

# Event Program



## International Applied Reliability Symposium

**JUNE 7 - 9, 2011**  
**SAN DIEGO, CALIFORNIA**

Global Issues, Local Perspectives!<sup>SM</sup>

South America ● North America ● Asia Pacific ● Europe ● India

## PROGRAM HIGHLIGHTS

**THEME:** Sharing applications, success stories and lessons learned in reliability and maintainability engineering.



**30 PRESENTATIONS:** The program offers thirty results-oriented presentations by actual practitioners in industry and government. Topics include: Reliability Program Planning, Design for Reliability, FMEA, Fault Tree Analysis, Reliability Growth Analysis, Accelerated Testing, Life Data Analysis, FRACAS, Repairable System Analysis, RCM, Optimized Maintenance Planning, Risk Analysis, Software Reliability and much more.



**4 TUTORIALS:** The program also includes four tutorials by experts in the field of reliability analysis:

*A Conceptual Introduction to Object Based Reliability Modeling (OBRM)* by Pantelis Vassiliou of ReliaSoft Corporation

*Increase Your Reliability Presence Without Increasing Staff* by Stan Stephenson of Halliburton

*Application Lessons for Effective FMEAs* by Carl S. Carlson of ReliaSoft Corporation

*Optimization in Reliability and Maintainability Applications* by Edward A. Pohl of the University of Arkansas

## VENUE

The 2011 ARS, North America will be held at the **San Diego Marriott Mission Valley Hotel** in San Diego, California. Participants must make hotel reservations on their own, either at the Marriott or at another hotel of their choosing. For details, please see page 4.

# INDUSTRY AND GOVERNMENT SHARING SUCCESS STORIES AND LESSONS LEARNED

## OTHER SYMPOSIA

The Symposium is held annually at locations throughout the world. Other scheduled events include:

**Europe**  
March 2011

**South America**  
May 2011

**India**  
October 2011

**Asia Pacific**  
October 2011



<http://www.ARSymposium.org>

# 2011 INTERNATIONAL APPLIED RELIABILITY SYMPOSIUM - NORTH AMERICA

The **International Applied Reliability Symposium** provides a forum for expert presenters from industry and government to come together with reliability practitioners from all over the world to discuss the application of reliability principles to meet real-world challenges. The Symposium has been designed to encourage results-oriented presentations with interactive discussions about best practices, success stories and lessons learned. Most of the presenters have been applying reliability, maintainability and related techniques in their day-to-day work for years.

**Symposium Theme:** "Sharing applications, success stories and lessons learned in reliability and maintainability engineering."

The Symposium's 30 presentations and 4 tutorials cover a range of subjects, such as:

- |  |                                  |
|--|----------------------------------|
| ◆ Reliability Program Planning             | ◆ Reliability Growth Analysis    |
| ◆ Design for Reliability (DFR)             | ◆ Repairable System Analysis     |
| ◆ Accelerated Testing                      | ◆ Optimized Maintenance Planning |
| ◆ Failure Mode and Effects Analysis (FMEA) | ◆ Risk Analysis                  |
| ◆ Life Data Analysis                       | ◆ Software Reliability           |

**JUNE 7 - 9, 2011**  
**SAN DIEGO, CALIFORNIA**

<http://www.ARSymposium.org/northamerica/>

The 2011 event is organized by ReliaSoft Corporation ([www.Reliasoft.com](http://www.Reliasoft.com)) and the System Reliability Center ([SRC.AlionScience.com](http://SRC.AlionScience.com)).

**ReliaSoft®**



# 2011 ARS, NORTH AMERICA

2011	Tuesday - June 7th		Wednesday
	Track 1	Track 2	Track 1
7:00-8:00	<b>Registration and Check-in</b> (You also have the option to check-in on Monday from 4 - 7 p.m.) <i>Coffee and pastries served.</i>		<i>Coffee and pastries served</i>
8:00-9:00			Simulation of Time-Varying Throughput by Combining Availability and Solar Irradiance Models <b>Michael Mundt</b> <i>Sandia National Laboratories</i> T1-S5 <input type="checkbox"/>
	<b>Welcome Address</b> (starts at 8:30 a.m. in the Track 1 Room)		
9:00-9:10	10 Minute Break		10 Minute Break
9:10-10:10	Design for Reliability, What It Is and What It Isn't — Practical Steps for Implementation <b>Andre Kleyner</b> <i>Delphi Corporation</i> T1-S1 <input type="checkbox"/>	Achieving Reliability from Data at Cerrejón Coal <b>Murray Wiseman</b> <i>Optimal Maintenance Decisions Inc. (OMDEC)</i> T2-S1 <input type="checkbox"/>	Effective Reliability Testing to Drive Design Improvement <b>Keyanna Qi</b> <i>Ingersoll Rand</i> T1-S6 <input type="checkbox"/>
10:10-10:30	20 Minute Break		20 Minute Break
10:30-11:30	USMC Ground Weapons Systems Lifecycle Reliability and Logistics Engineering Analysis <b>Joseph Katz</b> <i>Marine Corps Systems Command</i> T1-S2 <input type="checkbox"/>	Reliability Prediction in Early Program Development <b>Robert Graber</b> <i>Science Applications International Corporation (SAIC)</i> T2-S2 <input type="checkbox"/>	Accelerated VAVE Validation Testing <b>Harland MacKenzie</b> <i>Dana Power Technologies</i> T1-S7 <input type="checkbox"/>
11:30-1:00	1 Hour 30 Minute Lunch Break		1 Hour 30 Minute Lunch
1:00-2:00	Integrating System Safety Analyses into the Reliability, Maintainability and Testability (RMT) Development Process on a Radar Development Program <b>Mark Midoux</b> <i>Raytheon</i> T1-S3 <input type="checkbox"/>	When is a Markov Analysis Required? <b>Vito Faraci Jr.</b> <i>VFJ Consultants</i> T2-S3 <input type="checkbox"/>	Proving a New Refinery Design Using Reliability Throughput Modeling <b>Damien Willans</b> <i>SSR Engineering Pty Ltd.</i> T1-S8 <input type="checkbox"/>
2:00-2:20	20 Minute Break		20 Minute Break
2:20-3:20	Ensuring Robustness and Reliability in Lean Product Development <b>John J. Paschkewitz</b> <i>Watlow</i> T1-S4 <input type="checkbox"/>	Reliability Growth Modeling of a Multi-Stage Single-Shot System <b>Jennifer L. Nicholls</b> <i>U.S. Navy</i> T2-S4 <input type="checkbox"/>	Fault Tree Analysis in Product Engineering <b>Shri Gupta</b> <i>Motorola</i> T1-S9 <input type="checkbox"/>
3:20-3:30	10 Minute Break		10 Minute Break
3:30-5:00	A Conceptual Introduction to Object Based Reliability Modeling (OBRM) <b>Pantelis Vassiliou</b> <i>ReliaSoft Corporation</i> T1 - Tutorial 1 <input type="checkbox"/>	Increase Your Reliability Presence Without Increasing Staff <b>Stan Stephenson</b> <i>Halliburton</i> T2 - Tutorial 1 <input type="checkbox"/>	Application Lessons for Effective FMEAs <b>Carl S. Carlson</b> <i>ReliaSoft Corporation</i> T1 - Tutorial 2 <input type="checkbox"/>
5:30-9:00			

