An Introduction to the US Naval Air System Command RCM Process and Integrated Reliability Centered Maintenance Software

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(A paper presented at RCM 2006 - The Reliability Centred Maintenance Managers' Forum organised by Netexpress USA inc)

Abstract

This paper is an update to RCM in the Public Domain: An Overview of the US Naval Air Systems Command's RCM process presented at RCM-2005. This paper and presentation will provide an overview of the NAVAIR process. The NAVAIR RCM process and tools are openly available to the public and are rapidly gaining acceptance and increasingly being used in the commercial sector.

The US Navy's Naval Air Systems Command (NAVAIR) has been one of the leading implementers of Reliability-Centered Maintenance (RCM) methodologies in its efforts to improve reliability, safety, and minimize costs associated with the operation and maintenance of the US Navy's aircraft fleet. NAVAIR's RCM methodologies have been updated and refined with over 30 years of RCM experience on a wide variety of complex systems.

Background

The US Navy has been one of the leaders in development and application of RCM analysis. In one of the earliest applications of RCM principles, the US Navy began applying Maintenance Steering Group (MSG) logic developed by the commercial airline industry to the P-3, S-3 and F-4 aircraft in the early 1970's. In 1975, NAVAIR applied an updated version of MSG-2 called the Analytical Maintenance Program to Naval aircraft and engine programs. In 1978 the Department of Defense (DoD) sponsored DoD report AD-A066579, "Reliability Centered Maintenance" by Stanley Nowlan and Howard Heap of United Airlines. This report was based on the principles of MSG logic and was the foundation of most modern day RCM processes (reference 1). Throughout the 1980's DoD issued several documents related to RCM analysis; most notably in 1986, DoD issued MIL-STD-2173, "RCM Requirements for Naval Aircraft, Weapons Systems and Support Equipment". This document was the basis of the current NAVAIR RCM Process. In 1996, MIL-STD-2173 was superseded by NAVAIR 00-25-403, "Guidelines for the Naval Aviation Reliability-Centered Maintenance Process", which contains the current RCM process described in this paper (reference 2).

The objective of this paper is to introduce the NAVAIR RCM process; identify some of the tools and resources available to those interested in using RCM analysis; and demonstrate the use of the NAVAIR RCM process using the IRCMS software. The NAVAIR RCM process is a completely non-proprietary process that is free and openly available to the general public. It is the hope of the author that exposure to this information will encourage some people to pursue the use of RCM who might not otherwise do so because of the perception that a long term and expensive commitment to a proprietary process and tools is required.

Anyone who has been exposed to any of the public discussion surrounding RCM knows that there are many vendors offering RCM services. Many of the claims about these competing processes seem to be contradictory and confusing. Some of the information being passed around is, at best, unsubstantiated and, at worst, purposely inaccurate. A secondary purpose of this paper is to address some of the public misconceptions about RCM, particularly those associated with the NAVAIR RCM process and the closely related SAE JA1011 RCM Standard. The basic tenets of RCM are fairly simple and simply adding a letter or number before or after the "RCM" name does not make a process significantly different. The simple fact is that the NAVAIR RCM process has all of the features, tools, and capabilities that most of the proprietary processes have. Furthermore, any method of implementing RCM, such as through facilitated groups, which is often claimed as a distinguishing feature of some processes and vendors, can be used with NAVAIR RCM process, despite claims to the contrary.

However, it is not the intent of this paper to compare RCM processes. Many RCM vendors provide experience in specific industries, different approaches to executing RCM analysis, and various tools such as software that may be beneficial to a particular user. It is the hope of the author that this paper can provide potential users with a means to learn more about RCM independently and decide for themselves what type of process and set of skills best meets their needs, before committing to one particular process or vendor.

NAVAIR RCM and the SAE JA1011 Standard

In the early 1990's the US DoD began a series of initiatives to streamline the acquisition process for military procurements. One of these initiatives was a decision to eliminate, as much as possible, the use of military standards in new acquisitions, and instead, rely on commercial or performance standards. This decision was documented in a memorandum from Secretary of Defense William Perry dated 29 June 1994. The decision was enforced with the systematic canceling of a large number of military standards. One of those cancelled was MIL-STD-2173, which documented the RCM process used by NAVAIR at the time.

