

Reliability Society

NEWSLETTER

Vol. 51, No. 1, February 2005

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President's Message



Dear IEEE Reliability Society Members:

Welcome to the 56<sup>th</sup> year of the IEEE Reliability Society! In this message, I'd like to introduce you to your current Society volunteers, and I hope you'll note the Society positions that are vacant seeking additional volunteers. If you have an interest in these vacancies, please get in contact with me.

To begin, the ADCOM Class of 2005-2007 that the membership elected includes: Robert Loomis, Scott Abrams, Ann Miller, Christian Hansen, Shuichi Fukuda, and Sam Keene. Congratulations to all! Also, Eric Snyder has opted to resign due to other commitments, and in his place, I have selected Bret Michael to serve out the rest of Eric's term.

And the 2005 elected officers are: President: Jeffrey Voas, VP Meetings: Alan Street, VP Membership: Marsha Abramo, VP Publications: Christian Hansen, and VP Technical Operations: Shuichi Fukuda.

The 2005 Appointments for 2005 are: Dick Kowalski: Treasurer, William Tonti: Secretary, Way Kuo: Transactions on Reliability Editor-in-Chief, Lon Chase: Newsletter Editor-in-Chief. And per our by-laws, our Junior Past President is Dennis Hoffman and our Senior Past President is Ken LaSala.

Other 2005 appointments include:

- A. Transactions on Reliability, Editor-in-Chief (appointed by the President; currently Professor Way Kuo)
- B. Newsletter Editor-in-Chief (appointed by the President; currently Lon Chase)
- C. Newsletter Associate Editor (appointed by the VP Publications and Newsletter Editor-in-Chief; currently vacant)
- D. Newsletter Business Manager (appointed by the VP Publications; currently Scott Abrams)
- E. T-DMR Liaison (appointed by the VP Publications; currently Alan Street/Bill Tonti/Eric Snyder)
- F. Transactions on Semi-conductor Manufacturing Liason (appointed by the VP Publications; currently Marsha Abramo)
- G. Video offerings (appointed by the VP Publications; currently Sam Keene)
- H. Historian (appointed by the President; currently Dave Franklin)
- I. Webmaster (appointed by the VP Publications; currently vacant).

Since Technical Operations (Tech Ops) oversees special interest groups that require volunteers to lead and participate in their subcommittees, I'd like to update you on the existing Tech Ops committees for two reasons: (1) There are opportunities to chair and organize vacant committees, and (2) those committees already chaired still continue to recruit new members. The VP of Technical Operations for 2005 is Shuichi Fukuda, and if you want more information on any of these committees, feel free to contact him at: s.fukuda@IEEE.ORG.

[IEEE RS Technical Operations Committees](#)

Please note that the Society's ADCOM leadership hopes that you'll consider getting involved in one or more of these groups. We want your membership to be as beneficial to your career and professional development as possible, and our TECH Ops committees are one way to make that happen.

And to finish this message off, I'd like to give you an update on a few other items concerning the Society and its status. First, it appears that when the books are closed on 2004, the Society will have collected a surplus around \$102K. But until the 2004 books close, and several receivables that we anticipate get credited to our books, we are unsure as to where we will end up. Nonetheless, the Society remains in healthy financial shape and it appears that that health should continue beyond 2005.

Secondly, the Society will undergo a 5-year Society and Publications review in Feb. 2005 in San Francisco at the Institute's Technical Activities Board meeting. This review is an event that all societies face on a 5 year rotating basis, and we are prepared to defend our efforts from the past 5 years and introduce the members of the review board to our strategic plans for the coming years.

Thirdly, I'd like to congratulate the Society's two 2004 RS fellows: Lois Walsh and Hoang Pham. We are delighted to get two fellows approved in one year, and I hope you will congratulate these individuals along with me.

Fourth, the Transactions on Reliability received nearly 150 submitted papers in 2004, and our publication queue is nearly clear now. That allows us to help our authors get published more quickly than in past years. This is quite important for those authors seeking tenure justification.

And finally, the Society's ADCOM leadership is aggressively continuing to re-evaluate the state of the Society, where it is heading, and what new technical areas have evolved that the Society needs to be involved in. For example, the Society's new cyber-security initiative is one example that is ongoing and should be ready by mid-year for a launch as a new product of the Society. Also, the Society is investigating the value offered by having a new publication that is in a magazine format (as opposed to a transactions or newsletter format). It appears that there is a gap in the publications of the Institute in the area of "trust", and if true, we'd like our Society to take the lead and fill that gap.

And so in summary, I'd like to encourage you to get more involved in your Society. We are hoping that 2005 is a year for growth in membership, revenues, and the technical content that we deliver to members as well as non-members. And to make that happen, we need you!

**Best Regards,**

**Jeffrey Voas**

[Jeffrey.M.Voas@SAIC.com](mailto:Jeffrey.M.Voas@SAIC.com)

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**From the Editor**

Welcome to the first IEEE Reliability Society e-

Newsletter. As in the past with the hardcopy newsletter, an issue will be published quarterly and published to the Reliability Society website.

We welcome your articles, comments or questions. All RS Newsletter inputs should be sent electronically to [l.chase@ieee.org](mailto:l.chase@ieee.org).

<b>February</b>	<b>Inputs due January</b>
<b>May</b>	<b>Inputs due April</b>
<b>August</b>	<b>Inputs due July</b>
<b>November</b>	<b>Inputs due October</b>

Publishing of advertisements will be available in future issues. Advertisements will be accepted in common graphic format.

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## Society Announcements

The Reliability Society held its annual awards banquet at the Alexandria Mark Center Hilton in Alexandria, Virginia on January 22, 2005. Newly appointed RS officers were introduced, a society lifetime achievement award was presented (see below), along with other presentations.

RS Annual Banquet



Newly Elected RS Officers



### IEEE Reliability Society Lifetime Achievement Award Presented to Dr. Wayne B. Nelson

Tom Fagan, former RS President and Nominations and Awards Committee member, presented to Dr. Wayne Nelson (in absentia) the 2004 IEEE Reliability Society (RS) Lifetime Achievement Award at the RS AdCom Awards Banquet. Mr. Fagan's written statement was as follows:

"The 2004 IEEE Reliability Society Lifetime Achievement Award is presented to Dr. Wayne Nelson.

Throughout his long and still productive career, Dr. Nelson has been a reliability expert on product life data analysis and accelerated testing. He has advanced the effective practice of reliability engineering as an innovative developer of practical methods for reliability data analysis and accelerated testing, as an effective and knowledgeable teacher of thousands of reliability practitioners, and as a highly skilled reliability consultant for many hundreds of clients and applications.

Dr. Nelson is a Fellow of IEEE, of the American Statistical Association (ASA), and of the American Society for Quality (ASQ). To the Reliability profession, he has made contributions through books, developments, software, consulting, and mentoring. His approaches are held in high regard because of their clarity, innovations, and practical value.

It is with great pleasure that the IEEE Reliability Society presents its Lifetime Achievement Award to Dr. Nelson."

Even though Dr. Nelson could not be present to accept his Award because of business conflicts, he provided his acceptance comments which were read by Dennis Hoffman, RS Jr. Past President and Nominations and Awards Committee Chair. Dr. Nelson's comments are the following:

"I treasure the Lifetime Achievement Award as an acknowledgment from the Reliability Society that my work on analysis of reliability and accelerated test data and on reliability education has been useful to reliability engineers, whom I regard as valued friends, clients, and colleagues. I wish to gratefully acknowledge the Reliability Society as a means for professional growth and its volunteers for the service they give to all of us.

It is a great honor to immediately follow Ralph Evans, first to receive the Award and deservedly so, as his contributions to Reliability have been truly outstanding. There are many others worthy of the Award, and it is a privilege to be the first of them.

I thank Dennis Hoffman and the Awards Committee, who generously donate their time to advancing Reliability. I gratefully acknowledge Dr. Guangbin Yang; he nominated me for the Award because of his regard for my work, although he did not know me personally. Since then I have had the pleasure of meeting him and becoming friends.

