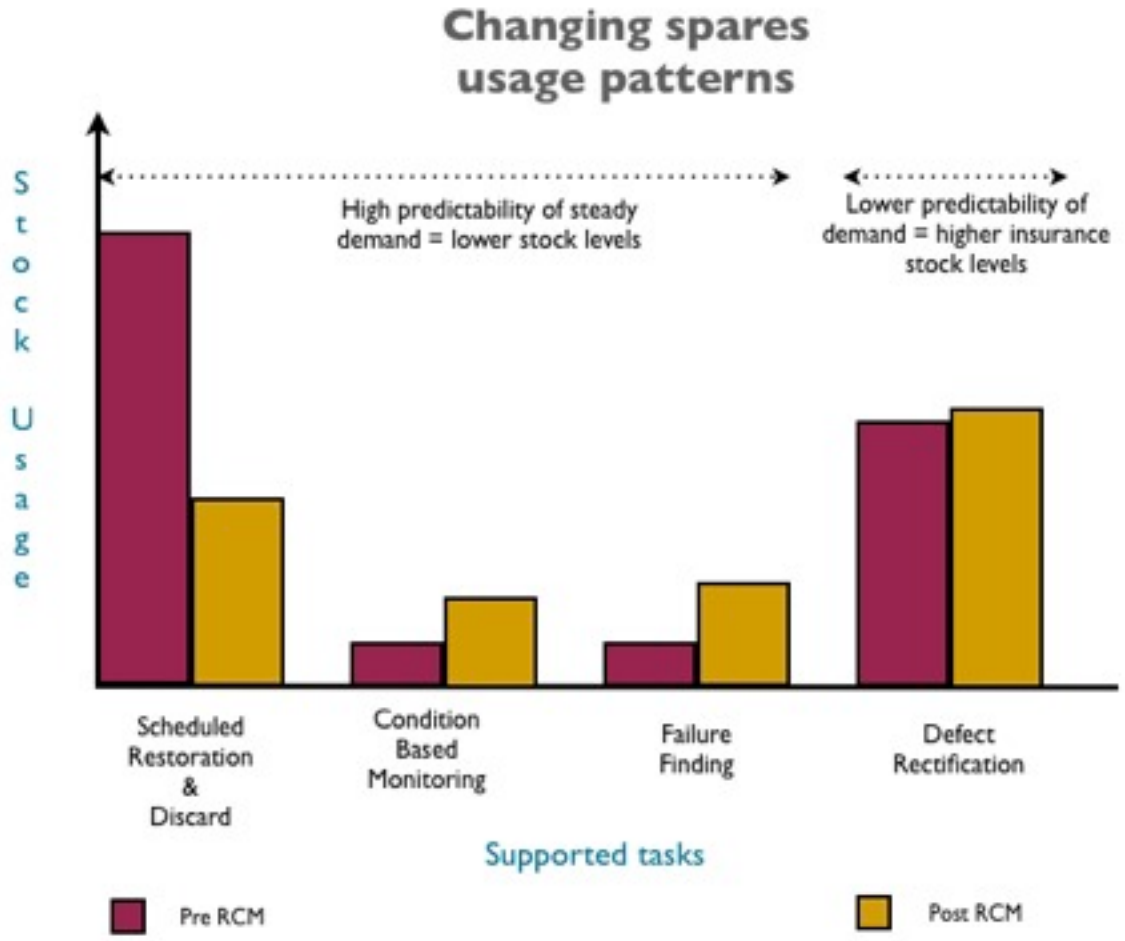
The acceptance of run-to-failure as a positively selected policy, often causes consternation with maintenance and operations personnel. It goes against most maintenance engineer's training and nature to simply 'do nothing' when they know that a failure might eventually happen even if they don't know when. There are however, frequently many constructive things that can be done to minimise the consequences of failures, even randomly occurring ones. These include steps taken before the failure has occurred: opportunities to 'do something' prior to the event. An important element in this approach is the reduction of defect repair time to maximise equipment uptime. This can be achieved by having appropriate tools, materials and

procedures to hand, with suitably skilled and experienced personnel available.

Think of the pit crew in a formula 1 race. They might not be in control of *when* a tyre change is required, but when it does, the focus of the team is to get the car back into the race as quickly as possible. They develop slick well rehearsed procedures and ensure they have replacement tyres to hand.

Basically a maintenance organisation might not be able to always predict *when* a particular failure mode will happen: but it is often possible to change *how* it matters if it does occur. Even if it is often impossible to influence equipment *reliability*—which is inherent in its design and the way it is operated—it is often possible to increase its *availability*.

One key opportunity to 'do something' even when failures occur at random, (although it does nothing to increase reliability) is having the right spare parts in place to increase equipment availability by reducing repair time when a failure occurs. Fundamentally all spare parts are always obtained or held in stock simply to help avoid or minimise the consequences of failure modes - maintenance and stores personnel should never loose sight of this fact.



RCM analysis work changes the tasks in your maintenance schedules, so logically the inventory stock profile also needs to be adapted to support those new tasks. Stocks that support scheduled restoration and discard tasks may be reduced or eliminated, but slightly increased stocks will probably be needed to support condition monitoring, failure-finding and run-to-failure RCM decisions.

Attempting to support a new RCM based maintenance regime with the inventory used to support the old maintenance regime can actually be a backward step undermining the achievement of the benefits RCM analysis work should deliver. This can manifest itself as an excess of inventory to support scheduled tasks, some of which are no longer required, yet shortages of inventory for defect repair. The net effect is stagnant stock and reduced asset availability.