In support of this acquisition streamlining effort, a group called the Reliability, Maintainability and Supportability (RMS) Partnership, began coordinating the efforts of various other organizations involved in developing standards related to reliability, maintainability and supportability. Through the RMS Partnership, the Society of Automotive Engineers (SAE) was asked to lead the development of an RCM Standard to replace the various Military RCM standards being cancelled since no equivalent commercial standard existed at the time.

SAE chartered a sub-committee to begin development of an RCM standard under its G-11 Supportability Committee. The RCM subcommittee initially consisted of representatives from the US Navy and various DoD contractors. It was noted that the development of a "commercial" standard was being performed almost exclusively by personnel associated with DoD.

The group started down several different paths in development of this standard, including one directed by "higher-ups" in SAE that the sub-committee develop a "preventive maintenance" standard because they didn't think there would be enough interest in RCM. The actual quote from an email is presented for its humor value: "We [the SAE Supportability Committee] are not interested in an 'RCM spec'. We want a 'scheduled maintenance spec'. An 'RCM spec' would be too narrow in scope. There's not enough general interest in RCM to justify SAE involvement in such a spec." If they could only see us now!

The group also found itself, at various times, trying to correct known or perceived deficiencies in current processes but could not always agree on how to correct them. After several of these false starts the group concluded that there was no one "standard" RCM process and that a "standard" was not the place to develop new and untried procedures. They also decided to ignore the directive to create a preventive maintenance standard. The group began to settle on the idea of creating a set of criteria with which to compare existing processes to ensure a given process was conforming to the original tenets of RCM as defined by Nowlan and Heap.

The group made further efforts to seek out additional experience from commercial industry. In late 1997, the well-respected John Moubray became involved. With new participation and a clearer direction in place, and despite some lively debate, the group was able to complete the SAE JA1011 Standard in 1999. The group also continued work on SAE JA1012, which was intended to "provide additional clarification and amplification for some of the key concepts and terms in JA1011"1 (references 3 and 4).

At about the same time the SAE effort was started, NAVAIR started an effort to retain their RCM process information in a format that would not be viewed as objectionable as a "standard". The effort also was intended to capture the many lessons learned and improvements identified from significant RCM efforts performed after the release of MIL-STD-2173 in 1986. The result of this effort was the NAVAIR manual, NAVAIR 00-25-403. Many of the participants in this effort were also participants in the SAE JA1011 development effort including the author of this paper who participated in both efforts.

At this point it is worth discussing how DoD uses standards. In what may be a gross oversimplification, DoD uses standards to ensure it knows what it is getting when it buys a product or process. While there is an assumption that a standard referenced in a procurement specification satisfies the exact requirements of the procuring activity, solicitations often encourage vendors to provide alternative solutions as long as they can be proven to meet all relevant requirements and are advantageous in some manner. In the opinion of this author (who was also an author of SAE JA 1011), SAE JA1011 was intended to be used the same way; as a reference to ensure a potential user of a particular RCM process understood what they were getting relative to the original RCM concept as proposed by Nowlan and Heap. It was not intended to conclude that this was the only process to determine maintenance requirements or even the best process for every situation. In other words, it is the responsibility of the user of a process to decide whether or not a process complies partially or completely with JA1011 and whether it even matters. Like other tools it is up to the user to decide how and where to use it.

Finally it is also worth noting that there seems to be a notion in some camps that SAE JA1011 was primarily developed from the RCM2™ process. In fact, SAE JA1011 was heavily influenced by users of both the RCM2™ and the NAVAIR RCM processes and others. However, as noted above, much work was accomplished prior to the involvement of Mr. Moubray. In the opinion of this author, as a participant in its development, SAE JA1011 was an impartial assessment of the original tenets of RCM and was as unbiased by any particular personal or business agenda as was humanly possible. Any of the dozen or more people involved will attest that debate was lively and no one person or group got everything they wanted in the document.