I am deeply indebted to hundreds of friends, colleagues, clients, and others, who stimulated and supported my work. General Electric Co., where I consulted for 25 years, provided me with outstanding training, experience, colleagues, and clients. GE provided many fascinating applications and time to publish GE reports and training materials on my developments, which resulted in my literature articles and books."



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## Society Solicitations

### Reliability Society AdCom Candidates Sought for 2006/2007/2008 Term

The IEEE Reliability Society is seeking candidates for serving on its Administrative Committee (AdCom) for the three-year term that spans 2006/2007/2008. For clarification, the AdCom manages the operation of the Reliability Society. The candidates need to be a member of the IEEE Reliability Society and should have both technical and managerial experience. Serving on the AdCom requires attending periodic AdCom meetings (max of quarterly) and participating in one or more of the following areas of Reliability Society committee activities: Technical Operations, Meetings, Membership, and / or Publications. More about these areas of activity can be found within the Reliability Society Constitution and By Laws on our Society web site at <http://www.ieee.org/portal/site/relsoc/>

If you are interested in running for election to become an AdCom member, please send the following information to Dennis Hoffman, your Society's Junior Past President, at [d.hoffman@ieee.org](mailto:d.hoffman@ieee.org) by not later than **15 May 2005**:

- Your full contact information: name, mailing address, telephone number, FAX number, and e-mail address.
- A concise professional biography that summarizes your technical and management experience and your educational background. The biography needs to be 350 words or less.
- A short statement describing why you want to be an AdCom member and what you can contribute to the Reliability Society

through being an AdCom member.

- A short statement that identifies in which Reliability Society activity area you would like to participate.
- Please include an endorsement from your supervisor / manager if possible. If that is not possible, please have a Reliability Society AdCom member, Chapter Officer, or member endorse your candidacy. In addition, please provide assurance, either personal or from your employing organization, that you will have adequate support to attend and participate in the scheduled AdCom meetings (usually held on Saturdays at different city locations) each year of your elected term.
- Statement that you are a current IEEE member with Reliability Society membership.

Your information will be forwarded to our Nominations Committee for their review for inclusion in our AdCom ballot in early fall of 2005. To be included in the ballot, all requested information needs to be provided on time. If you have questions, e-mail Dennis Hoffman at [d.hoffman@ieee.org](mailto:d.hoffman@ieee.org).

### **Reliability Society Engineer of the Year Award for 2005**

The IEEE Reliability Society is soliciting nominations for its Reliability Society Engineer of the Year Award for 2005. This award is aimed to recognize key contributions to the Reliability profession within the last few years. Nominees will be considered according to the following criteria:

- **Reliability Contributions**
  - Reliability Technical Contributions
  - Reliability Management Contributions
  - Reliability Publications
  - Contributions to Reliability Education
- **Professional Services to IEEE**
  - Reliability Society Service
  - Other IEEE service positions

An administrative superior of the nominee (e.g. department head, supervisor, or chapter chair) should make and submit the nomination. The nomination package should consist of a one-half page biography of the nominee plus up to four pages of concise descriptions of the accomplishments. For technical contributions, please concisely describe why the contribution is unique. For managerial and educational contributions, please concisely explain the obtained benefits. Please limit identified publications to only those in which the nominee was the sole or principal author. The accomplishments should be organized according to the above-described criteria. The nominations must be submitted by 1 October 2005. Send the nominations to Dennis Hoffman, your Society's Jr. Past President, at [d.hoffman@ieee.org](mailto:d.hoffman@ieee.org)

### **Reliability Society Lifetime Achievement Award for 2005**

The IEEE Reliability Society is soliciting nominations for its Reliability Society Lifetime Achievement Award for 2005. The IEEE Lifetime Achievement Award was created to recognize sustained outstanding contributions to the field of Reliability Engineering. Typically the contributions will span the career of the individual, usually in excess of 25 years. The contributions meriting this award must clearly be within the area of Reliability Engineering.

Nominations must be submitted by a peer or supervisor of the nominee. Self nominations or nominations from a member of the IEEE Reliability Society Nominations and Awards Committee will not be accepted. The nomination package should consist of a one-half page biography of the nominee plus up to four pages of concise descriptions of the nominee's lifetime accomplishments / achievements. Nominations may be submitted until the end of September 2005. Send the nominations to Dennis Hoffman, your Society's Jr. Past President, at [d.hoffman@ieee.org](mailto:d.hoffman@ieee.org)

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## **Technical Operations**

### **Society Technical Committee Recruiting Notice**

The IEEE Reliability Society national organization is recruiting technical committee members and possibly committee chairpersons for the following technical committees: Software Reliability, System Safety Technology, Human Interface Technology, Mechanical

Reliability, Standards & Definitions, CAD/CAE, Microelectronic Technologies, Industrial Systems, Sensor Systems, Information Technology & Communications, Consumer Electronics, International Reliability, Aerospace & Defense Systems, Testing and Screening Technology, Automotive Systems, Energy Systems, 6 Sigma Reliability, Medical Systems, Reliability Design, Warranty, Nuclear Reliability, Maintainability Technology, Assurance Technology, and Emerging (New) Technology.

The basic work for each technical committee consists of developing plans associated with the reliability aspects of the respective field, both present day tactical issues, and long term strategic direction. This is accomplished through four short quarterly written reports that are edited and compiled by the reliability society technical operations editor, and placed in the Reliability Society newsletter, which can be found on our [Web site](#). Additionally, an annual written assessment of the technology in the committee's area of interest is requested. This Annual state of Reliability Technology Report is published world wide, and receives a high level of readership and interest from communities that extend well beyond the IEEE and the Reliability Society. It has become the societies cornerstone publication.

Other work may include the development of standards, guidelines and educational tutorials through the society infrastructure. Working in one of the technical committees is an excellent opportunity to "network" and keep your knowledge current. If you are interested, please contact me and send a short biography with an indication of your experience in the field of interest.

If you do not have a direct interest in either of the above opportunities, please pass this to a fellow reliability, hardware, software, or systems engineering professional who might have an interest.

Thanks for your consideration.

William R. Tonti  
VP Technical Operations  
Tel: (802) 769-6561  
E-mail: [wtonti@ieee.org](mailto:wtonti@ieee.org)

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A list of the Technical Committees and their Chairs:

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## Technical Committee Activities Focus Spot

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## Six Sigma Improvement Opportunities Dr. Samuel J Keene

Six Sigma's most pro-active application is improving processes as well as developing better products. These go hand in hand in Six Sigma. Some areas to look for Six Sigma improvements is enumerated below:

- Waste reduction
- Defect reduction
- Cycle Time reduction
- Risk quantification and reduction
- Capability optimization
  - Assuring robustness
  - Harvesting excess margin
- Optimizing testing
  - Assuring that a sufficient number of samples are tested
  - but not an excess number of samples
  - Statistically sound practices are used, with respect to representative sampling, randomization, blind and double blind testing, validation of results
- Establishing optimum specification limits
  - Optimizing the allocation of design tolerances
- Assuring proper process measurement capability.
- Reducing rework - - (hidden factory in Six Sigma terms)
- Reducing process and product variability

### Implementing Six Sigma

Six Sigma systemically works to improve core processes, to eliminate chronic problems, and harvest improvement opportunities. It provides a statistical tool based focus for product development and support. It accomplishes this in four steps:

#### 1. Measure

There is the axiom, "that whatever is measured, will improve". The first part of measurement is to assure the measurement system is capable, i.e., that the data is correct and can be relied upon. The data collection capability must be sufficiently consistent, and under control, to distinguish good and bad parts. There is a lot of science to measurement systems analysis (MSA). MSA evaluates the capability of the measurement system in terms of:

- Linearity of readings over the measurement range
- Accuracy of the readings
- Stability of the readings over time
- Repeatability of the readings by the same operator over time
- Reproducibility of readings by different operators or different measuring equipment
- Precision of readings with respect to the "critical differences" desired to be detected

The repeatability and reproducibility are the most fundamental measure of the measurement capability. These two measures make up the "Gage R & R" or measurement repeatability and reproducibility. One would like the gage R&R to contribute less than 10 percent error to the part-to-part measurement, where the parts span the measurement range of interest.

