The Need for Increased Attention on Improving Reliability, Maintainability, and Supportability of Legacy Weapon Systems

by Andrew J. Foote

Within the United States Department of Defense (DoD) reliability, maintainability, and supportability (RMS) are facing increased scrutiny based on recent policy changes, such as:

- DoD Guide for Achieving Reliability, Availability, and Maintainability – August 2005
- DoD Instruction 4152.22 “Condition Based Maintenance Plus (CBM+) for Material Maintenance” – December 2007
- DoD Weapon System Acquisition Reform Product Support Assessment – November 2009
- DUSD (AT&L) State of Reliability Memo – June 2010
- DUSD (AT&L) Better Buying Power Memo – September 2010
- DUSD (AT&L) Implementation Directive for Better Buying Power – November 2010
- DTM 11-003 – Reliability Analysis, Planning, Tracking, and Reporting – March 2011
- Defense Acquisition Guidebook – January 2012

These recent documents all strive to ensure that the primary objective of DoD acquisition can be achieved, which (per DoD RAM Guide) is to acquire quality products.

The Cost of Refusing to Change Individual and Organizational Behavior is a Cost Driver

by Russell A. Vacante, Ph.D.

On November 13, 2012 Frank Kendall, Under Secretary of Defense for Acquisition, Technology, and Logistics, published a “Memorandum for the Defense Acquisition Workforce” with the subject line “Better Buying Power 2.0: Continuing the Pursuit for Greater Efficiency and Productivity in Defense Spending.” The attachment to this memorandum, “Better Buying Power 2.0,” contains 36 initiatives grouped into seven focus areas. The focus area I will discuss in this editorial is listed in the attachment as “Promote Effective Competition” and, specifically, the first topic of four, “emphasize competition strategies, creating and maintain competitive environments.”

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that satisfy user needs with measurable improvements to mission capability and operational support in a timely manner, and at a fair and reasonable price. Many of these policy changes emphasize the need for a robust systems engineering process to achieve satisfactory levels of RMS, successfully demonstrate them during operational test and evaluation, and sustain them through the system’s life cycle.

The ability to successfully achieve RMS objectives is often dependent on the demonstrated level of commitment by management, particularly at the upper levels. This commitment can be reinforced by making sure that RMS objectives are an integral part of the corporate technological and business strategy. Demonstrated and emphatic management commitment will help reinforce any “culture change” that may be necessary to implement those actions necessary to achieve the RMS objective(s).

Many organizations face tough challenges acquiring management commitment to RMS activities. Often translating RMS metrics into cost metrics piques the interest of leadership, when they see the financial consequences associated with poor RMS characteristics from the standpoint of warranty costs and loss of market share as customers select alternate more reliable, maintainable, and/or supportable products.

Although there has been a pendulum shift based on recent policy changes and related scrutiny being placed on RMS within the DoD there still remains challenges to get management commitment. Typically, the “cost of reliability” is not realized for several years (or decades) on DoD systems, which is often far beyond the life of the DoD and contractor management that set requirements, design, and test for RMS. A practice that some DoD acquisition contracts have implemented effectively is the introduction of RMS incentives, which benefit the customer and supplier in a manner that both are committed to improving the “cost of reliability.”

The DoD RAM Guide and GEIA-STD-0009 focus on the four key steps necessary for acquiring systems with the required levels of reliability, availability, and maintainability (RAM):

1) Understand and Document User Needs and Constraints
2) Design and Redesign for RAM
3) Produce Reliable and Maintainable Systems
4) Monitor Field Experience and Sustain RAM Performance

The DoD has made great strides to improve system reliability, maintainability, and supportability through stressing the importance of designing these capabilities into the weapon system up-front. A significant gap remains in what improvements are possible to address the RMS characteristics of systems that were acquired without the due diligence required in the recent policy changes. Therefore, further policy emphasizing the importance of Step 4 “Monitor Field Experience and Sustain RAM Performance” will be required to balance the needs of newly acquired weapon systems with legacy systems. Newly acquired weapon systems must ensure RMS characteristics that were designed in during current acquisition procedures are vigilantly monitored after deployment. Whereas countless legacy weapon systems must address methods to stress the importance of developing actionable improvements on these systems that were fielded within a DoD environment that did not adequately stress the importance of designing RMS characteristics into the systems up-front. Numerous studies have indicated that a great percentage of legacy weapon systems fielded in the last two decades did not achieve RMS requirements during test and evaluation, which will inevitably lead to challenges throughout DoD to continue to operate and support these systems for years (or decades) to come.