# SYMPOSIUM PROGRAM

- June 8th	Thursday - June 9th	
Track 2	Track 1	Track 2
<i>Coffee and pastries served. Attendance certificates distributed.</i>		
<p>How to Achieve a 1% Return Rate <b>Nematollah Bidokhti</b> <i>Cisco Systems</i></p> <p style="text-align: right;">T2-S5 <input type="checkbox"/></p>	<p>Applying Physical Asset Reliability Analysis Methods to Predict the Probability of Human Susceptibility to Chronic Diseases <b>David Sada</b> <i>Andromeda Systems Incorporated (ASI)</i></p> <p style="text-align: right;">T1-S10 <input type="checkbox"/></p>	<p>Developing and Implementing an Effective Reliability Program Plan <b>Richard Coronado</b> <i>Lockheed Martin Corporation</i></p> <p style="text-align: right;">T2-S10 <input type="checkbox"/></p>
<b>10 Minute Break</b>		
<p>V-22 Osprey: Development to Deployment <b>Gregg Skinner</b> <i>U.S. Marine Corps</i></p> <p style="text-align: right;">T2-S6 <input type="checkbox"/></p>	<p>Determining Software Reliability and Readiness <b>Jack Olivieri</b> <i>MITRE Corporation</i></p> <p style="text-align: right;">T1-S11 <input type="checkbox"/></p>	<p>Reliability and Risk Analysis Ahead of the International Space Station Life Extension <b>Fareed Hayek</b> <i>NASA</i></p> <p style="text-align: right;">T2-S11 <input type="checkbox"/></p>
<b>20 Minute Break</b>		
<p>What is DFR and What is Not DFR? <b>Mike Silverman</b> <i>Ops A La Carte LLC</i></p> <p style="text-align: right;">T2-S7 <input type="checkbox"/></p>	<p>Physics of Failure in Five Minutes <b>Randy Schueller</b> <i>DfR Solutions</i></p> <p style="text-align: right;">T1-S12 <input type="checkbox"/></p>	<p>Structural Reliability for Mechanical Components Under Road Vibration Loading <b>Julio E. Pulido</b> <i>Ingersoll Rand</i></p> <p style="text-align: right;">T2-S12 <input type="checkbox"/></p>
<b>1 Hour 30 Minute Lunch Break</b>		
<p>Knowledge Based Qualification — Know the Failures to Guarantee No Failures <b>Paul Ngan</b> <i>NXP Semiconductors</i></p> <p style="text-align: right;">T2-S8 <input type="checkbox"/></p>	<p>Challenges in Implementing a DFMEA Program <b>G. Michael Smith</b> <i>Linamar Corporation</i></p> <p style="text-align: right;">T1-S13 <input type="checkbox"/></p>	<p>Effect of Natural Frequency Shifting on Accelerated Life Vibration Testing <b>Mark Paulus</b> <i>U.S. Navy</i></p> <p style="text-align: right;">T2-S13 <input type="checkbox"/></p>
<b>20 Minute Break</b>		
<p>Driving Product Reliability and Service Quality in the Oil Services Industry <b>Randolph G. Phillips</b> <i>Baker Hughes Incorporated (BHI)</i></p> <p style="text-align: right;">T2-S9 <input type="checkbox"/></p>	<p>FRACAS, A Key to Successful Performance Based Logistics Programs <b>Ken Millsbaugh</b> <i>Raytheon</i></p> <p style="text-align: right;">T1-S14 <input type="checkbox"/></p>	<p>The Khurais Producing Facility's Preventive Maintenance Optimization Assessment <b>Abdullah A. Al-Aqeel</b> <i>Saudi Aramco</i></p> <p style="text-align: right;">T2-S14 <input type="checkbox"/></p>
<b>10 Minute Break</b>		
<p>Optimization in Reliability and Maintainability Applications <b>Edward A. Pohl</b> <i>University of Arkansas</i></p> <p style="text-align: right;">T2 - Tutorial 2 <input type="checkbox"/></p>	<p>Calculating the Reliability Improvement Value of HALT <b>Neill Doertenbach</b> <i>Qualmark Corporation</i></p> <p style="text-align: right;">T1-S15 <input type="checkbox"/></p>	<p>Dramatic COTs Design Accomplishments Traced to Innovative DFR Practice <b>Gene Bridgers</b> <i>Mercury Computer Systems Inc.</i></p> <p style="text-align: right;">T2-S15 <input type="checkbox"/></p>
<p><b>Hosted Reception and Awards Dinner</b> (for attendee and a guest) Reception from 5:30 to 6:30 on the Pavilion patio. Dinner from 6:30 to 9:00 in the Pavilion room.</p>		

## EVENT LOCATION AND HOTEL ACCOMMODATIONS

The 2011 North America Applied Reliability Symposium will be held at the **San Diego Marriott Mission Valley Hotel** in San Diego, California.

Please make hotel reservations on your own, either at a hotel of your choosing or at the San Diego Marriott Mission Valley Hotel. A rate of US\$159.00 for Single/Double (US\$147.00 for government employees) is available to Symposium participants. To be eligible for this rate, rooms must be reserved by **May 16th**. Please refer to "ReliaSoft Corporation" and/or the "Applied Reliability Symposium" when making your reservations.