#### 2. Analyze.

Six Sigma process tools are applied to describe the current process. This benchmarks the current state of quality and provides concise data representations of the process to better enable cross-functional understanding and collaboration. Six Sigma focuses the team focused on identifying and improving critical processes. The analyze phase sets the benchmark to gage the process improvement during the Improve Phase.

#### 3. Improve

This phase typically involves designed experimentation or Design of Experiments (DOE). DOE simultaneously evaluates key variables, both singly and in combination, to assess their influence on a critical process output parameter. The significant combinational effects are called variable interaction.

Variables are said to interact when the effect of one input variable on the key output variable depends on the level of another input variable. A good example of was the Firestone tire problem on the Ford Explorer automobiles when the tires were under inflated. The combination of those factors led to severe tire failures, whereas independently the factors did not cause problems by themselves.



A series of DOE can be run to successively improve process variable settings and controls. This is called a “response surface analysis” which maps out the desired response as a function of the key input variables. This looks like a topographical map, which allows setting the input variables to maximize the stability and level of the output variable.

#### 4. Control

Six Sigma contains tools such as Statistical Process Control (SPC) that track the performance of the desired output response. It will signal any significant change in the process output. The goal is to maintain the gains developed from the first three steps.

A practical example of Six Sigma application concerned the reconstruction of the bridge in Oklahoma that was knocked down by a barge 3 years ago. It was rebuilt in 6 weeks. One reason was the Six Sigma Black Belt supporting that construction project found a way to reduce the average cure time of the cement. The contractor used to wait a time, X, say 10 days for the cement to set up, although it often could cure in half of that time. The Black Belt found a way to actively measure the curing process and not have to allow any extra time to make sure it was cured. The imbedded instrumentation broadcasted when the concrete was adequately set. The slack time was taken out. Waste time was removed and the development speeded up.



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## Book Review

Book review for Technometrics (Aug. 2003) by William Q. Meeker, Department of Statistics, Iowa State University, Ames, IA 50011

**Recurrent Events Data Analysis for Product Repairs, Disease Recurrences, and Other Applications**, by Wayne B. Nelson (ASA-SIAM Series on Statistics and Applied Probability), ASA-SIAM, 2003, ISBN 0-89871-522-9, 151 pages, \$59.50 ASA/SIAM members, \$85.00 nonmembers

Recurrence count data arise when an observational unit or group of units is monitored over time and the times of a particular event or class of events are recorded. Examples include counts of maintenance actions on repairable systems, transactions with customers, recurrences of a disease, and the birth of children. More generally, each event may have an associated "value" (e.g., the cost of a maintenance action or the size of an order). Questions of interest include the behavior of the recurrence rate (or cost accumulation rate) as a function of time (i.e., whether the rate is increasing, decreasing or constant over time). The population mean cumulative number of events (or mean cumulative cost) per unit at a particular time (e.g., at the end of the warranty period) is also of primary interest. Such a cumulative function is called, generically, a mean cumulative function (MCF). The need to compare MCFs (e.g., for units manufactured in different manufacturing periods or individuals receiving different treatments for a disease) is also common.

This is Wayne Nelson's third book-length contribution to the statistical/ engineering literature. Like its predecessors, this book provides a timely, self-contained treatment of an important area of application. All of the material is carefully motivated by actual applications. The examples consist of an interesting mixture of applications from engineering, medical science, and other areas. In spite of the fact that some of the material is technically difficult, the writing style is crystal clear.

This book will appeal to statisticians, engineers, biomedical professionals, and other scientists who face the task of extracting and presenting information from recurrence data. Each chapter concludes with a collection of exercises and thus this book could also serve as a supplementary text for courses in biostatistics, reliability data analysis, reliability engineering, or for a more general course on event time data analysis. This book will also be an important reference for those wanting to do research in the development of methods for recurrence data analysis.

Recurrence data have been around for a long time, as demonstrated by Nelson's examples. Such data, however, have received little focus in practice because there has not been a flexible, robust, consistent set of methods to analyze such data (at least not in commercially available software). The use of the methods described in this book will escalate in the near future both because of this book itself and the fact that interest in such methods has sparked development of commercial software to do the analyses. The major statistical packages (e.g., Minitab 2000, JMP 2002, SAS 1999, S-PLUS 2002, and the SPLIDA 2003 add on to S-PLUS) all recently have added or are planning to add capabilities to do some or all of the analyses in this book. Nelson surveys the capabilities and provides examples of the outputs for most of these packages.

This book has the following chapters:

1. Recurrent events data and applications
2. Population model, MCF, and basic concepts
3. MCF estimates for exact age data
4. MCF confidence limits for exact age data
5. MCF estimate and limits for interval age data
6. Analysis of a mix of events
7. Comparison of samples
8. Survey of related topics

Each chapter begins with a stated purpose and overview and concludes with problems on analyzing actual data and extending the methods.

Chapter 1 introduces recurrence data with six applications. These include transmissions in automobiles, bladder tumors in patients, births of children to statisticians (with an interesting comparison of the differences between male and female statisticians). Each application has a description of the motivating problem, the structure of the data, information sought, and a graphical (event plot) display of the data. This chapter also introduces and explains some of the important basic concepts and practical issues that need to be considered when attacking a

real problem. These include such issues as definition of time zero, choice of an appropriate time scale (e.g., time might be defined as amount of calendar time or the amount of use that a unit has seen), how to view types of events, etc. These discussions allow us to benefit from Nelson's vast experience in working with the sticky, but important, definitional issues that arise with real problems involving data collection, analysis, and interpretation.

Chapter 2 describes the population stochastic model and its MCF, which contains most of the information sought from recurrence data. The MCF is the population mean cumulative number or cost of events, across all of the units in a population, as a function of time. This flexible nonparametric model requires no assumptions about the form of the MCF or about homogeneity or independence of population units. Although the MCF increases in most applications, this is not a requirement of the model (e.g., the response at any given point in time could be negative, as in the return of merchandise). This flexibility, alone, greatly increases the range of potential applications. Moreover, this model is more realistic than the well-known Nonhomogeneous Poisson Process (NHPP) model. There is also useful discussion that contrasts this recurrence model with the more commonly used life distribution model for survival data. Often there has been confusion between the hazard rate function of a life distribution and the recurrence rate function of a counting process. Although both have been referred to as "failure rate," they are not the same (therefore many avoid using the term "failure rate" in favor of less ambiguous terms).

Chapter 3 develops the basic method for estimating the MCF in the presence of multiple censoring, which arises when different units are under observation for different amounts of time. MCF plots produced by the various statistical packages are presented in this chapter. Plots of the sample MCF provide insight into the behavior of a recurrence process and answers to most of the questions of interest.

Computing an estimate of the MCF would be trivial if all units were under observation for the same length of time, but such situation is rare in practice due to staggered entry or "time" scales that depend on usage, such as hours of service for a jet engine or miles driven for an automobile. The MCF estimation method also allows for left censoring and gaps in the observation of units. The MCF estimator presented in this chapter (first presented in Nelson 1988) is reminiscent of Nelson's cumulative-hazard-based estimate of the fraction failing as a function of time for population nonrepairable units when the failure-time data are multiply censored (Nelson 1969). That is, estimates of the incremental change in the MCF can be obtained directly (based on the known number of units that are "at risk" for an event), even in the presence of censoring. Then, these are accumulated into an estimate of the MCF.

Chapter 4 builds on the technical presentation in Chapter 3, developing expressions for the variance of the MCF estimator and an estimator for this variance. A variance estimate is then used to construct approximate confidence intervals for the population MCF. Such intervals should generally be presented in the plot of the sample MCF and are available in the statistical packages mentioned above.