On top of the inherent design challenges associated with the RMS characteristics of these systems they are often further stressed by changing requirements related to their operating environment, threats, mission, operational tempo (e.g., increased usage due to Operation Iraqi Freedom and Operation Enduring Freedom), maintenance, service life (e.g., B-52 Stratofortress is projected for end-of-service in 2044 or after 84 years of service, which is far beyond the 25 years originally planned), etc.

From the very beginning of a new development or major modification program, the development team in conjunction with the user should employ a continuous assessment process. A continuous assessment process enables Step 4 “Monitor Field Experience and Sustain RAM Performance” to continue to define and document the capability and limitations imposed by the level of RMS on the weapon system with an emphasis on the operational impacts. Continuous assessment can be optimized through the introduction of an integrated RMS data and information management system that can be used to monitor lessons learned and bridge to future product development.

Monitoring field performance enables the user to perform corrective actions (best when based on a robust reliability growth program) as needed, but the continuous monitoring of the deployed system enables the user to respond quickly and effectively, thus improving their corrective action process.

- Monitoring field performance also maintains RMS performance during operational life and feeds deficiencies into evolutionary acquisition increments.
• Tracking RMS performance over time is an important part of an overall strategy of achieving and sustaining required levels of RMS.
• Failure and false alarm trending involves applying continuous plotting and monitoring of relevant RMS performance characteristics.
• If a problem persists and RMS performance degrades below an acceptable threshold, then the problem must be addressed, whether it is localized to a single system or across all systems.

Effective RMS data collection and analysis is absolutely essential to accurately identifying problem areas and identifying solutions that offer the greatest impact to the bottom line. Properly executed and integrated, data collection and analysis can eliminate costs associated with inefficient or inaccurate problem identification, allowing engineers and managers to concentrate on those issues having the greatest impact on RMS characteristics. Applied early, it supports requirements definition and design decisions and applied later on, it supports testing and maintenance decisions.

Effectively identifying the needs of a data collection program early is vital to the success and accuracy of the data analysis it later supports. Unfortunately needs are often misidentified or change as the data collection process continues. Solutions must then be identified to bridge the gap between the needs of the data collection program and the existing data. Organizations proficient in collecting data often lack the resources or knowledge to develop an integrated data management system that can support various RMS analyses. Converting the collected data to common measures and formats is often laborious and many organizations do not have the experience or expertise to effectively accomplish this integration. An integrated data management system increases the value of the data from being a historical record to a forward-thinking utility.

An integrated data management program will determine objectives that support:

• Estimation of warranty and support costs
• Evaluation of trade-offs for design alternatives
• Integrated logistics support
• Identification of manufacturing problems
• Accurate life cycle cost analysis
• Estimation of sparing needs

In conclusion, the DoD is unveiling logistics enterprise architecture through Global Combat Support System (GCSS) family-of-systems currently in varying levels of utilization within the Marine Corps, Army, Navy, Air Force, and Joint (e.g., Defense Information Systems Agency) that will enhance combat support effectiveness through system interoperability. The GCSS family-of-systems will improve the visibility of data to allow the DoD and its services to apply a holistic approach to sustaining the warfighter. The GCSS family-of-systems presents a significant improvement for the DoD towards a truly integrated data and information management system that captures logistics information globally, near real-time, and accurately across all functional areas. Although designed to provide integrated data...
Increase:

- reliability
- maintenance quality
- support efficiency

...while reducing costs by 60%

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management many of the GCSS systems being employed were planned for spiral development and thus not all features are fully operational. Therefore, the DoD must ensure that strategies are introduced to integrate these data and information systems in a manner that can support analyses that ensure RMS levels for newly acquired weapon systems and identify improvements to RMS levels for legacy weapon systems that face future financial constraints.

**About the Authors**
Andrew Foote is an American Society for Quality Certified Reliability Engineer with 14 years of experience as a reliability engineer and program manager with Alion Science and Technology. Andrew currently manages business opportunities and satisfies the requirements of existing customers for the Alion System Reliability Center, which is a center of excellence in RMS that provides engineering consulting to government and commercial organizations. Andrew received a B.S. degree in Mechanical Engineering from the Rochester Institute of Technology. Andrew was the primary author of *DoD Guide for Achieving Reliability, Availability, and Maintainability*, which was published in June 2005. Andrew has been recognized as a 40 Under 40 recipient for Mohawk Valley in 2006.