*NOTE: Given seasonal occupancy rate conditions, the hotel might engage in promotions that occasionally offer a lower rate. Be sure to check the online rates before booking to take advantage of any additional discounts that may be available.*

### Contact Information and Reservations:

- **Website:** <http://www.marriott.com/hotels/travel/sanmv-san-diego-marriott-mission-valley/>
- **Telephone Reservations:** 1.800.842.5329



For more information about the venue, please visit [http://www.ARSymposium.org/2011/ars2011\\_location.htm](http://www.ARSymposium.org/2011/ars2011_location.htm).

## TUESDAY JUNE 7, 2011

### Welcome Address 8:30 to 9:00 a.m. on Tuesday, June 7th

To begin the event program, Pantelis Vassiliou will represent the Symposium's organizers by delivering a brief welcome address.

Pantelis Vassiliou is President and CEO of ReliaSoft Corporation. He directs and coordinates ReliaSoft's R&D efforts to deliver state-of-the-art software tools for applying reliability engineering concepts and methodologies. He also consults, trains and lectures on reliability engineering and related topics to Fortune 1000 companies worldwide. Mr. Vassiliou is the original architect of ReliaSoft's Weibull++® software and is ReliaSoft's founder. He holds an M.S. degree in Reliability Engineering from the University of Arizona.

### Session 1 9:10 to 10:10 a.m. on Tuesday, June 7th

#### TRACK 1

**Andre Kleyner - Delphi Corporation**

#### Design for Reliability, What It Is and What It Isn't — Practical Steps for Implementation

Design for Reliability (DFR) is an important trend in today's product development process; however, there is no consensus on what DFR exactly entails and how it should be properly implemented. This presentation contains an overview of the most common definitions, procedures and guidelines for DFR, and describes the steps of transforming DFR into an enterprise-wide activity. The presentation also addresses the problem of limited engineering resources in today's workplace and suggests how to approach and deal with that problem in successful pursuit of Design for Reliability.

#### TRACK 2

**Murray Wiseman and Daming Lin - Optimal Maintenance Decisions (OMDEC)**

**Juan Carlos Consuegra and Gerardo Vargas - Cerrejón Minería**

#### Achieving Reliability from Data at Cerrejón Coal

There can be no reliability analysis without an adequate data sample, and there can be no systematic, verifiable improvement in reliability nor in operational economy without reliability analysis. Well-known obstacles impede the reliability engineer in his role to analyze maintenance data. The main problem lies in the difficulty in obtaining analyzable data samples. In this context, a "sample" is a collection of failure mode life cycles, and each life cycle is defined by a beginning and ending event. Although modern CMMS systems should provide the needed information, they rarely deliver data samples of adequate quality. Cerrejón Minería, an integrated mining operation in Colombia, South America, solved the information management problem by applying a Living Reliability Centered Maintenance (LRCM) process to its fleets of trucks, graders, dozers, scrapers and shovels.

This presentation describes a method wherein completed work orders capture the information required for reliability analysis. The "right" maintenance observations reference significant failure modes. Work orders link to records in a continuously growing RCM-structured knowledge base. Grouped and filtered knowledge-to-work order links, being instances of failure modes, provide the samples required by reliability analysis software tools and methods. LRCM software and related procedures facilitate the growth of knowledge, manage the work order-to-RCM relationship and generate samples for subsequent reliability analysis.

**Session 2**

10:30 to 11:30 a.m. on Tuesday, June 7th

**TRACK 1**

**Joseph Katz - Marine Corps Systems Command  
and Andrew J. Foote - Alion Science and Technology**

**USMC Ground Weapons Systems Lifecycle Reliability and Logistics Engineering Analysis**

As the smallest and most lethal fighting force today, the Marine Corps requires that its equipment is mission ready and combat capable at all times. Program Managers at Marine Corps Systems Command have been tasked to manage ground combat systems from cradle to grave. In order to accomplish this task, they need to have an understanding of how their systems are performing, and how the logistics chain is helping to sustain these weapons systems. The Assistant Commander for Product Support (AC PROD) supports the Program Managers with lifecycle analysis through the use of the Systems Operational Effectiveness Decision Support Tool (SOE DST). The SOE DST provides reliability metrics and enables reliability and logistics engineering analysis to help Program Managers make the right lifecycle decisions in order to sustain the warfighter.

This presentation will provide insight on how the Marine Corps is conducting lifecycle analysis given the quality of data that is being captured, and how it can support acquisition and sustainment decisions related to overhaul, service life extension, performance based logistics, condition based maintenance, reliability centered maintenance and predictive modeling initiatives.

**TRACK 2**

**Robert Graber - Science Applications International Corporation (SAIC)**

**Reliability Prediction in Early Program Development**

Predicting or estimating the reliability of a system or item before it is built or even fully designed is challenging and fraught with uncertainty. However, today's major acquisition processes usually call for a reliability prediction to be accomplished very early in order to provide for system architecture and design trade-off studies, and for use in estimating other performance metrics such as risk and mission success probabilities.

This presentation provides a discussion of the data collection, management and analysis needed to support early reliability prediction on a large-scale program and summarizes many of the latest data sources, tools and methods. The presentation draws upon some of the reliability program and prediction processes and data sources used in NASA's Constellation Program.

**Session 3**

1:00 to 2:00 p.m. on Tuesday, June 7th

**TRACK 1**

**Mark Midoux and Micah Koons - Raytheon**

**Integrating System Safety Analyses into the Reliability, Maintainability and Testability Development Process on a Radar Development Program**

This radar development program case study illustrates how reliability, maintainability, testability and system safety (RMTS) analyses conducted during the preliminary and critical design phase can be integrated to provide traceability between each analysis. Using a centralized data collection point and a common interface mechanism, the RMTS analyses could be performed by a moderately large team, while at the same time eliminating redundancies and reducing data entry defects.

The presentation will describe the analytical development process, provide an overview of the software tools used, and detail the benefits that this approach afforded the program (in terms of both quality and timeliness). In particular, the presentation will demonstrate how the integration of system safety analyses into the RMT process provided more robust and quantifiable fault tree analyses as well as hazard analyses that are traceable to the Failure Modes, Effects and Criticality Analysis (FMECA). In addition to improved quality, the integrated approach streamlined schedule and cost performance by eliminating redundant efforts and automating the interfaces between the analyses performed by each specialty discipline.