Nelson compares his unbiased variance estimator with a "naïve" estimator that is based on the assumption of independent increments, a property of the commonly used parametric NHPP model (but not required in Nelson's setup). The assumption of independent increments is, however, often inappropriate in applications. Nelson notes that, in the usual case where population increments are positively correlated, use of the naïve variance estimator yields confidence intervals for the MCF that are too narrow. Such positive correlation arises, for example, in the common situation when samples are from a nonhomogeneous population. In Nelson's approach, robustness is achieved by estimating the variances and covariances of the increments with simple moment statistics. Then these moment estimators are combined with the usual formula for the variance of a sum of dependent random variables. Lawless and Nadeau (1995) provide a similar robust estimator for the MCF, which, although biased, is guaranteed to be positive. Nelson's unbiased estimator has positive, albeit small, probability of being negative.

Chapter 5 extends the methods in Chapters 3 and 4 to provide MCF estimates and confidence intervals for interval age data. Such data are common and arise when data have been summarized into counts (or costs) of events that have occurred in given time intervals. For example, reporting the number of events in each month of service is often used to summarize product warranty data. When intervals are small, and when event histories are available for all units, the exact methods in chapters 3 and 4 can be used directly. When, for example, unit histories are grouped to give monthly counts of events, then the information needed to compute Nelson's variance estimate for the sample MCF, described in chapter 4, has been lost. Nelson describes and illustrates, instead, how to compute a simple "naïve" variance estimate and confidence intervals that would be correct under the assumption of an underlying nonhomogeneous Poisson process model.

Chapter 6 describes methods for analyzing recurrence data when events can be divided into categories. Examples include different failure modes for a system and gender of a child born. The basic underlying model is that each category has its own population MCF. Under weak assumptions, the MCFs for individual event types can be added to give the MCF for a specified set of event types. Knowing the MCF for each category would allow answering questions about the MCF for a) all types of events combined, b) for a particular type of event, and c) for any chosen subset of the event types. Each of these questions is illustrated with data on failures of traction motors for subway cars. For example, a reliability analyst can estimate the MCF for a system under the assumption that one or more failure modes can be eliminated.

As Nelson points out, the MCF estimators presented in this chapter do not require independence of the underlying

stochastic processes that generate the different kinds of events. This is in contrast to the life data competing risk model where the assumption of independence is critical for making inferences about the effect removing a failure mode (see, for example Chapter 5 of Nelson 1982). For the MCF model, there is, however, the tacit assumption that eliminating a failure mode will not affect the MCF functions of the other failure modes.

Although the methods based on the nonparametric recurrence stochastic process model are versatile and require minimal assumptions, in more complicated situations, they cannot be applied without careful thought. Consider, for example, a repairable system that has a replaceable unit with two failure modes (A and B), both of which are caused by a common mechanism (e.g., corrosion). Due to the common cause, the times to failure for the two components are highly correlated. When the component fails from either A or B, it is replaced, censoring the other mode. If this censoring of the other mode is naively overlooked, and an engineering change is made to eliminate one of the failure modes (say A), then only the symptom has been fixed and there will be a corresponding increase in the MCF for mode B. Then looking at the past data for the occurrence of Mode B to estimate the MCF of Mode B alone would be misleading.

Chapter 7 presents methods for comparing sample MCFs to see if they differ statistically. The methods are based on an estimate of the difference between two MCF of processes to be compared and confidence intervals computed for this difference. The methods are illustrated by comparing treatments for recurrent bladder tumors and replacements of two different batches of locomotive breaking grids. Both pointwise and simultaneous (over time) comparisons are described. There is also brief discussion of multiple comparison methods that would be needed if more than two MCFs are to be compared.

Chapter 8 provides a very useful survey of other topics that are closely related to the methods presented in the main part of the book. Topics described include Poisson process and nonhomogeneous Poisson process models, renewal process models, models with covariates, and other models.

As with Wayne Nelson's other books, this book contains a valuable collection of interesting actual applications and corresponding data that we can expect to be used in future publications by other people doing research in this area. An Excel workbook that contains all of the data in the book is available from <http://www.siam.org/books/sa10>.

In summary, this is an important and interesting book from which most statisticians and many others who analyze data will derive benefit. As the easy-to-use tools described here become more commonly known, I predict that the methods will be much more widely used.

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## WORKSHOP ON DYNAMIC RELIABILITY: RESULTS AND LESSONS LEARNT ON A BENCHMARK

Prof. Enrico Zio  
 Politecnico di Milano

In the year 2004, the Italian Association of Environmental, Safety and Reliability Analysts, 3ASI (Associazione degli Analisti dell'Ambiente, dell'Affidabilità e della Sicurezza Industriale), the leading national association in the field of safety and reliability, has launched a benchmark exercise on the theme of dynamic reliability, with the aim of testing some emerging methods.

Dynamic reliability aims at broadening the classical event tree/ fault tree methodology so as to account for the mutual interactions between the hardware components of a plant and the physical evolution of its process variables. The dynamical aspects concern the ordering and timing of events in the accident propagation, the dependence of transition rates and failure criteria on the process variables values, the human operator and control actions. Obviously, a dynamic approach to reliability analysis would not bear any significant added value to the analysis of systems undergoing slow accidental transients for which the control variables do not vary in such a way to affect the component transition rates and/or to demand the intervention of the control.

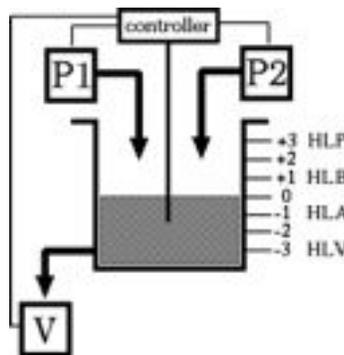
Dynamic reliability methods are based on a powerful mathematical framework capable of integrating the interactions between the components and the environment in which they function. These methods perform a more realistic modeling of the system and hence improve the quality and accuracy of risk assessment studies. A formal approach to incorporating the dynamic behavior of systems in risk analysis was formulated under the name Probabilistic Dynamics [Devooght and Smidts, 1992]. Several methods for tackling the solution to the dynamic reliability problem have been formulated over the past ten years [Cojazzi et al., 1992; Aldemir et al., 1994; Siu, 1994; Izquierdo et al., 1994; Labeau, 1996; Marseguerra and Zio, 1996]. Among these, Monte Carlo methods have demonstrated to be particularly efficient in taking up the numerical burden of such analysis, while allowing for flexibility in the assumptions and for a thorough uncertainty and sensitivity analysis [Marseguerra and Zio, 1996; Labeau and Zio, 1998].

For realistic systems, a dynamic approach to reliability analysis is likely to require a significant increase in the computational efforts, due to the need of integrating the dynamic evolution with its characteristic times. The fast increase in computing power has rendered, and will continue to render, more and more feasible the incorporation of dynamics in the safety and reliability models of complex engineering systems.

### Description of the benchmark

#### Nominal Case Study

The system is composed by a tank containing some fluid, two pumps (P1 and P2) to fill the tank, a valve (V) to remove fluid from the tank, and a controller monitoring the fluid level (H) and acting on P1, P2 and V [Marseguerra and Zio, 1996].



Initially H is equal to 0, with P1 and V in state ON, and P2 in state OFF; since both pumps and the valve have the same fluid level variation rate, while the initial configuration holds, the fluid level does not change. The cause of a variation of H is the occurrence of a failure involving P1, P2 or V; a failure consists of turning to the states stuck ON or stuck OFF. The failure probability obeys to the negative exponential distribution ruled by state independent failure rates.

If H reaches the level denoted as HLB (+1) there is the risk of the fluid overflowing; this event occurs when H exceeds the level denoted as HLP (+3). To avoid this undesired situation, the controller orders both pumps to switch OFF and the valve to switch ON, with the aim of decreasing H. If a component is stuck, it does not obey to

the controller order and maintains its current state.

The other undesired situation is the tank dryout; this happens when H is below H<sub>LV</sub> (-3); to avoid the dryout, when H reaches H<sub>LA</sub>, the controller orders both pumps to switch ON and the valve to switch OFF, with the aim of increasing H.

