

INTRODUCTION OF RELIABILITY CENTRED MAINTENANCE TO THE RN AND RFA WHAT PROGRESS?

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ABSTRACT

The WSA embarked upon the Reliability Centred Maintenance initiative some twelve years ago as the only viable option to meet the key objectives of the Review of Maintenance. Following the success of the pilot trials in four of the HUNT class MCMVs in the late 1990s, the WSA implemented a programme of roll-out of an RCM based maintenance methodology to selected legacy RN and RFA vessels. HMS *Ocean* is the most recent project to rollout RCM coupled with UMMS, the new maintenance management tool. There is considerable activity in hand to roll out to remaining legacy vessels, work with the DPA for future vessels, and with work to improve coherency, effectiveness and efficiency across the WSA maintenance support arena. The late John MOUBRAY, the innovator and author of the RCM II methodology that underpins the RN RCM Def Stan (02-45), regarded the Royal Navy as the leading exponent and implementer of RCM in the international military arena. This article provides an update

Introduction

This short article aims to set out the progress that has been made with the introduction of a Reliability Centred Maintenance (RCM) methodology for selected in-service platforms and equipment (as part of the solution to the much needed 'Review of Maintenance' set in train in the early 90s). The concept of RCM requires a step change in thinking for all involved in the conduct, support, planning and funding of warship maintenance and goes beyond just the route to generation of more appropriate and cost effective maintenance. The initiative has required considerable drive, resolve and perseverance from a varied number of stakeholders, and 'up-front' investment to achieve the progress to-date; however, this is to be expected from a spend-to-save initiative. Ten years since the start of this initiative, the rewards are now being seen.

Background

The 'Review of Maintenance' (RoM) project undertaken in the early 1990s had three key objectives:

- Establish the engineering risks associated with the budget reductions taken by LTCs 92 and 93.
- Ensure that the selected maintenance strategy was appropriate and auditable.
- Examine the scope for further savings from a more effective maintenance regime.

Following the examination of the identified options, the RoM reported that the only viable method available and robust enough for the future needs of the RN was RCM. This led to the current position where RCM is not only mandated in the DLO Strategic plan but is also a thread of the 'Sustainability' Pillar within the Naval Strategic Plan.

Economic pressure has been a key driver, for those responsible for maintenance and repair, with the need to innovate and develop new methods of achieving their required outputs for less resource. The application of new technology in platforms and the implementation of new business practises mean that effective maintenance of plant and equipment requires ever-greater technical and managerial skill. The introduction of RCM is not only an asset in the engineer's toolbox, but is also a proven opportunity (firstly for industry and now for the RN) to capitalize on an effective, robust and auditable process for generating the maintenance requirements of our equipment and systems. Some of the benefits that have accrued with the introduction of RCM include:

- A more relevant maintenance definition.
- A clear audit trail of the maintenance management decisions taken.
- An increased awareness of the risk being taken when preventive maintenance is deferred, or when consideration is given to changes in the Upkeep cycle for a vessel.
- Use of condition monitoring where shown to be applicable and effective.
- A reduction in intrusive maintenance.
- When coupled with a new maintenance management software application, the result is a more motivated workforce that can move forward from 'Planning Boards and T-Cards' to e-business in their planning and oversight of maintenance and repair.

The introduction of RCM has not been without its problems, but then change never is. However, after completion of an initial 2 year trial on 4 HUNT class MCMVs in 2000, RCM now forms the basis of the maintenance strategy for new equipments and systems. It is part of an exciting and challenging programme of investment that is a key enabler to optimized maintenance and support and is assisting in achieving required DLO savings whilst helping to sustain Operational Capability.

What is RCM?

More than ever now, in a rapidly expanding and increasingly technical age, we depend on the continued integrity of physical assets (assets being individual components, equipment or systems) be it in the domestic or the business environment. Yet when assets fail, not only are services interrupted, but for the military the ramifications can be significantly greater. Thus the processes by

which these failures occur and what must be done to manage them needs to be understood. Consequently a new strategic framework has evolved that ensures any asset continues to perform as its user wants it to perform (i.e. preservation of the function of an asset on the basis that failures will always have consequences, the question is, how bad?). This framework is known as RCM and is essentially a formal application of common sense.