**TRACK 2**

**Vito Faraci Jr. - VFJ Consultants**

**When is a Markov Analysis Required?**

This presentation focuses on some of the major challenges the engineer faces when performing a Fault Tree Analysis (FTA) or a System Reliability Analysis (SRA), and tries to answer *when* a Markov Analysis (MA) is required. In order to better understand *when* a Markov analysis may be required, a short discussion on *why* Markov analysis is required will be presented along with examples. This presentation will concentrate on the qualitative aspect of an FTA or SRA, as opposed to the quantitative methods for solutions (*i.e.* the math). There are three basic reasons for this:

- Quantitative solution methods generally involve solving simultaneous differential equations, which is another subject all by itself.
- It is the qualitative analysis that determines whether Markov analysis is required.
- Software packages are readily available for quantitative analysis segments of FTA and MA, but not for the qualitative segments; therefore, the qualitative aspect may offer the greater challenge.

System failure propagation characteristics depend mainly on two variables: component failure rate (constant or non-constant) and component configuration (series, parallel, combinatorial or non-combinatorial). These two variables can get confused but actually they are independent, one having nothing to do with the other. Therefore, a short discussion will be presented to highlight and stress the distinctions.

## Session 4

2:20 to 3:20 p.m. on Tuesday, June 7th

### TRACK 1

John J. Paschkewitz - *Watlow*

#### Ensuring Robustness and Reliability in Lean Product Development

Many companies have begun their lean journey and have implemented lean manufacturing methods. The next step is applying lean to other processes including product development. While Lean New Product Development (Lean NPD) does focus on customer value and eliminating waste, it is also a front-loaded, knowledge-based approach. From a quality and reliability perspective, this should be viewed positively because it offers the opportunity to do what is needed up-front to ensure robust and reliable products. This presentation provides an introduction to Lean NPD and shows how it can be applied in a variety of areas to improve product reliability and robustness. This includes reliability requirements definition, design decisions, risk assessment and mitigation, critical characteristics and process control, product testing, and failure analysis/corrective action.

### TRACK 2

Jennifer L. Nicholls - *U.S. Navy*

#### Reliability Growth Modeling of a Multi-Stage Single-Shot System

Single-shot systems such as weapons or launch vehicles present a unique challenge in reliability growth modeling. Frequently these systems remain in storage or standby for a long period of time, and operational use for these systems can remain low. Determination of failure cause and correction during operational use is difficult or impossible for most of these types of systems. So the reliability prediction challenges that exist for development systems remain throughout the life cycle of a one-shot system. Continued testing of representative articles remains the only method of measuring reliability throughout the life of the system, though budget constraints limit this number as well. Therefore, even in the best case, there are a limited number of data points for classic reliability calculations. This presentation uses a Bayesian model to look at continuing the application of reliability growth models throughout the life of a single-shot system. Traditional attribute growth models characterizing each event as either a success or failure are an over-simplification that does not adequately address the complex nature of today's systems. Models are extended here to account for a multi-stage sequential system. A real data set from the complete test and operational history of a multi-stage single-shot system is examined.

## Tutorial 1

3:30 to 5:00 p.m. on Tuesday, June 7th

### TRACK 1

Pantelis Vassiliou - *ReliaSoft Corporation*

#### A Conceptual Introduction to Object Based Reliability Modeling (OBRM)

Object Based Reliability Modeling (OBRM) uses a new paradigm and data architecture for reliability analysis and associated modeling. The new approach is designed to integrate, streamline and enhance reliability activities across the enterprise, while at the same time enabling and encouraging the management and reuse of existing reliability knowledge. As product development complexity increases and organizations become geographically dispersed, it becomes increasingly difficult to coordinate and implement reliability activities in a way that enables engineers throughout the organization to leverage the data and results obtained in other projects, departments and/or facilities. The OBRM methodology and architecture is designed to overcome these constraints while maximizing the organization's return on investment related to reliability activities.

### TRACK 2

Stan Stephenson - *Halliburton*

#### Increase Your Reliability Presence Without Increasing Staff

Would you like to increase the reliability presence of your projects without increasing the headcount of your reliability staff? This additional presence can be realized by training your design engineers in reliability principles. Since the goal for reliability is the minimization of life cycle costs, training your design engineering staff in the fundamentals of reliability provides direct reliability involvement at the start of every project where the greatest impact on life cycle costs can be achieved. Once trained in reliability principles, your design staff will better recognize when they need to seek out reliability expertise for their projects. The intent of this tutorial is not to teach reliability principles to the conference attendees, but to present effective methods for teaching various reliability principles to the design engineers. Some of the principles are presented in more than one manner to help the design engineers better grasp the principles. A balance of detail, cartoons and movies is used to keep the design engineers engaged in the material.

## ARE YOU INTERESTED IN PRESENTING NEXT YEAR?

Do you have a useful reliability application or lesson learned that you would like to share with your colleagues in the field? The "Call for Presentations" for the 2012 Symposium will be posted soon after the completion of this year's event. The proposals will be reviewed in **November/December 2011**. For specific details, including the required proposal submission form, please visit <http://www.ARSymposium.org/present.htm>. As the primary author of a presentation delivered at the ARS, you will receive complimentary registration to the event, a "Presenter" shirt with the ARS logo and our sincere appreciation for helping to make the event thought-provoking and rewarding for your fellow reliability professionals. You will also have a chance to win one of the cash prizes that will be awarded to the top three presentations, as voted by Symposium attendees.

**Session 5**

**8:00 to 9:00 a.m. on Wednesday, June 8th**

**TRACK 1**

**Michael Mundt, Elmer Collins, Steven Miller, Joshua Stein, Rob Sorenson, Jennifer Granata and Michael Quintana - Sandia National Laboratories**

**Simulation of Time-Varying Throughput by Combining Availability and Solar Irradiance Models**

A reliability and availability model that includes time-varying throughput in kilowatt hours (kWh) has been developed for a portion of the 4.6 megawatt (MWdc) photovoltaic system operated by Tucson Electric Power at Springerville, Arizona. The model was developed using a commercially available software tool, GoldSim®. The reliability model was populated using analyses performed with ReliaSoft's Weibull++® and RGA® software, with life distributions and off-time distributions derived from data accumulated during multiple years of operation of this system. Using the life, repair and other off-time distributions, the GoldSim software combines the system reliability and availability model with another model that simulates daily and seasonal solar irradiance due to variations in weather and geography, as well as inverter and photovoltaic module performance. The resulting combined model allows prediction of kWh energy output of the system. This model was then used to study the sensitivity of energy output as a function of photovoltaic module degradation at different rates, the effect of location (solar irradiance) and the effect of accelerated aging models. Plots of cumulative energy output versus time for a 30 year period are obtained for each of these cases.