Failure of the system occurs when either the dry out or the overflow occurs.

#### **Modified Case Studies**

Some variations to the nominal case study have been considered:

- **The case with state dependent failure rates:** the failure rates of P1, P2 and V, change their value with respect to the current state of the component (ON or OFF);
- **The case with a possible failure on demand by the controller:** in this case, there is a certain probability that the controller may not act on the components state, though it is necessary due to the current fluid level ( $H \leq H_{LA}$  or  $H \geq H_{LB}$ );
- **The case with repairable components:** the stuck components can be repaired; the time to repair a component obeys to the negative exponential distribution ruled by the component repair rate;
- **The case with temperature dependent failure rates:** the component failure rates depend on the current temperature of the fluid in the tank; the fluid injected by the pumps has a constant temperature, while a heating source increases the temperature of the fluid inside the tank. A third failure condition is considered: the fluid temperature reaches a certain maximum temperature.

#### **Workshop**

On December 13, 2004, a workshop presenting the results of the benchmark was organized jointly by 3ASI and the Italian Chapter of the IEEE Reliability society. The host of the Workshop was the Politecnico di Milano, Department of Nuclear Engineering. A presentation of dynamic reliability and its general framework was given by Prof. Enrico Zio. Then, two contributions were given to report the results obtained with two different techniques:

#### **A. Bobbio, D. Codetta Raiteri, Solution of dynamic reliability problems via ordinary and fluid stochastic Petri nets, Turin University**

The reliability evaluation of the benchmark has been performed by modeling the system behaviour as a Generalized Stochastic Petri Nets (GSPN) [Ajmone-Marsan et al., 1995], a particular evolution of Petri Nets where transitions firing can be immediate or randomly delayed.

Since GSPNs are not suitable to deal with continuous variables, the fluid level has been discretized to several intermediate values, while its variations have been modelled as timed transitions.

The analytical approach has been applied to the GSPN model of the benchmark; the obtained results [Bobbio and Codetta, 2005] have been validated successfully, by comparison with those reported in [Marseguerra and Zio, 1999] obtained by Monte Carlo simulation, and with those obtained by modelling and simulating the system as a Fluid Stochastic Petri Net (FSPN) [Gribaudo et al., 1999], a rather recent evolution of GSPN with the aim of dealing with both discrete and continuous variables.

So, we showed how GSPN modelling combined with continuous variables discretization, can be a suitable method to evaluate the reliability of hybrid and/or dynamic systems.

#### **J. Beati, M. Caira, Dynamic Event Trees, "La Sapienza" University, Rome**

The University of Rome has carried out the benchmark using a Dynamic Event Tree methodology. This methodology takes into account the effect of aging, maintenance and accident time transient on the component reliability. These effects are considered modifying the term of the failure rate in the exponential relation of the reliability and calculating the failure probability in the different steps of the transient.

The methodology shows good results by comparison with the analytical solution of the benchmark made with Monte Carlo simulation and also with the solution of the Generalized Stochastic Petri Nets of the Torino University. Only for slow transient with time interval comparable to the maintenance interval the methodology shows some differences in the results. In any case this methodology appears very easy and fast to apply in many cases during the first row analysis of the accident in order to take into account the dynamics of the transient.

The meeting was concluded by a participated discussion on the applicability of the methods.

The technical reports regarding the two presentations are posted on the 3ASI web site ([www.3asi.it](http://www.3asi.it)), in English language.

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**January 22, 2005 ADCOM Minutes (Excerpts)**  
**Held at RAMS'05, Alexandria Mark Center Hilton**  
**Alexandria, VA**

**Desired Outcome of the Meeting** – An agreement on whether the Society’s ADCOM wishes to move towards turning off “auto-pilot” mode (in 2005) or remain essentially unchanged. If so, our revenue business model, mission statement, field of interest, by-laws, management organizational structure, nominations and elections, etc. may require modifications. That will require volunteer effort. That also requires commitments of participation in those efforts now. This all involves risk.

**1.0 Introduction:**

Welcome, Introductions, Overview of recent EXCOM meetings and the state of the Society – J. Voas and S. Keene

The previous ADCOM meeting minutes were approved.

This list represents those who physically attended this 1/2005 ADCOM meeting

**Attendees:**

William Tonti	EXCOM Member	wtonti@ieee.org, wtonti@us.ibm.com
Christian Hansen	ADCOM Member	c.k.hansen@ieee.org
Thad Regulinski	Visitor	regulinski@ece.arizona.edu
Loretta Arellano	ADCOM Member	L.Arellano@ieee.org
Dennis Hoffman	ADCOM Member	d.hoffman@ieee.org
Shuichi Fukuda	ADCOM Member	fukuda@tmit.ac.jp
Yvonne Lord	Tech Ops Chair	yvonne.lord@ngc.com
Judy Koslov	ADCOM Member	Judith.koslov@sun.com
Sam Keene	ADCOM Member	s.keene@ieee.org
Jeff Voas	ADCOM Member	voas@cigital.com
Ann Miller	ADCOM Member	milleran@umr.edu , annmiller@ieee.org
Alan Street	ADCOM Member	astreet@qualcomm.com
Tom Fagan	Rams Rep	tfagan@ieee.org
Lou Gullo	ADCOM Member	louis.gullo@flextronics.com
Bob Stoddard	ADCOM Member	Robert.Stoddard@motorola.com
Scott Abrams	ADCOM Member	sabrams@omnicongroup.com
Lon Chase	ADCOM Member	l.chase@ieee.org
Bob Loomis	ADCOM Member	r.j.loomis@ieee.org
Ted Freeman	ADCOM Member	74427.341@compuserve.com
David Barber	Rams/IRPS Consultant	DBARBSTA@aol.com
Way Kuo	T-Rel EIC	way@utk.edu

- **New ADCOM Class ('05 – '07)**

Dennis Hoffman: Congratulations to the 2005 ADCOM Class!

The new members are: Robert Loomis, Scott Abrams, Ann Miller, Christian Hansen, Shuichi Fukuda, and Sam Keene

- **ADCOM 2005 Appointments:**

Jeff Voas announced his appointments for 2005 – the AdCom concurred via vote with these “with AdCom vote” appointments:

Dick Kowalski: Treasurer

William Tonti: Secretary

Way Kuo: Trans on Rel editor

Lon Chase: Newsletter editor

- **2005 Elected Officers:**

Dennis Hoffman introduced the officers for 2005:

President: Jeff Voas

VP Meetings: Alan Street

VP Membership: Marsha Abramo

VP Publications: Christian Hansen

VP Technical Operations: Shuichi Fukuda

Junior Past President: Dennis Hoffman

Senior Past President: Ken Lasala

- **Additional Appointments:**

A. Transactions on Reliability, Editor in Chief (appointed by the President; currently Way Kuo)

B. Newsletter Editor in Chief (Appointed by the President; currently Lon Chase)

C. Newsletter Associate Editor (appointed by VP Pubs and Newsletter EIC, currently vacant)

D. Newsletter Business Manager (appointed by VP Pubs; currently Scott Abrams)

E. T-DMR Liaison (appointed by VP Pubs; currently Alan Street/Bill Tonti/Eric Snyder)

F. T-SM Liason (appointed by VP Pubs; currently Marsha Abramo)

G. Videos (appointed by VP Pubs; currently Sam Keene )

H. Historian: Dave Franklin, appointed by the president.

I. Webmaster (appointed by VP Pubs; currently vacant).

## **2.0 Budget:**

Dick Kowalski

- **2004 budget status:**

Expected 2004 Annual Surplus: \$102k. against our budget of \$89.2K. This is the likely scenario based on past history.

Worst Case scenario: If all goes against the items not closed to date:

For 2004 we run a deficit of (\$95K). This scenario is unlikely.

(See handout that was passed out at this meeting for further details)

Note: Dick mentioned that all ADCOM members have the 2005 expense forms in their respective e-mails. When filling out an expense form, don't forget to sign it and also to fill in your IEEE number (At the bottom) and the address where you would like your check to be remitted (Top of form).

