Reenergizing
R&M ENGINEERING

In the Department of the Navy

James W Woodford, P.E.
Director, R&M Engineering
DASN (Research, Development, Test & Evaluation)
™ ASN (Research, Development & Acquisition)

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Reenergizing R&M Engineering

- **History**
  - How did we get here?
- **Policy and Guidance**
  - Department of Defense
  - Department of Navy
  - SYSCOM
- **People**
  - Resource constraints limit any prospect of adding people
  - For larger programs there may be some new faces
  - For smaller programs R&M Engineering may be an additional duty
- **Training and Tools**
  - Existing courses are being evaluated
  - Development of new courses is being considered
  - To fill the gap, we need tools for the seasoned pro and the newbie

Quick History

Decades ago R&M was a top priority:

- Hundreds of military documents
  - Specs, Standards, Handbooks
  - Manuals, Guides
  - Directives
  - Instructions
- Hundreds of government people
- Thousands of industry people

And then there was Acquisition Reform:

- Industry convinced DOD Management not to worry, they knew what to do
- Specs/Standards were cancelled
- People were reassigned
- R&M Engineering disappeared
  - By direction; not by failure

10 Years Later: R&M was Rediscovered

- The high suitability failure rates were caused by the lack of a disciplined systems engineering process, including a robust reliability growth program, during system development.
- The implementation of Acquisition Reform provided flexibility but, when combined with an eroding workforce, sometimes resulted in less discipline in program formulation and execution.
- Ensure an adequate cadre of experienced [R&M Engineering] personnel is part of the Service acquisition and engineering office staffs.

Reliability Improvement Working Group Established in Feb 2008

OSD DOT&E-AT&L:

- Recent Test and Evaluation related reports have highlighted poor operational suitability of weapon systems, primarily as a result of [R&M] deficiencies.
- Establish the Reliability Improvement Working Group to:
  - Ensure programs are formulated to execute a viable systems engineering strategy from the beginning, including an [R&M] growth program, as an integral part of design and development.
  - Ensure government organizations reconstitute a cadre of experienced T&E and [R&M Engineering] personnel.

USD(AT&L) “Policy” Letter

On July 21, 2008, the Under Secretary of Defense for Acquisition, Technology and Logistics declared:

“Further, effective immediately, it is Department policy for programs to be formulated to execute a viable [R&M] strategy that includes a reliability growth program as an integral part of design and development.”

- Note keyword “viable”

ASD(R&D&A) Responded

August 2008

- DON is committed to improving [R&M].
- Two Pass/Six Gate Process ensures appropriate [R&M] requirements are included and/or executed.
  - Conducted by senior leadership.
- Probability of Program Success (PoPS)
  - Assesses program health at each gate review.
- DON goal is to design [R&M] into our programs.

OSD Motivates The Navy to Take Action December 2008

- Services required to brief progress of R&M implementation at OSD Systems Engineering Forums.
  - At the December ’08 review, Army was touted as being head and shoulders above the other Services for [R&M] actions.
- ASN(R&D&A)CHSENG Challenged Jim Woodford
  - Determine the validity of the OSD assertion that increased suitability failures for DON systems at OPEVAL are the result of [R&M] deficiencies.
FINDINGS:

- [R&M] is not doing as poorly as stated, but suitability problems do exist and need to be solved.
- There are far too many test failures, [R&M] and all others.
- DON can do better at OT&E in all areas.
- DON can do more to increase structured [R&M] activity.
- Increased [R&M] visibility and activity will improve all OT&E results.
- Increased emphasis on “Design for Reliability” and “Design for Maintainability” will improve R&M and Availability.

OSD assertion: Increased suitability failures at OPEVAL are the result of [R&M] deficiencies.

Response: Based on the study, we know [R&M] deficiencies are not increasing, but we need to reduce their numbers by re-energizing the [R&M] team

- [R&M] study conducted
  - ASN(RDA) Gate Review records (minutes and action items) for 38 reviews.
  - FY03-FY09 OPEVAL data – approximately 100 OT final reports reviewed.
- Primary causes of UNSAT resolutions for [R&M] in IOT&E
  - Inherent limitations of COTS Operating Systems (e.g., Windows).
    - Memory management and rebooting issues.
    - Functional testing at the modular level does not reveal "reliability" failures.
  - Inadequate maintenance and training documents and inadequate training.
  - Spares and tech manual availability at OT.
  - Built in Test false alarms and misdirection -- a design issue impacting R, M, & A.
  - Most problems have been seen before. A tracking system is needed.