**TRACK 2**

**Nematollah Bidokhti - Cisco Systems**

**How to Achieve a 1% Return Rate**

This session discusses methodologies and approaches to achieve a 1% return rate. This goal might be too stringent for some markets and not strong enough for others. In the presentation, various techniques and tools are presented that will enable the attendees to gain the appropriate level of knowledge to tackle this challenging issue. It should be noted that designs in general are becoming more complex with many requirements being requested by customers, management and industry. Therefore, it is not surprising to see products that are not as reliable as they need to be. It is difficult to design the perfect reliable product with the exact design. But, this task becomes feasible through a proactive reliable design methodology.

**Session 6**

**9:10 to 10:10 a.m. on Wednesday, June 8th**

**TRACK 1**

**Keyanna Qi and John Wold - Ingersoll Rand**

**Effective Reliability Testing to Drive Design Improvement**

Reliability testing is critical for new component qualification, design change validation, or field failure simulation for root cause analysis. In many cases, with tight project schedules and scarce available resources, some important critical characteristics of a component or subsystem are overlooked. This will potentially result in new failure modes after implementing changes in production. The author will explain how to develop an effective test plan using the 6σ (Six Sigma) problem solving process, IDOV (Identify, Design, Optimize and Validation), to make the testing simple but efficient.

- **Teamwork.** It is very essential to get inputs from subject matter experts to understand part functions, failure modes and root cause of failures.
- **Test to Failure.** In contrast to the traditional qualification test, "Test to Failure" (ALT and HALT) can help to identify the root cause using a smaller sample size, but gaining high confidence.
- **Validation.** Once the qualification test confirms that the component meets the design requirement, the system integration validation shall be executed to ensure there is no malicious interference with other components.

These three factors — teamwork, test to failure and validation — will ensure that the reliability test is done successfully to drive design improvement.

**TRACK 2**

**Gregg Skinner and Michael Belcher - U.S. Marine Corps**

**V-22 Osprey: Development to Deployment**

The V-22 Osprey combines the capabilities of a helicopter with a turboprop. Additionally, it incorporates state-of-the-art fly-by-wire controls, advanced automation for aircrew interfacing and component monitoring, as well as rigorous susceptibility and vulnerability requirements. The Osprey has been changing the battlefield since it began worldwide deployments in 2007 but it has been in development for almost 30 years. Behind this modern day technological success is a program that offers lessons learned across the spectrum and phases of acquisition. The assumption-to-knowledge ratio on the V-22 has been larger than most programs. Scaling the weapon system, sub-system and component reliability from its 1/3 scale mechanical prototype (XV-3) has proven challenging and insightful. Following predictions from analogy, parametric, engineering to actuals has required different skill sets, testing, data and knowledge management tools. Program support and funding to incorporate corrective actions never hurts either.

This presentation provides a practical example of the challenges associated with reliability predictions, design and redesign on a new technology program. Maintaining alignment and preparing for key transition points in the life cycle of the program will help ensure success of the Reliability, Maintainability and Availability (RM&A) program as well as the weapon system.

## Session 7

10:30 to 11:30 a.m. on Wednesday, June 8th

### TRACK 1

Harland MacKenzie - Dana Power Technologies

#### Accelerated VA/VE Validation Testing

Quite often, the most time-consuming step in implementing a product change or improvement is validating whether the new design is as good as, or better than, the existing design. Accurate field data is not available in some cases and, if the current design is appropriate to task, it is unlikely that much failure mode data exists. Furthermore, the cost of full system testing is quite often prohibitive for small product changes. At other times, the capability to perform full system testing may not be present. While full system testing is the preferred validation method in a lot of industries, the need to do so is often overestimated.

This presentation will detail a methodology to take a design change concept through Value Analysis/Engineering (VA/VE) validation testing. It will address topics related to: 1) the selection of validation tests, 2) accelerating the testing and c) comparison methods between the existing and the proposed design. While the presentation focuses on automotive components, many of the fundamentals can be applied to all fields of design validation. The methods will add to engineers' and managers' toolkits for performing "bench" type validation testing. This sort of testing, especially if used early in development, can yield significant results not only in cost savings but also in product improvement.

### TRACK 2

Mike Silverman - Ops A La Carte LLC

#### What is DFR and What is Not DFR?

Design for Reliability (DFR) is a hot term in the reliability industry but what does it really mean? Many people have misconceptions about how to apply this concept to their industry. In this presentation, we will review some of the basic building blocks of DFR and point out some erroneous practices that people today are using. DFR is not a bunch of random reliability techniques thrown together during a design activity. It consists of the following three steps:

- Set a reliability goal.
- Write a plan to achieve this goal.
- Execute the plan.

In Step 1, we may need to assess where we are, and we may need to benchmark against competitors in order to properly set the goal. In Step 2, we need to identify a set of reliability techniques we can utilize to achieve our goal. The techniques chosen must be integrated cohesively into the reliability program to maximize the effectiveness of each technique. In Step 3, we need to follow our plan and implement each of the reliability activities called out in the plan when and how we have stated we would. We also need to develop metrics so that we can measure where we are against our goal at various stages in the product development process. Toyota and British Petroleum learned tough lessons in 2010 about what the lack of reliability can cost a company. Design for Reliability can help prevent these types of errors in the future.

## Session 8

1:00 to 2:00 p.m. on Wednesday, June 8th

### TRACK 1

Damien Willans - SSR Engineering Pty Ltd.

#### Proving a New Refinery Design Using Reliability Throughput Modeling

The design, construction and operation of large-scale resource projects are now subject to extreme levels of competition and cost, with many projects running into billions of dollars. For this reason, resource companies, bankers and every participant in the design train are now compelled to understand every aspect of risk to be undertaken, usually well before the project becomes a reality. A key element of the design process is knowing if the plant can actually produce the required output – along with a clear understanding where the areas of potential risk might be.