NAVAIR RCM Process Description

The NAVAIR RCM process has been evolving ever since the first applications of MSG-2 logic on US Navy aircraft in the 1970's. The RCM logic, analytical tools, and associated execution and implementation processes have been refined and improved over the years based on the experience and lessons learned from many applications of the process under a variety of circumstances.

The NAVAIR RCM process is fully described in NAVAIR 00-25-403. This manual provides information on the following topics:

- RCM analysis planning and preparation
- RCM Training and certification
- Failure Modes, Effects, and Criticality Analysis (FMECA)
- The RCM analysis decision logic process
- Implementation of analysis results
- Sustaining the maintenance program through RCM analysis
- Assessing RCM effectiveness

Figure 1 shows the overall NAVAIR RCM process, which includes four major steps: planning and preparation, the analysis, implementation of results, and sustaining the program. It can be seen from this process overview that the NAVAIR RCM process provides a comprehensive RCM program that addresses not just the analysis process but also the preliminary effort and follow-on efforts necessary to ensure the RCM effort achieves the desired results.

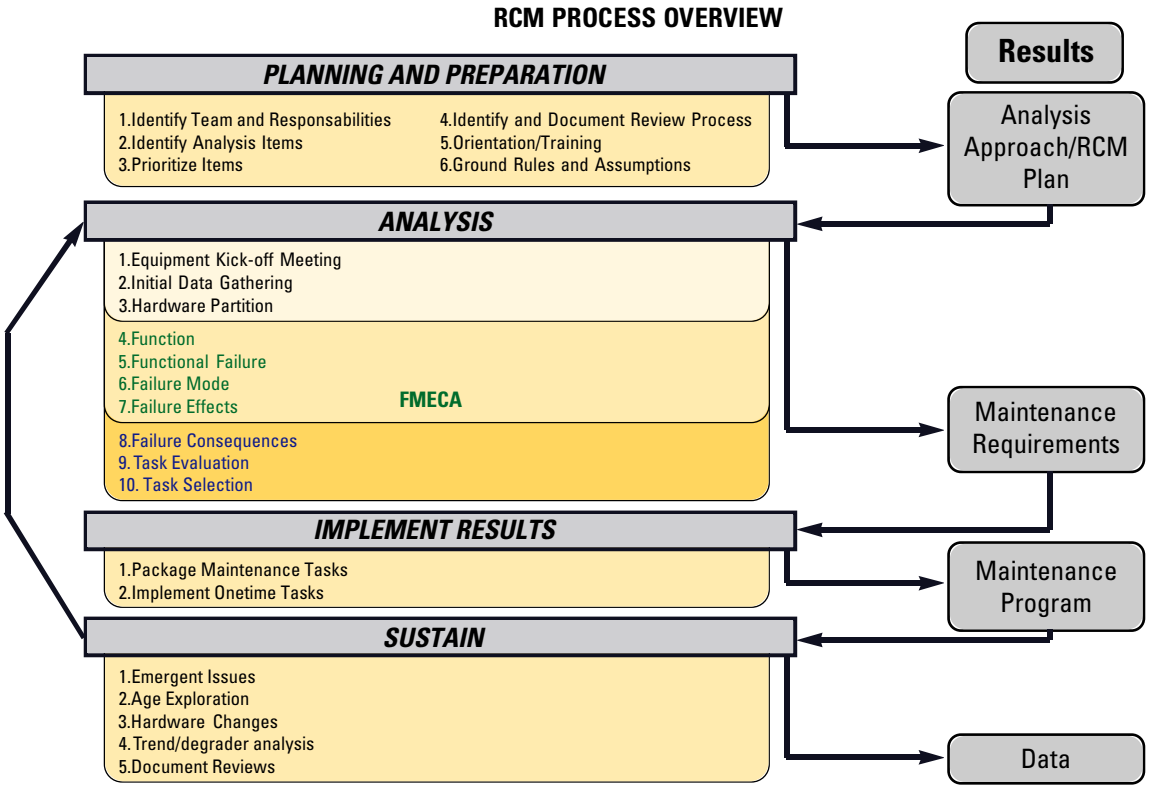

Figure. 1

Figure 2 is the NAVAIR RCM logic diagram. The NAVAIR RCM logic has many similarities and a few noteworthy differences from many of the earlier processes. Like many other logic charts, it differentiates safety and non-safety and hidden and evident failures. It also addresses environmental consequences in the safety branches. Applicable task types and other outcomes depend on which branch of the logic tree the failure mode falls into. One of the most noticeable differences from other logic diagrams is the lack of a preferential order in the review of each task type. Most RCM processes assume a preferred order in the selection of a maintenance task, e.g. on-condition first, time-directed or hard-time second, etc. In these processes, if one of the tasks is deemed to be applicable and effective, it is selected and the analysis continues with the next failure mode. The NAVAIR RCM process encourages consideration of all applicable failure management strategies for a given failure mode and provides comparison methods to help select the most effective of all applicable solutions.