The strength of the RCM process is that it brings together into peer groups the relevant engineering expertise (operators, maintainers and manufacturers). Under the guidance of an RCM Facilitator this dedicated team derives the most appropriate failure management strategy by developing an operating context, defining how assets are intended to deliver the required functions, and then carrying out a Failure Mode and Effects Criticality Analysis (FMECA). The FMECA establishes the plausible functional failures and failure modes in a systematic and structured manner. It is important to stress that the study starts with a 'blank piece of paper' i.e. no maintenance related routines are in place. The process requires the examination of each functional failure and associated failure modes to determine the effects (at asset and then the wider platform level) and thus the appropriate maintenance strategy. The chosen maintenance strategy will take into account safety, environmental and operational consequences and if appropriate the technical feasibility and cost effectiveness of the maintenance driven out by the process. The effects of equipment redundancy, cost of spares, equipment ageing and repair times will also be taken into account along with many other parameters. The RCM analysis can also assist with understanding system performance predictions and costs, expected support requirements and maintenance loading on ship's staff.

The new software environment that goes hand-in-hand with the RCM process provides for a 'living' strategy with the platform data being updated when RCM studies are reviewed or design changes take place. If used correctly in the early stages of build, it provides a powerful means of identifying and supporting design changes. Benefits can also be obtained by applying RCM to equipment and platforms later in their lives.

Maintenance Management Software Applications – RCMS and UMMS

Prior to the initial Unit Maintenance Management System (UMMS) roll-out to *Richmond* in September 2003, the RCM trial solution – Reliability Centred Maintenance System (RCMS) had been the RCM maintenance management software application. The interim use of RCMS provided the vehicle to get an RCM based Maintenance Management System (MMS) to sea whilst the new UMMS completed its initial development. With the advent of UMMS, RCMS now has a limited life and roll out plan, the final vessel to receive RCMS being *Fort Victoria* in August 2004. All RCMS vessels will then be subjected to a subsequent roll-over to UMMS commensurate with operational and other programme drivers.

UMMS

UMMS provides ships and shore support organizations with a state-of-the-art windows based maintenance management tool, which is already winning over maintenance managers. It will enable ship and support staff ashore to view the maintenance state of a vessel in a common environment and, significantly, will enable Superintendent Fleet Maintenance (SFM)s and Platform Project Integrated Project Teams (PIPTs) to lead on the planning of fleet time and non-Fleet Time support packages. This shared visibility of data relies on regular data transfer between the ship and shore databases. UMMS provides all users with a single environment for the clear visibility of maintenance, defects and other

work/activities being planned in Fleet Time (including Fleet Time Support Periods) and Upkeep Period work packages. It also provides the ability to raise and provide feedback in various forms including S2022s, S1182s, S2012s, special reporting and concessions. Shore users include the appropriate PIPTs, associated Equipment Integrated Project Teams, WSA engineering support groups, SFMs and FLEET. The phased development of UMMS is currently working towards phase 2 rollout (September 2004 for web enablement, January 2005 for RFAs then further functionality additions later that year). Work is also underway to articulate the user requirements for future development that will include provision of additional functionality required by the RFA, Submarine and Surface communities. An example is the amalgamation of the S340, T3 and RFA 48 forms into one work requisition form with the ability to attach information in a variety of digital media.

Current Business

Building on the RCM pilot in the HUNT class MCMVs, and the 'demonstrator' in HMS *Lancaster*, the WSA RCM enabled MMS roll-out to other legacy platforms, HMS *Richmond*, RFA *Fort George* and more recently HMS *Ocean*, has seen the project move into an intensive period of activity. By the end of 2004 there are 23 platforms scheduled to be operating on a maintenance system based on RCM methodology.