- **5 Year Review**

5-year Society and Publications review in Feb.'05 in San Francisco at TAB

– Many thanks to ALL that helped get the paperwork done!

### **3.0 IEEE Fellows:**

Thad Regulinski:

Fellow evaluations:

~1500 submitted each year. These are too many to evaluate. e.g. Computer Society submits 500 names/year.

Fellow board is recommending that the societies eliminate the lower quartile of the nominations.

Fellow nomination resource center: Helps nominator to identify resources. Thad does not support this. Issue is that the resource center cannot identify folks who can make a recommendation if the nominator cannot locate anyone. i.e. a catch 22.

Note: 2004 RS members elevated to Fellows are Lois Walsh and Hoang Pham.

### **4.0 Meetings:**

Ann Miller / Alan Street:

- **RAMS T. Fagan**

RAMS Treasurer and Advanced Registration Chair Ray Sears Reported that RAMS has ~400 paid attendees (Advance registration, and roughly 66 walk ins.)

- **RS Tutorials / External Meetings:**

David Barber (IRPS and Rams Meeting Consultant)

David Barber presented the logistics of the RS tutorial seminar, and also described the concept of ADCOM going overseas.

Note: In conversations with David Barber, Alan and Bill, it was understood that a future RS tutorial does not have the overhead cost as this has been completed for the 9/2004 offering. It is also fair to note actual costs would have to be clarified for a future endeavor.

- **All Tech Ops Conference: Shuichi Fukuda**

This issue was briefly discussed in the ADCOM meeting. It was then explored in great detail in the Tech Ops meeting. The results of this discussion are:

- Shuichi/Alan will follow up determining exactly what technical areas the RS would be interested in pursuing.

- Alan Street, Sam Keene, Bill Tonti, Shuichi Fukuda and David Barber met and discussed an "all tech ops" meeting in Japan.

- **2006 joint conference RS/SMC Reprs: Sam Keene/Bill Tonti**

Background: S. Keene and W. Tonti investigated the option of RS joining the SMC Society. In a report by Bill and Sam this was deemed to not be pursued by RS. However, both RS and SMC agreed in principal to spawn a new joint RS/SMC conference containing subject matter of interest to both societies. Hoang Pham, who is the SMC representative, is in contact with Sam and Bill and initial planning for a 2006 conference is underway. Sam and Bill also met with IEEE headquarters. They are also in support of this endeavor. At this point both societies will have to agreed to seeding the conference. Actual seed money cannot be determined until a budget is submitted to IEEE. The motion below is to allow RS to proceed with the conference development in anticipation of an approved budget. Again, funds will not be disbursed until a budget is approved.

[Adcom passed a motion for RS to cap \\$25K in seed money for an RS/SMC joint Conference.](#)

- **New Initiative:**

Development of a Reliability Magazine: Present concept is “Trust or Trustworthy Computing:”. This has the support of IEEE headquarters, i.e. M. Loeb, and has been accepted by the RS EXCOM.

- **Progress on RS/JRELS joint meeting (Shuichi Fukuda)**

Action item: Shuichi to take this to the next step and begin a dialogue.

## **5.0 Publications:**

Christian Hansen

The following is a discussion on what is and what should / could be available on a Reliability Society IEEE renewal form.

What is (i.e. what was in 2004):

RAMS/IRPS/IIRW proceedings available for free through IEEE Xplore in 2005.  
i.e.: Base memberships Offer Xplore Conference Proceedings: RAMS, IRPS,IRW and the Trans on Rel and T-DMR

What should / could be additionally made available on the 2005 renewal form: Keep the base membership above PLUS offerings to purchase:

- Option to purchase paper / xplore option TSM
- Option to purchase T-DMR(1-CDROM /yr)
- Option to purchase Transactions on Reliability

Action Item: Jeff Voas/ Dick Kowalski to investigate the should / could items at the upcoming TAB meeting, and to formulate these via an electronic vote

- Transactions on Reliability: Way Kuo (Editor in Chief)

150 papers submitted in 2004

Publication que is clear.

Investigating pure web based submission. Not investigating IEEE manuscript central based on high \$10K/year cost and existing investment already made on Reliability Society electronic system.

Action Item: Way Kuo (owner) proposed that the RS sponsor a scholarship. Way to develop a scholarship model for ADCOM to vote on.

## **6.0 Technical Operations:**

William Tonti / Shuichi Fukuda:

### A. Standards and Definitions

Yvonne Lord: Standards Issue: 1413 (1998) Standard "Reliability Prediction" On 5 yr calendar, 1413 was up for review by the end of 2003, presently extended through March 2005. SEC 37 working group (open to multiple IEEE Societies) has picked up 1413, and tried to submit a 1413 par to revive it. RS would have to agree to give up ownership of 1413 to SEC 37 in order for the IEEE standards board to allow SEC 37 to take it over. Net: RS to ask IEEE Standards to place ownership of 1413 and 1413.1 back to the Reliability Society.

[Adcom passed a motion to bring 1413 and 1413.1 ownership back to the Reliability Society. Adcom passed a motion to approve par 1413.](#)

B. Committees or Sub-Societies operating in specific technical sub-areas of the Reliability Society field of interest -- every AdCom member should support at least one technical area.

### C. Tech Ops Assurance 2004 Cyber Security Initiative:

Background: IEEE headquarters under Matt Loeb funded a Cyber Security initiative (\$50K) under the guidance of Bret Michael. In July 2004, the ADCOM was presented a working model. Presently the project is in need of additional funding to complete the project. The Rel. Soc. is unclear with the outcome of what the additional funding will provide. It is the Rel Soc expectation that such funding would in fact complete the project, and as such it could be deployed in the market.

Stakeholder Issue: Continue funding Cyber Security funding (\$30K requested)

## **7.0 Membership:**

Marsha Abramo:

Although Marsha was not able to attend ADCOM the following items were placed on the table for ADCOM consideration.

Explore new initiatives, i.e.: Reliability Society certification.

Membership Development Committee: Chair: M. Abramo; members: L. Arellano, L. Gullo, J. Koslov, R. Kowalski, S. Abrams, J. McLinn, R. Stoddard, D. Franklin

Define **Basic** and **Optional** RS member benefits / Prices for 2006

## **8.0 New Business:**

The ADCOM throughout this meeting has embraced the Reliability Society's new vision, which is to become active by altering our business model, and in doing so to agree in principal to update our mission statement, field of interest, our by-laws, organizational structure, and electoral process.

The motions and action items seen throughout this document are in fact the vision the EXCOM has brought to this ADCOM: Netted out topically:

The Trustworthy magazine; Cybersecurity; Joint RS/SMC conference activity and financial; Conducting Tutorial programs; All Tech Ops Japan conference; and joining and/or chairing a tech ops committee. These were items the EXCOM discussed in some detail and brought to the AdCom in this meeting for consideration.

The remaining items are left detached from the rest of this report as they tends to stand by themselves.

- **Discussion of RS Constitution and ByLaws**

Dennis Hoffman:

During past EXCOM meetings it was agreed by the EXCOM that an overhaul of the Reliability Society Constitution and Bylaws is in order to help the Society retain and recruit the best personnel in EXCOM positions. To this end the following motions were made to begin this process.

Adcom approved a motion to add a President Elect to the ADCOM. This will be a bylaws and constitution change consistent with the president's term limitations. Motion passes 100%

Adcom passed a motion to support an Adcom member at the level of EXCOM travel reimbursement through an increase of \$3000.00 in the president's discretionary fund.

- **Formulation of comprehensive Transactions on Reliability and RAMS DVD**

Although not discussed in great detail at the ADCOM meeting due to time limitations, Bill Tonti presented this idea to the EXCOM, i.e. providing a comprehensive DVD available only to RS members, or possibly to anyone, but at a cost differential for non-RS and non-IEEE members. EDS put together such a DVD on it's 50'th anniversary, and it is a success.