**Reliability Functions of Flight-Critical Structural Materials from Stress-Strength Analysis**
*by William R. Wessels, PhD PE CRE*

Figuring out how to “teach an old dog new tricks” is part of what we are faced with every day. And, on occasion, we forget we’re the old dogs.

**Abstract**
The currently accepted body of knowledge for reliability engineering and analysis applied to system design and sustainment relies on characterization of part failure rates from measurement of part times-to-failure. The sources for time-to-failure include historical field data, experimental data, and subjective ‘expert’ estimates. This approach suffices if the part has only one statistically significant failure mode and fatigue, or wear-out, occurs at a constant rate over the useful life. Structural and dynamic parts do not behave this way. Such parts suffer from multiple failure mechanisms that cause multiple statistically significant failure modes, and fatigue results from increasing instantaneous failure rates over the useful life. A valid approach to implementing reliability engineering and analysis applied to system design and sustainment bases the characterization of reliability functions on an understanding of the applied stresses and material strengths of the parts. Both approaches to reliability assessment are presented in this paper where a simple fastener is provided as an example.

**Notation**
- $A =$ Availability
- $cdf, F(t) =$ Cumulative Distribution Function
- $h(t) =$ Hazard Function
- kips = 1,000-Inch-Pounds
- LRU = Line Replaceable Unit
- $Mct =$ Mean Corrective Maintenance Time
- $Mpt =$ Mean Preventive Maintenance Time
- $MTBF, \theta =$ Mean-Time-Between-Failure
- $MTTR, \mu =$ Mean-Time-To-Repair
- $n =$ Sample size
- $pdf, f(t) =$ Probability Distribution Function
- $R =$ Deterministic Reliability
- $r =$ Number of Failed Parts
- $R(t) =$ Reliability Function
- $S(t) =$ Survival Function
- $TTF =$ Time-to-Failure
- $U =$ Deterministic Unreliability
- $\beta =$ Weibull Shape Parameter
- $\eta =$ Weibull Characteristic Life
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survival function, $S(t)$, and estimates the per cent of the part population that will have survived to time $\tau$. The reliability function, $R(t)$, is the conditional probability of the survival function from the beginning of the mission, and is expressed as $R(\tau) = S(\tau|t) = \frac{S(t+\tau)}{S(t)}$. Common practice of expressing the survival function and the reliability function as $R(t)$ poses some confusion. The instantaneous failure rate, the hazard function, $h(t)$, is expressed as $h(t)$. The indefinite integral of the survival function expresses the MTBF, $\theta$. Mean-Time-to-Repair, MTTR, mean corrective maintenance time, Mct, mean preventive maintenance time, Mpt, and mean administrative and logistics downtime, ALDT, are maintainability statistics characterized from analysis, experimental data, historical data, and subjective ‘expert’ estimates. Availability is the ratio of uptime to the sum of uptime and downtime, expressed as $A = \frac{\text{Uptime}}{\text{Uptime} + \text{Downtime}}$. Variations of availability functions, i.e., inherent, operational, achieved, etc., are determined by how uptime and downtime are calculated.

Example Part

Fastening and joining are crucial to design and sustainability of structural and dynamic parts and higher design levels. A simple hex shoulder bolt used to fasten two planar components is selected for the example in this paper. The data sets used to fit time-to-failure and stress-strength probability distributions are notional. The assumed mission duration for the system is three hours.

Best Practice for Time-to-Failure Based Reliability Functions

Two time-to-failure reliability assessment methods are provided: the exponential and the Weibull approaches. A failure-censored experiment is performed under typical conditions of use for 20 test articles and the time to failure for each bolt is tabulated below.
Exponential Approach to Characterize Reliability Functions

The exponential approach is often used to calculate the part failure rate. The total time on test for the test articles is 1,335.7 hours, and yields a failure rate of 0.01497 failures per hour. The MTBF of 66.8-hrs for the test article is calculated as the inverse of the failure rate.