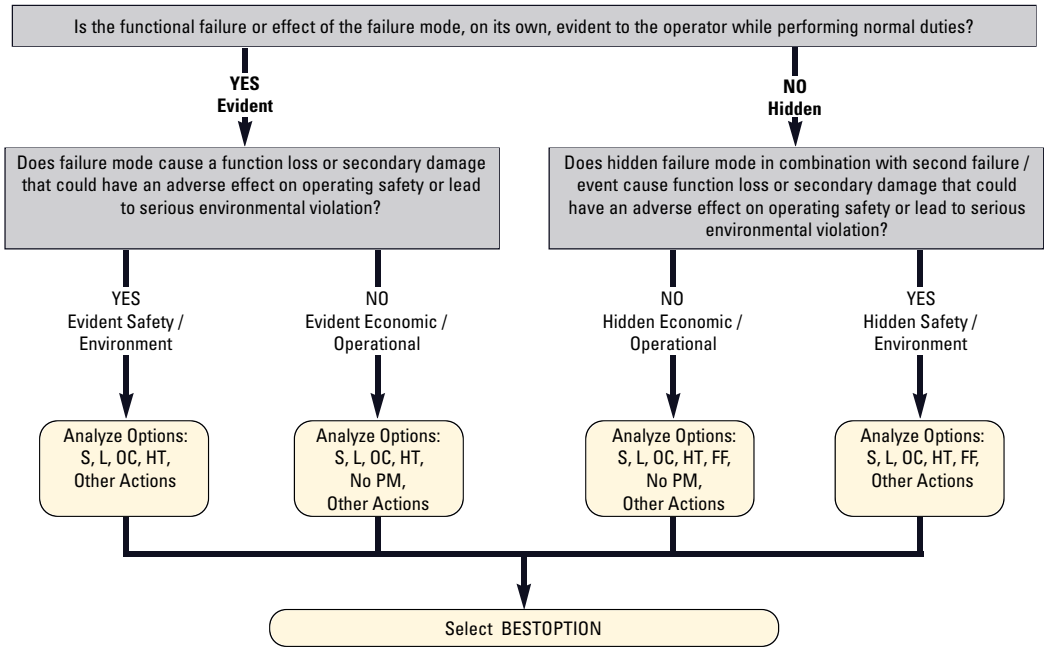

Figure. 2

While it is not the intent of this paper to provide a complete description of the NAVAIR RCM process, there are a few additional points about the NAVAIR RCM process worth mentioning:

- The process provides analytical methods for task interval determination. However, the process does not require them to be used. Users are free to use whatever means they choose for task interval determination.
- The process provides specific data collection tasks called Age Exploration tasks for use where the analysis may have been based on assumptions that warrant further analysis when better data is available. The use of these tasks is also optional.
- The process contains provisions to develop specific non-maintenance solutions called "Other Actions" to address failure modes. These Other Actions can include design changes, operating restrictions, operator training, equipment replacement, procedural changes, etc. The process contains procedures to assess the relative benefits of these actions compared to other applicable preventive maintenance options and run-to-failure.
- The process does not require any specific execution strategy. It has been used with facilitated teams, as well as by dedicated RCM analysts. Guidance is provided for both methods. Additional discussion on this issue is provided below.
- The process has been applied to many types of equipment including industrial equipment, power generation, and facilities.
- The process provides guidance for application on a limited basis based on user determined priorities when resources do not allow a full application.
- The process provides guidance for developing a living RCM program
- The process considers both physical and automated inspections to be on-condition maintenance and emphasizes the need to justify implementation of integrated sensing technologies on the same basis as other RCM options.
- The process provides information on grouping maintenance tasks to gain additional efficiencies.