### **Action Item List:**

1) ADCOM Photos:

W. Tonti to transmit all prior ADCOM photos to Dave. Status: Completed

2) Rams IP

Formation of a committee: Robert Loomis (Chair) , Tom Fagan and Christian Hansen are to review and propose an equitable arrangement for RS use of the intellectual property generated by the RAMS symposium.

3) RS Tutorials:

Bill Tonti to forward to Alan Street the Business model developed for the RS tutorials.  
Jeff Voas to investigate synergistic conferences the S/W tutorial would have a high degree of success if timed in accordance with another event.  
Sam Keene (The S/W tutorial chair) to ask the authors for their respective availability in 2005.

4) All Tech Ops Conference:

Shuichi Fukuda will poll the tech ops chairs to assess who is willing to prepare conference material.  
Shuichi Fukuda, Alan Street, and David Barber will work together and determine if a cost effective venue is available in Japan.

5) RS Trustworthy Magazine

ADCOM members willing to work on this activity (Trustworthy Computing) to contact Bill Tonti. Status: 2/18/05. No ADCOM volunteers to date.

6) **Progress on RS/JRELS joint meeting (Shuichi Fukuda)**

Shuichi to take this to the next step and begin a dialogue.

7) Option to purchase Transactions on Reliability

Action Item: Jeff Voas/ Dick Kowalski to investigate the should / could items at the upcoming TAB meeting, and to formulate these via an electronic vote

8) RS Scholarship

Way Kuo (owner) proposed that the RS sponsor a scholarship. Way to develop a scholarship model for ADCOM to vote on.

9) 1413/1413.1 Standard

Adcom passed a motion to bring 1413 and 1413.1 ownership back to the Reliability Society. Adcom passed a motion to approve par 1413.

Action Item: Dennis Hoffman / Yvonne Lord to execute the aforementioned requests for 1413 and 1413.1.

10) Committees or Sub-Societies operating in specific technical sub-areas of the Reliability Society field of interest -- every AdCom member should support at least one technical area.

Action Item: All ADCOM members to review the Tech Ops committees below, and join one of them, reporting back to Bill Tonti. Status: No inputs to date from ASDCOM members (2/18/2005)

11) Stakeholder Issue: Continue funding Cyber Security funding (\$30K requested)

Action Item: Sam Keene to ascertain what the state of this project will be after an additional \$30K investment, and what are the expected productization plans from the intended parties. ADCOM will vote via e-mail on future funding pending these results.

12) RS Displays (3 of them):

Lou Gullo and Scott Abrams to contact Marsha Abramo and update the two full size and one table top display. See Dick Kowalski for budget inputs. The west coast display update is needed for the IRPS meeting in 4/2005.

13) Medical Technology Policy Committee:

Action Item: Bill Tonti to contact Tech Ops chairman or a Medotronics engineer and ask for respective support. Status: Request formulated, No response. Action closed.



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## Tech Ops Committees

Status of Tech Ops technical committees:

### Technologies:

- | <u>Name</u>                   | <u>Chair</u>  |
|-------------------------------|---|
| 1) Reliability Design         | <b>vacant</b>   |
| 2) Software Reliability       | Sam Keene s.keene@ieee.org  |
| 3) MicroElectronics           | <b>vacant</b>   |
| 4) Human Interface            | Ken Lasala: k.lasala@ieee.org   |
| 5) International Reliability  | Joe Fragola fragola@prodigy.net   |
| 6) Warranty                   | Judith Koslov Judith.Koslov@Sun.com                                     |
| 7) Testing and Screening      | Anthony Chan h.a.chan@ieee.org  |
| 8) Standards and Definitions  | Y. Lord yvonne.lord@ngc.com /<br>T. Brogan Thomas_L_Brogan@raytheon.com |
| 9) CAD / CAE                  | <b>vacant</b>   |
| 10) Mechanical Reliability    | Dick Doyle ddoyle@cts.com   |
| 11) System Safety             | Takeshia Khoda kohda@vib.kuaero.kyoto-u.ac.jp                           |
| 12) Assurance                 | James Bret Michael bmichael@nps.navy.mil                                |
| 13) Six Sigma Reliability     | Sam Keene s.keene@ieee.org  |
| 14) Maintainability           | Stefan Mozar s.mozar@ieee.org   |
| 15) Emerging (new) Technology | <b>vacant</b>   |

### Systems:

- |   |   |
|---|---|
| 16) Aerospace and Defense                   | Lon Chase l.chase@ieee.org              |
| 17) Automotive                              | Guangbin Yang gyang1@ford.com           |
| 18) Information Technology & Communications | <b>vacant</b>                           |
| 19) Energy Systems                          | Mark Lively MbeLively@aol.com           |
| 20) Medical                                 | Patrick Corcoran patcorkshome@yahoo.com |
| 21) Consumer Electronics                    | Fred Schenkelberg fms@hp.com            |
| 22) Sensors                                 | Ken Lasala (acting) k.lasala@ieee.org   |
| 23) Industrial Systems                      | Hiroshi Yajima yajima@sdl.hitachi.co.jp |



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- JOIN NOW!**

## Cleveland Chapter

The Cleveland Chapter had three meetings in this period.

### PAST MEETINGS

The September meeting was the Fall Roast. The Officers and Committee Chairs were selected. A brief business meeting was held to install the staff. The Group enjoyed a nice outing, a beautiful day, good companionship, grilled food, sports activities, and enjoyed a delicious meal. It was a very nice, relaxing, social event.

For the October meeting, Mark Pollard, First Energy, gave a talk on "Implementing a Risk Management Program." Energy Projects uses continuous risk management (CRM) throughout the life cycle of a project. The six functions of CRM: identify, analyze, plan, track, control, and communicate are performed on the project. Each risk goes through these functions sequentially. The activity occurs continuously, concurrently throughout the project life cycle. These methods have contributed to improved project performance. Schedule and costs have been handled as risks. The project managers are using this tool. The space projects are using these same methods. The members enjoyed the meeting and learned some good things to use in their organizations.

Ernie Bertone, NASA GRC, gave the November presentation. His talk was on NASA Plans. The focus was on the cafeteria problem. There are two cafeterias and two snack rooms at GRC. The main cafeteria is where the food is prepared. Hot food is sent to the DEB cafeteria. Vending machines are used in the snack rooms. The Small Dining Room is where these meetings are held. The contract to operate these facilities is running out. A new Statement of Work is being prepared. The RFP should be on the e-Commerce for bidders in late spring. Meanwhile the food service is being arranged for each meeting. We may have to use outside facilities for a while. Please be patient things should be back to normal in a few months.

### CHAPTER ACTIVITIES

We are supporting '06 RAMS on the Management Committee, with papers, tutorials, and session suggestions. The Chapter Staff are all working to make it a big success.

We are working to get support for AUTOTESTCON in Cleveland. An effective Technical Committee is needed to do this job. Hin Yee has been appointed as our Rep to the ADCOM. The Chapter would like to bring a major Conference to NASA GRC in Cleveland. The staff is ready, willing, and able to do the job.

The Assurance Technology Symposium will be held at the Ohio Aerospace Institute in June 2005. There will be presentations, exhibits, training, and splinter meetings in the three and one half day symposium. An award for the best presentation will be given. This symposium provides the Safety and Mission Assurance (SMA) community and Project personnel with a unique opportunity for interchange and interaction on innovative assurance technologies and tools. It promotes dialog and cooperation with the Projects, Centers, and the SMA community.

Overall, here in Cleveland we are having fun staying active and trying to serve the needs of our members.

Regards,

Vince Lalli, Chair



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## Dallas Chapter

By Lon Chase, Chair

### Chapter Programs

The Dallas chapter is continuing its program of technical presentations with the following.