<table>
<thead>
<tr>
<th>Exponential Fit Experimental Time-to-Failure</th>
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<tbody>
<tr>
<td>41.6</td>
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<tr>
<td>52.5</td>
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<td>49.0</td>
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<td>53.9</td>
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<tr>
<td>42.5</td>
</tr>
<tr>
<td>53.8</td>
</tr>
<tr>
<td>54.4</td>
</tr>
</tbody>
</table>

n = 20
r = 20
ΣTTF = 1,335.7
θ = 66.8
λ = 0.01497

The parameter of the exponential pdf is the failure rate, λ. The pdf for the test article is \( f(t) = 0.01497 e^{-0.01497t} \) from the general equation for the exponential pdf, \( f(t) = \lambda e^{-\lambda t} \). The exponential survival function is \( S(t) = e^{-0.01497t} \) from the general equation \( S(t) = e^{-\lambda t} \). The hazard function, \( h(t) \), is a constant equal to the failure rate, \( \lambda \); \( h(t) = \frac{f(t)}{S(t)} = \frac{\lambda e^{-\lambda t}}{e^{-\lambda t}} = \lambda \). The reliability function, \( R(t) \), is also a constant equal to \( e^{-\lambda t} = e^{-(0.01497\times1335.7)} = 0.956084 \). \( R(t) = S(t+\tau) = e^{-\lambda \tau} \). The four reliability functions are graphically shown below.

Weibull Approach to Characterize Reliability Functions

The Weibull distribution is often used to model parts that wear out as they age. The parameters of the Weibull are the shape parameter, \( \beta \), and the characteristic life, \( \eta \). The experimental data from the experiment fit the parameters of the Weibull as shown below.

<table>
<thead>
<tr>
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<tbody>
<tr>
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<tr>
<td>53.8</td>
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<td>54.4</td>
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\( \beta = 2.653 \)
\( \eta = 75.629 \)

The exponential pdf graphically describes a bolt that experiences 4.5% failures for every 3-hr mission. The bolt continues to fail each mission since the hazard rate is constant, and the reliability of the bolt remains constant regardless of its age. A new bolt and a bolt with 100-hrs use are equally liable to fail on the next mission. Engineering judgment and field experience with fasteners suggest that bolts wear out over the useful life; therefore the exponential distribution is not an adequate failure model.

Using the parameters from the experimental data to fit a single Weibull model is a common error that may yield a failure model no better than the exponential approach. The best practice is to plot a frequency distribution of the experimental data as shown on the following page.
The accuracy of estimation for mean time-to-failure, mean-time-to-repair, mean-downtime, and availability are based on the facts portrayed in the timeline. A more accurate table of time-to-failure by failure mode follows.

<table>
<thead>
<tr>
<th>Weibull Fit Experimental Time-to-Failure</th>
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</thead>
<tbody>
<tr>
<td>SHEAR</td>
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<tr>
<td>41.6</td>
</tr>
<tr>
<td>52.5</td>
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<tr>
<td>49.0</td>
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<td>53.9</td>
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<td>42.5</td>
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<td>53.8</td>
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<td>54.4</td>
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<tr>
<td>40.0</td>
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<td>35.7</td>
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<tr>
<td>55.0</td>
</tr>
<tr>
<td>39.5</td>
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<tr>
<td>52.6</td>
</tr>
</tbody>
</table>

\[ \beta = 2.653 \quad \text{and} \quad \eta = 75.629 \]

Table 3 - Time-to-Failure by Failure Mode

The frequency distribution shows that the time-to-failure for the bolt is multimodal, bimodal in this example. Statistical analysis demands that sample measures of central tendency and dispersion must be drawn from a single population. Multimodal data results from samples drawn from two or more populations. The statistical inferences from multimodal samples are worthless.

Failure modes analysis of the bolt finds that shear and tensile stresses act on the bolt and cause it to fail. The operating behavior of the bolt including failure, repair, and idle time is shown in the timeline below.
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The hazard function is other reliability function that influences the suitability of design and logistical support. The hazard function also characterizes operating risk that can be used to specify time-directed maintenance intervals. The single hazard function would dangerously understate the risk of this bolt design and would propose maintenance intervals that would allow failures during scheduled operations. The hazard rate is also used to compute consumption rates. The single hazard function would be wrought with error adversely impacting the sparing strategy and associated costs.
Interference theory posits that stress and strength are statistically distributed and therefore have an overlap on the stress-strength axis, as shown in the notional plot below. The overlap characterizes the probability that stress exceeds strength causing part failure.