Execution Strategies

Unlike many other RCM processes, the NAVIR process does not promote one particular execution strategy over another. Additionally, users of the NAVAIR process have employed many of the techniques other processes use as reasons to claim their processes are better, faster, or more efficient.

For discussion purposes, we will discuss three main types of execution strategy (with the acknowledgement that there could be any number of others or combinations that we are unaware of):

- Formal facilitated groups: One of the most widely accepted methods of performing RCM today is the use of an RCM "facilitator" to lead the analysis of a system in a meeting setting using a group of system experts that include maintainers and operators.
- Dedicated analysts: The analysis is performed by one or more RCM analysts who gather information from all relevant sources including system experts, operators and maintainers. Typically the analyst is an RCM and maintenance expert and has some knowledge of the equipment he or she is analyzing. It is important to point out that using analysts does not mean that operator and maintainer input into the process is ignored. This is an often heard false claim by some as discussed below.
- Informal facilitated analysis: Analysis is performed by one or more facilitators using one to a few key subject matter experts in informal settings gathering additional data from other sources as needed. This could be considered a combination of the other two approaches.

Other techniques for expediting the analysis include the use of analysis templates that contain partially completed analysis from similar equipment, limiting the analysis to address only existing preventive maintenance tasks, and limiting either the systems or failure modes addressed in the analysis. The NAVAIR RCM process has been applied using some form of all of these approaches

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Tools and Resources

The NAVAIR RCM process is supported by some excellent tools and resources. These tools are again openly available to the public at no charge. These include technical documentation, software, analytical tools, and process improvement forums.

Software

The primary software tool used by NAVAIR for RCM analysis is the Integrated Reliability-Centered Maintenance System (IRCMS). IRCMS is a stand-alone software tool designed to assist in the analysis process as well as provide a repository for analysis decisions that are easily reviewed as needed. IRCMS is a public domain tool developed for the US Navy and is available via the World Wide Web at the sites listed below. IRCMS has been used on aircraft and related systems as well as industrial equipment and in commercial settings.

The current version available at the time of writing of this paper is version 6.3 (as of June 2006). One of the primary purposes of this latest version was to eliminate the military and aircraft specific terminology and processes. This was accomplished for two main reasons: 1) NAVAIR and DoD have been increasingly using RCM on equipment unrelated to aviation such as facilities and manufacturing equipment, and 2) NAVAIR recognizes that benefits can be realized from absorbing the experience of others using a common process and are hoping to broaden its use. Version 6.3 also has some new advanced features such as the addition of a pre and post RCM analysis hazard risk index assignment, improved reports, and new task comparison metrics.

IRCMS is relatively easy to use; however experience has shown that a full understanding of its features and capabilities is best accomplished through hands on training via another experienced user, or through readily available formal training. IRCMS was designed to be very open to process changes and therefore does not restrict the analysis with an overly rigid decision logic. As a result, a thorough understanding of the RCM process being used is required to effectively use IRCMS. In other words, to use

IRCMS you must understand RCM. Although we are unaware of anyone trying this, there is no reason IRCMS couldn't be used with any RCM process that closely follows the requirements in SAE JA1011. Software offered by vendors may prove better for a given application, but IRCMS can provide a means to explore the process and provide a frame of reference for available capabilities for those considering an RCM project.

IRCMS is primarily a documentation aid and decision assistance tool. It is not intended to be a highly automated decision making tool based on large quantities of failure data. It is intended to be used with other analytical tools such as statistical analysis packages for more detailed analysis.

Technical Guidance and other tools

As mentioned throughout this paper, the NAVAIR 00-25-403 manual is the primary guidance document for the NAVAIR process. It is available for download at the websites listed below along with several other guidance and program documents. Also available, although not on the website, is an Excel spreadsheet that provides analytical methods for determining maintenance task intervals based on the methods described in NAVAIR 00-25-403.