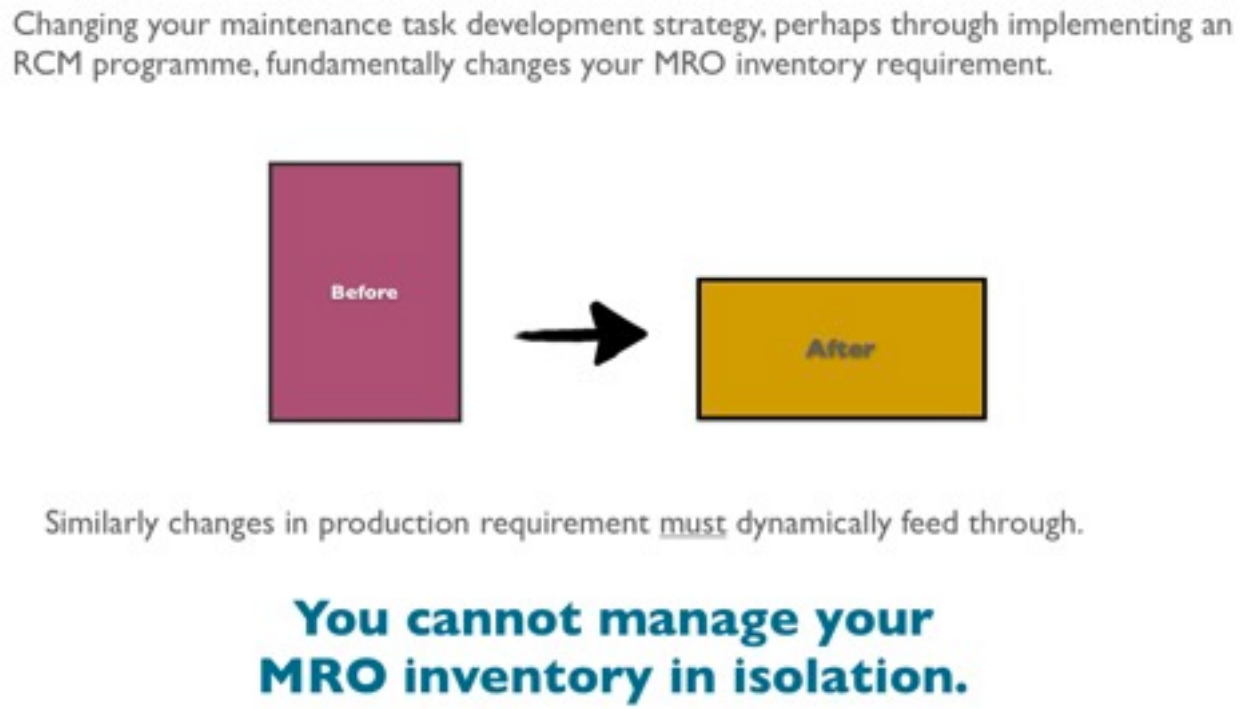
Interestingly, after commissioning, a large portion of the year on year expenditure on spare parts required to support defect rectification on an equipment does not usually change significantly pre and post RCM analysis work. The reason is that unscheduled defect repairs resulting from random failure modes were always happening and always required purchase of parts to rectify them in the past. However it is common to find that initial spares provisioning prior to equipment commissioning, without appropriate context related stock analysis work, resulted in procurement of the ‘wrong’ parts (often at high cost) and these parts then don’t turnover or even help rectify the failure modes actually experienced in service at your site.

RCM analysis work should therefore always trigger a review of the supporting associated spares stock levels. This work should not be undertaken as an after thought and rigorous defensible methods need to be used to recalculate stock levels based on sound risk management principles - not simply satisfying uniform service level and fill rate KPIs. It is important that the information used to calculate stock levels is valid, up to date and relevant to your own operating context. Your personnel are best positioned to estimate MTBF information of in service items and equipment down time costs on your particular site along with the typical lead times you actually experience from key suppliers needed to do this analysis work. Particularly for slow moving high value items, it is vital to balance the cost of procuring and holding an item against the expected business costs of not holding the item. It is worth noting however that there is no direct correlation between a spare parts criticality to your business and its purchase cost.

Ideally this spares review work should always be done with a view to minimising waste across the wider organisation: an item that proves to be in excess at one location may in fact be in deficit elsewhere. An effective regime

for internal stock transfer in this scenario reduces any net cash outflow from the business.

Once stock review work is complete the revised stock holding and consumption profile may be either larger or smaller, but it will almost definitely be a different shape and better support your operations.



The benefits of getting this inventory review work right are seen by the organisation as increased equipment availability, reduced capital outlay, lower holding costs and lower disposal costs of unused spares at end of equipment life usually alongside lower annual expenditure. These benefits, particularly the first, can rapidly feed into the bottom line through increased asset productivity.

Summary points

- Don’t review your maintenance strategy or spares stocking policies in isolation: they are intrinsically linked.
- Be sceptical of any methodology that claims always to reduce spares stock holding: sometimes stock levels need to be ‘right sized’, not necessarily downsized.
- Don’t rely on guesswork; use stock level calculation tools designed for the job.
- Make sure that that the calculation tools used to optimise your spare part inventory work intrinsically with the methodologies and tools you are using to optimise your maintenance strategy
- RCM-derived maintenance strategies and associated stock level justifications are live documents. Keep them up-to-date and act on recommended changes when circumstances change.
- Develop a plan and put in place procedures to change your inventory from its pre to post RCM analysis levels that minimises corporate waste.
- Continually test your suppliers. Verify that the lead times you actually experience reflect the terms in your supply contract and that up-to-date information is used in your stock level calculations.

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