Rather than ignoring the reality of failure effects or, more commonly, de-rating the entire design by some "accepted" operating availability number and trying to justify it, companies are now turning to plant reliability modeling up-front to prove more efficient designs, even with the uncertainties of failures well before plant startup. The concept of calculating "throughput" provides an absolute plant (design) model output for given inputs, by directly linking plant flows and consequences to the equipment availability. This presentation describes a project recently undertaken, including the project background, modeling stages and processes, and the successful outcomes provided for one client who is currently undertaking a very large-scale resource investment.

### TRACK 2

Paul Ngan - NXP Semiconductors

#### Knowledge Based Qualification — Know the Failures to Guarantee No Failures

There are two qualification methodologies in use today: Stress Driven and Knowledge Based. Each methodology has its own merits and limitations. For example, the Stress Driven approach is supported by some well-known international standards (e.g. JESD47, AEC-Q100), while the Knowledge Based approach puts additional demand at development.

This presentation will start by reviewing the two methodologies and their applicability to semiconductor product qualification. NXP started implementing Knowledge Based Qualification in 2008. Its approach and, in particular, its experience in relation to a microcontroller product will be described in this presentation. The session will conclude with some ideas for those who are considering whether to adopt a Knowledge Based Qualification methodology.

**Session 9**

**2:20 to 3:20 p.m. on Wednesday, June 8th**

**TRACK 1**

**Shri Gupta - Motorola**

**Fault Tree Analysis in Product Engineering**

Fault Tree Analysis (FTA) is a top-down deductive approach for analyzing critical failure modes. Although FTA is not as popular as Design Failure Modes and Effects Analysis (DFMEA), our finding is that FTA does bring a lot of value to product development engineering. It is also a powerful Design for Six Sigma (DFSS) tool, which helps in root cause analysis of major failures seen during the development life cycle of a product. FTA helps reduce system development time by resolving issues quickly when they occur unexpectedly.

FTA has been applied widely in conjunction with Accelerated Life Testing (ALT) during the development life cycle of major subscriber products to improve reliability. In this presentation, the author will describe what FTA is, the selection criteria for where FTA is applied, how to create a fault tree and how to use it effectively to resolve a difficult situation. This will be illustrated with examples chosen from recent development programs in Motorola Solutions.

**TRACK 2**

**Randolph G. Phillips and Greg Butler - Baker Hughes Incorporated (BHI)**

**Driving Product Reliability and Service Quality in the Oil Services Industry**

Challenging applications, environmental conditions and service execution variation have limited Oil Services companies from achieving the service reliability growth demanded by customers. Specific areas covered in this presentation will be:

- Mission modeling to predict the stochastic time-varying stressors on parts.
- Maintenance planning to minimize on-rig downtime.
- The diagnostics and robust design concepts to minimize the impact of transactional failures on service quality.

In this session, we will discuss the transformation occurring in the Oil Services industry to improve both product reliability and service quality in order to meet the growing demand of Oil & Gas companies. Examples will include drilling, well completions and production applications.

Reliability improvements to Oil Services products are not free, yet they not only improve the utilization and reduce the repair and maintenance costs, but also minimize downtime on rigs, which represent expensive customer assets. Thus, this is the classic business case for improved reliability when no government agency is mandating.

**Tutorial 2**

**3:30 to 5:00 p.m. on Wednesday, June 8th**

**TRACK 1**

**Carl S. Carlson - ReliaSoft Corporation**

**Application Lessons for Effective FMEAs**

Quality and reliability tools must be applied correctly to get optimum results, and Failure Modes and Effects Analysis (FMEA) is no exception. Yet many companies continue to accept less than effective results from their FMEA applications. Given the increasing importance of uniformly achieving high reliability, it is imperative that FMEA is done correctly and effectively to improve product and process designs early in the product development cycle, and support manufacturing and maintenance applications.

- What are the specific FMEA lessons that separate best practice from poor quality?
- How can we make FMEA live up to its potential for product and process improvements?
- How can FMEAs get done in a timely manner with full support from subject matter experts and management?

This presentation examines and answers these questions for a wide variety of applications. Attendees will understand the primary pitfalls that generate less than effective outcomes and learn the *vital few* keys to successful FMEAs.

**TRACK 2**

**Edward A. Pohl - University of Arkansas**

**Optimization in Reliability and Maintainability Applications**

Optimization is an extremely valuable tool in the area of reliability and maintainability (R&M). It is optimization that actually allows us to obtain the best possible system designs and maintenance policies. Without optimization, all that exists is a model with no solution. Optimization exists in a wide variety of fields other than R&M so we will focus only on those methods most applicable to R&M itself. We will provide some key models to demonstrate the application and formulation of various optimization methods.

The remainder of this tutorial seeks to address the following topics:

- What is optimization?
- Introduction to optimization theory.
- Overview of the optimization techniques most often used in R&M.
- Reliability optimization models and solution procedures.
- Maintenance optimization models and solution procedures.

## Session 10

8:00 to 9:00 a.m. on Thursday, June 9th

### TRACK 1

**David Sada and Greg Thompson - Andromeda Systems Incorporated (ASI)**

#### **Applying Physical Asset Reliability Analysis Methods to Predict the Probability of Human Susceptibility to Chronic Diseases**

This presentation will discuss the application of reliability analysis techniques typically used to predict failure of physical assets to predict the occurrence of disease events in humans. Currently, efforts to assess the risk of disease occurrence are heavily based on studies employing empirical techniques. Typical disease studies focus primarily on the significance of one or two risk factors while attempting to normalize other risk factors of all types (heredity, environment, lifestyle). However, unless ALL known (and even unknown) risk factors are definitively normalized, the true value of these studies can be questioned. Moreover, risk factors for most diseases are typically not completely independent.

While the true significance of the generally accepted risk factors may be unknown, they can be used as a starting point for a Design of Experiments (DOE) analysis. The use of DOE and other probabilistic techniques would identify the most influential risk factors, the least influential ones and the critical interactions between risk factors. Adaptive learning techniques and non-linear performance evaluations can then be applied to improve the model's prognostic ability as additional data are collected and assimilated. Finally, the model will provide insight into how changes in behavior, environment, etc. can quantitatively change the risk of disease occurrence. Available patient data will be used to validate and refine the prediction models over time. Each iteration of the model will improve the risk assessment profile, and will enable healthcare professionals to efficiently target, prevent and treat diseases while reducing the cost of care.