Recommendations and Actions

- A Deficiency Tracking System for DT and OT deficiencies is being developed.
- Emphasis on Test Readiness Reviews and corrective actions is needed.
- Appropriate software requirements and aggregated test during development.
- Revitalize the [R&M] team.
- Design for Reliability, Design for Maintainability, Achieve Availability.

DOT&E and USD(AT&L):
‘Next Steps’ Memos

Purpose: To address Dr. Carter’s challenge to recommend means to improve reliability policy across the Department.

Workings Groups Established:
- WG-1 Policy and Guidance
- WG-2 Workforce
- WG-3 Practice

Primary Product:
PMs shall formulate a comprehensive R&M program using an appropriate reliability growth strategy.

PM shall prepare a Reliability, Availability, Maintainability and Cost Rationale Report.

The Acquisition Strategy shall specify how the sustainment characteristics have been translated into R&M design requirements and contract specifications.

Reliability Growth Curves shall be included in the SEP and TEMP.

PMs shall assess the growth required to achieve the reliability threshold.

Reliability Growth shall be monitored and reported at Defense Acquisition Executive System reviews.

DoD Policy: The DTM is an instantaneous change to Policy.
- Will be incorporated into the DODI 5000.02 at the next update.

DoD Guidance:
- R&M Engineering provisions have been incorporated into the Systems Engineering Plan (SEP) Outline.
- New DoD level DTM Implementation Guide documents have been drafted and are being reviewed by the members of the DOD R&M Engineering Leaders Group.
  - Phase by phase discussions of the DTM requirements.
  - R&M Engineering Activities and associated “touch points” with the many competencies R&M Engineering works with (e.g., PM, T&E, Logistics...).
  - Contract Statement of Work (SOW) language appropriate for each activity.
  - Data Item Descriptions (DIDs) for the data and reports needed.
  - Further guidance on reporting Reliability Growth to the Defense Acquisition Executive System reviews.

Service Level Policy and Guidance based on DoD Policy, but may be applied to lower than Major Defense Acquisition Programs (MDAPs).
- The Department of Navy intends to apply the DTM to all ACAT levels with some tailoring at the lower levels.

People

ASN(RDA) Overall Structure
OFFICE OF THE ASSISTANT SECRETARY OF THE NAVY (RESEARCH, DEVELOPMENT AND ACQUISITION)

Assistant Secretary of Navy (RDA)

Chief of Naval Operations

Assistant Secretary of the Navy (R&D)

Assistant Secretary of the Navy (Acq)

Assistant Secretary of the Navy (Eng)

Assistant Secretary of the Navy (M&L)

Assistant Secretary of the Navy (PA)

Assistant Secretary of the Navy (Man)

Assistant Secretary of the Navy (Int)

Assistant Secretary of the Navy (CT)

Assistant Secretary of the Navy (CSC)

Assistant Secretary of the Navy (OR)

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The DTM’s Immediate Impact on Programs

- What they heard:
  - Growth Curves
  - Growth Curves in the Systems Engineering Plan (SEP)
  - Growth Curves in the Test and Evaluation Master Plan (TEMP)
  - Growth Curves in the Defense Acquisition Executive System (DAES)

- What they said:
  - What’s a Growth Curve?
  - Where do I get one?
  - Do you have one we can use?
  - Why do I need one?
  - Ships are different
  - We buy commercial off the shelf (COTS)

All The Attention is on Curves
Where does GROWTH come from?

- Properly stated REQUIREMENTS.
  - Stated in design appropriate terms (translated) and verified.
  - User (war fighter) requirements are nearly always stated in USER terms.