**Deterministic, Fixed Approach**

The expression for the deterministic, fixed reliability of the part is shown in its general form under the interference theory plot. The fit for stress and strength distributions for each failure mode is performed by finite element modeling, simulation and analysis with source inputs from design analysis performed to specify part selection and acquisition.

The deterministic reliability is a single, constant value. The fixed reliability assumes that the measures of central tendency and dispersion for stress-strength distributions do not vary over the useful life. Deterministic, fixed interference area is shown graphically as follows.

**Advantages and Disadvantages for Time-to-Failure Reliability Assessment**

The exponential failure distribution has the singular advantage of ease of use at both the part level and the system design level. The exponential failure distribution serves design and sustainment so long as a part has but one failure mode and the consequences of failure are benign. The Weibull failure distribution provides more precision for understanding the failure behavior of wearout parts.

The most important disadvantage for time-to-failure based reliability functions is that they are statistical analyses of the incidence of failure that provide little understanding of the engineering aspects of part failure largely due to the lack of distinction between multimodal failure mechanisms. Time-to-failure characterizations can be performed by statisticians lacking any engineering insight into failure mechanisms.

Time-to-failure characterizations of parts requires time consuming, expensive experiments. Case study reviews find that time-to-failure characterizations lag design often to the point of not influencing design at all, or become disruptive schedule and cost events.

**Interference Theory: Stress-Strength Analysis Approach**

Reliability functions should be integral elements of part and system design. Properly performed reliability functions during design improve the understanding of failure mechanisms that directly influence design analysis to produce high reliability. The understanding of failure mechanisms leads to implementation of interference theory to characterize parameters of reliability functions based on an understanding of failure mechanisms and strength of materials.

The example bolt design is found to have two statistically significant failure modes as shown below. The survival function for the bolt is based on the serial configuration in the following diagram.
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The value for the deterministic reliability of the bolt due to the shear failure mechanism is calculated in MathCad™ as follows in Equation 1.

\[
R_{\text{shear}} := \int_{0}^{\infty} \left[ \frac{\beta_{\text{shear strength}}}{\eta_{\text{shear strength}}} \right]^{\beta_{\text{shear strength}}-1} \frac{\xi^{\beta_{\text{shear strength}}-1} e^{-\frac{\xi}{\eta_{\text{shear strength}}}}}{\eta_{\text{shear strength}}^{\beta_{\text{shear strength}}} \Gamma(\beta_{\text{shear strength}})} \left[ 1 - e^{-\frac{\xi}{\eta_{\text{shear strength}}}} \right] d\xi
\]

\[R_{\text{shear}} = 0.998733\]

**Equation 1 - Deterministic Bolt Shear Reliability**

The value for the deterministic reliability of the bolt due to the tensile failure mechanism is calculated in MathCad™ as follows in Equation 2.

\[
R_{\text{tension}} := \int_{0}^{10} \left[ \frac{\beta_{\text{tensile strength}}}{\eta_{\text{tensile strength}}} \right]^{\beta_{\text{tensile strength}}-1} \frac{\xi^{\beta_{\text{tensile strength}}-1} e^{-\frac{\xi}{\eta_{\text{tensile strength}}}}}{\eta_{\text{tensile strength}}^{\beta_{\text{tensile strength}}} \Gamma(\beta_{\text{tensile strength}})} \left[ 1 - e^{-\frac{\xi}{\eta_{\text{tensile strength}}}} \right] d\xi
\]

\[R_{\text{tension}} = 0.998911\]

**Equation 2 - Deterministic Bolt Tensile Reliability**

The design specification states a shear stress of 3.3-kips and a tensile stress of 2.15-kips. The design strength using a safety factor of 2.00 and bolt specifications selected a bolt that has 7.5-kips and 5.6-kips for shear and tension respectively. Weibull distributions for the interference area for shear and tension are plotted below.
The principle advantage for stress-strength based reliability functions is the understanding of failure mechanisms and guidance that understanding provides to mitigate failure during the performance of part design analysis. Stress-strength based reliability functions are achieved through analysis unlike time-to-failure experiments. It is the least expensive approach that stays on schedule and best achieves technical requirements.

Stress-strength based reliability provides invaluable information for system sustainment by providing insights into the conditions of failure for critical parts. Condition-based maintenance is defined by the ability to measure and understand a metric for wear out; stress-strength based reliability provides that insight directly. Time-to-failure based reliability treats all parts with population statistics that provide no insight into part condition.