Process Improvement

Since the mid 1990's NAVAIR has had an officially chartered committee dedicated to improving the NAVAIR RCM process and tools. The NAVAIR RCM Steering Committee provides a forum to receive feedback on the NAVAIR RCM process and tools. Among other functions, the RCM Steering committee is charged with: coordinating the development, distribution, maintenance, and update of the IRCMS software; training and certification requirements; and maintaining and disseminating knowledge of advancements in RCM related technologies and processes among other services, industry, and academia. The RCM Steering Committee appreciates feedback from all sources on NAVAIR's RCM processes and tools. This feedback can be provided via the NAVAIR web site listed below.

Resources (as of June 2006)

Nearly all of the tools and resources mentioned in this paper are available at no charge from the following websites.

1. NAVAIR RCM website: http://logistics.navair.navy.mil/rcm/index.cfm (For download of IRCMS 6.2.5)
2. Anteon website: http://www.anteon-rcm.com (For download of IRCMS 6.3)

RCM Myths

As mentioned previously, there seems to be a tremendous amount of controversy over what RCM is and what constitutes "proper" RCM analysis. Of course, much of this is driven by competition in the market place and the need for vendors to differentiate their products and services from that of another. Unfortunately some have taken this a bit far by making claims about other processes that cannot be substantiated. Other inaccuracies are misunderstandings or misperceptions that have been perpetuated over time through various forums. In this section of this paper we will attempt to continue to clarify some of the existing misinformation as it applies to NAVAIR, or other military versions of RCM, and the SAE JA1011 Standard. This discussion is intended only to address some of the more often heard inaccuracies. These issues are not universally distributed nor is the discussion here comprehensive.

Myth #1: RCM, especially "classical" RCM, is cumbersome, time consuming, and expensive.

This myth is typically perpetuated by those who use processes that they espouse to be much faster than "traditional" RCM. Early applications of MSG and RCM were very rigorous and highly detailed, and were therefore time consuming. Users began to look for ways to shorten the process. Some looked to change the process itself to make it shorter. For discussion purposes we'll call these "abbreviated" or "derivative" processes. Implied in the "abbreviated process" view is that the "abbreviated processes" will yield the exact same results as a more detailed analysis. Others looked to improve the way they performed the process with only minor changes to the process itself. We'll call these "classical" RCM. In general, the "classical" processes try to abide by the original tenets of Nowlan and Heap's process, and are therefore more likely to be compliant with SAE JA1011. As with any undertaking, people learn how to do things faster and better with experience, so both approaches should yield a faster analysis than the earlier applications of RCM.

Fact #1a: Any RCM process is no more than a set of steps. The basic steps of ALL known RCM processes are very simple. The amount of effort put into each step is completely up to the user of the process. The time spent on these steps ultimately depends on the equipment level the analysis is performed at, the amount of information examined and included in the analysis, and how much detailed analytical processing is performed on the data. Basic answers to the process steps can often be completed in a matter of minutes. The only real way to shorten the process is to reduce the information considered or to become more experienced and efficient at processing that information.

As mentioned above, the NAVAIR RCM process not only includes a set of steps very similar to those described in SAE JA1011, but also includes some analytical tools for interval determination, and cost and availability assessment of maintenance tasks. The extent to which these tools are used on each system, individual failure mode, or maintenance task is at the sole discretion of the user. Recent applications of the NAVAIR RCM process range from years for some aircraft applications to days for some commercial plant systems. **Our opinion:** ***Applied appropriately, any SAE JA1011 compliant process (including the NAVAIR RCM process) should require nearly the same effort as an appropriately applied "abbreviated process".***

Fact #1b: There have been no comprehensive independent studies of various RCM processes to determine if any are in fact faster than others. There has been at least one study (reference 5) that compared the results of a "classical" process and an "abbreviated" process on two identical systems at different locations. This study demonstrated that, at least in this one case, the

two different analysis processes applied on similar systems, did not produce similar results. The results are summarized as follows:

Output [2]	**Classical**	**Abbreviated**
Number of Functions	6	2
Number of Functional Failures	14	2
Number of Components in the System Boundaries	13	3
Number of Failure Modes Analyzed	130	8
Hidden Failure Modes	88	0
Number of Critical Failure Modes	73	5
Number of PM Tasks Specified (incl. RTF)	141	8
Number of "Items of Interest" (IOI's)	49	0

Myth #2: RCM must be performed in facilitated teams to give the best, or even valid, results. Variations: a) NAVAIR RCM and other processes that may use independent RCM analysts do not include proper mechanisms for obtaining maintainer and operator input, b) NAVAIR RCM doesn't allow or provide for the use of facilitated groups.

The argument goes something like this: Including experts from various elements of an organization in the analysis process will extract as much relevant information from as many sources as possible. In addition, the group analysis process will promote "buy-in" from the participants through development of consensus in the analysis results. It is argued that the RCM results are much more likely to be implemented and therefore the RCM more likely to be successful because affected parties participated in and agreed with the analysis.

The facilitated group method is an excellent method of performing RCM analysis in many cases. However, some proponents of this method would have you believe that using any other method, ever, is inefficient, ineffective, or even dangerous. Reasons cited include:

- Other methods fail to include relevant maintainer, operator, or subject matter expert knowledge
- Other methods are likely to fail because they do not get maintainer buy-in to the requirements generated by the analysis.
- Other methods take longer due to getting bogged down in unnecessary detailed analysis of data
- Other methods do not disseminate the information developed in team meetings as well

None of these reasons are true.

Fact #2a: RCM has been successfully and efficiently executed, and the results implemented, using several different execution strategies including the use of facilitated groups and analysts. NAVAIR 00-25-403 contains extensive discussion on the importance of operator and maintainer input into the analysis and how to obtain it no matter which execution method is used.

Fact #2b: There are situations where the facilitated team advantages may not apply or where other approaches may be better overall, considering that the facilitated team approach requires participants to all be trained in RCM and away from their regular jobs while participating in the analysis effort. Remember, any valid approach will still be required to obtain necessary information from operators and maintainers.

- Contracted maintenance: Some contract maintenance situations may make it impossible to include relevant maintainers. For example, in some facility maintenance environments, maintenance may be performed on an on-call basis. The same maintenance personnel or even the same company may not perform the same task each time.
- Highly specialized equipment: Equipment such as gas-turbines, aircraft structure subject to fatigue, or other highly complex equipment may require detailed engineering analysis of failure mechanisms and associated task intervals. While maintainer and operator input may still be useful, it may make no sense to subject them to the details of such analysis.
- Highly stressed or lightly manned operations: Some organizations simply cannot afford to remove key players from their primary responsibilities long enough to perform the analysis in meetings over days or weeks. Or, it may be more cost effective to outsource the analysis effort. Again, any outsourced effort should ensure appropriate means of collecting relevant information from key sources and ensuring organizational buy-in to results are employed.
- Highly regulated industries: In cases where maintenance is regulated and closely monitored such as aircraft, nuclear power, etc., the consideration of buy-in from maintainers is likely moot. The tasks get done or someone gets fired or goes to jail.

New acquisitions or new technology: The majority of available data may be engineering or test data that might be most efficiently analyzed by one or two technical specialists.

The bottom line is that there are more ways to get information into an analysis than by having a group sit in a room and talk about it. There may be times when that is the most effective way and others when it is not.

Myth #3: The Military/aviation environment is so different from the industrial environment that analytical processes for one do not apply to the other

This general myth can be broken down into several similar misperceptions that most likely come from a misunderstanding of military and aviation environments:

Myth #3a: Military and aviation deal mainly with highly critical failures that warrant detailed analysis.

Fact #3a: In military equipment, especially aviation systems, designers have spent years and invested huge resources designing in redundancy and designing out critical failures. Most failures of aircraft components are economic or operational in nature. Critical failure is simply unacceptable from a design standpoint.

Myth#3b: Military applications are more concerned with safety and operations than cost and have large amounts of money to throw at things like RCM.