### TRACK 2

**Richard Coronado - Lockheed Martin Corporation**

#### **Developing and Implementing an Effective Reliability Program Plan**

The objective of any reliability program is to assist in designing and manufacturing a reliable product in the most cost-effective manner. To effectively achieve that result, one must fully understand the customer's reliability expectations up-front and understand their needs. The Reliability Program Plan describes all the reliability tasks necessary to satisfy the reliability requirements expected by your customer. In addition, by being approved by different Integrated Product Team (IPT) members and program management, it engages everyone to be actively committed in meeting the reliability requirements through an appropriate allocation of resources. The major points covered in this presentation include:

- Why we need a Reliability Program
- Reviewing Requirements
- Performing Reliability Design Analysis
- Providing Design Support to IPTs and at Program Reviews.

## Session 11

9:10 to 10:10 a.m. on Thursday, June 9th

### TRACK 1

**Jack Olivieri - MITRE Corporation  
and Abhaya Asthana - Alcatel-Lucent**

#### **Determining Software Reliability and Readiness**

The industry has moved to more mature software processes (e.g. CMMI) but there is increased need to adopt more rigorous, sophisticated (*i.e.* quantitative) metrics. While quantitative product readiness criteria are often used for business cases and related areas, software readiness is often assessed more subjectively and qualitatively. Quite often, there is no explicit linkage to original performance and reliability requirements for the software. The criteria are primarily process-oriented (versus product-oriented) and/or subjective. Such an approach to deciding software readiness increases the risk of poor field performance and unhappy customers.

Unfortunately, creating meaningful and useful quantitative in-process metrics for software development has been notoriously difficult to date. This presentation describes novel and quantitative software readiness criteria to support objective and effective decision-making at product shipment. The method organizes and streamlines existing quality and reliability data into a simple metric and visualizations that are applicable across products and releases.

### TRACK 2

**Fareed Hayek - NASA**

#### **Reliability and Risk Analysis Ahead of the International Space Station Life Extension**

In view of the United States President's direction to NASA to extend the life of the International Space Station (ISS) to 2020 and possibly to 2025, there is a great need to perform reliability and risk assessment to ensure mission success and safe operations of the ISS hardware through the extended period.

In this session, we will perform failure rate modeling using Weibull analysis on a selective group of Orbital Replacement Units (ORUs) from different ISS subsystems. The analysis for this presentation will utilize failure and anomaly data listed in the Problem Reporting and Corrective Action (PRACA) and Items for Investigation (IFI) databases. The operating hours of the ORUs will be obtained from the Maintenance Analysis Data Set (MADS) database.

**Session 12 10:30 to 11:30 a.m. on Thursday, June 9th**

**TRACK 1 Randy Schueller, Craig Hillman and Nathan Blattau - DfR Solutions, LLC**

**Physics of Failure in Five Minutes**

In terms of reliability prediction techniques, Physics of Failure (PoF) has always been the next best thing. This is especially true as the pace of technology incorporation increases (no field data) and electronic parts become increasingly fragile (wearout encroaches onto operational life). Despite its obvious superiority and need, PoF still lags behind empirical prediction because of the time and expertise required. The MIL-217 revision team has proposed eventually migrating to Computer Aided Engineering (CAE) tools with science-based PoF reliability modeling, simulations and probabilistic mechanics techniques in order to expand beyond the current limitations of actuarial reliability prediction methods. This presentation will provide a thorough overview of the latest techniques and tools that allow this broader range of analyses to be performed.

**TRACK 2 Julio Pulido - Ingersoll Rand**

**Structural Reliability for Mechanical Components Under Road Vibration Loading**

Fatigue is a complex phenomenon that is affected by a number of factors, such as the surface finish of the component, environmental effects, heat treatments, presence of stress concentration factors, etc. It is therefore important to carefully analyze components subjected to fluctuating loads so that the desired reliability can be built into these components, and over-designed or under-designed components can be avoided. This presentation will cover examples of mechanical structures under road and self-induced vibration inputs, and correlate to actual vibration testing using finite element techniques associated with several fatigue live models. The presentation also covers practical testing considerations for the selection of fatigue testing equipment and fatigue cycle counting methods to actual testing.

**Session 13 1:00 to 2:00 p.m. on Thursday, June 9th**

**TRACK 1 G. Michael Smith - Linamar Corporation**

**Challenges in Implementing a DFMEA Program**

This presentation will cover topics such as: 1) Challenges in implementing an FMEA program in organizations. 2) What is an FMEA. 3) What organizations may be using. 4) Conditions needed to implement. 5) Choosing the right tool. 6) Getting traction. 7) Ultimate gain/benefit. This discussion will help to highlight the process for getting the FMEA project, infrastructure, buy-in and maintenance in place so that a sustaining effort will continue long past the initial champion of the project has left. This case study discusses the real world journey of one organization from a concept of future state to the tactical buy-in and usage on a day-to-day basis by all the relevant stakeholders.

**TRACK 2 Mark Paulus - U.S. Navy**

**Effect of Natural Frequency Shifting on Accelerated Life Vibration Testing**

Many development programs use vibration testing to help enhance the reliability of their products. Due to time and budget constraints, vibration tests are often accelerated in the lab. Simplifications such as single-axis testing instead of multi-axis testing, and smoothing of field data are also done. It has been discovered that frequency shifting that occurs during vibration fatigue failure can lead to lab results that do not represent field conditions. Frequency shifting leads to possible undetected defects in fielded components. Furthermore, it has been shown that input power spectral density values far from the natural frequency are significant in characterizing the field environment.

**Session 14 2:20 to 3:20 p.m. on Thursday, June 9th**

**TRACK 1 Ken Millspaugh - Raytheon**

**FRACAS, a Key to Successful Performance Based Logistics Programs**

Key aspects of Performance Based Logistics (PBL) programs are the understanding and controlling of product return for repair. This presentation will describe how core features of a Failure Reporting, Analysis and Corrective Action System (FRACAS) were “designed in,” the evolution of the data collection process and the compelling rationales as related to these key PBL aspects. In doing so, the presentation will address improvements made to transition from “75% data management, 25% engineering analysis” to “25% data management, 75% engineering analysis” for high reliability radar systems.