Stress-strength based reliability provides quantified metrics of risk that can be used to define inspection intervals for time-directed maintenance. Time-to-failure based reliability can only offer lower confidence limits of the population that infuses high costs.

The deterministic, fixed approach relies heavily on the current state of the art for strength of materials applied by design engineers. Professional development courses that enable engineers to fit statistical stress-strength models are needed.

The non-deterministic, variable approach has one fatal disadvantage; it hasn’t become practical yet. The algorithms have yet been developed that pass scrutiny.

The most salient conclusion is that reliability functions should become an essential aspect of the part to system design process. This will assure the best design solution within the same timeframe. The proposed process is not tied to costly part testing.

The values of the deterministic, fixed survival functions for failure mode reliability are used to evaluate design alternatives and to evaluate reliability growth actions. The deterministic failure mode reliability is also used to characterize the survival function of the part over time. Characterization of the bolt failure mode and part survival functions, assuming time is measured by cycles, \( \nu \), is provided below.

\[
\begin{align*}
\text{Sshear}(\nu) &= R_{\text{shear}} \\
\text{Stension}(\nu) &= R_{\text{tension}} \\
\text{Spart}(\nu) &= \text{Sshear}(n) \times \text{Stension}(\nu)
\end{align*}
\]

The survival functions are plotted below.

**Advantages and Disadvantages for Stress-Strength Analysis Approach**

The principle advantage for stress-strength based reliability functions is the understanding of failure mechanisms and guidance that understanding provides to mitigate failure during the performance of part design analysis. Stress-strength based reliability functions are achieved through analysis unlike time-to-failure experiments. It is the least expensive approach that stays on schedule and best achieves technical requirements.

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http://Synthesis.Reliasoft.com
to determine design parameters. While algorithm development does incur costs, to move to rely on this analytical approach will have a positive impact on overall system costs.

References
2) Birolini, Alessandro [1994], Quality and Reliability of Technical Systems, Zurich, Switzerland: Swiss Federal Institute of Technology.

About the Author
Dr. William Wessels is the Technical Director of the Reliability & Failure Analysis Laboratory in the UAHuntsville Research Institute. He serves as the Principal Investigator on research projects that investigate reliability and maintainability for mechanical and structural design-for-reliability and reliability-centered maintenance. His reliability & maintainability career includes 15-years in mining mobile and process systems, 15-years in military aviation, radars and missile systems, and 7-years in basic and applied research. He is the author of Reliability Engineering & Analysis for System Design and Life-Cycle Sustainability (CRC Press, 2010), and the co-author of GEIA STD-0009. He is a member of the SAE G-11 Committee for Reliability. He is a 1970 graduate of the U.S. Military Academy at West Point and received a PhD in Systems Engineering in 1996 from the University of Alabama in Huntsville. He and his wife, Tudor, live on a small farm in New Market, AL.

IN MEMORIAM

Bernard C. Price

Bernard C. Price is survived by his beloved wife Margaret, his children Amanda and Mike Ransom, Lisa Price, and Adam Price; his grandchildren Cole and Chase Ransom; and his mother-in-law Lottie Symes. He is also survived by his siblings Fred and Laura Price, Elaine and Dan Rubinstein, and Idelle and Dan Claypool. Mr. Price was born in Chicago, IL and moved to Van Nuys, CA at age sixteen. Mr. Price earned a Bachelor’s in Engineering and a Master’s in both Industrial Engineering and Electrical Engineering. He worked for the Army at Fort Monmouth, NJ as a civilian for thirty-five years and was Chief of Systems Analysis for about half that duration. He was proud to have led a team which applied and developed many tools to recommend best value decisions among possible alternatives. Working as a premier analyst and logistician, Mr. Price made many lasting friends in the workplace. He culminated his career with presentations that were placed on the Defense Acquisition University website. Over the years, Mr. Price was a member of multiple organizations. He was one of the founders of the Central Jersey Ski Club and held various officer positions, including President. Mr. Price was an active member of the International Society of Logistics Engineers (SOLE) and had served as President of the Garden State Chapter. He had actively given presentations and short courses for the Reliability, Maintainability, and Supportability (RMS) Partnership and later served as its Membership Director. He is a member of the National Active and Retired Federal Employees (NARFE) Association. During his retirement years, Mr. Price was an avid bowler and enjoyed traveling with his wife. Both Mr. and Mrs. Price enjoyed their retirement years together and are grateful for the many friends they made in El Paso, TX.
As most in the defense acquisition workforce are aware, maintaining a competitive environment is not an easy task given the defense mission, the rapid development of advanced technology, Congressional mandates and oversight and the relatively limited competitive customer base. Stated in ‘government speak,’ the ultimate mission of the defense department is to safeguard our national security by killing people and breaking things with the use of advanced technology, under the watchful eyes of Congress, as implemented by limited members of a well-controlled group that has little or no input to the acquisition process—the Warfighters. This is quite a different mission scenario than what takes place in the competitive, domestic global marketplace.