Taking a closer look at a recent project, HMS *Ocean* was the 14th RN vessel to have a maintenance system based on RCM methodology and the 2nd to receive UMMS (HMS *Richmond* led the UMMS roll-out in September 2003). Underpinning this roll-out programme is a multi-skilled team involving many areas of the DLO including the WSA Business Development Group – UMMS Project, RCMG, DOPsP, SFMs, MLSIPT, in *Ocean's* case the MWIPT, various contractors and DCSA. *Ocean's* technical staff (past and present) have also played an important role and done much to assist with the Project. DCSA personnel have installed the application in the Ship and a significant number of shore support areas in preparation for the go-live. Take-on training has been provided locally by SMDC take-on teams and HMS *Sultan* are providing PJT packages. As a ship that is In Class with Lloyds Register (LR), LR staff have been involved with auditing the package (for those items appearing on the master list of surveyable items) leading to approval of the MMS.

In addition to fulfilling its traditional role of receiving and analysing vibration data, MIMIC also provides an interface between DECCA ISIS and UMMS for run time collection and parameter monitoring allowing UMMS to generate maintenance based on vibration and machinery parameters and running hours.

Whilst there remain a few ongoing issues to resolve or improve upon, overall the package has been welcomed by ship's staff who see much potential. Besides various 'softer' benefits of RCM (such as an auditable maintenance process, environmental compliance, reduced spares off-take and a provision of a fault finding aid) the key driver for implementing RCM in HMS *Ocean* is to drive down the maintenance burden on a particularly lean complement. Examples (quoted in percentages of scheduled maintenance man-hours) include:

- External communications – reduction of 90%.
- SIRS – reduction of 88%.
- Lub oil filling and storage – reduction of 84%.
- AVCAT stripping system – reduction of 40%.
- AVCAT embarkation and storage – reduction of 15%.

In the case of both AVCAT examples, the reduction in man-hours is against an overall increase in the number of maintenance tasks (approx 20%) – a point to

note that RCM provides a thorough review of the maintenance requirement and is not simply focused on savings.

Other Projects

Other projects in the pipeline include the SRMHs – first roll out in December 2004, TRAFALGAR and VANGUARD Class submarines with roll outs due in 2005 and 2006 respectively, and up-issue from RCMS to UMMS in some HUNTS - an ongoing programme in 2004.

Assistance to the DPA

The application of an RCM methodology is not confined to legacy platforms. An increasing area of business, and outwith the original remit of the Group, has been that of the New Build community, primarily LPD(R) and AO(R), and to a lesser degree T45, CVF, ASTUTE and FSC. In the case of LPD(R) and AO(R) there is an RCMG resource commitment to managing data improvement packages, for the T45 an analysis audit service and for CVF, the Group have contributed to the Support Strategy Paper. With RCM mandated in the cascade of strategic plans and a corner stone of the ILS process, it is very much a part of daily business for a wide range of stakeholders.

Tri-Service RCM Coherency

The RCM Group maintains close links with the DLO Corporate Technical Services RCM Head of Specialisation (RCM HoS) based at Andover. The HoS are not only responsible for the 'Review of Maintenance' for both Air and Land environments but are also responsible for pan-defence RCM Policy, Training and RCM software tools. The RN RCM methodology Def Stan (02-45) has been adopted by the Land RCM team, along with the RN RCM software application (RCM RN Toolkit) for projects such as Warrior, Rapier FSC and De-mountable Rack Off loading & Pickup System (DROPS). Furthermore, the philosophy behind Def Stan 02-45 has been used to influence the RCM team at RAF Wytton and the approach taken to review maintenance for military aircraft. Def Stan 02-45 has also been used as the basis for the development of a single pan-defence RCM standard and will on a similar vane be used to influence the re-write of Def Stan 00-60. Finally, the HoS are looking to deliver a coherent pan-defence training programme for RCM as well as a single RCM toolkit.

Reliability Centred Maintenance Stores Prediction (RCMSP)

Whilst the RCM process identifies the range of spares required to support the derived maintenance, the process does not however determine the scale (quantity) of spares required.