Date: Tuesday, Jan. 18, 2005

Title: "Intermetallic Morphology and Damage Evolution of Pb-Free Solder Interconnections in Area Array Packages"

### **Program Summary:**

Tin-lead eutectic solder interconnections have been extensively studied and characterized over the last 50 years. However, restrictions on Pb included in the European WEEE -(Waste of Electrical and Electronic Equipment) and RoHS (Restriction of Hazardous Substances) legislation have focused attention on how little is understood about the structure and behavior of lead-free solder interconnections. Significant differences in the failure mechanisms have been observed in different Pb-free solder alloys when compared to the Pb-based alloys. Higher percentages of Cu and Ag combined with minor elements from component surface finishes can significantly influence the formation of intermetallic compounds in the solder. The role played by these complex compounds and their relationship to potential failure modes and mechanisms is critical to designing reliable electronic assemblies.

This presentation will highlight the variety and complexity of intermetallic morphologies in some Pb-free solders and show their relationship to the preferred crack propagation paths in solder joints of Sn3.8Ag0.7Cu and Sn3.5Ag solder on organic solderability preservative (OSP) and electroless Ni immersion Au (ENIG) pad surface finishes. The relationship of these intermetallic formations on solder failure under thermal cycle fatigue will be described using x-ray imaging and optical, metallurgical and scanning electron microscopy images to show the mechanisms and progression of damage.

### **Speaker:**

Steven O. Dunford is a Research Specialist at Nokia Research Center, Irving, Texas. His work has included research in Pb-free SMT assembly and board-level reliability and other advanced technology programs. Prior to joining Nokia, he was instrumental in process development for the implementation of area array packaging (BGAs, CSPs) in high reliability military applications at the Texas Instruments and Raytheon Circuit Card Assembly operations and in the processing of structural composites for survivability in high temperature environments.

Steven co-authored , "Reliability Aspects of Lead Free Solders in Electronic Assemblies", recently published in the Handbook of Lead (Pb)-Free Technology for Microelectronic Assembly  
 He also co-authored "Chip Scale Package Technology", with P. Viswanadham and T. Chung, Chapter 18 in the Area Array Interconnection Handbook

Steven holds a B.S.I.E. from New Mexico State University and a M.S. in Science and Technology Commercialization from the University of Texas in Austin, IC2 Institute.

\*\*\*\*\*

Date: Tuesday, Feb 15, 2005

Title: " Failure Analysis of Crystal Oscillators "

### **Program Summary:**

Crystal Oscillators are used in a variety of applications in the Raytheon Corporation but are primarily used as the clock control in a variety of microprocessor circuits. In many applications a stable accurate and robust oscillator is needed. Over years of failure analysis investigation we can say that some of the more typical failure modes are jumping or spurious modes, temperature sensitive operation, no oscillation, high start up voltage and intermittent electrical operation. This presentation will attempt to thoroughly discuss four of the most common failure modes by covering the aspects of the failure analysis performed during the history of these oscillator problems. This includes an in-depth discussion of failure analysis techniques, and equipment used during the analysis.

### **Speaker:**

James Izzo is a Senior Engineering Technician with Honors at Raytheon Corporation Failure Analysis Lab McKinney Texas. James responsibilities include analysis and troubleshooting of microelectronic circuits and systems. James has been working in the Failure Analysis Lab for over 25 years. Jim is a recent recipient of the Raytheon Senior Technical Honors Award.

Jim presented with Barb Waller, "Minimizing the impact of Counterfeit Devices", Raytheon Reliability Engineering



Brown Bag (1/2004) and IEEE Reliability Symposium (2/2004).

Jim presented, "The Role of Microscopy in Microelectronic Failure Analysis", Texas Society of Microscopy, (10/2004).

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## Denver Chapter

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The Denver Chapter was founded amongst 3 foundation meetings, accompanied by major snow falls in the Spring of 1979. (Major snowfalls in Denver are above 12"). The 25th anniversary dinner drew those original members plus those currently serving at the National Level.

Six of those shown in the picture serve or have served at the national level. The chapter spans 100 miles from Colorado Springs to Ft Collins.

Shown L to R are Robert Jaquess, James Yakura, Ron Watts, John Adams, Sam Keene, Gene Bagenstos, Judy Koslov, Tom Basso, Jason Rupe and Juan Hernandez. In addition, Tom Basso holds a national office with the Power Society. Fittinly it snowed 10 inches the day before our anniversary dinner.

Sam Keene  
Chapter Chair



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## Twin Cities Chapter

Here is a short report from the Twin Cities chapter.

On January 18 th Kevin Becker of Hutchinson Technology, spoke to a group of 22 about "Achieving PPM Reliability numbers for Hard Drive Suspension Mechanisms".

February 15 th had Larry Akre of Emerson speaking on "Value Stream Mapping and Reliability"

March 15 th will be Six Sigma and Reliability.

James McLinn  
Chapter Chair



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Dear Colleague:

We would like to bring to your attention that the 2nd Conference on Nanoscale Devices and System Integration (NDSI) will be held in Houston, Texas on April 4-6, 2005.

NDSI, sponsored by IEEE Nanotechnology Council, is a highly interactive meeting, serving as an open forum to identify priorities in today's broad range of nanoscale technologies.

The meeting has a single session format with the invited talks forming the body of the conference. Contributed work is showcased at several poster sessions throughout the conference. The quality of the technical program is ensured by the broad participation of the nanotechnology leaders from both industry and academia.

Contributed paper submissions are welcome. The submission instructions and digest format can be found at [http://www.nanointernational.org/call\\_for\\_papers.htm](http://www.nanointernational.org/call_for_papers.htm).

Major topics related to device fabrication/synthesis at the nanoscale and integration of nanoscale technologies into functional systems will be covered, including:

- \* Nanoelectronics
- \* Nanomagnetism and Spintronics
- \* Nanophotonics
- \* Nano/bio inspired devices and system
- \* Nanorobotics
- \* Materials for Nanotechnologies
- \* Fabrication for nanoscale devices
- \* Metrology

Work presented at the conference will be published in a special issue of IEEE Transactions on Nanotechnology, subject to the usual peer-review process.

Houston is beautiful this time of year and the conference hotel is nestled in the museum district overlooking one of Houston's most beautiful parks. Sports venues and recently revitalized downtown Houston are a few minutes away by light rail.

Additional information about the conference can be found at <http://www.nanointernational.com>. If you did not receive this message directly and would like to receive future NDSI announcements, please send an e-mail to [ndsi@nanointernational.org](mailto:ndsi@nanointernational.org) <mailto:ndsi@nanointernational.org> and your name will be added to the mailing list.

Thank you for your attention.

NDSI'05 Organizing Committee



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## CALL FOR ABSTRACTS

Second International Workshop on Nano & Bio-Electronic Packaging  
March 22-23, 2005, Atlanta, Georgia  
Georgia Tech's Technology Square Research Building

Program Agenda and Further Information: [www.prc.gatech.edu/nanobiopack](http://www.prc.gatech.edu/nanobiopack)  
Download event flyer (PDF)

The "Second International Workshop on Nano and Bio-electronics Packaging" is a two-day event offering informative keynote presentations and technical sessions on Nano technology. The currently scheduled technical sessions and their chairs are as follows:

Nano Package Design  
James Libous - IBM & Madhavan Swaminathan - Georgia Tech

Nano Biomedical Packaging  
Jorma Kivilathi - Helsinki University of Technology and Terry Dishongh - Intel

Nano Photonics  
Avi Bar-Cohen - University of Maryland and Ephraim Suhir - Designed Nano-Materials

Nano Packaging Materials  
Goran Matijasevic - University of California

Nano Manufacturing  
Srinivas Rao - Solectron and Randy Rannow - Hewlett-Packard

Industry Perspective  
Charles Lee - Infineon, Singapore

NEMS & Fluidics  
Michael Wahl - University of Siegen

Nano Interconnections  
Andrew Tay, National University of Singapore

Nano Lithography  
Ajay Malshe, University of Arkansas

Nano Testing, Modeling and Imaging  
Sheng Liu, Wayne State University

Conference Coordinator: Dr. Swapan Bhattacharya ([swapan@ee.gatech.edu](mailto:swapan@ee.gatech.edu))