Fact #3b: The US Military has been faced with declining budgets and aging equipment since the end of the Cold War. Much like private industry, most of the impetus for RCM in the US Military is to maintain an acceptable state of operational availability while reducing the cost of operations and maintenance.

Myth#3c: Military versions of RCM require large amounts of data including previously performed FMECAs.

Fact #3c: The NAVAIR RCM process contains the same methods for determining failure modes and effects as other RCM processes. Previously or independently performed FMECAs are often used as source data for analysis, but when available, are often performed at lower equipment indenture levels that make them unusable as a direct input to RCM analysis. Other data such as CMMS data is used in much the same way it is in other industries.

Myth #4: The RCM process only applies to new designs

This myth, whose origins are unknown, most likely came about because RCM was originally developed from the MSG-2 process, which was developed for new commercial aircraft.

Fact #4: The RCM process developed by Nowlan and Heap was developed for DoD to apply to new and in-service aircraft. In

fact, Nowlan and Heap has a section dedicated specifically to application to in-service aircraft. MSG Logic was originally developed for new commercial aircraft[3] . Most recent applications of RCM to equipment in DoD have been to equipment that has been in-service for a significant portion of its life cycle prior to RCM being performed.

Myth #5: RCM must be a zero based analysis

Fact #5: RCM can be performed as a zero based analysis or using existing maintenance program as a starting point. Many NAVAIR RCM applications have effectively used the existing maintenance program as a starting point. NAVAIR 00-25-403 provides guidance on limiting the scope of analysis by limiting the source of failure modes considered. Analyzing all failure modes would be at one end of the extreme and analyzing only new failure modes as they occur would be at the other. Most NAVAIR applications of RCM fall somewhere in the middle of this range.

Myth #6: NAVAIR RCM is not SAE JA1011 compliant

This is probably the most absurd of the inaccuracies heard, given the histories and relationship of SAE JA1011 and NAVAIR RCM. It probably hasn't been widely distributed, but it seems to persist in certain circles. Most of the claims made in this argument were based on outdated or inaccurate information about the NAVAIR process, for example from NAVAIR training materials that pre-dated SAE JA1011.

Fact #6: The NAVAIR RCM process is fully compliant with the spirit and intent of all provisions of SAE JA1011, as many of the participants in its development were also authors of NAVAIR 00-25-403. Reference (6) explores this issue in great detail. This paper is available on the websites previously listed.

Conclusions

RCM is a relatively simple process. RCM is mostly an application of "common sense" using some basic physical and reliability principles. Detailed analytical methods have a place, but are not required all of the time. The best approach to executing an RCM program will depend on the goals, resources (time, fiscal, manpower, and technical), and commitment of the organization attempting to perform RCM. The most common trait in successful implementations of RCM is good leadership from those seeking to implement it no matter what process or execution strategy is used.

There is probably no one best RCM process or execution strategy for all situations. Be wary of claims that suggest otherwise. Be especially wary of those that claim they are the only ones that can do RCM "properly". There are true success stories from many different applications of RCM. Many of the differences in RCM vendors are as much about style, approach, and personality as technical process. However, these can be important in the ultimate success of a project. In fact, which process is used is probably the least important determining factor in a successful implementation. The main purpose in hiring outside help is to bring in their expertise. If you need outside assistance, make sure that they have the expertise you need and that it complements your organization. The NAVAIR RCM process and resources, as well as SAE JA1011, can be valuable tools to help you learn more about RCM even if you ultimately settle on using different processes and/or tools.

Finally, it is the continued hope of this author that all of us do a better job advancing the state of the art in RCM rather than arguing about whose 7 step flow chart or facilitated team structure is better. There is a lot of work yet to be done in developing better maintenance technologies and better methods of collecting and analyzing maintenance data.

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Acknowledgments

The authors would like to acknowledge the contributions of Craig Paylor of the NAVAIR DEPOT, Cherry Point, NC and Daryl Hoffman of the NAVAIR DEPOT Jacksonville, FL for their contributions in reviewing and providing valuable input to the original paper. Additional contributors to the original paper included: Steve Leep and Chris Rooksberry of Anteon Corporation and Steve Adamczyk of the NAVAIR Depot Jacksonville, FL.