During the September 19-20, 2012 RMS Partnership workshop and symposium that addressed ground vehicle safety and reliability, I had an ‘ah-ha moment’ when a number of speakers mentioned that no automobile company wants to be known as having an unsafe (and I may add unreliable) vehicle—to do so would make them highly uncompetitive and eventually reduce or eliminate their customer base. Automobile manufacturers are well aware that the buying public, the customer, has the necessary information and leverage to make an intelligent and economically wise purchase. They can and will vote with their feet by walking away from products that fail to meet their needs and expectations. Along with a lack of independent watchdog agencies, e.g., Consumer Reports, that kind of purchasing leverage is leverage is lacking, for the Warfighter and in the DoD acquisition community.

During that September workshop, representatives from the Nevada Automotive Test Center (NATC), the Insurance Institute for Highway Safety and Calspan, an aerospace and transportation research company, provided me great insight into competition and marketing in the automotive industry. These three organizations conduct crash and related testing that provides empirical evidence pertaining to the safety and reliability of automobiles in the global marketplace. The results of much of their testing regarding automobile safety and reliability is documented in writings and on videos. Their test findings are often made public for all to see, to include the general public, manufacturers, and government officials.

This information, without question, makes it easier for consumer, manufacture, and government agencies to make decisions regarding automobile safety and reliability that align with their particular priorities and interest. For instance, manufacturers that have vehicles that are safer and more reliable are quick to exploit these vehicle attributes through commercial advertisement in the hope of increasing their market share in the industry. Those manufacturers with vehicle products that reflect less favorable ratings know they have to either improve the safety and reliability of their vehicles or possibly risk

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financial disaster. This competitive environment among automobile manufacturers provides tangible benefits for the general public and government regulatory agencies; safer and more reliable vehicles for the public; empirical evidence that government agencies can utilize to establish appropriate automobile safety and reliability standards—all of which promotes advanced technology that’s dependable that can be implemented in a cost-effective manner.

Within the defense acquisition community information concerning the products of manufacturers and their competition are seldom, if ever, known. Safety and reliability requirements are viewed within the government-industry defense community as program cost drivers. The result is acquisition cost(s) continuing to escalate while the advancement of leading-edge technology, from a safety and reliability perspective, remain secondary in importance to schedule and performance. Each of the Services has dedicated, skilled test professionals that admirably carry out their duties and responsibilities however, their proverbial playing field is not as level as that of the domestic testing community. DoD product test results are generally tightly controlled within government-manufacturer circles, and Warfighter-user input into the acquisition process is negligible. Since there are few defense contractors, they can’t be pitted, competitively, against each other and, most importantly, members of the DoD acquisition community and the Warfighter can’t vote on product safety and reliability issues with their feet.

So what is the answer to having “competition strategies and creating and maintain competitive environments with the Department of Defenses?” It may be as easy as applying best industry practices where possible, as well as knowing when not to use them. The DoD acquisition community needs to move towards a more open and transparent competitive acquisition process that broadens the number of defense industry partners who in turn are obliged to make their safety and reliability test results available to the general public. The acquisition decision makers and the Warfighter should be given the opportunity to vote with their feet.

Another Day At The Office

by Russell A. Vacante, Ph.D.

Stovepipes not only exist within organizations but also across organizations. This failure to effectively communicate lessons-learned often results in an expensive duplication of efforts.

That’s a superb idea. Such a cross training program would help improve communication within organizations and across organizations. In addition to improving vehicle safety and reliability great cost savings could be achieved by sharing related lessons-learned and having cross-training intern programs.

More cross training and sharing of information and experience will improve the performance of most organizations. For example, the safety and reliability of many ground vehicles would greatly improve if cross training programs were institutionalized within industry, DoD and DoT.