**TRACK 2 Abdullah A. Al-Aqeel and Muhammad F. Al-Muaibed - Saudi Aramco**

**The Khurais Producing Facility’s Preventive Maintenance Optimization Assessment**

The Khurais preventive maintenance (PM) program was established during the construction phase of the Khurais facility during the first and second quarters of 2009. However, after one year of operation, it was realized that further assessment and development for the current PM process is required in order to include some new equipment that does not exist in the other facilities and to eliminate any unnecessary PM tasks to meet the targeted “Best In Class” performance of the Khurais facilities. A team of carefully selected individuals was formed to perform this assessment and come up with a recommendation. In order to achieve the most out of this study, three groups were formed to cover different disciplines — electrical, instruments and mechanical — in addition to the PM coordinator from the maintenance planning group to support the implementation of the team recommendations. The review process included equipment PM checklists, the basis of PM frequencies, equipment classification and criticality, system status (either active or mothballed) and vendor PM recommendations. As a result of this assessment, we are anticipating a reduction in the required PM forecasted man-hours by 35%. This corresponds to more than \$3,000,000 annual savings in preventive maintenance activities.

## Session 15

3:30 to 4:30 p.m. on Thursday, June 9th

### TRACK 1

**Neill Doertenbach - Qualmark Corporation**

#### **Calculating the Reliability Improvement Value of HALT**

Highly Accelerated Life Testing (HALT) is a design tool that exposes design flaws and weaknesses in new, unreleased products. These are defects that may cause failures during design verification testing, create early "infant mortality" failures soon after the new product is released, or lead to expensive warranty issues later in the product's life cycle. There is a financial advantage in finding these defects early in the design cycle. By calculating the Return on Investment (ROI) of HALT, the value of the reliability improvements enabled by the HALT process can be demonstrated. This presentation will outline the process of calculating HALT ROI, describe the data needed to complete the calculation and provide an example of a HALT ROI calculation. The extended value of applying HALT throughout the life cycle of a product will be discussed. Consideration factors for implementing HALT in-house versus outsourcing will also be evaluated.

### TRACK 2

**Gene Bridgers and Darryl McKenney - Mercury Computer Systems Inc.**

#### **Dramatic COTs Design Accomplishments Traced to Innovative DFR Practice**

Design for Reliability (DFR) practices have a spotted success history. When implemented effectively, dramatic design accomplishments occur. Our innovative DFR tool has proven to be powerful for reducing product design and manufacturing risks, and empowers dramatic product launches in record times. This presentation examines why our innovative DFR approach is so successful and we want to share the details so you can enjoy the same success. The key success factors are: 1) An innovative DFR tool using standard electrical and CAD design tools to deliver our DFR knowledge directly to the design engineer so they have the data when the electrical parts are initially being selected. 2) The same innovative DFR tool automatically sends e-mail with the DFR-annotated Bill of Materials (BOM) as an attachment, in a standard Excel® format, to the reliability engineer and the electrical design engineer as soon as the design engineer initially provides the schematic to the CAD group. 3) The reliability engineer reviews the BOM for DFR alerts and immediately confers with the design engineer by e-mail.

It should be very obvious that if the same DFR alert were discussed much later in the design process, the willingness would not be as high. Our innovative DFR requests appear before the board layout is started, before the electrical simulation work is complete, before the design freeze occurs, before changes must be documented, before Design for Manufacturing (DFM) audits are done, before prototype builds occur, before design verification testing, before HALT, before production builds occur and before customer complaints are received. Our DFR library contains base failure rates from MIL-HDBK-217F-1 and Bellcore/Telcordia SR-332-1, so we also get free MTBFs.

## Hosted Reception and Awards Dinner

5:30 to 9:00 p.m. on Thursday, June 9th

On Thursday, June 9th, there will be a hosted reception from 5:30 to 6:30 p.m. on the Pavilion patio, followed by the Awards Dinner from 6:30 to 9:00 p.m. in the Pavilion room. You are welcome to bring a guest to this event, which provides an opportunity to interact with colleagues in a comfortable and relaxed setting. This is also your final chance to submit your vote for the best presentations that you attended during the Symposium. During the evening, awards will be granted to the top three presentations, as voted by attendees. As with the rest of the Symposium, the typical style of dress will be "business casual."

## MAKE THE MOST OF YOUR SYMPOSIUM EXPERIENCE

### Meet Colleagues, Share Ideas, Explore Available Solutions

#### **Choose the sessions that you will attend**

The Symposium offers a choice of 30 presentations and 4 expert tutorials. You can use the matrix on pages 2 and 3 to mark the presentations and tutorials that you plan to attend. It is not necessary to pre-register for selected sessions.

#### **Take advantage of opportunities to converse with colleagues**

The catered breaks between sessions and the hosted dinner on Thursday evening provide good opportunities to talk with and learn from fellow reliability practitioners.

#### **Learn about available software tools and services**

We encourage you to spend some time visiting the exhibit booths to learn about a variety of available products and services.



# 2011 International Applied Reliability Symposium, North America

Industry and government  
sharing applications, success stories and lessons learned.

June 7 - 9, 2011  
San Diego, California



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**Will you be attending the Reception and Awards Dinner?** (check one) \_\_\_ With guest \_\_\_ Without guest \_\_\_ No

**What size do you prefer for the complimentary polo shirt?** (circle one) S M L XL XXL

**Would you like to share your contact information with other participants?** (check one) \_\_\_ Yes \_\_\_ No

## Additional Details

ARS reserves the right to cancel/reschedule the Symposium at any time up to 4 weeks prior to its start date. In the event of cancellation, all registration fees will be refunded. ARS is not responsible for other charges, such as non-refundable airline tickets.

- **Hotel Reservations:** You will need to make reservations on your own.
- **Substitutions:** Substitutions are allowed provided that ARS is notified 7 days prior to the Symposium start date.
- **Cancellations:** Cancellations received up to 15 working days prior to the Symposium start date will be entitled to a full refund of the registration fee minus a US\$50 administration fee. After this period, all cancellations will be subject to the full registration fee.
- **No Shows:** Registrants who do not attend and who do not notify ARS of a cancellation are subject to the full registration fee.

The registration fee includes your choice of presentations and tutorials, copies of the *Proceedings* and any other handouts, the Thursday night dinner and refreshments provided during the breaks. A certificate of attendance will be provided. Attendees are eligible for 1 CRP Course Credit and 1.8 CEUs.

**Applied Reliability Symposium**

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