- Properly selected and applied R&M ENGINEERING ACTIVITIES that are fully integrated within the Systems Engineering Processes and Technical Reviews.
  - R&M allocations, block diagrams, and predictions.
  - Documented failure definitions and scoring criteria (FD/SC).
  - Failure Mode, Effects, and Criticality Analysis (FMECA).
  - Built in test (BIT) and maintenance demonstrations.
  - Reliability Growth Planning and Tracking at the system and subsystem level.
    - Combined with block diagrams when done separately.
    - The curve is a management tool that can focus their attention (Time and Resources).
  - Failure Reporting, Analysis and Corrective Action System (FRACAS).
    - Analysis all the way to the ROOT CAUSE.
    - A review board that makes the right corrective action recommendations.

- Program Management
  - That makes the right corrective action decisions. (Time and Resources).

Reliability Growth is the Result of:

- Properly stated REQUIREMENTS.
  - Stated in design appropriate terms (translated) and verified.
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R&M Engineering Competency Goals

Current Goals (Walk before run)
- Using the new OSD policy, re-establish R&M policy and guidance at DON and SYSCOM levels.
- Energize and support a proactive R&M Engineering team.
- Provide the tools for the SYSCOMs and OTAs to do the work.
- Nurture the R&M Engineering Competency.
  - Build the workforce with mentoring and training whenever and wherever possible.

Future Goals (Run)
- Refine policies and training through self assessments, oversight and metrics.
- Assist the SYSCOMs, PEOs and Programs.
R&M Engineering TODAY:

- R&M Engineering is once again a priority component of System Engineering.
  - Making steady progress overcoming inertia and filling gaps.
- A proactive R&M Engineering team is taking shape.
  - DON and SYS.COM leaders in place; working on the lower tiers.
  - We need an R&M Engineering POC is each and every program, each PEO and each Warfare Center. No exceptions.

CURRENT PROJECTS

- Support OSD in R&M Engineering guidance and training updates.
- Recommend new DON R&M policy for ASN(R&D&A) signature.
  - DTM to apply at all ACAT levels with some tailoring at the lower levels (small programs).
- Building the workforce through mentoring and training whenever and wherever possible. Providing tools so they can work beyond their present experience.
- Increase the use and utility of our internal website at NSERC:
  - R&M Engineering SharePoint website.
  - DON Test Report Repository and DON T&E Deficiency Tracking System.
  - Integrated Reliability Software Suite (IRSS) 
    - Software tools robust enough for the journeyman as well as being a guide for the newbie.

The DON Integrated Reliability Software Suite (IRSS)

Purpose: To provide a common set of tools for R&M Engineering (and related) practitioners throughout the DON.

- Robust enough for the journeymen
- Enabling for the new comer
  - Provides structure
  - Supplements or creates a training experience
  - Provides a pathway to the publishers resources and training
- Provides a new means of communicating with substance (data) between:
  - Within a program; R&M Eng, T&E, Logistics/Sustainment, PMs, Class Desks
  - Programs to management (Both internal and external to the PEO)
  - Programs to programs (including SYSCOMS to SYSCOMS)
  - Programs to prime contractors AND primes to programs
  - Programs to the Operational Test Activity (COMOPTEVFOR & MCOTEA)
  - Programs to oversight (DON and OSD)

Strategy: Build it and they will come

- Started with one SYSCOM using their software; simply moved it to NSERC.
- Increased the number of licenses of existing tools.
- Expanded the tool set.

Built It and They Will Come...

NSERC Data:

- IRSS Applications Approved: 720
- RGA 238
- Weibull++ 219
- BlockSim 198
- XFRACAS
- RAPTOR 13
- Minitab 51

ReliaSoft Server Data:

- RGA 343 users
- Weibull++ 171 users
- BlockSim 170 users
Summary: Reenergizing R&M Engineering

- History
  - Where are we? How did we get here?
- Policy and Guidance
  - DoD
  - Department of Navy
  - SYSCOM
- Knowledgeable People
  - Resource constraints limit any prospect of adding people.
  - For larger programs there may be some new faces.
  - For smaller programs R&M Engineering may be an additional duty.
- Training and Tools
  - Existing courses are being evaluated.
  - Development of new courses is being considered.
  - To fill the gap, we need tools for the seasoned pro and the newbie.
- TIME
  - The Laws of Physics apply to any MAJOR change of state.
  - It takes TIME and MANAGEMENT SUPPORT.

QUESTIONS?