Current logistic processes can consolidate specified spares scales and subsequently refine them by use of dynamic feedback mechanisms. However the processes are unable to generate the initial sparing scales recommendations required to support the reduced maintenance and associated sparing range generated by RCM. Without a process to generate spares scales to match revised maintenance spares requirements, the capital costs in spares holdings are likely to be higher than is necessary.

To address this, the RCMSP project was initiated in 2001 as a process to both determine and consolidate the scale of engineering spares required in support of RCM derived maintenance. Unlike current scaling processes, RCMSP not only revises the scaling requirement of those engineering spares currently subject to

Dynamic Scaling Methodology, but also engineering spares classified as Mission Essential Items.

An initial RCMSP study to generate an engineering spares Consolidated Allowance recommendation has been conducted for the HUNT Class. This will be subject to validation against a recent HUNT class Consolidated Allowance List, generated using the current scaling process.

Further work to generate engineering spares scales for T23 Frigates operating RCM derived maintenance is also nearing completion. The possibility of proving the revised engineering stores package during 2004/5, in parallel with the roll out of RCM in one of the T23 class, is being investigated.

WSA DWOps has recently initiated a review of the management and application of current processes for determining the range and scale of stocks held afloat across the Fleet. RCMSP may inform and/or influence some elements of the review. The possible integration of RCMSP processes, along with other supply chain improvements, into an evolving and modernized supply chain process will need to be explored.

Challenges

Implementation has not been without its difficulties. Imperfect data sets, application software bugs, software interface issues, project co-ordination, training, economies, business processes and manpower resource limitations have all been, and in some cases continue to be, responsible for clouding the project and causing considerable frustration both ashore and afloat. Work continues to resolve or make improvements with these issues and it is now widely accepted that the system is only as good as the users make it. Problems of this nature are to be expected with such a radical shift in maintenance strategy.

A steady improvement in the functionality of both RCMS and UMMS will allow afloat and shore users to conduct their business more efficiently and, will provide the vehicle for further business improvements and coherency.

Centralized Maintenance Support Function

Maintenance within the WSA bounds a considerable array of software packages, delivery mechanisms and business processes. As this article goes to press, considerable effort is in train to rationalize this whole area of activity. A steering group headed up by WSA DOpsP has the remit of generating a proposal for delivery of a centralized maintenance support group to enable IPTs to use RCM and its applications to deliver effective strategies. The new maintenance group will pull together the disparate resources and business elements (SMDC, BDG-UMMS, RCMG and DOpsP) that are spread between Bristol, Foxhill and Portsmouth. Very much aware of the DLO restructuring programme, the steering group is concentrating on improving coherency, effectiveness and efficiency within the WSA maintenance support arena, as the first level of work. This centres on the new group drawing together, amongst other things:

- RCM and 'legacy' maintenance support to Platform and Equipment IPTs.
- Responsibility for coherence of documentation.
- Facilitating new, and updates to, RCM studies.
- The co-ordination of UMMS and RCMS training.
- Much of the low level administration and husbandry of legacy and RCM maintenance databases.

Conclusion

With the bulk of the RCM study programme for legacy ships nearing completion and the rump of the programme due to complete over the next two years, RCM in the naval environment is coming of age. In addition to the legacy ships, the population of new-to-service vessels also operating RCM derived maintenance is steadily increasing.

RCM solutions as delivered through modern maintenance systems such as UMMS are highly dynamic and require a responsive shore community to ensure that the potential benefits they offer are achieved. The development of a centralized maintenance support group is currently being explored. This may be the solution to provide the necessary coherence, resources and pool of expertise and flexibility to ensure responsive processing of maintenance issues, and ensure that RCM benefits are realized through life and not just with the initial gains following implementation.

The development of RCMSP provides the opportunity to match engineering spares requirements to a safety and operationally prioritized maintenance regime. The opportunity to refine this and integrate it, along with other supply chain improvements, into modernized supply chain processes represents a challenge worth pursuing and an opportunity to realise other RCM associated benefits.

It is never easy to sell preventive maintenance as 'interesting'. However, at present, no one would dispute that the maintenance environment is lively, with a multitude of initiatives that deliver not just savings but also some significant advantages for the maintenance community in the round both single-Service and pan-defence.